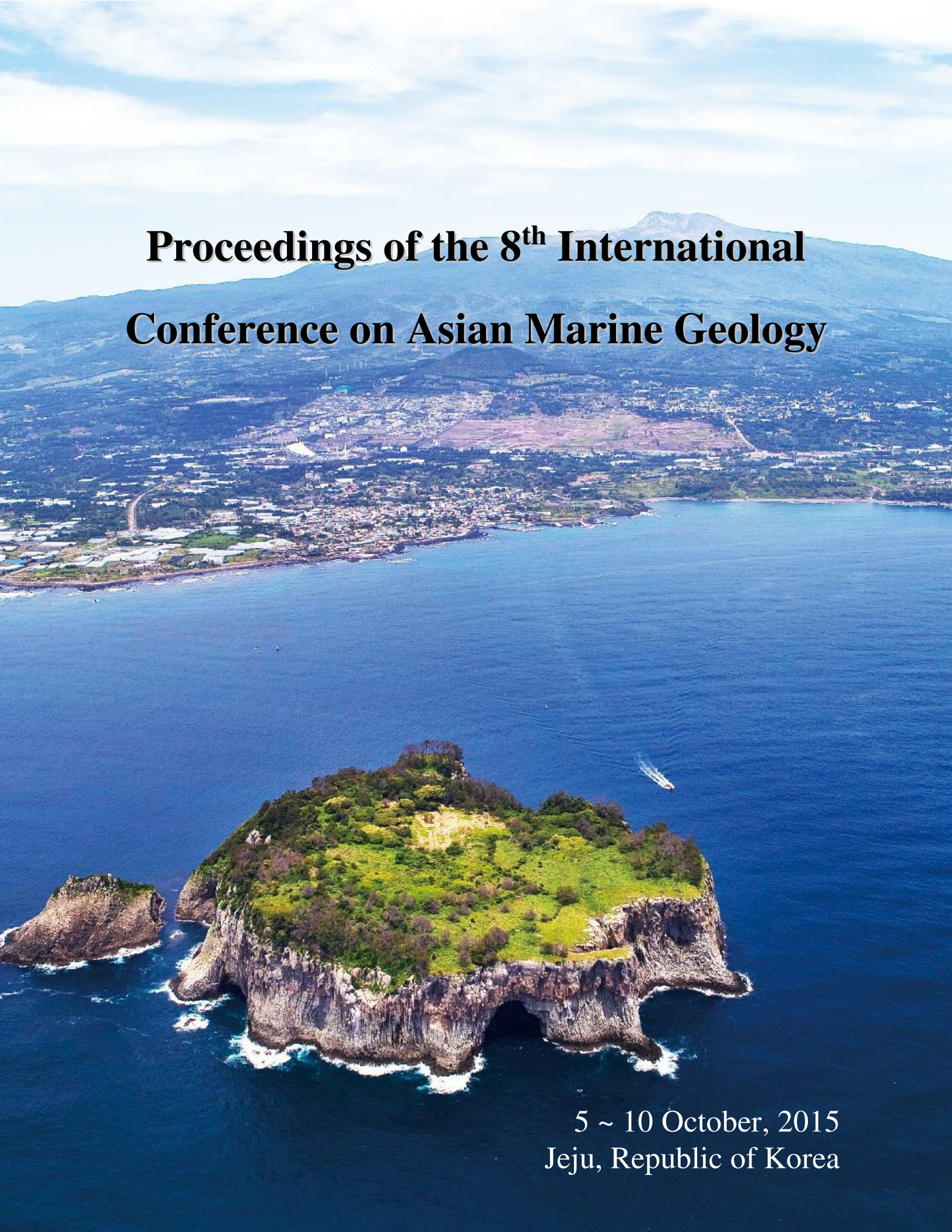
Proceedings of the 8th International Conference on Asian Marine Geology



5 ~ 10 October, 2015
Jeju, Republic of Korea

ORAL

PRESENTATIONS

Grain-size characteristics and their environmental climatic significance of Zarinanmucuo lake sediments in Cuoqin Basin, Tibet

KEYU ZHU[1] LIDONG ZHU[2]

[1]College of Earth Science, Chengdu University of Technology, China (474595632@qq.com)
[2]Institute of Sedimentary Geology, Chengdu University of Technology, China

Grain-size distribution and sorting of soft sediment is used to measure the carrying ability of water, and it is not only good markers judging natural geographical environment and power of the water, but also a ripe marker of paleoclimate environment. Exploring the relationship between Tibet plateau's and global climate change has become a hotspot in Quaternary environment climate researching. Focusing on Zarinanmucuo lake sediments continuously and sensitively in Cuoqin Basin of Tibet, based on the analysis result of sedimental lithology, grain-size characteristics and total of organic carbon, the paleo-climatic changes between 11810 ~ 3420 a B.P. in the area have been reconstructed. The research result shows that the lake sediment in Zarinanmucuo lake of Cuoqin Basin in Tibet has well recorded the drying-up to moist process of water body and climate changes can be divided into three stages as following: the first stage, being divided into two small section, 1) stage Ⅰ1 (11810 ~ 8957 a B.P.) when climate raised slowly, the lake was deep water with drying climate and low rainfall. In the 10300 ~ 9964 a B.P, lake shrink made by a rapidly temperature cooling happened. The event in Tibet is later than the Younger Dryas climate event. 2) stage Ⅰ2 (89578 ~ 7447 a B.P.)when temperature descended tardily and where the lake gradually shrink, the climate in the period was still arid with less rainfall. At the end of the period, a quick climate warming event appeared. 3) stage Ⅱ (7447 ~ 5266a B.P.) when temperature continued decline but rainfall increased , the climate in the period became cold and humid. 4) stage Ⅲ (5266 ~ 3420 a B.P) when temperature fluctuated while precipitation was not reduced, the climate in the period was humid. The regional climate change records based on lake sedimentary grain-size in Cuoqin Basin of Tibet is similar to global climate event with quiet a little contrary phenomenon. Hence, the Zarinanmucuo lake sediments grain-size characteristics in Cuoqin Basin reflected the climate changes in Tibet, recording the information of the global climatic event as well.

This work was financially supported by National Science Foundation of China (Grant No.41173058).

Keywords: grain-size characteristics, climatic significance, Quaternary, Cuoqin Basin in Tibet

References

Alley, R. B., Meese, D. A., Shuman, C. A., Gow, A. J., Taylor, K. C., Grootes, P. M., White, J. W. C., Ram, M., Waddington, E. D., Mayewski, P. A., Zielinski, G. A., 1993, Abrupt increase in greenland snow accumulation at the end of the Younger Dryas event, Nature, 362,527-529

Campbell, C., 1998, Late Holocene lake sedimentology and climate change in southern Alberta , Canada, Quaternary Research , 49, 96-101

Dansgaard, W., White, J. W. C., Johnsen, S. J., 1989, The abrupt terimination of the Younger Dryas climate event, Nature, 339,532-533

Xie, Y. Y., Li, C. A., Wang, Q. L., Yin, H. F., 2007, Grain - size Characteristics and Their Environmental Significance of Jiangling Lake Sediments in Jianghan Plain, Journal of Jilin University (Earth Science Edition), 37, 570-577

Early interglacial carbonate-dilution events in the South China Sea: Implication for strengthened typhoon activities over subtropical East Asia

ENQING HUANG[1], JUN TIAN[1], PEIJUN QIAO[1], SUI WAN[1], XIN XIE[1] AND WENGUANG YANG[2]

[1] State Key Laboratory of Marine Geology, Tongji University, 200092 Shanghai, China (ehuang@tongji.edu.cn)
[2] Institute of Sedimentary Geology, Chengdu University of Technology, 610059 Chengdu, China

A compilation of many high-quality sediment cores from the broad northern South China Sea (SCS) continental slope confirms a significant reduction in sedimentary calcium carbonate concentrations by up to 15-50% during the early Holocene. This low carbonate% event is constrained between 11.0-8.5 ka BP by intensive radiocarbon dating, a time period when the regional sea level rose from -50 m to -10 m and drowned large areas of continental shelves especially those near and within the Taiwan Strait. This event is also associated with a prominent increase in bulk sedimentation rates on the upper continental slope and an evident increase in the percentage of fine-grained terrigenous detritus. Sediment provenance analyses suggest that terrigenous input during the low carbonate% event is primarily from Taiwan, which is similar to other time periods of the Holocene. An extension of high-resolution paleoenvironmental reconstructions to pervious time periods further favor to identify two equivalent low carbonate% events occurred at the beginning of marine isotope stage 5.5 and 7.3. We exclude the influence of changes in carbonate dissolution and carbonate accumulation rate, and conclude that an increase input of terrigenous dilution is the main reason for the recurrence of the early interglacial low carbonate% event. We further hypothesize that an enhancement of typhoon activities during early interglacials could have significantly strengthened sediment discharge of Taiwanese mountainous rivers. The fine-grained river discharge from South Taiwan and the opened Taiwan Strait could be dispersed southwestward along the northern SCS continental slope mainly by deep ocean currents. The conjecture of strengthened typhoon activities over East Asia during the early Holocene is supported by high ocean heat contents in the West Pacific Warm Pool area and the prevailing La Niña-like conditions.

Keywords: carbonate cycle, typhoon, interglacial, South China Sea, sea level, sedimentary process

Provenance and paleoclimate record in the northeastern Indian Ocean since the last glacial period

SHENGFA LIU[1], PENG CAO[1], XUEFA SHI[1], SOMKIAT KHOKIATTIWONG[2], NARUMOL KORNKANITNAN[3]

[1] Key Laboratory of Marine Sedimentology and Environmental Geology, First Institute of Oceanography, State Oceanic Administration, Qingdao, 266061, China (liushengfa@fio.org.cn)
[2] Phuket Marine Biological Center, Phuket, 83000, Thailand
[3] Marine and Coastal Resource Research Center, Samut Sakhon Province, 74000, Thailand

Provenance and paleoclimate changes in the Andaman Sea during the last 26 ka were reconstructed from high-resolution records of grain-size, major elements and Sr-Nd isotopes in core ADM-9. The values of εNd(0) and $^{87}Sr/^{86}Sr$ were in good agreement with those of Irrawaddy River sediments, indicating a common source of origin. Two sensitive grain-size intervals (3.4-7.5 and 16.8-21.2 μm) were identified; the former was controlled primarily by sea-level change, whereas the latter was related to Irrawaddy River discharge and South-west Current transport driven by the Indian Summer Monsoon (ISM). Proxies of chemical weathering (K/Al) and terrigenous input (Ti/Ca) coupled with sensitive grain-size interval (16.8-21.2 μm population) revealed that the ISM was weak during ~15-26 ka BP and then strengthened gradually to a maximum during ~7-9 ka BP; subsequently, the ISM exhibited a generally declining trend to ~2 ka BP. The variation of the ISM recorded in this work is consistent with ISM variations observed in an open area in the northern Indian Ocean and in adjacent continents, implying the evolution of the Asia summer monsoon since 26 ka.

Keywords: grain size, element, Sr-Nd isotopes, Indian Summer Monsoon, Andaman Sea

Low latitude hydro-climatic changes inferred from alkane records in South China Sea

LI LI[1], QIANYU LI[2,3], JIANRU LI[4], PINXIAN WANG[5]

[1] State Key Laboratory of Marine Geology, Tongji University, China (lilitju@tongji.edu.cn)
[2] State Key Laboratory of Marine Geology, Tongji University, China
[3] School of Earth and Environmental Sciences, University of Adelaide, Australia
[4] State Key Laboratory of Marine Geology, Tongji University, China
[5] State Key Laboratory of Marine Geology, Tongji University, China

The inert leaf wax deposited in deep sea sediment preserves the clues of the past climate change. In particular, the *n*-alkane distribution patterns characterized by the *n*-alkane chain length index provide useful information on the hydrological changes, as longer chain alkanes are more frequently biosynthesized under relatively arid condition to prevent water loss. Our data from the South China Sea revealed progressively reduced moisture since 2.9 Ma and to bigger fluctuations between wet and dry conditions since 1.2 Ma during Plio-Pleistocene and a systematic regime shift in the regional mean precipitation at ca. 420-270 ka during the late Quarternary. This long term hydro-climate trend is superimposed by glacial dry and interglacial wet patterns over the glacial cycles. Combined with other proxy records, our results indicate that precipitation over the tropical Asia-Pacific strengthened before the onset of the northern hemisphere glaciation, the mid-Pleistocene climate transition at about 1.2 Ma, and late Quarternary during 420-270 ka. These dramatic humidity changes over some major climate transitions imply a crucial role of tropical hydrology dynamics on global climate change.

Keywords: *n*-Alkanes; *n*-Alkanes chain length; Hydrological dynamics; South China Sea

References

Li L. , Li Q.Y., Li J.R., Wang H., Dong L., Huang Y.S., Wang P.X., 2.15, Late Quaternary n-alkane chain-length record indicates a regime shift in the mean hydrological states around 270 ka in the western tropical Pacific. Palaeogeography Palaeoclimatology Palaeoecology, 427, 79-88.

Li L., Li Q.Y., Tian J., Wang H., Wang P.X., 2013, Low latitude hydro-climatic changes during the Plio-Pleistocene: evidence from high resolution alkane records in the southern South China Sea. Quaternary Science Reviews, 78, 209-224.

New marine evidence helps constrain the historical biogeography of C4 biomass in East Asia over the last ca. 20 million years

BIN ZHOU[1], MICHAEL BIRD[2], HONGBO ZHENG[3], ENLOU ZHANG[4], CHRISTOPHER M. WUSTER[2], LUHUA XIE[5] & DAVID TAYLOR[6]

[1]Key Laboratory of Surficial Geochemistry (Ministry of Education), School of Earth Sciences and Engineering, Nanjing University, Nanjing, China (zhoubinok@nju.edu.cn)
[2] School of Earth and Environmental Sciences, James Cook University, Cairns, Australia
[3] School of Geography Science, Nanjing Normal University, Nanjing, China
[4] State Key Laboratory of Lake Science and Environment, Nanjing Institute of Geography and limnology, Chinese Academy of Sciences, Nanjing, China
[5] CAS Key Laboratory of Marginal Sea Geology, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou, China
[6] Department of Geography, National University of Singapore, Singapore

The expansion of C_4 plants is one of the most important ecological transformations of the Cenozoic, but the timing and environmental drivers remain open to discussion. Variations in abundance and carbon isotope composition of *n*-alkanes and pyrogenic carbon (PyC) from sediment core ODP 1146, northern South China Sea, reveal a highly varying abundance of C_4 plants in East Asia over the last ~ 20 Ma. The existence of C_4 taxa on the East Asia continent has increased in abundance evident from ca. 8 Ma based on $\delta^{13}C_{PyC}$ and from ca. 1.5 Ma based on $\delta^{13}C_{Alk}$. Generally both *n*-alkane and PyC data, with several C_4 signals during the Miocene-Pliocene transition (8.0-5.0 Ma). A marked divergence is evident in the *n*-alkane and PyC data from ~ 1.5 Ma, however, with PyC data indicating a reduced contribution of C_4 taxa to biomass burning in East Asia at the same time as the *n*-alkane data indicate an increase in abundance of C_4 plants. The divergence likely reflects differences in provenance, with PyC representing a larger source area that includes higher altitudes and more temperate latitudes (Jia et al., 2003), where temperatures became too low after mid-Pleistocene to support C_4 taxa (Zhou et al., 2014). Variations in C_3:C_4 taxa appear linked to a combination of environmental factors that have varied temporally and geographically. A major, Quaternary-aged expansion of C_4 biomass in tropical and/or subtropical East Asia is later than other parts of the world, indicating the importance of local factors in influencing C_3:C_4 variations.

Keywords: biomarker, n-alkanes, biomass burning, climate change, carbon isotope, Miocene, pyrogenic carbon.

Running title: Variations in C4 biomass in Asia

***Corresponding author:** Bin Zhou, School of Earth Sciences and Engineering, Nanjing University, Nanjing 210023, China, zhoubinok@163.com; zhoubinok@nju.edu.cn

Applicability of method for reconstructing dissolved CO_2 concentrations in the East Sea using the carbon isotopic composition of alkenones

SI WOONG BAE[1], KYUNG EUN LEE[1,2], KAHEE KIM[2]

[1]Ocean Science and Technology school, Korea Maritime and Ocean University, South Korea (kyung@kmou.ac.kr)
[2]Division of Marine Environment and Biosciences, Korea Maritime and Ocean University, South Korea

The partial pressure of carbon dioxide (pCO2) of surface seawaters can be estimated from the carbon isotopic composition of alkenones (δ13C37:2). However, the applicability of the use of this technique is still controversial because stable carbon isotope fractionation can be influenced by a number of additional factors including algal growth rate, nutrient availability, and so on. In order to examine the applicability of this method, we reconstructed current and past pCO2 of the East Sea using δ13C37:2 of sinking particles in sediment traps (JN, JS-2) and sediment core (05PC-21) samples, respectively, and then the results were compared with observed pCO2. Changing pattern of current seasonal pCO2 reconstructed from sediment trap samples were similar to those of observed pCO2. Especially, the minimum oceanic pCO2 occurred in spring, and maximum occurred in summer for both cases. The reconstructed pCO2 in summer at JS-2 station was only compared directly to observed pCO2 because of the lack of observed data, both pCO2 were similar to each other (330 μatm). During the last 190 cal ka BP, patterns in the glacial-interglacial changes of past pCO2 reconstructed from δ13C37:2 of marine sediment were similar to those of atmospheric pCO2 reconstructed from ice sheet cores. Both reconstructed and observed pCO2 were low in the glacial (180 ppm) and high in the interglacial (280 ppm). Therefore, it is appropriate to use δ13C37:2 for reconstructing surface CO2 concentration in the East Sea.

Keywords: Alkenone, Carbon isotopic composition, Carbon dioxide, East Sea.

Seasonal flux variability of planktonic foraminifera in a sediment trap from Xisha Trough, South China Sea

RONG XIANG[1], JIANGUO LIU[1], DONGXIAO WANG2, MUHONG CHEN[1], CHEN HAN[1], ZHONG CHEN[1], WEN YAN[1], SHILIN TANG[2]

[1]Key Laboratory of Marginal Sea Geology, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou 510301, China

[2]State Key Laboratory of Tropical Oceanography, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou 510301, China

The flux and seasonality of planktonic foraminiferal were studied through a time-series sediment trap deployed in the Xisha Trough, South China Sea (SCS) from June 2009 to August 2011. The general flux pattern for planktonic foraminifera showed high values during the winter half-year/season (from late September/October to February) and low flux during the rest of the year. This flux pattern contrasts with the bimodal pattern in the central and southern SCS, which shows two high flux peaks corresponding to the prevailing summer and winter monsoon periods, respectively. Apparent interannual flux differences, which may be related to the climate change from an El Niño year to a La Niña year, were observed. Monsoonal driven seasonality is most prominent in Pulleniatina obliquiloculata, Neogloboquadrina dutertrei and Globigerina bulloides, with over 80% of their species-specific fluxes (93% for G. bulloides) occurring from late September/October to February. Globigerinoides sacculifer and Globigerinoides ruber show similar seasonality, generally following the trend of the total flux of planktonic foraminifer. G. bulloides may have the potential to be developed as a winter proxy-species. Globigerinoides conglobatus mostly appears in June to August and can be developed as a summer proxy-species.

Keywords: planktonic foraminifera; sediment trap; South China Sea; shell flux; seasonality

Dark/light layers sequences in the northern and central Japan Sea and their linkages with abrupt climate and sea level changes: lithological, geochemical and pollen evidences.

S.A. GORBARENKO[1], Y.V. RYBIAKOVA[1], A. A. BOSIN[1], X. SHI[2], Y. LIU[2], J. ZOU[2]

[1]V.I. Il\ichev Pacific Oceanological Institute, Russia (gorbarenko@poi.dvo.ru)
[2]First institute of oceanography, china

An alternation of dark/light layers (D/L) in the Quaternary Japan Sea sedimentation is important perculiarity of this marginal sea (Tanaka, 1985; Nakajima et al., 1996; Oba et al., 1991). According to Tada et al. (1999) thypothesis the D/L alternation reflect millennial-scale variations which associated with Dansgaard-Oeschger cycles, with each dark layer appearing to correspond to an interstadial. Sediment cores LV 32-33 and LV 53-23-1 recovered in the northern and central Japan Sea were studied by geochemical (TOC, chlorin, CaCO3, Ba-bio, δ18O of planktonic foraminifera (δ18Opf), lithological (color, IRD) and pollen methods with high resolution. Their age models were constructed by AMS 14C data, tephrochronology, δ18Opf and the correlation of DLs with lightness of Japan Sea core MD01-2407 (Kido et al., 2007) and with δ18O records of Chinese stalagmites (Wang, et al., 2001, 2008). Regional interstadials were also independently established by vegetation amelioration of the surrounded land, inferred from the pollen results. During MIS 3, with sea level above -90m, DL were formed mostly consistent with the Tada et al. (1999)'s hypotheses. During MIS 2 and 4, when sea level was nearly and below -90m, sea level descending led to water column stratification and oxygen depletion in bottom water facilitating the DLs formation. High-resolution lightness and productivity proxies defined the subtle structure of pronounced interstadials 14 and 12.
Work is performed with financial support of the Russian-Chinese and Russian grants (№ 40710069004, № 41076038 NNSF of China, SOA; GASI-GEOGE-03; RFFI (№,12-III B-07-118, 13-05-00296) and Russia-Taiwan 14-HHC-002.

Lithostratigraphy and geochemical evidences for paleoceanographic changes in core sediment from the Korea Plateau of the East Sea (Japan Sea), Korea over the last 400 kyr

SANGMIN HYUN[1], JIN-KYUNG KIM[1], HAI-SOO YOO[2], SONG-YI KIM[1] AND BAREUM SONG[1]

[1] Marine Geology and Geophysics Division, Korea Institute of Ocean Science and Technology (KIOST), Korea (smhyun@kiost.ac.kr)

[2] East Sea Research Institute, Korea Institute of Ocean Science and Technology (KIOST), Korea

High-resolution measurements were performed on core E09-08, which was taken from the top flat area of the Korea Plateau in the East Sea (Japan Sea). Based on the high-resolution oxygen isotope results, the sediment color (L*), and comparison with previous results from the eastern part of the East Sea, the detailed lithostratigraphy was reconstructed. The biogenic components (TOC and carbonate) and the carbon ($\delta^{13}C_{org}$) and nitrogen ($\delta^{15}N_{org}$) isotopes of the organic matter in sediments from core E09-08 were investigated to delineate the paleoceanographic variations. This demonstrated that the cores, which covered about 400 kyr, approximately the middle of Marine Isotope Stage (MIS) 11, providing high-resolution paleoceanographic records of the Korea Plateau, northern part of Ulleung Basin in East Sea, Korea.

Based on the $\delta^{13}C_{org}$ and $\delta^{15}N_{org}$ excursions, this study provides three modes of paleoceanographic environment characterizing the oceanographic conditions: the strong negative anomalies (SNA), the strong positive anomalies (SPA) with respect to the $\delta^{13}C_{org}$ and $\delta^{15}N_{org}$ ratio, and the intermediate values of the $\delta^{13}C_{org}$ and $\delta^{15}N_{org}$ ratios (IVA). These three modes were interpreted as the terrestrial organic matter source domain, the productivity and diagenetic domain, and the increased productivity domain, respectively. This variation suggests that the paleoceanographic environment of the Korea Plateau has not been stable since the last MIS 11. The main causes of the changes may come from variations in $\delta^{13}C_{org}$ and $\delta^{15}N_{org}$ related to paleoceanographic conditions in the Korea Plateau, East Sea. Additionally, the oceanographic conditions were associated with various factor such as terrestrial organic matter input and changes in productivity, the nutrient supply, ocean currents, and the paleoclimatic variations. One or more of these factors may have modulated the paleoceanographic changes in the East Sea over the last 400 kyr.

Keywords: lithostratigraphy, paleoceanography, East Sea (Japan Sea), paleoclimatology

References

Hyun, S., Kim, J-M., Yim, U.H., Shim, W.J., Yoon, S-H.,Woo, K-S., 2013. Variations in sea surface temperature based on alkenones in Korea Plateau sediments of the East Sea (Sea of Japan) over the last 300,000 year. Journal of Asian Earth Science, 66, 140-149.

Kido, Y., Minami, I., Tada, R., Fujine, K., Irino, T., Ikehara, K.,Chun,J-H.,2007. Orbital-scale stratigraphy and high-resolution analysis of biogenic components and deep-water oxygenation conditions in the Japan Sea during the last 640 kyr. Paleogeography, Paleoclimatology, Paleoecology, 247, 32-49.

Yoon, J.H., Kawamura, H., 2002. The formation and circulation of the intermediate water in the Japan Sea. Journal of Oceanography, 58, 197-211.

Provenance of mineral dust delivered to the Northwest Pacific and its implication for the transport mechanism of Asian dust: Isotopic and Clay Mineralogical Evidence

INAH SEO[1,2], YONG IL LEE[1], KISEONG HYEONG[3], CHAN MIN YOO[2], HYUNG JEEK KIM[2]

[1] School of Earth and Environmental Sciences, Seoul National University (inahseo@snu.ac.kr)
[2] Deep-sea and Seabed Mineral Resources Research Center, Korea Institute of Ocean Science and Technology
[3] Marine Geology and Geophysics Division, Korea Institute of Ocean Science and Technology

The arid and semi-arid regions in the Central-East Asia have supplied a tremendous amount of dust, namely Asian Dust, to nearby continent and the North Pacific Ocean. To date, most studies using pelagic eolian sediment from the North Pacific have focused on understanding the mass flux variation of Asian dust in terms of long-term climate variability, but have not considered specific transport pathways or dust source regions. To characterize the provenance and transport pathways of the Asian Dust deposited in the western tropical/subtropical Pacific and to investigate its changes over the late Quaternary, source regions of mineral dust were investigated with the clay mineral assemblage and the 143Nd/144Nd and 87Sr/86Sr composition of the eolian fractions of deep-sea sediment core retrieved from the Palau-Kyushu Ridge (12°30′N, 134°60′E, 3,728 m water depth) in the Philippine Sea, deposited for the last 600 kyr. The analyzed attributes of the eolian sediment resemble those of dust from the Central Asian deserts (CADs; e.g., Taklimakan and nearby deserts) as in the North Central Pacific, but published aerosol data collected near the study site during winter/spring has the mineralogical signature of dust originating from the East Asian deserts (EADs; e.g., the Chinese Loess Plateau and nearby deserts). These data indicate that the relative contribution of EAD dust increases with the northeasterly surface winds associated with the East Asian Winter Monsoon (EAWM) during boreal winter/spring, but the Prevailing Westerlies and Trade Winds that carry dust from the CADs have been the dominant transport agent for the last 600 kyr. The results of this study contradict the prevailing view that direct dust transport by the EAWM winds in spring dominates the annual flux of eolian dust in the northwest Pacific.

Asian dust depositional flux changes during the last 100 years recorded in Lake Suigetsu sediment, Japan

KANA NAGASHIMA[1], YOSHIAKI SUZUKI[2], YUKARI HARA[3], MASAYUKI TAKIGAWA[1], TOMOHISA IRINO[4], KAZUYOSHI YAMADA[5], Ryuji Tada[2], Takeshi Nakagawa[6]

[1] RCGC, JAMSTEC, Japan (nagashimak@jamstec.go.jp)
[2] Department of Earth and Planetary Sciences, University of Tokyo, Japan
[3] Research Institute for Applied Mechanics, Kyushu University, Japan
[4] Faculty of Environmental Earth Science, Hokkaido University, Japan
[5] Museum of Natural and Environmental History, Shizuoka, Japan
[6] Research Center for Palaeoclimatology, Ritsumeikan University, Japan

The depositional flux record of Asian dust during the late Holocene provides key to understand the role of Asian dust in meteorology and bio-geochemical cycles. Lake Suigetsu in Central Japan is known for the annually-laminated sediments which cover from 70 ka to 11 ka and after 1640 AD. Recently, accurate age model is established for SG06 core based on varve counting and more than 800 radiocarbon dates (e.g., Ramsey et al., 2012; Staff et al., 2013). Lake Suigetsu sediments are expected to contain dust particles from continental Asia. However the dust particles in the sediment matrix are not easy to identify and analyze quantitatively as they are diluted with the detrital materials supplied directly from surrounding slopes of the lake and indirectly from the catchment areas of Hasu River through the Lake Mikata, which is connected to the Lake Suigetsu by a shallow sill. We therefore developed a method to identify Asian dust within lake sediments and apply the method to the near-surface sediment samples of Lake Suigetsu to reconstruct dust flux changes during the last 100 years.

We focus on two mineralogical parameters, the plagioclase (anorthite vs. albite) and alkali-feldspar (orthoclase vs. albite) types. These mineralogical parameters were determined for fine-silt sized Asian dust collected in Japan and detrital materials collected at nine sites within Lake Suigetsu drainage and from the drainage areas of Hasu River. Compared to the detrital materials from local sites, Asian dust is characterized by the anorthite-rich plagioclase type. The recognized differences were then applied to the lake Suigetsu sediments to quantify air-born dusts from continental Asia. The estimated dust flux exhibited interannual to decadal-scale variations which are different from the trend of dust emission frequency at source regions of Asian dust (Gong et al., 2007), probably representing the changes of dust-transport path. In the presentation, we will also examine the relation between the wind-system and dust transport path changes during the last 100 years using the model simulation, and further discuss the dynamics of Asian dust transport.

Keywords: Asian dust, Lake Suigetsu, Decadal scale, Feldspar

Rock-magnetic properties of deep-sea sediments from the Shatsky Rise: anomalous sedimentary environments during MIS 6 and 8

JI-YOUNG SHIN[1], WONNYON KIM[1], KISEONG HYEONG[1]

[1] Korea Institute of Ocean Science & Technology, Republic of Korea (wkim@kiost.ac.kr)

Rock-magnetic properties of deep-sea sediments from the Shatsky Rise (32°17.55' N, 158°13.57' E) were investigated to understand changes of sedimentary environments over glacial-interglacial cycles. Correlation of magnetic susceptibilities with a nearby core reveals ~300 ka at the depth of ~520 cm and an average sedimentation rate of ~1.73 cm/ky. Magnetic parameters show significant deviations from a general down core trend at the depth of ~250–330 cm and ~430–500 cm, corresponding to the MIS 6 and 8, respectively. In those horizons, concentration-related magnetic parameters (e.g., magnetic susceptibility, ARM and SIRM) decrease abruptly in magnitude, associated with reduced contribution of low-coercivity minerals (decrease of S-ratio). The drops are also concordant with grain-size coarsening (decrease of ARM/SIRM). Such anomalous rock-magnetic properties can be attributed to the change of the major eolian source, which can provide high-coercivity mineral rich sediments. Increased input of high-coercivity minerals could result in decreases of S-ratio and the magnetic concentration parameters due to their low magnetization. Alternatively, as a result of post-depositional alteration (i.e., diagenesis), fine-grained magnetite preferentially can be dissolved. In this case, the remaining magnetic minerals would have larger average grain-size, higher fraction of high-coercivity minerals, and thus, produce decreased values of magnetic concentration parameters.

Keywords: Shatsky Rise, Rock-magnetic property, MIS 6, MIS 8, sedimentary environment

ITCZ and ENSO-like pacing on the East Asian winter monsoon: sedimentological evidence from the Okinawa Trough

XUFENG ZHENG[1], ANCHUN LI[2], SHIMING WAN[2], SHUHJI KAO[3]

[1] Key Laboratory of Marginal Sea Geology, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou, 510301, China

[2] Key Laboratory of Marine Geology and Environment, Institute of Oceanology, Chinese Academy of Sciences (CAS) 7 Nanhai Road, Qingdao, 266071, China

[3] State Key Laboratory of Marine Environmental Science, Xiamen University, Xiamen, China

Deep-sea fan sediments provide an excellent geological archive for paleoenvironment reconstruction. Grain size, clay mineral and elemental (Ti, Fe, Ca) compositions were measured for a core retrieved from a submarine fan in the Okinawa Trough. Varimax-rotated Principal Component Analysis (V-PCA) on time-evolution of grain size spectrum reveals that, since the Holocene, sediment was transported mainly by the benthic nepheloid layer (33%) and upper layers (33%) which is driven by the East Asian winter monsoon (EAWM). The intensification of the Kuroshio Current during the Holocene, masks the fluvial signal of the summer monsoon and obstructs clay minerals derived from the Yellow River, a major contributor prior to 12 ka BP. A new grain size index (GSI), which represents the EAWM well, exhibits a negative correlation with the δ18O record in Dongge Cave, China during the Holocene when sea level was relatively steady. This anticorrelation suggests the southward migration of the Intertropical Convergence Zone (ITCZ). The consistency among our records and rainfall records in Peru, Ti counts in the Cariaco Basin, monsoon records in Oman and the averaged summer insolation pattern at 30°N further support the ITCZ's impact on monsoon systems globally. Cross-Correlation Analyses for GSI and log(Ti/Ca) against δ18O record in Dongge Cave reveal a decoupling between the East Asian winter and summer monsoon during 5500–2500 cal yr BP, with greater complexity in the last 2500 years. This can be attributed to exacerbated ENSO mode fluctuations and possibly anthropogenic interference superimposed on insolation and ITCZ forcing.

Key words: East Asian monsoon, ITCZ, ENSO, Holocene, Okinawa Trough

Variations in the sea surface and thermocline water temperatures over the Indo-Pacific Warm Pool during Glacial-Interglacial transitions

HAOWEN DANG[1], ZHIMIN JIAN[1], LIMING YE[1,2], WEIJIA FAN[1,2], ZHIHUI CHU[1,3], CHAO ZHOU[1], AND PEIJUN QIAO[1]

[1] State Key Laboratory of Marine Geology, Tongji University, Shanghai, China, 200092
[2] Second Institute of Oceangraphy, State Ocean Administration, Hangzhou, China, 310012
[3] ShanghaiTech Univeristy, Shangi, China, 200031

The sea surface temperature (SST) of the tropical Pacific is crucial for the global climate change, due to its direct forcings on the global cycles of heat and moisture. On the other hand, the sub-surface heat content of the tropical Pacific is believed to be responsible for the "missing heat" of the 21st centry, indicating its pronounced role in modulating the global climate. In this study, we compiled 9 records of paired SST and thermocline water temeprature (TWT, at ~100 m water depth) derived from planktonic foraminifera Mg/Ca proxies, over the Indo-Pacific Warm Pool and the eastern equatorial Pacific, focusing on the last two Glacial-Interglacial transitions, to dicypher their distinct behaviors and possible mechanisms. The SST variations, dominated by ~100 kyr cycle, are generally consistent with changes in the sea-level and ice-volume, and atmosphere CO2 content, suggesting a dominant control by the global climate signal. The TWT variations demonstrate stronger precession periodicity, which is characterized by significant cooling trends during the peak interglacials. Hence, we argue that the TWT of the tropical Indo-Pacific is, at least partly, modulated by the precessional insolation changes, probably through the sub-surface linkage between the tropical and extra-tropical ocean and/or the equatorial ocean-atmoephere coupled climatic processes. Assuming the TWT in this study could represent the heat content of the tropical Pacific, our findings pointed out a direct insolation forcing for the tropical ocean, particularly on the precessional time-scale, and such a tropical ocean heat engine could play important roles in the Earth's climate feedback system.

Precessional Forcing on the Sea-Air CO2 Exchange in the Western Tropical Pacific over the Last Glacial Cycle

ZHIMIN JIAN[1], HAOWEN DANG[1], TINGTING WANG[1], XINGXING WANG[1], CATHERINE KISSEL[2]

[1] State Key Lab of Marine Geology, Tongji University, Shanghai 200092, China (jian@tongji.edu.cn)
[2] Laboratorire des Sciencesdu Climat et del'Environnement, CNRS-CEA, 91198 Gif-sur-Yvette, France

Atmospheric CO2 content is considered as one of the main mechanisms regulating the climate change during the Quaternary glacial cycles, which itself is also much influenced by the sea-air CO2 exchange. At present, the surface seawater CO2 of the western equatorial Pacific equilibrates with the atmosphere, while that of the South China Sea (SCS) is a weak source to the atmospheric CO2. However, how the surface seawater of the western tropical Pacific exchanged CO2 with the atmosphere over the past glacial cycles is still unknown. To resolve this problem would be helpful to better understand the role of the ocean in the atmospheric CO2 change and hence the global climate.

In this study, planktonic foraminifers Globigerinoides ruber and Pulleniatina obliquiloculata from cores MD05-2896 and MD12-3434 of the SCS and MD10-3340 of the Halmahera Sea were measured for B/Ca and Mg/Ca ratios to reconstruct surface and subsurface seawater pH and temperature, respectively, over the last glacial cycle, and then to calculate the seawater partial pressure of CO2 (pCO2sw) and the pCO2 difference between surface seawater and atmosphere (ΔpCO2sw-atm) and between subsurface and surface seawater (ΔpCO2tw-sw). The ΔpCO2sw-atm values of cores MD05-2896 and MD12-3434 were positive during the Holocene and from MIS5.1 to MIS5.4, indicating that the SCS was a source of atmospheric CO2 during that periods. But, during the last glacial period, the SCS became a sink of atmospheric CO2, indicated by the negative ΔpCO2sw-atm values. The difference between the Halmahera Sea and the southern SCS is that the Halmahera Sea was the source of atmospheric CO2 all the time over the entire last glacial cycle. However, the source effect of the Halmahera Sea was weakened in the glacial period compared with the interglacial period. Particularly, the ΔpCO2sw-atm, ΔpCO2tw-sw and the vertical temperature difference (ΔTSST-TWT) between the sea surface temperature (SST) and thermocline water temperature (TWT) from the three cores have similar change pattern, displaying obvious 20,000-year precession cycles. When the TWT deceased (accompanied by the increased ΔTSST-TWT and shoaled thermocline depth), the upper ocean was reduced to release CO2, causing that the pCO2 difference between surface seawater and atmosphere decreased and the surface water tend to absorb more CO2 from the atmosphere.

Therefore, our results show that over the last glacial cycle in the western equatorial Pacific the effect of carbon source was reduced generally during glacial periods, while in the SCS there was glacial-interglacial transformation of carbon sink-source pattern. This would play a certain influence on the glacial decrease of the atmospheric CO2 content. The precessional insolation driven TWT change is one of the dominant factors regulating the western tropical Pacific to absorb or release CO2, at least over the orbital time scale.

Keywords: sea-air CO2 exchange, glacial cycle, tropical Pacific, precessional forcing, thermocline water temperature

Reconstruction of paleoproductivity in the central equatorial Pacific Ocean during the mid-Pleistocene transition using lipid biomarker approach

ADEGOKE OLUGBOYEGA BADEJO[1], INAH SEO[2, 3], KISEONG HYEONG[2], SE-JONG JU[1]

[1] Deep-sea and Seabed Mineral Resources Research Center, KIOST, Ansan, Korea (badejo@kiost.ac.kr)
[2] Marine Geology and Geophysics Division, KIOST, Ansan, Korea
[3] Marine Geology and Geophysics Division, KIOST, Ansan, Korea:
[4] School of Earth and Environmental Sciences, Seoul National University, Seoul, Korea

The mid-Pleistocene climate transition (MPT) is a period of complex climatic change which brought about the Late Pleistocene ice age around 0.9Ma and a shift in the dominant periodicity of glacial- interglacial oscillations from 41 to 100kyr. The MPT also marks changes in the deep water circulation, caused by global cooling and the intensification of the Northern Hemisphere glaciation. We examine the changes in productivity in the central equatorial pacific during the MPT by applying a lipid biomarker approach. A sediment core from the central equatorial Pacific (5º 55' N, 177º 26' W, 557 cm long and 4136 m water depth) was studied for biomarkers on the time interval from 400 kyrs to ~1Ma, largely coinciding with the MPT. Contents of marine lipid biomarkers (alkenone, brassicasterol and dinosterol) showed different down-core variation. The concentration of brassicasterol and dinosterol increased during the MPT (0.7Ma) while alkenone concentration decreased. The shift in the phytoplankton marker concentrations likely reflects the changes in physical properties of the water column, as the relative contribution of alkenone to brassicasterol and dinosterol is greatest in well stratified oligotrophic water. Sea surface temperatures (SSTs) reconstructed showed ~ 2 ºC fall during the same time period.

Keywords: Alkenone, brassicasterol, dionosterol, mid-Pleistocene climate transition

Differences in Late Quaternary primary productivity between the western tropical Pacific and the South China Sea: evidence from coccoliths

CHUANLIAN LIU [1] , XIANG SU [1, 2], LUC BEAUFORT [3], NICOLAS BARBARIN [3], ZHIMIN JIAN [1]

[1] State Key Laboratory of Marine Geology, Tongji University, Shanghai 200092, China (liucl@tongji.edu.cn)
[2] Key Laboratory of Marginal Sea Geology, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou 510301, China
[3] CEREGE, CNRS/Aix Marseille Univ., BP80, 13545 Aix-en-Provence, France

Changes in Late Quaternary oceanic primary productivity in the western tropical Pacific were reconstructed using coccolith counts from the improved SYRACO system in piston core MD01-2386 retrieved from the Halmahera Sea near northwest New Guinea. The calculated primary productivity exhibits cycles on obliquity and precession timescales over the last 192 ka. There are marked differences between primary productivity records from the western tropical Pacific and the South China Sea (SCS), with the former being dominated by precession, and the latter showing all three Milankovitch cycles (eccentricity, obliquity and precession). Empirical Orthogonal Function (EOF) analyses reveal two significant EOF modes in the western tropical Pacific and SCS records. EOF-1 accounts for 38% of the total variance and exhibits obvious precessional cycles corresponding to Northern Hemisphere summer insolation, while EOF-2 accounts for 22% of the total variance and exhibits strong 41-kyr periodicity, suggesting different biological responses to hydroclimate changes in the two regions. A more complex hydroclimate regime influenced by the East Asian monsoon and the large contrast in regional topography and circulation during glacial cycles are considered to be the primary drivers of the stronger temporal variability in productivity in the SCS compared to the relatively stable western tropical Pacific.

Keywords: Primary productivity, Florisphaera profunda, Western tropical Pacific, South China Sea, Milankovitch cycles

Biserial planktic foraminifers Streptochilus: A proxy for paleo-productivity?

KIMOTO, K.[1], HARUNAGA, M.[2], NAKAMURA Y.[1] AND KURASAWA A.[3]

[1] Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Japan (kimopy@jamstec.go.jp)
[2] Chiba City Museum of Science, Japan
[3] Marine Works Japan .Ltd, Japan

The genus Streptochilus, is named for small biserial-formed planktic foraminifers. There are two known species in modern ocean but their distribution and ecology are still unknown because they are completely overlooked from the Quaternary paleoceanographic analysis for a long time. Here we firstly reported the occurrence of biserial planktic foraminifers in the water column and the Quaternary sediment in the subtropical and western tropical Pacific, respectively.

Living biserial planktic foraminifers Streptochilus was recovered from the oligotrophic water by the vertical plankton tow in the subtropical Pacific (30°N, 145°E) on the research cruise of R/V Mirai during 7 cruises from 2010 to 2014. Two morphological types of Streptochilus were identified and they occurred in all seasons constantly. Maximum abundance in vertical distributions of both species were located at deep chlorophyll maximum (DCM) and/or its just beneath, and showed no apparent seasonal migration. On the other hand, the occurrence of fossil species of Streptochilus in the Quaternary sediment recovered from the Ontong-java Plateau (KH90-3 2PC, 2,494m water depth) were anomalous: It occurred only between glacial-interglacial periods during MIS 6/5 and 3/2, but their accumulation rate was extremely high (3,500 individuals /cm2/kyr in maximum). Such sporadic occurrences were completely different from that of other planktic foraminifers. Oxygen isotope records of Streptochilus showed lighter value as same as spinose planktic foraminifer Globigerinoides sacculifer and it clearly indicated that Streptochilus has surface-dwelling depth habitat.

According to the ecological aspects in modern ocean, Streptochilus is very sensitive to the nutrient conditions in the water column than any other planktic foraminifers and their higher occurrence might be indicated higher primary productivity in the water column. In fact, it is confirmed that mass accumulation rate of organic carbon and calculated primary productivity in the western equatorial Pacific had increased during the periods of MIS 6/5 and 3/2 (e.g. Kawahata et al., 1999). It indicates the possibility as a new proxy for evaluating paleo-productivity based on fossil assemblages of biserial planktic foraminifera.

Keywords: biserial planktic foraminifers, western Pacific, paleo-productivity, new proxy

The surface water environment changes in the western Bering Sea during the last glaciation-deglaciation-Holocene

ALEKSANDR A BOSIN[1], MIN-TE CHEN[2], MARIYA S OBREZKOVA[1], SERGEY A GORBARENKO[1], YURIY VASILENKO[1], JIANJUN ZOU[3], YANGUAN LIU[3], MIKHAIL I MALAKHOV[4]

[1] V.I. Il'ichev Pacific Oceanological Institute, Russia (bosin@poi.dvo.ru)
[2] National Taiwan Ocean Univ., Taiwan
[3] First Institute of Oceanography, SOA, China
[4] North-East Interdisciplinary Science Research Institute, Russia

western Bering Sea. The SST record indicates obvious glacial-interglacials variations, ranging from 3-8 ℃ during the Holocene.

However, the SSTs are relatively stable and lower throughout the last glacial. The C37 alkenones concentrations indicating marine coccolithophore productivity are also higher during the Holocene, paralleling to the higher SSTs. The relatively higher C37:4 alkenone (C37:4%) content in the glacial suggests fresher surface water mass dominated in this period. The terrigenous record derived from long-chain n-alkanes (C27, C29, C31) reveals higher terrestrial materials input during the glacial. However, the maximum n-alkanes concentration coincides with the maximum SST and C37 alkenones concentration in the early Holocene. The diatom abundances were relatively high during Bolling-Allerod warming event (B-Al) and reached maximum during the Holocene. Therefore these periods were characterized by enhanced marine productivity as a result of a prolonged vegetation season and reduced sea-ice influence. The peak of P.sulcata during the YD reflect possibly an abrupt melting of sea ice that results in surface water freshening during the B-Al. During the Heinrich event 1 and Younger Dryas cooling episodes an increased sea-ice extension limited the marine productivity due to shortened vegetation season. An increase in relative percent of N.seminae at the beginning of Holocene indicates an increased influence of the Pacific waters coeval with opening of the Bering Strait and with changes in surface water circulation. Overall, our initial data from LV63-13-1 indicate that more extensive sea-ice covers resulted in the reduced marine productivity, fresher surface water mass, and more terrestrial materials transported into the ocean by the outgrowth of sea ice into the western Bering Sea during the glacial. This work was supported by grants 13-05-00296, 14-05-31364, 14-HHC-002, GASI-GEOGE-03, 41420104005, 40710069004,40431002.

Keywords: Bering sea, climate change

Millennial regime variability of sea ice condition in the Sea of Okhotsk during Last Glaciation (during 75-11.7 kyr)

YURIY VASILENKO[1], SERGEY GORBARENKO[1], XUEFA SHI[2], JIANJUN ZOU[2], YANGUANG LIU[2]

[1]V.I. Il'ichev Pacific Oceanological Institute, Vladivostok, Russia (vasilenko@poi.dvo.ru)
[2]First Institute of Oceanography, Qingdao, China

We have studied the change in the content of coarse terrigenous material and its character in the sediments core LV28-44-4. This core was recovered in the eastern part of the Sea of Okhotsk. The results were compared with variations of the coarse fraction content in the core of the central part of the Sea of Okhotsk. Both cores were designed high-resolution age model. This allowed us to analyze the changes in the ice conditions of the Sea of Okhotsk during the Last Glaciation (Mrine isotope-oxygen stages (MIS) 2-4) with highly detailed. The supply of coarse terrigenous component into sediments of the eastern part of the sea, which have accumulated during the Last Glaciation, was caused exclusively by sea ice. Sea ice transport of terrigenous material in the eastern part of the sea is clearly observed during MIS 4 and was the most active during Dansgaard-Oeschger stadials of MIS 3, and is not expressed in the MIS 2. In contrast, in the central part of the Sea of Okhotsk supply of terrigenous material was greatest during MIS 2, slightly below the MIS 4, but was relatively low during the MIS 3. In our opinion, the changes of sea ice transport are the response of sea ice conditions to the reorganization of the atmospheric circulation high and middle latitudes of the Northern Hemisphere during the Last Glaciation. This work was supported by the Russian Fund of Basic Research, grant No 13-05-00296a, 14-05-31364 mol_a; by the National Natural Science Foundation of China (Grant number: 41420104005; 40710069004; 40431002; GASI-GEOGE-03) and by the Far East Branches of the Russian Academy of Sciences, grant No 14-HHC-002.

Keywords: the Sea of Okhotsk, ice rafted debris, millennial-scale variation, sea-ice conductions

Millennial-scale changes of surface and bottom water conditions in the Northwest Pacific during the last deglaciation

S. KIM[1], B.K. KHIM[1], K. IKEHARA[2], T. ITAKI[2], A. SHIBAHARA[3], M. YAMAMOTO[4]

[1] Department of Oceanography, Pusan National University, Busan, South Korea
[2] Geological Survey of Japan, AIST, Tsukuba, Japan
[3] Geological museum office, AIST, Tsukuba, Japan
[4] Faculty of Environmental Earth Science, Hokkaido University, Sapporo, Japan

The last deglacial changes of the water column conditions in the Northwest Pacific were reconstructed using geochemical and isotope proxies (biogenic opal, CaCO3, total organic carbon (TOC), redox sensitive elements, bulk nitrogen isotopes (δ15N), and silicon isotopes (δ30Sidiatom) of diatom frustules) along with the published data (alkenone temperatures and benthic foraminiferal faunas) at core GH02-1030 recovered from the slope off Tokachi (42°13.77′N, 144°12.53′E, 1212 m water depth) by the R/V Hakurei-Maru No. 2 of the Geological Survey of Japan. Age model for core GH02-1030 was determined using both planktonic and benthic foraminifer AMC 14C dates (Ikehara et al., 2006). Alkenone sea surface temperature (SST) shows that biogenic opal productivity, primarily representing the export production of diatom, was related to the degree of spring-summer mixed layer depth (MLD). Biogenic opal and TOC contents change almost in parallel. δ30Sidiatom values are high during the Holocene and low during the last glacial maximum. During the Bølling-Allerød (BA) and the Pre-Boreal (PB), silicic acid utilization represented by δ30Sidiatom increased when the biogenic opal productivity and export TOC productivity are high under shoaling of spring-summer MLD. The BA and the PB intervals contain laminated sediment layers, which are characterized by increases of CaCO3 contents, bulk δ15N values, and redox element concentrations (Mo/Al, Cd/Al, and U/Al). All these indicate low dissolved oxygen content of the bottom water during the BA and PB periods, which is supported by the good preservation of dysoxic benthic foraminifera. In addition, compared to the Holocene biogenic opal productivity and related silicic acid utilization, the high δ15N values during the BA and the PB seemed to be attributed more to denitrification through the water column rather than complete utilization of nutrients. Another distinct feature based on benthic foraminiferal assemblage, CaCO3 contents and redox element concentrations is that the dissolved oxygen content in bottom water was lower during the BA than the PB. Because biogenic opal productivity remained comparable during both periods, it implies that ventilation of the North Pacific Intermediate Water was much weaker during the BA, which may be related to warmer spring-summer SST.

Keywords: deglaciation, surface productivity, ventilation, North Pacific Intermediate Water

References

Ikehara, K., K. Ohkushi, A. Shibahara, and M. Hoshiba (2006), Change of bottom water conditions at intermediate water depths of the Oyashio region, NW Pacific over the past 20,000 years, Global Planet. Change 53, 78–91.

Deep Pacific Ocean circulation and carbonate chemistry linked to the Antarctic ice-sheet expansion

XIAOLIN MA[1], JUN TIAN[1], JIMIN YU[2], KE LI[1] AND HOWIE D. SCHER[3]

[1] State Key Laboratory of Marine Geology, Tongji University, Shanghai, 200092
[2] Research School of Earth Sciences, the Australian National University, Canberra, ACT 0200, Australia
[3] Department of Earth and Ocean Sciences, University of South Carolina, Columbia, South Carolina, USA

The Middle Miocene East Antarctic ice-sheet expansion (EAIE) during the Middle Miocene climate transition (MMCT) likely played a significant role in deep Pacific Ocean circulation and global carbon cycling. We integrate geochemical records including benthic stable isotopes, neodymium isotope in the fish teeth, benthic B/Ca ratio and weight percent of calcium carbonate (%CaCO3) between 14.1 and 13.5 Ma, derived from ODP site 1148 (water depth 3294 m, 18.83°N, 116.55°E) in the Western Pacific Ocean, to explore the relationship between deep Pacific Ocean circulation and carbon cycling during the period of EAIE. Together with preciously published benthic stable isotope and neodymium isotope records from Pacific Ocean, the results suggest that the deep Pacific Ocean circulation had a significant reorganization in pace with the EAIE. Our elevated Nd suggests deep Western Pacific Ocean water mixed with more radiogenic water from Northern Pacific Ocean following the strong meridional overturning circulation (MOC) induced by the EAIE. Simultaneously, the front the Antarctic intermediate water (AAIW) with a positive 13C could permeate 20°N with a depth ~2000 m as an overlay on the MOC, which is like a "triple-decker sandwich". Middle layer water mass in the Northern Hemisphere of this "sandwich", so-called modified "North Pacific Deep Water (NPDW)" has a negative 13C, which presumably originates from the mixing and upwelling of southern-sourced Circumpolar Deep Water (CDW) and North Pacific water in the carbon maximum (CM6) of the "Monterey Excursion". In the same time, the elevated carbonate burial flux likely resulted from the carbonate saturation increase due to the more southern-sourced CDW produced by the strong MOC, which is indicated by a 40 mol/kg increase in the benthic foraminiferal B/Ca-derived carbonate ion ([CO32-]) records and increased 13C gradient between the intermediate and deep water mass in the 20°N. We surmise that large amount of atmospheric CO2 was stored in the up layer water of the MOC, which further promoted the Antarctic ice-sheet expansion triggered by the striking transition from obliquity to eccentricity. Moreover, this hypothesis is supported by our box model.

Keywords: EAIE, ocean circulation, carbon cycle, Middle Miocene, Pacific Ocean

Isolation of geomicrobiological relevant species from benthic samples

FANGCHENG XU[1]

[1]College of Chemistry and Chemical Engineering, Xiamen University, Xiamen 361005, China

Microbe-mineral interactions may have played a central role on the early Earth, especially around the time of the Great Oxidation Event. For a long time in traditional biology and geology, such interactions as well as those among microbial species are thought to be mainly controlled by the diffusion process. In other words, organic matters and/or metal ions have to diffuse through the microbial membrane for such interactions. The key meaning of diffusion is that heterogenous species and also microbes to minerals are spatially separated by water. The recent discoveries of extracellular electron transfer and exoelectrogenic microbes (EMs) have implied that, beside the above mentioned indirectly mechanisms, direct mechanisms might have play important roles in the ancient Earth. By studying the interactions at these organic-mineral interfaces in modern samples, it gives a new way to look for traces of past microbe-mineral interactions recorded in ancient rocks. But up to date, EMs isolated from extreme environments such as from benthic samples are still limited. Here we report marine EM isolation from 4020-m's deep-ocean sediments. Seven EMs were isolated that belong to four genera - Shewanella, Aeromonas, Haemophilus and Morganella. Among them, Morganella sp. 8121 is the first EM reported in Morganella genus. Three methods, including microbial fuel cells (MFCs) for current production, reduction solid Fe(III) oxide and cyclic voltammetry, were used to identify and compare their capabilities of extracellular electron transfer. The results indicated all isolates exhibited high catalytic capability of ferric reduction, while 57.1% isolates could produce remarkable current in MFCs. These results demonstrate that our methods are good for screening such geomicrobiological relevant species.

Keywords: geomicrobiology; exoelectrogenic microbes; extracellular electron transfer; microbe-mineral interactions

References

Ahmed, E.; Holmström, S. J., Microbe–mineral interactions: The impact of surface attachment on mineral weathering and element selectivity by microorganisms. Chemical Geology 2015, 403, 13-23.

Miot, J.; Benzerara, K.; Kappler, A., Investigating microbe-mineral interactions: Recent advances in X-ray and electron microscopy and redox-sensitive methods. Annual Review of Earth and Planetary Sciences 2014, 42, 271-289.

Southern Annular Mode (SAM) for the Last Glacial Maximum derived from PMIP2 coupled model simulations

SEONG-JOONG KIM[1], JUNMEI LÜ[2], BAEK-MIN KIM[1]

[1]Korea Polar Research Institute, KORDI, PO Box 32, Incheon 406-840, Korea (seongjkim@kopri.re.kr)
[2]Chinese Academy of Meteorological Sciences, Beijing 100081, China

The increasing trend of the Southern Annular Mode (SAM) or Antarctic Oscillation in recent decades has influenced the climate change in the southern hemisphere. How does the SAM respond to the increase of greenhouse gases in the future is still remains uncertain. Therefore, understanding the variability of the SAM in the past under colder climate such as the Last Glacial Maximum (LGM) helps understand the response of the SAM for the future warm climate. We analyzed the changes in the SAM for the LGM in comparison to the pre-industrial (PI) simulation using 5 coupled ocean-atmosphere models (i.e. CCSM, FGOALS, IPSL, MIROC3.2, and UBRIS-HadCM3M2) from the second phase of Paleoclimate Modelling Intercomparison Project (PMIP 2). In CCSM, HadCM3M2, IPSL, FGOALS, the variability of the simulated SAM appears to be reduced in the LGM than the PI with a small decrease in the standard deviation of the SAM index. Overall, four out of five models suggest the weaker variability of the SAM in the LGM, in consistent with the weaker SH polar vortex and westerly winds found in some proxy records and model analyses. The weakening of the SAM in the LGM is associated with the increase in the vertical propagation of Rossby waves.

Presence of diatomaceous mud beneath stratified diamicton in the southwestern Ross Sea and its implication

JI LEE[1], HI YOON[1], KC YOO[1], HS MOON[1], E DOMACK[2], B ROSENHEIM[2], C SUBT[2]

[1]Korea Polar Research Institute, Korea (leeji@kopri.re.kr)
[2]University of South Florida, United States

In the western Ross Sea it has generally been considered that a thick ice sheet was grounded to the sea floor during the last glacial maximum (LGM) and the retreat of the ice sheet did not begin until ~13 ky BP. A gravity core (DG12-GC06) from the southern Drygalski Trough in the southwestern Ross Sea, however, raises a question about the stability of the Ross Ice Sheet during the last glacial period. 'Typical' Ross Sea sequence of LGM to Holocene age is composed of diatomaceous mud and underlying diamicton. The core sediment from the southern Drygalski Trough also contains post-glacial diatomaceous mud ('upper' mud) and glacial stratified diamicton, but the diamicton layers are overlain by another, 'lower' diatomaceous mud layers. The presence of 'lower' mud beneath diamicton indicates a seasonally open marine environment prior to/during the last glacial event in the southwestern Ross Sea. Radiocarbon dates of acid-insoluble organic matter (AIO) from the 'lower' mud range from ~32 to 39 ky BP. AIO radiocarbon age of surface sediment is ~4ky BP and corrected age based on surface sediment age is ~28 to 35 ky BP. However, this kind of age correction is ratified only when composition of organic matter of surface sediment is similar to that of the 'lower' mud. We applied ramped pyrolysis technique for radiocarbon dating of the 'lower' mud to date younger organic matter fraction, which produced ages of 22~23 ky BP. It seems that ice sheet on the western Ross Sea retreated at ~24 ky BP and advanced at ~21 ky BP. In order to preserve the 'lower' mud, we infer that the second advance featured a thinner ice sheet than the initial advance.

Keywords: Antarctic, Ross Sea, sediment, glacial

Last glacial to Holocene millennial scale climate variability in the Southeastern Bering Sea

WENSHEN XIAO[1], RUJIAN WANG[1], RAINER GERSONDE[2], JIAN REN[2], XUN GONG[2,3]

[1] State Key Laboratory of Marine Geology, Tongji University, Shanghai 200092, China (wxiao@tongji.edu.cn)
[2] Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven D-27568, Germany
[3] School of Earth and Ocean Sciences, Cardiff University, Cardiff CF10 3AT, UK

The last Glacial to Holocene climate is characterized by large shifts of environmental conditions and millennial scale oscillations as recorded in both Greenland and Antarctic ice cores. A detailed response to the high climate variability in the subarctic North Pacific, including the Bering Sea, is hampered by precise dating of the last glacial sediments due to the poor preservation of calcareous microfossils. High resolution diatom records from well dated gravity core SO202/22-4, retrieved from the Umnak Plateau, Southeast Bering Sea, show millennial scale environment changes during the past 32 ka. The last glacial millennial scale productivity pulses indicate temporal surface warming induced sea ice melt that correspond to warming intervals recorded by Greenland ice core or East Asian Summer Monsoon records. The strong productivity pulse during the Bølling/Allerød interval may be resulted from the enhancement of deep ocean circulation that induced upwelling of nutrient supply to the surface. Along with the rising sea level, the deglacial North Pacific water inflow to the Southeast Bering Sea started from ca. 13 ka, in association to the opening of the Unimak Pass. Major melt water input occurred in 3 intervals, together with icesheet breakup indicated by Ice Rafted Debris, indicating the breakup of Cordilleran Icesheet which contributed to the Melt Water Pulse 1a. The opening of the Bering Strait during the Early Holocene allowed freshwater export to the Arctic Ocean, and reduced sea surface stratification in the Bering Sea, thus terminated the early Holocene lamination in the Bering Sea sediments.

Keywords: Bering Sea, diatom, last glacial, termination 1, Holocene

Early Pliocene reorganisation of Nordic Seas circulation due to Atlantic-Pacific gateway changes

MICHAEL SCHRECK[1], STIJN DE SCHEPPER[2,3], KRISTINA M. BECK[3], JENS MATTHIESSEN[4], KIRSTEN FAHL[4] AND GUNN MANGERUD[3]

[1] Arctic Research Centre, Korea Polar Research Instiute, 26 Songdomirae-ro, 406-840 Incheon, Korea
[2] Uni Research Centre, Bjerknes Centre for Climate Research, Allegaten 55, N-5007, Bergen, Norway
[3] Department of Earth Sciences, University of Bergen, Allegaten 41, N-5007, Bergen, Norway
[4] Department of Earth Sciences, University of Bergen, Allegaten 41, N-5007, Bergen, Norway

The present day Nordic Seas are an essential part of the Atlantic meridional overturning circulation due to formation of North Atlantic Deep Water, and thus a key player in global climate. The establishment of its modern circulation pattern – with inflow of relatively warm Atlantic waters in the east and export of cool and fresher Arctic waters in the west – was hypothesized to be initiated in the early Pliocene, but precise timing, encompassing mechanism and conclusive data from the Nordic Seas remained elusive.

Here we compare palynological (dinoflagellate cysts, acritarchs) data from the present-day Atlantic domain off Norway with data from the Arctic domain off Greenland. Both records show a major assemblage turnover and significant decrease in productivity at around 4.5 Ma, which supplemented with a new alkenone sea surface temperature record, documents a wide-scale surface cooling across the entire Nordic Seas. While assemblages at both sides are similar prior to 4.5 Ma they develop independently thereafter indicating subsequent initiation of the zonal sea surface temperature gradient characteristic for the present day circulation system governed by the Norwegian Atlantic Current and the East Greenland Current.

The observed changes in the Nordic Seas precede global climate cooling and atmospheric CO2 decline by 500,000 years but occur in sync with reconfigurations at the Northern Hemisphere Pacific-Atlantic ocean gateways as evidenced in the first transarctic migration of cool-water Pacific molluscs. We thus propose that changes at the Bering Strait and Central American Seaway triggered the development of a modern-like surface circulation in the Nordic Seas, which is essential for North Atlantic Deep Water and setting the scene for more widespread Greenland glaciation in the Late Pliocene.

Keywords: Early Pliocene, Nordic Seas, ocean gateways, dinoflagellate cysts, ocean circulation

Millennial-scale variability in the Bering Strait inflow during the Holocene

MASANOBU YAMAMOTO[1], SEUNG IL NAM[2], DAISUKE KOBAYASHI[1], TOMOHISA IRINO[1], KOJI SHIMADA[3]

[1] Faculty of Environmental Earth Science, Hokkaido University, Kita-10, Nishi-5, Kita-ku, Sapporo 060-0810 Japan
[2] Korea Polar Research Institute, 26 Songdomirae-ro, Yeonsu-gu, Incheon 406-840, Republic of Korea
[3] Tokyo University of Marine Science and Technology, 4-5-7, Konan, Minato-ku, Tokyo 108-8477, Japan.

The Bering Strait inflow is an important carrier of heat and freshwater from the Pacific to the Arctic. Previous studies have suggested that this flow to the Atlantic can change the Atlantic meridional overturning circulation. We investigate a centennial-resolution record of the chlorite/illite ratio in a sediment core from the Chukchi Sea to understand the Holocene evolution of the Bering Strait inflow. The record shows an intense Bering Strait inflow to the Arctic during the middle Holocene, which is attributed to the effect of a weaker Aleutian Low. This intensified inflow during the middle Holocene was synchronized not only with a retreat of summer sea ice in the western Arctic but also with intense subpolar gyre circulation in the North Atlantic. We propose that the Bering Strait inflow is linked with the North Atlantic circulation via an atmospheric teleconnection between the Aleutian and Icelandic Lows. A correspondence between the stronger Bering Strait inflow and stronger North Atlantic Drift in the middle Holocene suggests that this atmospheric connection is involved in a mechanism muting the salinity change in the North Atlantic and thereby stabilizing the Atlantic meridional overturning circulation.

Is the composition of sediemntary organic matter changed in the Western Arctic Ocean under the Arctic rapid Change ?

HAIYAN JIN[1,2,3], JIANFANG CHEN[1,2],YANPEI ZHUANG[1], ZHONGQIANG JI[1]

[1] State Oceanic Administration Laboratory of Marine Ecosystem and Biogeochemistry, Second Institute of Oceanography, China (jinhaiyan@sio.org.cn)

[2] State key Laboratory of Satellite Ocean Environment Dynamics, Hangzhou, China,310012

[3] Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Germany.

The Arctic is facing the rapid and severe changes in recent decades. The global warming is rising the Arctic Ocean temperature and resulted in ice retreating, sea ice cover thinning, higher terrestrial river discharge input with more nutriet et ac. Such kind of changes have the critical influence to the maine primary production and the phytoplankton community strucures. In consequence, it changed on-site carbon flux efficiency. Furthermore, the inputs of terrestrial organic carbon were also changed due to increasing river runoff, thawing permafrost and coastal erosion. Nutrients, photosynthetic pigments, bulk organic carobn index and bGDGT were analysed during the investigation of 2008 Chinese Arctic Research Expedition(CHINARE 2008) . The change of the primary production and the phytoplankton community in upper layer of the Ocean, as well as the composition of sedimentary organic carbon will be discussed compared with the collected reference historical data. Pigments induced phytoplankton communities showed that diatom dominated in shelf area, and with the continuously nutrients support by Pacific inflow water, the pelagic ecosytem would be lasted much longer than before. while in the deep basin, the phytoplankton were dominated by nano- and pico-phytoplankton (with the increasing of prasinophytes and crysophytes relative abundance) due to ice retreating and freshening caused oligotrophic conditions.This would affect the marine origen organic carbon flux. A ternary model including N/C ratio, δ13C and BIT index parameters was used to evaluate the composition of sedimentary organic carbon. The result indicated that the east of Chukchi shelf, the region influenced with low nutrient Alaska Coastal Water, showed the lowest marine origine organic matter, but relative high terrestrial source. While in the middle shelf, the sedimentary organic matter mainly contributed to marine origin due to high primary production in this region.

Keywords: Western Arctic Ocean, primary production, pigments, sedimentary organic carbon, rapid Arctic change

Morphological variation of Neogloboquadrina pachyderma in the Arctic Ocean and its relevance for paleoceanographic reconstructions

ASAHI, H. [1], NAM, S-I. [2], SON, Y.J. [3], AND STEIN, R. [4]

[1] Korea Polar Research Institute, 26 Songdomirae-ro, Yeonsu-gu, Incheon, Korea (asahiro@kopri.re.kr)
[2] Korea Polar Research Institute, 26 Songdomirae-ro, Yeonsu-gu, Incheon, Korea
[3] Korea Polar Research Institute, 26 Songdomirae-ro, Yeonsu-gu, Incheon, Korea
[4] Alfred Wegener Institute, Am Alten Hafen 26, Bremerhaven,

Neogloboquadrina pachyderma (sinistral) comprises nearly entire planktic foraminifer population in the Arctic Ocean. Such monospeficic faunal composition brings difficulties paleoceanographic reconstruction using planktic foraminifer assemblage in the Arctic Ocean. Though recent studies have shed lights on potentail usabilities using morphological variation within N. pachyderma for paleoceanographic reconstruction (e.g. Eynaud et al., 2010; Moller et al., 2013), its application is still limited within a certain region. To test usability of morphological varioation of N. pachyderma representing surface water condition, planktic foraminiferal assemblages were investigated at total of 82 surface sediment samples collected in the Pacific Side of the Arctic Ocean. Within investigated surface sediment samples, we encountered seven morphological variation of N. pachyderma, which compromise to previous works by Eynaud et al. (2010) with slight modification. Clear geographic separation of morphological variations at different surface water condtions implies that they are echophenotypes in the Arctic Ocean, as been suggested by previous works. In detail, “Large-sized N. pachyderma (>250 μm)” that cannot be found in the modern Pacific water prefers “low-salinity” and “relatively warm” water off the Northern Alaska. Using echophenotypical assemblage, we have succeeded to establish regional transfer function reconstructing past temperature and salinity condition. Application of transfer functions at down-core foraminiferal assemblages at the Northwind Ridge (ARA01B-MUC05: 75 ˚N, 160˚W) showed general warming of ~0.5 ˚C and freshening of ~1.0 PSU during Holocene.

Water column structure changes on the Northwind Ridge, western Arctic Ocean since the Marine Isotope Stage 5: evidences from foraminiferal assemblages and their oxygen and carbon istopes

DUAN XIAO, WANG RUJIAN, XIAO WENSHEN, ZHANG TAOLIANG

[1] State Key Laboratory of Marine Geology, Tongji University, Shanghai 200092, China (rjwang@tongji.edu.cn)

The Chukchi Borderland, including the Northwind Ridge area, is undergoing significant changes in sea ice melting (Stroeve et al., 2012), as well as fresh water storage and biological productivity in recent climate warming (Rabe et al., 2011; Arrigo et al., 2008). To better understand these recent trends, it is necessary to examine the effects of past climate changes in this region using sediment core proxy records. Foraminiferal assemblage and planktonic foraminiferal stable oxygen and carbon isotopes have been investigated on core ARC3-P37, retrieved from the Northwind Ridge, in order to reconstruct the water column structure and circulation changes in response to climate variation. The abrupt increase of foraminiferal abundance may indicate warm intervals with pacific inflow to the Western Arctic Ocean. Planktonic species Neogloboquadrina pachyderma (sin.) (Nps) dominates the foraminiferal assemblage by over 90%. Benthic assemblage mainly comprises of deep water dwellers Cibicidoides wuellerstorfi and Oridorsalis umbonatus. The occurrence of Atlantic species Cassidulina neoteretis during cold periods indicates the deepening of Arctic intermediate water. Nps-δ13C is generally heavy during warm intervals, reflecting good ventilation and high productivity. Nps-δ18O variation is complicated and affected by its habitat, water temperature, halocline depth, meltwater etc., and generally showing heavy values during cold periods, while light values corresponding to meltwater input. Above the brown layer B2b in Marine Isotopic Stage (MIS) 3, light Nps-δ18O is affected by warm sea water and meltwater discharge; while below B2b, the heavy Nps-δ18O during warm intervals may suggest shallowing of the halocline and the migration of Nps habitat to deeper layers.

Keywords: Arctic Northwind Ridge, water column structure change, foraminiferal assemblage, oxygen and carbon isotopes, Marine Isotope Stage 5

References

Arrigo K R, van Dijken G, Pabi S. Impact of a shrinking Arctic ice cover on marine primary production. Geophysical Research Letters, 2008, 35, L19603, doi: 10. 1029/2008GL035028.

Rabe B, Karcher M, Schauer U, et al. An assessment of Arctic Ocean freshwater content changes from the 1990s to the 2006-2008 period. Deep-Sea Research I, 2011, 58: 173-185.

Stroeve J C, Serreze, M C, Holland M M, et al. The Arctic's rapidly shrinking sea ice cover: a research synthesis. Climatic Chang, 2012, 110: 1005-1027.

Silica pump in the west Arctic Ocean under ice rapid retreat

JIANFANG CHEN[1], HAIYAN JIN[1], QINGMEI ZHU[1], HONGLIANG LI[1], YANPEI ZHUANG[1]

[1]Laboratory of Marine Ecosystem and Biogeochemistry of SOA, Second Institute of Oceanography, State Oceanic Administration (SOA), Hangzhou 310012, China (jfchen@sio.org.cn)

The Arctic Ocean plays a key role in the global carbon cycle and budget. Over the last three decades rapid sea ice retreat not only leads to reducing of light limitation for the phytoplankton growth in the upper ocean, but also results in changing of freshwater input, water mass mixing and circulation, nutrient supply to the west Arctic Ocean, and finally, the biological pump (usually dominated by silica pump) is largely altered by these processes. In this presentation we will discuss the variation of nutrients dynamics and biological pump structure in the Chukchi Sea and the adjacent Canadian Basin based on data set of nutrients, phytoplankton identification of 6 Chinese Arctic Expedition since 1999, as well as time series sediment trap data and several sediment cores taken from this area. The highlights of our finding is as following: (1) since the last two decades, nutrients in the upper layer decreased dramatically in the west arctic ocean, the among the species of nutrients, nitrogen is the most limitation element; (2) diatom is most dominant phytoplankton (as estimated as biomass) but the percentage of diatom relative biomass is decreasing in the upper layer water, but not for the whole water column which is correspondent to deepening of nutricline; (3) the concentrations of BSi in shelf sediments influenced by the Alaska Coastal waters were lower than 4% while shelf sediments affected by the Anadyr Water had a BSi content higher than (6%-10%) ; (4) Chukchi Sea shelf had a high diatom productivity and biogenic silica burial rate. During the past 100 years, the siliceous pump of the Chukchi Sea shelf displayed an increasing trend. Due to the influences of waters and sea-ice, siliceous pump in the Chukchi Sea shelf was high in south and low in north with small changes in different years. The siliceous pump of the Chukchi Sea shelf had a positive response to the retreat of sea-ice.

Keywords: Chukchi Shelf, ice retreat, nutrient dynamics, Silica pump, sedimentary BSi

Bacterial Biogeography Influenced by Shelf-Basin Interaction in the Arctic Seafloor

DUKKI HAN[1], SEUNG-IL NAM[2], HO KYUNG HA[3], HYOUNGJUN KIM[2], MICHAEL J. SADOWSKY[4], YOO KYUNG LEE[2], AND HOR-GIL HUR[1]

[1] School of Environmental Science and Engineering, Gwangju Institute of Science and Technology, Gwangju 500-712, Republic of Korea

[2] Korea Polar Research Institute, Incheon 406-840, Republic of Korea

[3] Department of Ocean Sciences, Inha University, Incheon 402-751, Republic of Korea

[4] Department of Soil, Water, and Climate, Biotechnology Institute, and Microbial Plant and Genomics Institute, University of Minnesota, St. Paul, MN 55108, USA

Arctic seawater consists of distinctive water masses (surface mixed layer, Pacific, and Atlantic waters) that may partially intermix on the shelves around the Arctic basin as a consequence of shelf-basin exchange caused by very dense brine-enriched waters. In the current study, we found that bacterial assemblage of the surface sediment was different from that of seawater while seawater harbored local bacterial assemblages in response to the Arctic hydrography. This finding suggests that the Arctic seafloor may have distinctive bacterial biogeography. Moreover, the distribution of bacterial assemblages and physicochemical properties in surface sediments in the western Arctic changed gradually from continental shelf to deep-sea basin. This suggests that the bacterial biogeography within surface sediments may be influenced by an oceanographic trait linked to Arctic sedimentation. Indeed, oceanographic studies have implied sediment gravity flows can transport sediment particles on the seafloor, which affects the variability of sedimentation in the marine environment. We conclude that sediment gravity flows may play a key role for the dispersal of bacterial assemblages on the surface sediments, and oceanographic traits from the continental shelf to deep-sea basin in the western Arctic. The present study offers a deeper understanding of oceanic convection and its role in the construction of bacterial assemblages and the relationship between microbial distributional patterns and physicochemical properties in the Arctic Ocean.

Keywords: Arctic Ocean, Sediment gravity flow, Bacterial biogeography, Dispersal Limitation

Ice-grounding along the East Siberian margin and on the Lomonosov Ridge during the Pleistocene: Implications for circum-arctic ice shelves in the Arctic Ocean?

NIESSEN, F.[1], STEIN, R.[1], JENSEN, L.[1], SCHRECK, M.[2,1], MATTHIESSEN, J.[1], JOKAT, W.[1], HONG, J.K.[2] & NAM, S.-I.[2]

[1]Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany (frank.niessen@awi.de)
[2]Korea Polar Research Institute, Incheon, Republic of Korea

Over many years there was a general acceptance that thick ice sheets of marine isotope stages 2, 4 and 6 were restricted largely to continental Eurasia, Greenland and North America including the adjacent shelves of the Arctic Ocean. With this "Beringia" was understood as an ice-free land bridge between the continents of Asia and America during glacial times with low sea levels and exposed shelves. However, since about 15 years a growing number of evidence is found in water depth up to more than 1000 m that grounding of ice has occurred in various places of the Arctic Ocean since MIS 6 and/or before including the "Beringian" continental margin north of the present Chukchi and East-Siberian seas. With the decline in Arctic Ocean summer sea ice during the last decade it has been possible to hydro-acoustically survey areas so far sparsely investigated because of operational constrains. Glacial landforms were discovered on many continental slopes as well as ridges and seamounts of the Arctic Ocean, which rise up to less than about 1000 m below present sea level. These landforms include moraines, drumlinized features, glacigenic debris flows, till wedges, mega-scale glacial lineations (MSGL), and iceberg plough marks. They suggest that thick ice has occurred not only on nearly all margins of the Arctic Ocean but also covered pelagic areas. In our studies we present submarine glacial landforms from the western and central Arctic Ocean, which are interpreted as a result of a complex pattern of Pleistocene glaciations along the continental margin of the East Siberian Sea. This was discovered during the cruises of RV "Polarstern" in 2008 and RV "Araon" in 2012. Orientations of these landforms suggest thick ice has flown north onto the deep Arctic Ocean, thereby grounded on plateaus and seamounts of the Medeleev Ridge. In addition, during RV "Polarstern" cruise in 2014, hydro-acoustic data is presented from the Lomonosov Ridge (Siberian side to close to the North Pole), which support the hypothesis of widespread grounding of ice in the Arctic Ocean from different sources. The data suggest that thick ice-shelves have developed from continental ice sheets on a nearly circum-arctic scale. These ice shelves extended far north and covered large areas of the Arctic Ocean. Further analysis of bathymetric and sub-bottom acoustic data is needed to interpret ice-flow directions. Also, it now depends on the stratigraphical analysis of existing and future sediment cores to find out whether or not these ice shelves have occurred contemporaneously and when the individual grounding events have occurred.

Mechanical characterization of Arctic marine sediments reveals the life cycle of vanished ice sheets

INSUN SONG[1], SEUNG-IL NAM[2], JUNGHYUN KIM[3]

[1] Geoenvironmental Division, Korea Institute of Geoscince and Mineral Resources, Korea (isong@kigam.re.kr)
[2] Artic Research Centre, Korea Polar Research Institute, Korea
[3] Department of Marine Science and Convergence Technology, Hanyang University ERICA campus, Korea,

Geological and geomorphological evidences from terrestrial environments in the Beringian region of Siberia had confused our ideas on the exstence of Arctic ice sheets during the Pleistocene glaciation, while no controversy has come from the other Arctic areas that were widely covered by ice sheets (Brigham-Grette, 2013). Recently the west Arctic sea floor opened up to seismic survey and sediment core sampling due to the withdrawal of summer sea ice. Seismic echos in the forms of bathymetric maps and seismic profiles identified marine glaciogenic records on the sea floor and subsurface along the East Siberian continental margin (Niessen et al., 2013). The controversy seems to be terminated by leaning toward the inference that the Siberian Shelf edge and parts of the Arctic Ocean were covered by ice sheets of about 1 km in thickness extending to the continental margin at depths of up to 1 km. Remaining tasks are to refine the life cycle of the glaciation in terms of the time-based position and scale of the vanished ice sheets for restoring the ancient climatological conditions. The recovery of climate change for the human-time scale is a fundamental process of predicting the future climate and marine conditions.

During sedimentation, marine sediments undergo progressive consolidation by gravitational loading as they are buried and interstitial fluids are expelled (Song et al., 2011). When a sample is recovered from depth, it undergoes elastic rebound as the overburden is removed. Reloading of the sample along the same stress path that it was subjected to results in elastic recompression followed by the virgin consolidation after passing the maximum effective stress that has acted on the sample in the past (Craig, 2004). The maximum past effective stress is called the preconsolidation pressure that could be determined from laboratory tests. If the vertical load is raised by glaciation on sedimentary formation, the preconsolidation pressure of rock samples from the formation may indicate the load of ice sheets that has vanished. The glaciation also increases the pore-fluid pressure by compressing the sedimentary formation. The diffusion of pore pressure occurs during and after the glaciation. The pore pressure variation by the diffusion is a function of time and position with a central parameter called the diffusion coefficient. The information on pore pressure and hydraulic properties of marine sediments may suggest the scale and history of vanished ice sheets. In this paper we suggest geotechnical experiments of core samples and in situ measurements of formatin pore pressure to refine the life cycle of vanished ice sheets.

Keywords: Arctic ice sheet, uniaxial consolidation, preconsolidation pressure, life cycle of glaciation.

References

Brigham-Grette, J., 2013, A fresh look at Arctic ice sheets, Nature Geoscience, 6, 807–808.

Craig, R. F., 2004, Soil Mechanics, Chapman and Hall, London, pp447.

Niessen, F. et al., 2013, Repeated Pleistocene glaciation of the East Siberian continental margin, Nature Geoscience, 6, 842–846.

Song, I., Saffer, D. M., and Flemings, P. B., 2011, Mechanical characterization of slope sediments: Constraints on in situ stress and pore pressure near the tip of the megasplay fault in the Nankai accretionary complex, Geochem. Geophys. Geosyst., 12, doi:10.1029/2011GC003556.

Ice rafted detritus and grain size records on the northern Mendeleev Ridge, central Arctic Ocean over the past 920 ka

RUJIAN WANG[1], JING MEI[1], WENSHEN XIAO[1], BOO-KEUN KHIM[2], LEONID POLYAK[3], WEIGUO WANG[3]

[1]State Key Laboratory of Marine Geology, Tongji University, Shanghai 200092, China (rjwang@tongji.edu.cn)
[2]Department of Oceanography, Pusan National University, Busan 609-735, Korea
[3]Byrd Polar Research Center, The Ohio State University, 1090 Carmack Road, Columbus, OH 43210, USA

The spatial distribution of ice rafted debris (IRD) in the Arctic Amerasian Basin nowadays is mainly controlled by the Beaufort Gyre that deliver large amounts of IRD from the Canadian and Alaskan Arctic coastal areas (Darby and Zimmerman, 2008). Ice-sheet collapse events are documented by the IRD peaks in the sediment (Stein et al., 2010). When tracked across the basin, these events provide valuable information on the condition of ice sheets and the concomitant Arctic Ocean circulation (Stärz, et al., 2012). Core ARC5-MA01 from the northern Mendeleev Ridge, central Arctic Ocean, collected during the 5th Chinese National Arctic Expedition, provide important information about the Arctic Ocean circulation and ice sheet stability of the past ~920 ka. The core stratigraphy was established based on a combination of AMS 14C, XRF Ca and Mn variations, foraminifera/ostracode abundances correlation to other central Arctic records, paleomagnetic inclination correlation to ACEX record from the Lomonosov Ridge (O'Regan et al., 2008), and relative paleo-intensity (RPI) to global PISO-1500 stack (Channell et al., 2009). The core ARC5-MA01 extends back to MIS 23, with estimated base age of about 920 ka. 21 IRD events were identified in the core, with the earliest event occurred at boundary between MIS 22 and MIS 21. Ten IRD peaks correspond to Ca peaks, implying their Canadian Arctic Archipelago sources of carbonate rock outcrops. And the first occurrence of carbonate IRD in our record is located at boundary between MIS 19 and MIS 18, earlier than previous estimations (Cronin et al., 2013). While other high IRD intervals could be derived from the various circum-Arctic sources (Darby et al., 2011). Strong variations of silt and clay fractions occur since the MIS 18, close to the Mid Pleistocene Transition (MPT), which could suggest the responses to stronger glacial-interglacial amplitude after the MPT.

Keywords: Stratigraphy, IRD sources, fine grains, northern Mendeleev Ridge, central Arctic Ocean, past 920 ka

References

Channell, J.E.T., Xuan, C., and Hodell, D.A., 2009. Stacking paleointensity and oxygen isotope data for the last 1.5 Myr (PISO-1500). Earth Planet. Sci. Lett., 283, 14-23.

Cronin, T.M., Polyak, L., Reed, D., Kandiano. E.S., Marzen, R.E., Council, E.A., 2013. A 600-ka Arctic sea-ice record from Mendeleev Ridge based on ostracodes. Quat. Sci. Rev., 79, 157-167.

Darby, D. A., Zimmerman, P., 2008. Ice-rafted detritus events in the Arctic during the last glacial interval and the timing of the Innuitian and Laurentide ice sheet calving events. Polar Res., 27 (2), 114-127.

Darby, D., Myers, W., Jakobsson, M., Rigor, I., 2011. Modern dirty sea ice characteristics and sources: The role of anchor ice. J. Geophys. Res., 116, C09008, doi:10.1029/2010JC006675.

O'Regan, M., King, J., Backman, J., Jakobsson, M., Pälike, H., Moran, K., Heil, C., Sakamoto, T., Cronin, T. M., Jordan, R. W., 2008. Constraints on the Pleistocene chronology of sediments from the Lomonosov Ridge. Paleoceanography, 23, PA1S19, doi: 10.1029/2007PA001551.

Stärz, M., Gong, X., Stein, R., Darby, D. A., Kauker, F., Lohmann, G., 2012. Glacial shortcut of Arctic sea-ice transport. Earth Planet. Sci. Lett., 357-358, 257-267.

Stein, R., Matthiessen, J., Niessen, F., Krylov, A., Nam, S., Bazhenova, E., and Shipboard Geology Group. 2010. Towards a better (litho-) stratigraphy and reconstruction of Quaternary paleoenvironment in the Amerasian Basin (Arctic Ocean). Polarforschung, 79, 2, 97-121.

Marine-terrestrial interaction of climate changes in the western Arctic region over the last 10,000 years

SO-YOUNG KIM[1], SEUNG-IL NAM[1], LEONID POLYAK[2], IRINA DELUSINA[3]

[1] Arctic Research Centre, Korea Polar Research Institute, Incheon 406-840, Korea (kimsy@kopri.re.kr, sinam@kopri.re.kr)
[2] Byrd Polar Research Center, 1090 Carmack Rd., Columbus, OH 43210,USA
[3] Department of Earth and Planetary Sciences, University of California, Davis, California,USA

Marine-terrestrial palynomorph records such as dinoflagellate cysts, pollen, spores and freshwater algae in marine sedimentary archives document paleoclimate conditions, inferring the past terrestrial environment and sea surface conditions such as sea surface temperature, sea surface salinity and sea ice extent. In this study, we present marine-terrestrial palynomorph records of sediment cores from the Chukchi-Alaskan shelf sediments (core ARA01B/01A-GC and HLY0501-05) in order to understand the paleoenvironmental history of the western Arctic region in relation to the Holocene climatic changes associated with the opening of the Bering Strait and its influence over the regional environmental system. Using a radiocarbon-dated sediment core, we demonstrate changes in characteristics of the palynomorph records and discuss their possible source areas as well as its transport mechanisms from land to the ocean. Our terrestrial palynomorph records indicate a major environmental change from the early Holocene to the mid-to-late Holocene environments in the Chukchi Sea shelf regions. Considerable changes in the western Arctic vegetation are indicated by the percentage ratio between tree-herb pollen and spores, and the freshwater algae Pediastrum, notably between ~8-4 ka BP, at around 5 ka BP and 3 ka BP. In paralell, dinoflagellate cyst concentrations show a pronounced increase after ca. 8 ka BPsuggesting a major transition to a full-oceanic environment in respond to the sea-level rise and increased nutrient availability in relation with the Pacific water inflow via Bering Strait. A prominent shift in assemblage compositions from a dominance of Brigantedinium taxa to Pentapharsodinium dalei taxa at around 5 ka BP indicates a significant transition in oceanic environmental conditions in the Chukchi Sea shelf region.

Keywords: palynomorph, marine sediment, western Arctic, Holocene

What happened at ca. 40 ka in Arctic Ocean based on geochemical compositions of pelagic sediments?

WOO, K. S.[1], NAM, S.-I.[2], JI, H. S. [1], STEIN, R.[3],MACKENSEN, A.[3], AND MATTHIESSEN, J.[3]

[1]Department of Geology, Kangwon National University, Chuncheon, Gangwondo 200-701, Korea (wooks@kangwon.ac.kr)
[2]Arctic Research Centre, Korea Polar Research Institute, 406-840 Incheon, Korea
[3]Helmholtz Centre for Polar and Marine Research, Alfred-Wegener-Institute, D-27568 Bremerhaven, Germany

Authigenic carbonates and mud fractions of the sediment core (PS72/410-1)retrieved from the central Mendeleev Ridge of the western Arctic Ocean were investigated texturally and geochemically. The giant box core (GKG)is 39 cm long with age of ca. 76 ky BP and was collectedfrom the water depth of 1,802 m. The sediments are mainlycomposed of silty to sandy silty clay with various grey to brown colours, reflecting glacial-interglacial and/or stadial-interstadial cycles. Authigenic carbonates minerals (high Mg-calcite,low Mg-calcite and aragonite) are present through the whole sequence except for a few centimetres in the middle part. Various crystal shapes of carbonate crystalstogether with clear growth shapes suggest that they are inorganic in origin. Highly enriched carbon isotope compositions indicate that they formed in methanogenic zone just below sediment/water interface. However, a wide range of oxygen isotope values ($\delta^{18}O$ = -5 ~+5‰ vs. PDB)may indicate that porewater has been changed due to reaction between residual seawater and volcanic sediments. Relatively higher contents of K, Al, Fe and Be values of muddy sediments as well as low $\delta^{18}O$ compositions of authigenic carbonates may imply strong input of meltwater from volcanic region (Eastern Arctic region) whereas higher oxygen isotope compositions of authigenic carbonates and higher Sr and K contents of muddy sediments reflect stronger influence from carbonate-rich region (Canadian Arctic region). Mineralogical changes form low to high Mg-calcite together with decrease in Mg, Sr and Fe contents at ca. 40 ka strongly support less freshwater input from glacial mode to interglacial mode. All the analyzed results strongly imply that significant paleoceanographic changes took place at about 40 ka, which may have influenced global climate changes during the last glacial period.

Keywords: Arctic, pelagic, authigenic, carbonates, stable isotope, trace element

Ice Rafted Detritus Records and Paleoclimatic Meaning of Chukchi Borderland, Western Arctic Ocean

TAOLIANG ZHANG, RUJIAN WANG, WENSHEN XIAO, XIAO DUAN, ZHENGYING HU, JING MEI

[1] State Key Laboratory of Marine Geology, Tongji University, Shanghai 200092 (rjwang@tongji.edu.cn)

Sedimentary pattern of the Chukchi Borderland, Western Arctic Ocean, is different between glacial and interglacial times. The development of ice sheet surrounding the Arctic Ocean greatly affects the pass way and transport ability of the Beaufort Gyre (Stärz et al., 2012), which further affects the sediment origin in the Western Arctic Ocean. Ice Rafted Detritus (IRD) has been investigated on Cores ARC3-P37, ARC4-BN03 and ARC4-MOR02 collected from Chukchi Borderland during the Chinese National Arctic Expedition III and IV (2008 and 2010, respectively). The result is correlated with the published data (Yurco et al., 2010; Stein et al., 2010; Wang et al., 2013; Polyak et al., 2013) in order to study the spatial difference of IRD provenance in Chukchi Borderland in late Pleistocene. Our data shows that during MIS 5, five IRD events corresponding to Ca peaks are recognized on the Northwind Ridge (NR) area which has the contribution from the Canadian Arctic Archipelago (CAA). In MIS 3, the sedimentation rate of the Chukchi Plateau (CP) and Chukchi Abyssal Plain (CAP) area is higher than that of the NR area. Besides CAA, the IRD in the CP and CAP area show contributions from the Eurasian side. In MIS 2, the NR area still received IRD originated from CAA. Meanwhile, the sedimentation rate of CP and CAP area collapsed probably due to the extension of East Siberian icesheet during full glacial times (Niessen et al., 2013), which indicate that the Northwind Ridge region located in the edge of the ice sheet and wasn't completely covered.

Keywords: Western Arctic Ocean; Chukchi Plateau; Northwind Ridge; Late Quaternary; Ice Rafted Detritus; Arctic Ice Sheet

References

Niessen F, Hong J K, Hegewald A, et al. Repeated Pleistocene glaciation of the East Siberian continental margin [J]. Nature Geoscience, 2013, 6: 842-846.

Polyak L, Best K M, Crawford K A, et al. Quaternary history of sea ice in the western Arctic Ocean based on foraminifera [J]. Quaternary Science Review, 2013, 79: 145–156.

Stärz M, Gong X, Stein R, et al. Glacial shortcut of Arctic sea-ice transport [J]. Earth and Planetary Science Letters, 2012, 357–358: 257–267.

Stein R, Matthießen J, Niessen F, et al. Towards a better (litho-) stratigraphy and reconstruction of Quaternary paleoenvironment in the Amerasian Basin (Arctic Ocean) [J]. Polarforschung, 2010, 79(2): 97–121

Wang Rujian, Xiao Wenshen, März C, et al. Late Quaternary paleoenvironmental changes revealed by multi-proxy records from the Chukchi Abyssal Plain, western Arctic Ocean. Global and Planetary Change, 2013, 108: 100–118

Yurco L N, Ortiz J D, Polyak L, et al. Clay mineral cycles identified by diffuse spectral reflectance in Quaternary sediments from the Northwind Ridge: implications for glacial–interglacial sedimentation patterns in the Arctic Ocean. Polar Research, 2010, 29: 176–197.

Changes in ice drift pattern in in the western Arctic Ocean during the last 70,000 years

KENTA SUZUKI[1], MASANOBU YAMAMOTO[1], SENG-IL NAM[2], TOMOHISA IRINO[1], YU-HEYON PARK[1], AND TOSHIRO YAMANAKA[3]

[1] Graduate School of Environmental Science, Hokkaido University, Japan (kenta.suzuki@ees.hokudai.ac.jp)
[2] Arctic Research Centre, Korea Polar Research Institute, Republic of Korea
[3] Department of Earth Sciences, Okayama University, Japan

Recent global warming caused the shrinkage of summer sea ice in the Arctic. The distribution of the sea ice reflects ice drift pattern mainly controlled by the Beaufort Gyre circulation, Transpolar Drift, and Bering Strait inflow. Understanding the ocean circulation in climate regimes different from today is thus helpful to predict the future condition of Arctic sea ice. In this study, we investigated mineral compositions, grain size distribution, ice-rafted debris (IRD) content, glycerol dialkyl glycerol tetraethers (GDGTs), total organic matter (TOC) and total sulfur (TS) in five sediment cores retrieved in the western Arctic Ocean during RV "Araon" ARA02B (August 2011) and ARA03B (August-September 2012) expeditions to reconstruct changes in ice drift pattern in the western Arctic Ocean during the last 70 ka.

IRD-, quartz-, and dolomite-rich layers were found in the last glacial sediments in the Chukchi Sea and Chukchi Borderland areas and they are useful to correlate cores. Based on the distribution of minerals in the surface sediments and geological information, we suppose that dolomite grains were delivered by icebergs discharge from the Canadian Arctic Archipelago. Kaolinite-rich layers were found in the LGM or deglaciation intervals in the restricted area near the Chukchi Plateau. They show high concentration of branched GDGTs and the high C/S ratio. The molecular distribution of the branched GDGTs is typical in those on the shelf sediments in the western Arctic (Park et al., 2014 Marine Chemistry). This suggests that the kaolinite-rich grains were delivered from the nearly continental shelf by sea ice or icebergs. The quartz/feldspar ratio is much lower in the Holocene brown layer B1 than the glacial brown layers B2 and B3, suggesting that the former was delivered from the Siberian margin, whereas the latter from the Alaskan margin. These results indicate a drastic changes in ice drift pattern during the last 70 ka.

Keywords: Arctic Ocean, GDGT, ice-rafted debris

Late Quaternary sedimentary records of core ARC5-MA01 in the Mendeleev Ridge, the western Arctic Ocean

KWANGKYU PARK[1], RUJIAN WANG[2], JING MEI[2], WENSHEN XIAO[2], BOO-KEUN KHIM[1], SUNGHAN KIM[1], LEONID POLYAK[3], HYEN GOO CHO[4], WEIGUO WANG[5]

[1] Department of Oceanography, Pusan National University, Busan 609-735, Korea (bkkhim@pusan.ac.kr)
[2] State Key Laboratory of Marine Geology, Tongji University, Shanghai 200092, China
[3] Byrd Polar Research Center, The Ohio State University, 1090 Carmack Road, Columbus, OH 43210, USA
[4] Department of Earth and Environmental Sciences, Gyeongsang National University, Jinju 660-701, Korea
[5] Department of Earth and Environmental Sciences, Gyeongsang National University, Jinju 660-701, Korea

Late Quaternary deep sea sediments in the Arctic Ocean consist mostly of a succession of alternations between brown layers and yellowish to olive gray layers, in which the brown layers were deposited during interglacial (or interstadial) whereas the gray layers were deposited during glacial (or stadial) periods. A 5.35-m long gravity core ARC5-MA01 was obtained from the Mendeleev Ridge in the western Arctic Ocean by R/V Xue Long during scientific cruise CHINARE-V. Chronostratigraphy (~920 ka) of core ARC5-MA01 was established by a variety of approaches including AMS 14C dates and correlations of lithogenic features, foraminifera and ostracode abundance fluctuations, and geomagnetic inclinations with the well dated cores in the central the Arctic Oean (O'Regan et al., 2008; Stein et al., 2010; Cronin et al., 2013). Almost CaCO3 peaks correspond to high abundance of coarse (>63 μm) fractions (i.e., ice-rafted debris; IRD) rather than foraminiferal abundance, which suggests these IRDs are composed largely of detrital carbonates containing dolomites. A strong positive correlation (r2=0.89) between TOC content and C/N ratio indicates that the major source of organic matter is terrestrial. Thus, the good correlations of CaCO3 content to TOC (r2=0.56) and C/N ratio (r2=0.69) imply that detrital CaCO3 particles of IRDs mainly originated from the Canadian Arctic Archipelago. High kaolinite/chlorite ratios also correspond to CaCO3 peaks, suggesting that the fine-grained particles in the Mendeleev Ridge were transported from the northern coasts of the Alaska and Canada. Thus, the Beaufort Gyre, the predominant surface current in the western Arctic Ocean, has played an important role in the sediment delivery to the Mendeleev Ridge. Finally, it is worthy of note that TOC and CaCO3 peaks are obviously distinct in the upper part (brown layer 1 to 13) of core ARC5-MA01, whereas these peaks are reduced in the lower part (brown layer 14 to 23) of the core, which was marked at about 450 ka (478-424 ka; MIS 12). Such amplification of geochemical proxies during the mid-to-late Pleistocene may be related to the strengthening of Northern Hemisphere Glaciation, particularly, in the northern North America.

Keywords: geochemical proxies, IRD, clay minerals, Beaufort Gyre, Mendeleev Ridge, western Arctic Ocean

References

O'Regan, M., King, J., Backman, J., Jakobsson, M., Pälike, H., Moran, K., Heil, K., Sakamoto, T., Cronin, T. M., and Jordan, R. W., 2008, Constraints on the Pleistocene chronology of sediments from the Lomonosov Ridge. Paleoceanography, 23, PA1S19.

Stein, R., Matthiessen, J., Niessen, F., Krylov, A., Nam, S.-I., Bazhenova, E., 2010. Towards a better (litho-) stratigraphy and reconstruction of Quaternary paleoenvironment in the Amerasian Basin (Arctic Ocean). Polarforschung 79(2), 97-121.

Cronin, T. M., Polyak, L., Reed, D., Kandiano, E. S., Marzen, R. E., & Council, E. A., 2013, A 600-ka Arctic sea-ice record from Mendeleev Ridge based on ostracodes. Quaternary Science Reviews, 79, 157-167.

Sediment dynamics in Garolim Bay, west coast of korea

JUNGGWAN KIM[1] AND SEUNGSOO CHUN[1]

[1]Faculty of Earth Systems and Environmental Sciences, Chonnam National University, Korea (tidalflat@gmail.com)

The Garolim Bay located in the central west coast of Korean Peninsula is a typical semi-enclosed bay which has a narrow entrance and elongated boot shape in the north-south direction without any remarkable inflowing streams. It shows a tide-dominated environment with spring tidal range reaching up to 7 meters. For this study, 747 surface sediment samples were collected in summer (380 samples) and winter (367 samples) with a grid interval less than 1000 meters. Individual samples were analysed by sieve (< 4 Ø; sand particles) and sedigraph (settilng velocity, > 4 Ø; mud particles) with 0.25 phi intervals.

As a result of analysed spatial variation at each interval, three considerable phenomena can be observed between coarse sand (1 Ø) and fine sand (3 Ø).

1) The boundaries of distribution at each interval are moved toward inner bay from coarse sand to fine sand.
2) There are reversal zone of the boundary movement direction and seasonal change of reversal zone and spatial location. It has a range of 2.0 to 2.75 Ø in summer and 1.50 ~ 2.50 Ø in winter.
3) The content is reduced as more finer with 3 times significant changes at 1.25, 2.00 and 2.50 phi

The moving pattern of distribution boundaries shows that the sediments in Garolim Bay has been mostly supplied from the outside of bay (offshore). The reversal change of the direction of boundary movement and reduced content may be caused by the relationship between ebb and flood currents. Therefore, the transport and distribution of sediments in Garolim Bay are mainly dominated by tidal currents.

According to this study, determining the sediment dynamics has been generally refered by residual current patterns, but importantly to be considered the difference of sediment-transporting capacity in accordance with the size of particle.

Keywords: sediment dynamics, tide-dominated environment, sediment transporting capacity, Garolim Bay, surface sediment, residual tidal current

Acknowledgements: This study was supported by the research grant from the Korean Ministry of Oceans and Fisheries (PJT200538) (SSC).

Origin of tidal creeks on the radial sand ridges in South Yellow Sea

ZK ZHANG[1 2 3], BW SHI[1 2], SL JIANG[1 2], H REN[1 3], RF TONG[1 3], DL JIANG[1 3]

[1]School of Geographic and Oceanographic Sciences, Nanjing University, China (zhangzk@nju.edu.cn)
[2]Key Laboratory of Coast & Island Deve;opment of Ministry of Education, Nanjing University, China
[3]Collabortive Innovation Center of South China Sea Studies, China

Tidal creeks are commen landforms in the tidal flat during the time of edd tide, which distributed in the tidal flat of inner continent shelves, littoral and estuary environement (Healy et al, 2002),. The continental shelf of Yellow Sea is one of the largest shelves in the world, with the maximum width of over 600 km, with a smooth and flat topography. Surficial sediments on the shelf are mainly supplied by Yellow River and Yangtze River. Vast fluvial sediment supply makes the sea bed topography in the western Yellow Sea obviously higher than that in the east.The Yellow River shifted and flowed into the southern Yellow Sea from AD 1128–1855, forming the Old Yellow River delta (Zhang, 1984). In the southern YellowSea, a field of tidal sand ridges named Yellow Sea Tidal Sand Ridges, are consisted of more than 70 sand ridges separated by tidal channels and cover an area of 22,470 km 2 (Wang et al., 2012). On the inner shelf of the south Yellow Sea, a large sand ridge named Dognsha Shoal, is distributed at water depths of few meters to 25–55 meters. During the ebb tide the top part of the shoal is above the sea water level. In the sand shoal region the bottom sediments are dominated by fine sand.

Acoording to the field invesgation in 1-4 July, 2015 in the Dongsha Shoal, the largest shoal of the tidal sand ridges, the oringin of the tidal creeks are analyzed. Three sections are choosed for observation in Dognsha Shoal and the following results are interesting. The system of tidal creeks in Dongsha Shoal shaped as the dendritic structures, composed of three or four grade branches. The main channel is long than a few kilometers and the tributaries are shorter less than 100-102 meters. The head of the small creeks are usually connected with the much shallow depressions or leveling tidal flats. During the ebb tide the storaged water in the surface of the flat and much shallow depressions continously supply the water to the mini-creeks, and which is the first stage of the origin of the creek in large open tidal shoal in south Yellow Sea.

Most studies on the origin of the creeks in the tidal environment are located at the tidal flat close to the coast and it should be in a semi-open tidal environment. The origin of the creeks strongly influenced by the terrestrial environment and human activities (Healy et al, 2002; Shao, 1988; Chen, 2001, Zhang and Wang,1991). In this study, the study area is far from the coast and it is the real large open tidal environment srrounded by sea water during the ebb tide. The finddings of the creeks origin is ctrolled by the high land of the tidal shoal with the much shallow depressions and the continous water supplies from the depressions can form the earliest mini-creeks in the open tidal shoals environment.

Keywords: origin, tidal creeks, large open tidal environment, much shallow depressions, earliest mini-creeks

Acknowledgement: This study was supported by the NSFC Project (NO.41371024).

References

Healy, T., Wang, Y., Healy, J. (Eds.), 2002. Muddy Coasts of the World — Processes, Deposits and Function. Elsevier Science, Amsterdam, pp. 1-556.

Zhang, R., 1984. Land-forming history of the Huanghe River delta and coastal plain of northern Jiangsu. Acta Geographica Sinica, 39, 173–184 (in Chinese with English abstract).

Wang, Y., Zhang, Y.Z., Zou, X.Q., Zhu, D.K., Piper, D.J.W., 2012. The sand ridge field of the South Yellow Sea: originby river–sea interaction. Marine Geology, 291–294,132–146.

Shao X,1988. Genetic classification of the tidal creek and factors affecting its development. Acta Geographic Sinica, 43. 35-43 (in Chinese with English abstract).

Chen C., 2001. Changes in tidal creek after mud flat being enclosed in the middle coast of Jiangsu Province. Marine Science Bulletin, 20,71-79 (in Chinese with English abstract).

Zhang R and Wang X., 1991. Tidal creek system on the tidal mud falt at Jiangsu Province. Acta Geographic Sinica, 46, 195-206 (in Chinese with English abstract).

Spatial difference in predominated sedimentary process around Imjado tidal flat, southwestern coast of Korea : wave-dominated western coast and tide-dominated eastern coast

HYUN HO YOON[1] AND SEUNG SOO CHUN[1]

[1] Faculty of Earth Systems and Environmental Sciences, Chonnam National University, Gwangju 61186, Korea (sschun@jnu.ac.kr)

Imjado, one of rocky islands distributed in Shinan Arcipelago, southwestern coast of Korea, is located at the northernmost side among them. Typical intertidal mudflat and tidal channel systems are well developed in the eastern coast of Imjado, whereas sand tidal flat and tidal beach systems occur in the western coast of Imjado, resulting from strong wave action due to northwesterly strong wind especially during winter. In order to investigate the seasonal change of surface sediment distribution in the Imjado tidal flat, surface sediment samples of 153 on Imjado tidal flat were collected in February and August, 2014. The water depth for sampling was restrict to 8 m below mean sea level. The sampling points were at a grid position with interval of about 600×700 m. In addition, the monitoring was conducted along a intertidal flat profile in which sedimentary structures and surface sediments have been observed for the checking of seasonal changes in sedimentary process.

Surface sedimentary facies in the study area can be classified into sand, sandy mud, muddy sand, and mud facies. The distribution pattern of surface sediment around Imjado Island is completely different from the western coast to the eastern coast. Mud facies is distributed in the entire surrounding area of Imjado. Sand facies are observed along the coastal line in its western coast. The flat of east coast shows nearly gentle in slope, whereas that of west does a steep beach face and has a relatively flat middle terrace with bar-type undulation. The can-core peels (15 cm wide and 30 cm deep) show that homogeneous mud beds with top sand layer are common in the east coast, but parallel laminated sand and landward cross-laminated sand beds are observed in the west coast. In the can-core sample at 50 m from coast, thick layer of solidified mud occurs below 20 cm from the can-core surface. Depositional features along the cross section profiles suggest that the seasonal changes of energy in sedimentation have been preserved.

Keywords: wave-dominated coast, Imjado tidal flat, surface sedimentary facies, sedimentary process, seasonal change

Acknowledgements: This study was supported by the research grant from the Korean Ministry of Oceans and Fisheries (PJT200538) (SSC).

Contemporary Changes of Beach Sediments' Balance of Southern Part of Black Sea Coastal Line of Georgia

G.LOMINADZE[1], I.PAPASHVILI[2], S.KHORAVA[3], G.KAVLASHVILI[1]

[1] Ivane Javakhishvili Tbilisi State University, Vakhushti Bagrationi Institute of Geography, Georgia; (g_lomin@hotmail.com)
[2] g_lomin@hotmail.com
[3] Batumi Shota Rustaveli State University, Georgia

Contemporary shape of the Black Sea coast of Georgia was formed 5-6 thousand years ago, when the level of the Black Sea water surface, after a long rise, approached the current state. During the mentioned period along the shore were formed several series of dunes. The nearest dune to the sea shore line in totality conditions sustainability of the natural and geographical landscape. If the beach line is damaged because a variety of reasons, or suffers from nourishing sediment deficit, arises a danger of washing off of the dune. In the case of the dune wash-off, is expected seawater intrusion to the low land areas.

At present, in some sections of the beach is observed beach creating sediment loss in the submarine canyons heads. For example, in Inguri, Poti and Supsa canyons are lost each year approximately 400 000 m^3 material and in Batumi submarine canyon - about 100 000 m^3 of stone-gravel sediment. in Chorokhi Canyon river sediment transport is reduced to the minimum, which is caused by the important decrease of River Chorokhi solid sediments.

Reduction of volume of beaches and accordingly, washing out of the shore are conditioned by the adverse changes in the sediment balance. During the last 50 years, mainly due to construction of power plants on the river banks sediment inflow to the sea shore is significantly reduced. At the same time the volumes of beach sediment mass movements in the submarine canyons underwent changes. The sediment losses remained nearly unchanged at the expense of wear.

In the case of a global climate change and expected sea-level rise, will be kept the negative trend of the sediment balance. As a result, along the accumulative beaches the danger of dune degradation is increasing.

Keywords: Black Sea coast, Solid sediment, Submarine canyon, sea-level rise

Annual and seasonal characteristics of topography and surface sediments in the Gochang beach of 2014 year, southwestern coast of Korea

WH RYANG[1], SI KANG[1], AND SS CHUN[2]

[1] Chonbuk National University, Republic of Korea(ryang@jbnu.ac.kr)
[2] Chonnan National University, Republic of Korea

The Gochang beach is located on the southwestern coast of Korea along the eastern part of the Yellow Sea, comprising the Donghori, Gwangseungri, and Myengsasipri beaches from the north to south. The Gochang beach is characterized by macro-tide, open-coast, linear shoreline, and sand substrates. This study has investigated annual and seasonal characteristics of topography, accumulation rates, surface sediment properties, and sedimentary facies in 2014. During the four seasons of winter (Feb.), spring (May), summer (Aug.), and fall (Nov.) in 2014, topographic elevation and surface sediments of total 252 sites were measured and sampled along three survey lines. It consists of 21 sites at 30 m intervals in each transverse line to the shoreline, respectively. Annual accumulation rate of the Gochang beach in 2014 was -0.0776 m/yr, indicative of an erosion-dominated environment. The pocket-type Dongho beach is mainly composed of very fine sand to very coarse sand, and the ratio of fine sand is the largest. The average of grain size is the coarsest in the winter. The spatial distribution of surface sediments shows a coast-parallel trend of fine and medium sands during the four seasons. The surface sediments of the Gwangseungri beach are mainly composed of fine-grained sands, and the mean grain size is the coarsest in winter. Grain-size distribution shows a uni-mode pattern in the four seasons. Mud facies partly exist in spring and summer seasons, whereas it is rarely shown in autumn and winter. The spatial distribution of surface sediments shows a coast-parallel trend of fine to coarse sand during the four seasons. The Myeongsasipri beach is mainly composed of very fine sand to very coarse sand, and the ratio of fine sand is the largest. Grain-size distribution mostly shows a uni-mode pattern in the spring, summer, and winter. The mean grain size of the winter is the coarsest among those of four seasons. The spatial distribution of four seasons also shows a coast-parallel trend. In the Gochang beach of 2014 year, annual and seasonal characteristics of topography and surface sediments represent a fining trend from the upper to lower beach under erosional environments.

Keywords: topography, surface sediment, Gochang beach, macro-tide, open-coast

Acknowledgements: This study was supported by the research grant from the Korean Ministry of Oceans and Fisheries (PJT200538). This presentation is an interim result of the coastal research program in the study area.

Latest observations of the nearshore processes before the erosion-prone Haeundai beach, Korea

HEE J. LEE[1], JAE Y. JIN[2], JESUN YOO[3], JONG D. DO[4], SUN S. KIM[5], KIDEOK DO[6]

[1] Marine Geology and Geophysics Division, Korea Institute of Ocean Science and Technology, 787 Haeanro, Ansan 426-744, Korea (heelee@kiost.ac.kr)

[2] Coastal and Environmental Engineering Division, Korea Institute of Ocean Science and Technology, 787 Haeanro, Ansan 426-744, Korea

The Haeundae beach is one of the most popular attractions in Korea during the summer vacation season. However, it has suffered from beach erosion owing to the integrated effects of artificial developments during the past four decades. To prevent or mitigate the erosion of the Haeundae beach, the Korean government launched a comprehensive, multi-year beach monitoring program in 2013. The main focus of the program was on the nearshore processes related closely to the beach erosion. A total of 10 sites were stationed before the beach to measure three basic hydrodynamic variables of current, wave and suspended sediment concentrations. For the measurements, various self-contained instruments were employed including the current and wave equipment (Aquadopp and AWAC) and benthic tripods (SPHINX and TISDOS). In addition, bathymetry and shallow sediment stratigraphy were obtained from precision water-depth measurements and shallow seismic profiling. The results of those measurements were analysed and interpreted, together with previous, somewhat fragmentary data, with regard to residual current patterns, suspended flux and the associated erosion and deposition of the seafloor.

The interim results suggest that the nearshore processes are strongly seasonal. The wind and thus wave directions vary substantially with seasons. Summertime waves come from the south, in contrast to those of autumn and winter that come from the east to southeast. This variation in the wave direction results in changes in the residual current pattern and eventually the locales of erosion and deposition. In particular, summer typhoons dominate the erosion of the nearshore as well as the beach, and consequently lead to a net erosion of the Haeundae beach. Therefore, the program results are about to explain the beach erosion in the context of the hydrodynamic behaviour of beach sands and further to predict the fate of the Haeundae beach.

Keywords: beach erosion, typhoon, wave, sediment transport, Haeundae, Korea

Seasonal patterns of net sediments transport pathway in the Seocheon Songlim tidal flat, west coast of Korea

DAE GEON JANG[1] AND SEUNG SOO CHUN[1]

[1] Faculty of Earth System & Environmental Sciences, Chonnam National University, Gwangju 61186, Korea
(tidalflat@gmail.com

The Songlim coast is a slightly embayed and wave-dominated macrotidal flat bounded by rocky headlands. This flat shows slight seasonal change in coastal wave energy and sediment supply from Keum River. The Songlim coastal wetland (tidalflat) was designated as a wetland preservation area: thus a pilot project for wetland conservation and restoration of salt marsh has been conducted. This work is one of research results from long-term monitoring for basic studies about them.

For the monitoring, the regular and continuous sampling of surface sediment has been carried out in the study area from Feb. of 2013. The samples have been collected with a grid defined by constant interval (x 100m). Sand fractions (> 63um) were analysed by sieving method, and there Grain-size Trend Analysis by Gao and Collins (1992) has been adopted for analyzing sediment transport pathways.

Trends of sediment transport in Faburary of 2013 show relatively complex pathway. The general sediment transport direction shows from SSW to N, whereas sediment pathway nearby the tidal beach appears slightly to be direction change from SW to NW along the shoreline. The result of trends in Faburary of 2014 is also dominantly from SSW to N. These results disagree with that of well known direction of subtidal sediment transport (NW to SE) during winter, when is strongly influenced by monsoonal climate. During winter season, sand dune and surface of intertidal flat have here experienced strong erosion by strong attacks of wave. To protect from the severe erosion in these coast and intertidal flat, short bush fenses (German Lahnungen) have been installed as a pilot. It has been workable, and a rapid sedimentation has been observed on the flat and tidal beach. In summer (August, 2014), sediment transport trends were not change largely and pathway vector from S to N is more stronger than previous results.

The general sediment transport patway during winter in the west coast of Korea has been known as from NW to SE due to the strong influence of monsoonal wind but the opposite direction are observed in the study area, probably because of nearby geometry having several rocky headlans and small rocky islands.

Keywords: Seocheon Songlim tidal flat, sediment transport, seasonal change of intertidal sediment, wetland conservation, restoration of salt marsh

Acknowledgements: This study was supported by the research grant from the Korean Ministry of Oceans and Fisheries (PJT200538) (SSC).

Long-term shoreline changes on beaches in the Anmyondo

B. O. KIM[1] AND K. H. YUN[1]

[1] Research Institute of Marine Science, Chungnam National University (bkim1052@gmail.com)

Long-term shoreline changes on five beaches (Kkotji, Bangpo, Baeksajang, Sambong, and Kijipo beaches) in the Anmyondo, west coast of Korea were investigated using 7 sets of aerial photographs taken from the year 1985 to 2012. Both ground control points and check points were surveyed by GPS techniques were used to orient photographs absolutely. To improve the reliability of aerial photogrammetry, we adjusted ground control points and then performed the second aerial triangulation (Kim et al., 2014). Shoreline of the study area was defined as the Approximately Highest High Water Level which was 3.5 m or 3.6 m above datum depending on the region. Such 3-D shoreline as well as 1 m and 2 m contours were mapped by a digital photogrammetry and compiled into time-series data sets. The data sets of 1 m and 2 m contours were made to complement artificial shoreline, with which natural shoreline change cannot be considered. GIS techniques associated with Digital Shoreline Analysis System (Thieler et al., 2009) were employed to estimate rate of shoreline changes. Comparison in the rate of shoreline changes between beaches will be given and technique development from these studies will be briefley discussed.

Keywords: beach, shoreline change, aerial photograph, coastal erosion, Anmyondo

References

Kim, B. O., Yun, K. H., and Lee, C. K., 2014, The use of elevation adjusted ground control points for aerial triangulation in coastal areas. KSCE Journal of Civil Engineering, 18, 1825-1830.

Thieler, E. R., Himmelstoss, E. A., Zichichi, J. L., and Ergul, A., 2009, Digital Shoreline Analysis System (DSAS) version 4.0-An ArcGIS extension for calculating shoreline change: US Geological Survey Open File Report 2008-1278.

The accuracy of aerial triangulation for shoreline mapping on beaches in the Anmyondo

K. H. YUN[1] AND B. O. KIM[21]

[1] Research Institute of Marine Science, Chungnam National University (khyun1010@gmail.com)

It was analysed how accurate aerial triangulation for archive aerial photographs which were used for shoreline mapping on beaches in the Anmyondo, west coast of Korea was. Traditional photogrammetric processing has been based on a set of independently measured ground features to scale and orientate multiple aerial photographs by relating them into converting reference coordinate system (Wolf and Dewitt, 2000). For aerial photographs in coastal areas, it is very unfeasible to identify and acquire ground control points (GCPs) due to the existence of sea water. GCPs that are distributed dominantly on the land side may cause poor photogrammetric results. Among methods to overcome the uneven distribution of GCPs, Kim et al. (2014) proposed a two-step triangulation associated with elevation-adjusted GCPs. This method was useful for dealing with archive aerial photographs that need traditional aerial photogrammetry. In order to evaluate the quality of aerial photogrammetry, it is necessary to obtain check points. The status of check points can be various in source, quality and availibiltiy depending on the condition of coastal areas. Also, the evaluation techniques are proceeding. We will show case studies of evaluating the accuracy of arial triangulation in terms of the kind of check points as well as evaluation methods.

Keywords: shoreline, aerial triangulation, accuracy, Anmyondo

References

Kim, B. O., Yun, K. H., and Lee, C. K., 2014, The use of elevation adjusted ground control points for aerial triangulation in coastal areas. KSCE Journal of Civil Engineering, 18, 1825-1830.

Wolf, P. R. and Dewitt, B. A, 2000, Elements of Photogrammetry (with Applications in GIS), Third Edition, McGraw-Hill, Inc., New York, N.Y., pp. 624

Drone-based Remote Sensing Approaches on Coastal Topography Extraction: A Case Study of West Coast, South Korea

SUNGJI BAEA, JAEHYUNG YUB, DONGYOON YANGC

[1] Department of Astronomical Science and Geology, Chungnam National University, 99 Daehak-ro, Yuseong-gu, Daejeon, South Korea (jieun.kim814@gmail.com)

[2] Department of Geology and Earth Environmental Sciences, Chungnam National University, 99 Daehak-ro, Yuseong-gu, Daejeon, South Korea

[3] Mineral Resources Research Division, Korea Institute of Geoscience and Mienral Resources, Daejeon, South Korea

Understanding coastal topography is an essential parameter to understand coastal processes. More importantly, high resolution / high accuracy digital elevation model of a coastal area had been a challenge as natural hazard derived by climate change and sea-level rise get significant attention all over the world. To understand and predict the present and the future climate change, the extraction of high resolution topography for a coastal region is a must-have item. This study extracted a high resolution digital elevation model for a coastal area of South Korea located in the west coast. A low-altitude remote sensing technique employing a multi-copter is conducted for the study area. The acquired aerial images were geometrically and geospatially rectified and the high resolution aerial images were constructed. Stereoscopic techniques are applied to the rectified aerial images calibrated with ground control points acquired by post-differential global positioning systems. As a result of the drone-based low altitude remote sensing, high resolution-high accuracy digital elevation models were developed. We expect that this product would contribute in understanding of coastal processes related to climate change and sea level changes.

Keywords : natural hazard, high resolution, drone-based remote sensing, coastal topography, digital elevation model

Analysis of Observed Changes in the Sundarbans Mangrove Using Landsat Time-series Data

M. MAHMUDUR RAHMAN[12]

[1] Climate Resilient Participatory Afforestationand Reforestation Project (CRPARP), Bangladesh Forest Department (misgis.crparp@gmail.com)

[2] Bangladesh Space Research & Remote Sensing Organization (SPARRSO) (on-lien), Agargaon, Sher-E-Bangla Nagar, Dhaka-1207, Bangladesh

Mangroves are located at the inter-tidal zone of tropical and sub-tropical belt. Mangrove ecosystem is a vulnerable ecosystem because of the global climate change and sea-level rise. Sea level rise will accelerate coastal erosion at the sea-fronts of mangrove and induce landward progression if ecosystem favours for mangrove regeneration. The study will examine the rate of mangrove loss in sea-front by because of erosion and mangrove expansion in other locations by natural succession. The study area will be located in Sundarbans Mangrove Forest, the largest continuous mangrove tract in the world. Time-series data of Landsat Multi-spectral Scanner (MSS), Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+) of 1973, 1980, 1989, 2001 and 2010 have been used in the study. Mangrove forest was classified following a supervised method and knowledge based information was required to separate mangrove from other coastal vegetation. The classified Landsat scene was validated in the ground. In the 1970s, Sundarbans forest shows an accretion trends with a rate 316 ha/year. Since 1980s it shows an erosion trends; the loss of forest was 394 ha/year in the 1980s, 1,131 ha/year in the 1990s, and 698 ha/year in the 2000s. It is estimated that net loss of mangrove areas in the Sundarbans is 212 km2 in the last 37 years with a rate of 5.7 km2/year. The erosion is detected in many parts of the Sundarbans exposed to sea and large rivers. The total expansion of mangrove is noticed in the sheltered part of the forest. At this stage, it is unclear that how much coastal erosion is linked to the global warming and sea-level rise or whether any other associated factors such as geological and anthropogenic induced land subsidence, changes in the dynamic energy balance between water-flow from hinterland and tidal waves from sea front or other local factors are driving these changes. Further studies should be carried out to investigate on it. The result of the study will be useful to understand the rate of changes in Sundarbans mangrove and forecast for the future of this valuable coastal ecosystem.

Keywords: mangrove, erosion, expansion, Landsat, sea-level

Development of narrow coastal plains along the east coast of the Korean Peninsula during the Holocene

KWANG HEE CHOI[1]

[1] National Institute of Environmental Research, Incheon 404-708, Republic of Korea. (geoist@korea.kr)

Along the east coast of the Korean Peninsula, there are many narrow and elongate coastal plains which have been regarded as the result of the Holocene coastal progradation. Their evolution history including progradation processes and rates as well as sea level fluctuations, however, is still vague because little research has been done based on absolute chronologices (Choi et al., 2007; 2014). In this study, we used optically stimulated luminescence (OSL) dating and ground penetrating radar (GPR) surveys to reconstruct the development history of two coastal plains (GRB and WSJ) in Gyeongbuk Province, South Korea. They are identically composed of sandy beach, lagoonal wetlands, rivers, and sandy ridges. Both plains have been developed since around 6.0 ka, according to the results of OSL dating, but experienced different geomorphological processes. Analyses of sediments, chronology and internal structures in the two coastal plains showed that they have been developed mainly by the sand barrier systems such as beach-ridge (Hesp et al., 2005). However, the second ridge of WSJ was close to a “beach-foredune ridge”, because its sedimentological and geomorphological characteristics were similar with those of aeolian dunes which have landward-dipping structures and comparatively steep gradients. In addition, the luminescence dating results showed time difference indicating that the lower part of the second ridge was deposited at 1.3 ka, while its upper part was formed at around 0.2 ka. Therefore, this eolian cap might have been accumulated by winds around a thousand years after the deposition of the beach ridges. Given the internal structures and ranges of the luminescence ages, it is likely that the two coastal plains have been developed by the coastal progradation of beach-ridges or beach-foredune ridges since the Mid-Holocene.

Keywords: coastal dune, beach ridge, South Korea, mid-Holocene, sea level

References

Choi, K. H., Choi, J-H., Kim, J. W., 2014, Reconstruction of Holocene coastal progradation on the east coast of Korea based on OSL dating and GPR surveys of beach-foredune ridges. The Holocene, 24, 24-34.

Choi, K. H., Yoon, K. S., Choi, J. H., Shin, Y. K., Lee, J. C., Suh, M. H., Munyikwa, K. and Oh, K. H. 2007. Anthropogenic Geomorphological Changes during the Last Century in the Kangneung Area along the East Coast of Korea. Journal of Coastal Research SI 50, 1015-1022.

Hesp, P. A., Dillenburg, S. R., Barboza, E. G., Tomazelli, L. J., Ayup-Zouain, R. N., Esteves, L. S., Gruber, N. L. S., Toldo-Jr, E. E., Tabajara, L. L. C. d. A. and Clerot, L. C. P. 2005. Beach ridges, foredunes or transgressive dunefields? Definitions and an examination of the Torres to Tramanda?barrier system, Southern Brazil. Anais da Academia Brasileira de Ciências 77, 493-508.

Stratigraphic characteristics of late Quaternary deposits on an open-coast Dongho macrotidal coast, western Korea

CHANG SOO SON[1] AND SEUNG SOO CHUN[1]

[1] Faculty of Earth System & Environmental Sciences, Chonnam National University, Korea (tidalflat@gmail.com)

The subtidal area of Dongho, located at the western coast of Korea, was investigated with respect to stratigraphic characteristics of late Quaternary depostis. For this study, firstly, detailed seismic surveys were carried out in order to reveal the internal structures. On the basis of the seismic profiles, in addition, five underwater cores (about 6 to 23 m long) were recovered. From the sediments of the cores, various analyses such as grain size analysis, sedimentary strucutres, magnetic susceptibility analysis, OSL age dating, and so on were fulfilled for sedimentary facies analysis.

As a result, six distinctive facies comprising oxidized mud facies, flood plain mud facies, salt marsh facies, gravel lag facies, mixed tidal flat facies and beach to shoreface facies were recognized. Oxidized mud facies, placed in the lowermost part of a core (core-04), is characterized by mainly homogeneous mud containing peats and brownish gray colour. Flood plain mud facies, located in the lowermost parts of a core (core-05) is composed of silts including peats and charcoals. Sedimentary structures are hardly observed due to intensive bioturbations. Salt marsh facies also consists of silts and contains peats, charcoals and shell fragments. Tidal rhythmites are sparsely observed. Gravel lag facies overlying salt marsh facies or flood plain mud facies (core-01 and core-03) is composed of poorly sorted coarse sands and gravels. Mixed tidal flat facies overlain by beach to shoreface facies (core-01 to 05) is mainly characterized by very well developed tidal rhythmites. The mud layer, in general, tends to be thinner toward the upper part. Beach to shoreface facies, usually placed on the upper parts of the cores (core-01 to core-05), are composed of medium to fine sands. Prominent sedimentary structures are parallel-laminated sand, low-angled cross-laminated sand and massive shelly sand. According to the OSL analysis, four facies (oxidized mud, flood plain mud, salt marsh and gravel lag deposits) were formed during Pleistocene, whereas the upper two facies (mixed tidal flat and beach to shoreface deposits) were produced during Holocene.

Keywords: Pleistocene, Holocene, oxidized mud, flood plain, salt marsh, gravel lag, mixed tidal flat, beach, shoreface

Acknowledgements: This study was supported by the research grant from the Korean Ministry of Oceans and Fisheries (PJT200538) (SSC).

Early diagenesis processes of clay matters in decadal time-scale in tropical coastal sediments of Vietnam

DR. NGUYEN THI MINH NGOC

[1] Vietnam Institute of Geoscience and Mineral Resources, 67 Chien Thang Road, Ha Dong District, Hanoi, Vietnam/ CCOP Regional Expert in Bangkok, Thailand (ngoctmnguyen@gmail.com)

In recent decades, coastal zone are changing dramatically as a result of complex interactions among land, sea, mangrove biota and human activities. Imprints of these environmental variations recorded in clay minerals of coastal sediments in the Red river mouth and South Central coast of Vietnam were investigated based on XRD (i.e. XRD-peak area, crystalline domain size) and TEM-EDX (frequency spectra of mixed layer series, particle morphology, crystallite structures and chemical structures) in order to reveal early diagenesis. By modelling the chemical structures of clay particles based on TEM-EDX data, in support by XRD evidences, it was revealed that the studied sediments had diverse clay mineralogical compositions with predominance of four mixed layers series: Illite - Smectite mixed layer (IS-ml), Diorthahedra Vermiculite - Smectite mixed layer (diVS-ml) (68 – 72% of total particle frequency in the fractions < 2μm), Chlorite - Smectite mixed layer and Kaolinite - Expandable mixed layer (KE-ml). Post-sedimentary geochemical-mineralogical alterations include three principal diagenesis processes: dissolution, smectitization and kaolinitization.

Dissolution process in the coastal alkaline condition is a function of diagenesis time, giving rise to decrease in full frequency spectra of clay phases in fractions < 2 μm. It can be intensified by intensive hydrodynamic process (e.g. surficial erosion in low tidal mudflat and shrimp pond profiles) and also in contact with acidic microenvironment (e.g. rhizosphere layer in mangrove forest profiles). In diVS-ml series, smectitic structure is more easily dissolved in comparison to dioctahedral vermiculitic structure, as a linkage higher octahedral substitution in chemical structures.

Smectitization of diVS-ml series is evidently in clay matters of the studied profiles with the increase of expandable phases with depth, migration of frequency spectra from vermiculitic to montmorillonitic structures as well as morphological modification of particles. This alteration process can be intensified under intensive surficial dissolution as well as under influence of mangrove root in rhizosphere layer. The smectitization in diVS-ml structures occurs in group-wise layer by layer transforming mechanism. Each step is indicated by a gauss-like distribution of the octahedral layer charge. Potassium has a trigger function with commonly maximum occurrence in interlayers between two neighbored tetrahedral levels.

Kaolinitization of KE-ml series occurs also as function of time, in parallel to smectitization and dissolution processes. This alteration process can be intensified under intensive surficial dissolution as well as under influence of mangrove root in rhizosphere layer. When interlayer cations and tetrahedral layers of beidellitic component are released by dissolution process, attachment of hydroxyl group from sea water to the octahedral layer facilitates formation and growth of kaolinite patches. This solid transformation of KE-ml series is comparable to kaolinitization mechanism discussed by Dudek et al. (2006).

Keywords: Coastal sediments, tropical, clay minerals, mixed layer, TEM

References

Dudek, T., Cuadros, J., and Fiore, S., 2006, Interstratified kaolinite-smectite: Nature of the layers and mechanism of smectite kaolinization. American Mineralogist, 91, 159–170.

New Exploration on environmental significance of clay minerals combination characteristics – Study on the QG01 borehole in western coast of Bohai Bay, China

DAWEI LIU, YONGMING WANG, KE HU

[1]School of Marine Sciences, China University of Geosciences, Beijing, 100083, China (ldw861111@163.com)

Because of structural characteristic and physic-chemical properties, during the proceeding and evolution disciplinarian, clay minerals carry along rich information about the global climate change, and clay minerals have become one of effective auxiliary research subjects for the paleoclimate research. The sedimentary environment of Bohai bay, the only inland sea of China, changed dramatically during Holocene, because of the climate change, sea level change and the terrestrial input change. The sediment recorded the information of marine continent exchange, so it is a good sample for the research of environmental change in coastal zone.

In this paper, X-Ray Diffraction Analysis (XRD) was used to fix on the variety and relative content of clay minerals in coastal sediments in western coast of Bohai Bay. The results from 72 samples show that the clay mineral asseblage is illite-chlorite-kaolite-smectite. Illite (55.4% - 78.2%, average 67.4%) is the main clay mineral, while chlorite (10.9% - 23.9%, average 13.5%) and kaolinite (6.2%-20.1%, average 9.6%) are less, and smectite (0.2%-11.7%, average 5.9%) is the minor one. Combined with optically stimulated luminescence (OSL) dating data and grain size charateristics, the ratio of illite and chlorite to smectite and kaolinite (named W index in this paper) and illite crystallinity (Kübler index, KI) are used together as proxy indicator of paleoclimate evolution. The trends of W index and KI correlate to each other: high W index and low KI indicate the weather is dry and cold; while low W index and KI indicate the weahter is damp and warm. However, between the depth of 14.8m to 13.1m, the trends of W index and KI are totally opposite, the reason is maybe that the meterials from Yellow River and Bohai mixed with the meterials from Haihe River, or river migration of Haihe River caused the sedimental environment change, which caused the environmental information in the clay minerals were damaged. If the sedimental environment of this area did not change, W index would correspond with KI well, and they would be useful indicators of paleoclimate.

Keywords: clay mineral, W index, illite crystallinity, paleoclimate, Bohai Bay

Tsunami- and earthquake-induced event deposits by the 2011 Tohoku-Oki earthquake and its related tsunami from coastal to deep-sea, and their preservation potential at offshore of Sanriku

KEN IKEHARA, KAZUKO USAMI, TORU TAMURA, AND YUKI SAWAI[1]

[1] Geological Survey of Japan, AIST (k-ikehara@aist.go.jp)

•The 2011 off the Pacific Coast of Tohoku earthquake (2011 Tohoku-Oki earthquake) is one of the large and destructive earthquake. Huge tsunami by the earthquake attacked the Pacific coast of the northeastern Japan. Strong ground motion by the earthquake might make large sea-floor displacements, slope failures and sediment resuspension along the Japan Trench slope. Furthermore, large friction velocity of huge tsunami waves might erode, resuspend and transport sea floor sediments. The event deposits by the 2011 Tohoku-Oki earthquake and tsunami have been reported from wide area off Hachinohe to off Fukushima, and from shelf to trench. Most of them have the characteristics of fine-grained turbidites. For example, in the Japan Trench, a thick amalgamated fine-grained turbidite was occurred. An amalgamated and multi-layered character suggests the repeated generation and/or multi-place generation of turbidity currents along the slope. Similar sediments were collected from lower trench slope. On the other hand, on the outer shelf of Sendai Bay, repeated generation of turbidity currents was recorded as a multi-layered fine-grained turbidite. Large friction velocity of tsunami waves on shelf might resuspend the shelf mud and form highly suspended shelf water. Turbidity currents might be generated by the collapse of such a turbid water mass. Radioactive Cs profile in the event bed suggested that the suspended water mass was maintained at least several to a few tens days after the earthquake and tsunami. Huge tsunami eroded the shoreface and beach slope and redeposited the reworked shoreface sands at the base of slope as shallow marine tsunami deposits. Repeated survey on the Sanriku surface sediments clearly indicates the higher preservation potential at the lower slope having low benthos activity than at the upper slope where benthos activity is strong. Thus, sedimentary records of the offshore event deposits might preserve and find in the lower slope sediments than the upper slope sediments.

Keywords: earthquake, tsunami, event deposit, preservation potential

Three shell beds as evidence for a late Holocene storm-surge run-up on the Dasa-ri coastal dunes, west coast of Korea

TAE SOO CHANG[1], SANGHEON YI[1], KWANG HEE CHOI[2], AND JEONG-HEON CHOI[3]

[1] Korea Institute of Geoscience and Mineral Resources, Republic of Korea (tschang@kigam.re.kr)
[2] National Institute of Environmental Research, Republic of Korea
[3] Korea Basic Science Institute, Republic of Korea

The design criteria of most coastal defences are today solely based on instrumental records of water elevations associated with the most powerful storms or typhoons. As a consequence, the magnitude and frequency (e.g., recurrence interval) of extreme events are practically limited to a centennial time scale. Reports on millennial-scale storminess, on the other hand, go far beyond the historical records and it is thus advisable to develop coastal defence strategies on the basis of the evidence gained from such longer records. In this context, the present study primarily aims at identifying extreme coastal storm events preserved in the sedimentary record along the west coast of Korea. As changes in storminess patterns are closely related to global climate changes, such knowledge would ultimately be beneficial to coastal management. For this purpose, beach and dune systems along the macrotidal west coast of Korea, which are directly affected by storm impacts, were examined in detail. In the course, three buried shell beds were discovered in a beach-dune scarp at Dasa-ri, Seocheon County. A topographic survey revealed that the top of the uppermost shell bed is situated 3.5 m above the present highest high-water level. The deposit containing the three shell horizons comprising oysters, bivalves and snails is ca. 1 m thick. The shell beds, which also contain well-rounded pebbles, are encased in coastal dune sands and form flat-topped, lens-shaped deposits without basal erosion surfaces. This suggests that they represent infills of the lower troughs of a dune slack, which presumably formed in response to surge run-up. The timing of the extreme events was determined using optically stimulated luminescence on quartz sand grains and 14C-AMS dates on charcoal remains and shells. The obtained ages suggest that the shell beds were deposited between 2.5 and 2.0 ka ago. Considering that the parabolic dunes are aligned to the north-west and that the dune scarp is sheltered from typical typhoon tracks, it would appear that the shell deposits were more probably generated by storm surges generated by north-westerly winds coupled with high tides, It is thus demonstrated that the geological record can supply important information on past storm-surge levels, which may be useful in redefining the design criteria for coastal defences.

Keywords: paleo-storm, coastal dune, macrotidal, Korean west coast

Potential geohazards on the Eastern Sakhalin slope, Okhotsk Sea

B.V. BARANOV[1], Y.-K. JIN [2], K. A. DOZOROVA[1], V.G. PROKUDIN[3], A.S. SALOMATIN[3], D.D. RUKAVISHNIKOVA[1]

[1] Institute of Oceanology, Russian Academy of Sciences, Russia (bbaranov@ocean.ru)
[2] Korean Institute of Polar Research, Korea
[3] Pacific Oceanological Institute, Far East Branch, Russian Academy of Sciences, Russia

Analysis of geological and geophysical data obtained on the Eastern Sakhalin slope during 1998 - 2012 in frames of three international projects (Kurile-Okhotsk Marine EXperiment - KOMEX, Hydro-Carbon Hydrate Accumulations in the Okhotsk Sea - CHAOS и Sakhalin Slope Gas Hydrates - SSGH) and data from seismological catalogues afforded ground to distinguish several potentially hazardous geological processes in this region: seismic activity, active tectonics, gas seepage, slope failure and landslides formation. Spatial distribution of each process was examined and geological hazard zoning within the Eastern Sakhalin slope was fulfilled. In this regard the Eastern Sakhalin slope was divided into four segments: Northern (54.7° – 53.85°N), Central (53.85° – 51.5° N), Southern (51.5° – 48.8° N) and Kurile (48.8° – 46.0° N). It was established, that none of listed geohazards were recognized in the Southern segment. All of them are observed in the Northern, Central and Kurile segments. In the Northern segment slope is completely failed to the moment and origination of the new landslides is unlikely. For Central and Kurile segments we suppose that potential geohazards first of all stems from possible landsliding, as it may generate the tsunami waves with height of up to 10 m on the Sakhalin coasts. Thus Central and Kurile segments are characterized by the most geological hazard. Seismic activity, active tectonics and gas seepage within the Central and Kurile segments can serve as triggers for slope failure and landsliding. Taking into account oil and gas field development in this area, geohazards in the Central slope segment may cause maximum economical and ecological damage.

Keywords: geohazard, seismic activity, tsunami, active tectonics, landslides, Sakhalin slope

Geophysical features and inferred triggerring factors of submarine landslides in the western continental margin of the Ulleung Basin, East Sea of Korea

DENIZ CUKUR[1], SEONG-PIL KIM[2], GEE-SOO KONG[1], YOUNGHO YOON[1], JUNG-KI KIM[1], JOUNG-GYU CHOI[1]

[1]Korea Institute of Geoscience and Mineral Resources, 124 Gwahang-no, Yuseong-gu, Daejeon 305-350, Korea, (dcukur@kigam.re.kr)

[2] POHANG branch of KIGAM, 124 Gwahang-no, Yuseong-gu, Daejeon 305-350, Korea

Submarine landslides form very complex features in the seafloor and the implicated geological processes are yet to be known completely. Various researches are still undergoing not only for their profound academic significance but also for their hazardous impact potential to seafloor infrastructures and coastal areas. In order to investigate the style and cause of landslides along the western margin of the Ulleung Basin in the East Sea, we collected multiple geophysical datasets including sparker, subbottom profiler, and multibeam echosounder. The preliminary analysis of the bathymetric data shows multiple U-shaped scarps that initiate at water depths of ~600 m. The height of the individual scar ranges from less than ~25 m in the south to over 50 m in the north. Seismic data clearly image erosional headwalls and the basal sliding surface which is characterized by a prominent high-amplitude reflector. Chaotic-to-transparent seismic facies are seen immediately downslope of the headwall scarps; these chaotic facies represent landslide deposits of about 20 m in thickenss. Sediments upslope of the scarp are well-stratified indicating that they are not affected by the sliding event. Several V-shaped seafloor depressions near the head of these scarps are seen on the subbottom profilers. These depressions, which are ~5 m deep and ~150 m wide, are interpreted as pockmarks, resulted from upward migration of gas in the sediment layers beneath. The existence of those pockmarks immediately above the scars may suggest that the gases and/or gas fluids might be playing an important role for destabilizing slope sediments. In addition, subbottom profilers suggest the presence of numerous faults in close vicinity of headwall scarps; some are extending to the seafloor suggesting their recent activity. Earthquakes associated with tectonic activity are indicated to be the cause of these faults. Thus the earthquakes might be the final trigger for landslides in this region.

The Stratification and Circulation Characteristics of Estuaries Altered by Estuarine Dams

HYUN-JUNG SHIN[1], GUAN-HONG LEE[1], KIRYONG KANG[2], KYEONG PARK[3]

[1] Department of Oceanography, Inha University, Incheon, Korea (hyunjung_@inha.edu)
[2] National Typhoon Center, Korea Meterological Administration, Seogwipo 699-942, Korea
[3] Department of Marine Sciences, Texas A&M University, Galveston, TX, 77554, USA

An "altered estuary" is an estuary where the mixing of fresh and saltwater is influenced by a nearby estuarine dam. Such dams are situated in the transitional region where historically unhindered fresh water naturally diluted saltwater. However, the presence of estuarine dam led to freshwater discharge that is artificially controlled by humans. This in turn alters the processes and range of circulation of the natural estuarine environments, which has been studied by many scientists. The natural estuarine environments of the western coast of the Korean Peninsula are expected to be fully mixed estuary characteristics, largely due to the (super) macro-tidal environment. In contrast, a micro-tidal estuary can be expected to be stratified more easily, especially when there is a small freshwater discharge. In this study, the Yeongsan and Nakdong River estuaries which contain estuarine dams are classified by the stratification-circulation diagram introduced by Hansen and Rattray (1966). Salinity data from CTD and Velocity data from ADCP is measured in each estuary are used to calculate two parameters of the diagram. These cases of estuaries whose water circulation are altered by estuarine dams are further compared with the Han River estuary, which is a natural estuary. Although exhibiting a large discharge in the summer, the relatively deep (~20 m) and macro-tidal (~4 m) Yeongsan River estuary was found to exhibit stratification due the release of freshwater along the water surface layer by the estuarine dam. Whereas, the Nakdong River estuary, which is shallow (~9 m) and micro-tidal (~1.5 m), was a fully mixed estuary because the gate of the estuarine dam is opened from the seabed. These results show that the design of the estuarine dam's gate also affects the stratification and circulation characteristics of estuaries classified as altered estuaries.

Keywords: Estuary dam, Stratification-Circulation diagram, Altered estuary

Shifts in depositional environments as a natural response to anthropogenic alterations: Nakdong Estuary, South Korea

JOSHUA R. WILLIAMS[1], TIMOTHY M. DELLAPENNA[1], GUAN-HONG LEE[2], STEVEN M. FIGUEROA[2]

[1] Texas A&M University-Galveston, Department of Marine Sciences, 1001 Texas Clipper Rd., Galveston, TX 77551, USA (jwilliams@ocean.tamu.edu)

[2] Inha University, Department of Oceanography, 253 Yonghyun-Dong, Nam-Gu, Incheon 402-751, Republic of Korea

The Nakdong Estuary, located within the coastal zone of Busan, South Korea, has been subjected to a series of engineered alterations typical of many eastern Asian estuaries. The construction of two estuarine dams (1934 and 1983) and numerous seawalls associated with land reclamation projects has altered the timing and flux of sediment, and resulted in three contrasting discharge energy regimes. Additionally, the impoundments have appreciably reduced the tidal prism by at least 50%. Consequently, vast geomorphologic changes have occurred including the development of five new barrier islands. In order to assess the impacts of these modifications, 19 vibracores were obtained throughout the estuary. The dispersal and accumulation of sediment was evaluated utilizing ^{210}Pb and ^{137}Cs radioisotope geochronology of 6 cores. Average sediment accumulation rates range from 2.19 cm yr^{-1} adjacent to the first constructed dam to as high as 6.55 cm yr^{-1} in the middle region of the estuary. These high rates are further supported by comparison of bathymetric survey data from 1985 to 2009. Laser diffraction grain size analyses and X-radiographs revealed distinctive changes associated with dam construction, and correlation of events between cores conveys the episodic sedimentation corresponding to floodgate releases. Ultimately, anthropogenic alterations have resulted in a shift from a tide-dominated to a wave-dominated estuary. The increase in sediment trapping efficiency that has ensued resulting from extensive coastal construction provides the basis for reevaluating traditional facies models for estuaries. A conceptual model is developed here to characterize the alterations in sediment depositional patterns according to relative discharge energy of the adjacent floodgate.

Keywords: estuarine dam, Korea, trapping efficiency, ^{210}Pb and ^{137}Cs accumulation rate, facies models

References

Williams, J.R., Dellapenna, T.M., and Lee, G., 2013, Shifts in depositional environments as a natural response to anthropogenic alterations: Nakdong Estuary, South Korea, *Marine Geology*, **343**, 47-61.

Mechanisms for sediment convergence in altered microtidal Nakdong Estuary, South Korea

GUAN-HONG LEE[1], JOSHUA WILLIAMS[2], HYUN-JUNG SHIN[1], TIMOTHY DELLAPENNA[2]

[1] Department of Oceanography, Inha University, Incheon, Korea
[2] Marine Sciences Department, Texas A&M University-Galveston, USA

Previous sedimentological work has shown that an order of magnitude higher sedimentation (2-6 cm/yr) than sea-level rise resulted in, due to the emplacement of estuarine dams and land reclamation, at altered macrotidal Nakdong estuary of Korea [Williams et al., 2013]. To investigate the timing and rate of sedimentation, two autonomous sonar altimeters were deployed nearly a year. In the west Nakdong where no freshwater discharge occurs, the sedimentation was gradual up to 4 cm over a year which corresponds to long-term sedimentation. On the other hand, the episodic sedimentation up to 6 cm, which also corresponds to the long-term sedimentation rate, occurred in two months during the summer in the main Eulsuk channel where high energy discharge was allowed through the estuarine dam. To examine mechanisms of rapid sedimentation in the main Eulsuk channel, current velocity profiles were measured by Acoustic Doppler Current Profilers (ADCP) at three sites during increased discharge and wave activity events, and through spring and neap tidal cycles. Suspended sediment concentrations were obtained by converting ADCP backscatter profiles. These observations were decomposed into tidal pumping and advection terms to determine the primary factors controlling suspended sediment flux throughout the estuary. Inherently, results reveal that the highest sediment fluxes occur by mean advection during large discharge events. However, interestingly the cumulative sediment flux at the mouth of the estuary is of lower magnitude than adjacent to the dam, resulting in deposition of large volumes of sediment within the estuary. Suspension of sediments by waves and tidal currents also cause a flux into the estuary in the absence of strong discharge, which suggests the main mechanism for the gradual deposition, in the absence of freshwater discharge, in the west Nakdong.

Keywords: Nakdong estuary, altered estuary, freshwater discharge, sediment flux, sediment convergence

Sedimentary Impacts of Anthropogenic Alterations on the Yeongsan Estuary, South Korea

TIMOTHY DELLAPENNA[1,2], JOSHUA WILLIAMS[1], GUAN-HONG LEE[3]

[1] Marine Sciences Department, Texas A&M University-Galveston, USA (dellapet@tamug.edu)
[2] Oceanography Department, Texas A&M University, USA
[3] Oceanography Department, Inha University, S. Korea

Over the last half-century, coastal zones within the Republic of Korea (S. Korea) have experienced a wide range of engineered coastal modifications including construction of seawalls, extensive land reclamation, and installation of estuarine dams. The Yeongsan Estuary has experienced all of these modifications and provides an ideal case study on how sedimentation changes within a macrotidal estuary in response to these alterations. Combined, these alterations have considerably modulated the timing and intensity of river discharge, prevented natural tidal exchange, modified the shoreline profile, and altered the transport of sediment and organic matter within the coastal zone. These impacts have been investigated using 30 gravity cores analyzed for 210Pb radioisotope geochronology, laser diffraction particle size analyses, δ13C and δ15N isotope ratio mass spectrometry, and X-radiography. Average sediment accumulation rates range from 0.9 ± 0.6 cm yr-1 to 10.0 ± 2.9 cm yr-1, with the highest rates proximal to the downstream side of the dam, and some areas determined to be either actively eroding or recently dredged. These results are supported by comparison of multiple bathymetric surveys, and CHIRP seismic data suggest an order of magnitude increase from average Holocene sediment accumulation rates. Side scan sonagrams collected adjacent to the dam reveal distinctive scouring, transitioning to areas accumulating fine-grained sediments. Shifts in the organic matter source inputs are apparent in pre/post-dam sediments and reflect the occluding of tidal influence above the dam, resulting in increasingly terrestrial dominated signatures. Additionally, a time series of cores collected during periods of limited and high discharge analyzed for 7Be, indicates sediment deposition occurs episodically corresponding to high discharge dam releases. Our observations record a shift in depositional environments as a response to an extensive array of anthropogenic alterations. Ultimately, land reclamation and dam construction have severely altered the fate and transport of sediment within the estuarine system. As a consequence, sedimentation rates have increased dramatically and depositional events are primarily controlled by discharges from the estuarine dam.

Keywords: sediment accumulation; estuarine dam; anthropogenic effects; geochronometry

Historical Reconstruction of Anthropogenic Mercury Input from Sedimentary Records: Yeongsan Estuary, South Korea

JOSHUA WILLIAMS[1], TIMOTHY DELLAPENNA[1,2], GUAN-HONG LEE[3]

[1] Marine Sciences Department, Texas A&M University-Galveston, USA (jwilliams@ocean.tamu.edu)
[2] Oceanography Department, Texas A&M University, USA
[3] Oceanography Department, Inha University, S. Korea

The rapid economic growth of the Republic of Korea (S. Korea) within the last half-century has resulted in a pronounced increase in anthropogenic Hg emission from coal combustion, oil refining, cement production, and waste incineration. The impacts of increasing atmospheric sources have been investigated with a historical reconstruction of Hg input from 30 sediment cores collected from the Yeongsan Estuary. Within the last several decades, this region has undergone severe anthropogenic alteration, including the construction of an estuarine dam forming the Yeongsan Lake, and installation of numerous seawalls that eliminated vast tidal flats and restricted estuarine circulation. Total mercury concentrations (T-Hg) from pre-industrial sediments (i.e. background values) have been determined to be significantly lower than sediments deposited after 1980, with an average increase from 8.6 ± 2.7 (n = 274) to 23.2 ± 9.6 (n = 273) ng g^{-1}, respectively. Surface sample T-Hg results reveal the highest concentrations above the dam, with a gradient to lower values further offshore. The concomitant timing of enrichment of T-Hg within the sedimentary record and increased emissions suggests that regional sources dominate the input to the Yeongsan Estuary. This indicates that with sufficient regional historic emission data, T-Hg may be utilized as a geochronologic tool to corroborate traditional radioisotopic methods.

Keywords: mercury; estuarine dam; anthropogenic effects; geochronometry

Changes of the bottom turbuence and flow structure by discrete freshwater discharge in the Yeongsan estuary, Korea

KIRYONG KANG[1] AND GUAN-HONG LEE[2]

[1] National Typhoon Center, Korea Meteorological Administration, Jeju, 699-942, Korea
[2] Dept. of Oceanography, Inha University, Incheon, 402-751, Korea

Measurement of the water flow in the Yeongsan estuary, Korea, was made in August 2011, to investigate changes of flow structure and the bottom turbulence characteristics such as the Reynolds stress, turbulent kinetic energy (TKE) at the near bed (less than 35 cm above bottom). And comparison between the bottom TKE and suspended sediment concentration (SSC) was carried out to see how to link between the discrete surface freshwater discharge and the suspended sediment concentration near bed. Flow structure of horizontal component from the bed to 0.35 meters above bottom (mab) showed the upside-downed bell shape and maximum speed was less than 15 cm/s. However, vertical component was almost 1 cm/s in maximum, and showed peak at 0.1 mab and gradually decreased and then keep almost same magnitude. When the freshwater was discharged, the bottom flow rapidly responded by showing sudden change of direction. The magnitude of Reynolds stress was 2 cm^2/s^2 in maximum and TKE showed less than 10 cm^2/s^2 with upside-downed half bell shape. The stress and TKE component were directly responded by the surface freshwater discharging, and when the TKE was rapidly increased, the SSC was also increased in the bottom boundary layer, indicating that the active turbulent flow help suspending the bottom sediment. A hypothesis was suggested that the surface freshwater discharge by dam gate opening could increase the SSC of the bottom boundary layers by high turbulent flow activity.

Keywords: Reynolds stress, turbulent kinetic energy, suspended sediment concentration, bottom boundary layer, freshwater discharge

Floc Discharge and Sediment Accumulation at Altered Macro-Tidal Yeongsan Estuary of Korea

HOSAHNG RHEW[1], GUAN-HONG LEE[2], HYUN-JUNG SHIN[2], SOONGJI LEE[2], SEOK-YUN KIM[3], JOSHUA WILLIAMS[4], TIMOTHY DELLAPENNA[4]

[1] Department of Geography Education, Chonbuk National University, Chonju, Korea
[2] Department of Oceanography, Inha University, Incheon, Korea
[3] Department of Oceanography, Pukyung National University, Busan, Korea
[4] Marine Sciences Department, Texas A&M University-Galveston, USA

Macro-tidal Yeongsan estuary of Korea has been altered due mainly to the construction of an estuarine dam in 1981 as well as the reclamation of extensive tidal flats along the Yeongsan estuary. As a part of four-year (2010-2013) research program, 'Development of Integrated Estuarine Management System of Korea', a series of field experiments have been conducted to understand sedimentation process, especially the governing processes of source, transport and sink of fine sediments, in the altered Yeongsan estuary. The field campaign includes grain size analysis of surficial sediment, bathymetric survey, coring of bed sediment and subsequent dating analysis. In addition, transport mechanism was investigated by measuring of vertical profiles of flow, suspended sediment concentration and floc size using CTD, ADCPs, LISST and floc camera during wet and dry seasons. The construction of the dam caused significant impact to the Yeongsan estuary by blocking estuarine circulation and reducing tidal current velocity. Moreover, the dam operation became the main controlling factor for the discharge and transport of freshwater and sediment. Most of the discharged sediments from the river were fine sediments in the form of flocs. The discharged fine sediments were transported in the surface freshwater layer above the stratification. The flocs settled down further offshore where stratification weakened, and returned landward by tidal currents, causing sediment accumulation near the estuarine dam. Consequently, the Yeongsan estuary underwent high rates of sediment accumulation up to 10 cm per year.

Keywords: Yeongsan estuary, altered estuary, freshwater discharge, floc, sediment flux, sediment convergence

Meteorological events and Flood control structures impact on sedimentation characteristics of a tropical estuary

JOSEPH SEBASTIAN PAIMPILLIL[1] AND BALACHANDRAN K.K.[2]

[1] Center for Earth Research and Environment Management, Cochin 17, India (psjoseph@eth.net)
[2] National Institute of Oceanography, Cochin 14, India

The human intervention contributing to flood problems in Vembanadu Lake are principally in the form of reclamation of wetlands, embankment construction and change in land cover/1anduse pattern. One of the largest flood control works is the Thottappali spillway to protect the Kuttanad area from the heavy floods, but is functioning with an insufficient drainage capacity. The largest mud regulator in India (Thannermukkom salt water barrier) is to prevent tidal action and control intrusion of salt water during the dry season into the Kuttanad low-lands across to bolster paddy cultivation. A comprehensive study explaining the characteristics and functions of this estuary was undertaken to understand varies processes in the lake to develop an ecosystem model. The tides in the estuary are of mixed semi-diurnal (M2), which progressively attenuated towards upper reaches. However, an unusual amplification of tides in the south estuary when the hydraulic barrier (Thanneermukkom) was closed and a similar amplification of the fortnightly constituent (Msf) in the south estuary when the barrier was open were observed. It was also found that, Vembanad Lake is very sensitive to meteorological events (winds and fresh water flow) and Lake Hydrology has at least three different zones (North, Central and South). The currents are generally dominated by semi-diurnal tides and play an important role in bed-load sediment transport. The slack water has important implications, as settling of finest sediments takes place at mid-tide. The particle trajectories and residual currents are used to classify the study region to: northern, central and southern estuary. The central estuary is dynamic and other two zones are relatively weak. Amplification of measured tides in south estuary during March indicates the presence of standing waves caused by the hydraulic barrier at Thanneermukkom. The model results suggest that northern and southern zones showing flow restrictions are sensitive to environmental pollution. The net movement of water has strong implication on dispersion of materials, which in turn, have a direct bearing on the ecology of the estuary. The currents are generally dominated by semi-diurnal tides, which result in more swift currents than diurnal tides and play an important role in bed-load sediment transport. These currents are strongly rectilinear with a slack water at each reversal of direction. This slack water has important implications in the estuary, as settling of the finest fractions of sediments takes place at mid-tide. Morphological history indicates that the estuary has a settling environment, as the sediments are shown to exhibit a low to moderate energy regime in areas away from the river mouths. The concept of different zones in the estuary will be useful to planners in protecting the vulnerable regions of this productive ecosystem from human interventions.

Keywords: Hydraulic barrier, estuarine zonation, impacts of Meteorological events

Impact of climate change on a tropical estuary in India

SHADANANAN NAIR[1]

[1] Nansen Environmental Research Centre (India) A6, Oxford Business Centre, Sreekandath Road, Ravipuram, Kochi-682016, Kerala, India (nair59@yahoo.com)

The Cochin estuary connected to the Arabian Sea in the south-western part of India faces serious challenges from the changing climate and increasing anthropogenic activities. Two major rivers and numerous canals carry large quantities of sediments, mostly polluted, threatening the existence of the major port and rich biodiversity. This region is economically important, highly productive and plays an important role as nursery grounds for many commercially important fishes. The region receives more than 300cm rainfall from monsoons and local systems. Steep slopes of the Western Ghats Mountains where the rivers originate allow the rainwater falling in their upper reaches to flow fast to reach the estuary in few hours, carrying tremendous sediment load. Rainfall in this region is becoming more seasonal and intense, causing more erosion and changes in the estuarine water characteristics. Large raindrops from convective clouds enhance erosion in the mountains where encroachment and deforestation have already degraded the soil. High rainfall seasonality results in reduced runoff for longer period, resulting in salinity intrusion far inland. The estuary as well as the city of Kochi surrounding it is threatened by sea level rise and changing tracks and intensity of tropical cyclones. Anomalies in SST and changes in coastal circulation affect the existence of habitats in the estuary. Impact of climate change on the estuary largely affects the life of thousands who depend on the estuary for livelihood and the fisheries that is vital in national economy. This paper assesses the impacts of climate change on the estuary and the associated environmental and socio-economic issues. Trends in climate and sedimentation have been analysed. A critical review of the existing acts, policies and strategies related to estuaries and coastal zones have been made. Guidelines for an appropriate policy and adaptation strategy have been provided.

Keywords: estuary, Cochin, climate change, biodiversity, sea level, policy

River controls on large scale fluvio-deltaic morphodynamics: a numerical study

LEICHENG GUO 1, QING HE[1], VAN DER WEGEN MICK[2, 3], DANO ROELVINK[2, 3, 4]

[1] State Key Lab of Estuarine and Coastal Research, East China Normal University, China (leicheng120@126.com)
[2] UNESCO-IHE, Delft, the Netherlands
[3] Deltares, Delft, the Netherlands
[4] Faculty of Civil Engineering and Geosciences, Delft University of Technology, Delft, the Netherlands

River flow is one of the main primary forcing (others include tides and waves) controlling estuarine and deltaic morphodynamic development (Galloway, 1975). It is empirically known that a high river (and associated sediment supply) can lead to infilling of estuarine bay and formation of fan-shaped or bird-foot shaped deltas based on extensive field survey. However it is insufficiently understood how a river discharge of varying magnitude has effects on estuarine/deltaic morphdoynamics. Thereby this study uses a process-based morphodynamic model (Delft3D) to simulate long-term (millennial) morphodynamic development of a large-scale fluvio-deltaic system under varying river and tide conditions. The model couples water motion-sediment movement-bathymetric updating and long-term simulation is assisted by a morphological acceleration technique which bridges the time scale gap between hydrodynamics and morphology (Roelvink, 2006). A series of scenarios forced by river discharge varying between 0 and 80,000 m3/s is constructed to examine the sensitivity. The model results show fascinating morphodynamic development under varying river discharges and in-depth analysis suggests that river flow magnitude has effects on channel pattern (meanders followed by distributaries in the seaward direction), mean depth and tidal flat development. An intermediate river discharge is found to induce larger channel depth than a lower or higher river discharge. These numerical experiments, though in schematized configuration, shed lights on morphodynamics of river- and tide-controlled estuary or delta systems.

Keywords: Estuary, Delta, Morphodynamic, Modeling, River flow

Behavior characteristics and ecological functions of trace mentals in the Yangtze River Estuary and its adjacent waters

XIAODAN WU[1], TIEGANG LI[1], JINMING SONG[1], XUEGANG LI[1]

[1] Institute of Oceanology, Chinese Academy of Sciences, Qingdao, 266071, P. R. China (xdwu@qdio.ac.cn)

Dissolved trace metals (Se, Te, As, Sb) in Yangtze River Estuary and its adjacent waters were determined to examine the content level and distribution profile to distinguish the source and behavior and to identify the hydrographic, chemical and microbial processes. Results showed that: (1) concentrations were in the medium level, which did not exceed the given threshold. High concentration was observed along the west coast where is influenced by terrestrial runoff from Yangtze River, Qiantang River and Zhejiang Coastal Current. With the moving of shelf front towards the open sea, concentration decreased gradually and then increased and stratified in the west side of continental shelf where the Kuroshio Current and Taiwan Warm Current reached; (2) Se(IV) and Te(IV) behaved conservatively in the whole investigated area. Se(VI) and Te(VI) had conservative behavior when salinity is lower than 30. Yet, due to the incursion of Taiwan Warm Current, the deposition of organic material and the release of sediment, there was obvious adding for Se(VI) and Te(VI) in high salinity waters. As(III) and As(V) exhibited non-conservative behavior but oppositely Sb(III) and Sb(V) behaved conservatively in the estuary; (3) Se(IV), Te(IV) and Sb(III) can be desorbed from suspended particulate material and dissolved in the water column. Differently, As preferred to be adsobed, especially in the higher temperature and pH condition. As essential elements, Se and As certainly related to P in our study, manifesting the competition in being ingested by phytoplankton and the involvement in the biological cycle. As non-essential elements, rather surprising, Te and Sb been exceptionally displayed the nutrition effect as well, indicating great biological potency and potential. Particularly, Te related closely to P competed to N. However, Sb behaved like both N and P.

Keywords: Dissolved trace metals, Yangtze River Estuary, content level, distribution profile

Geological-geotechnical Correlation in Subsurface Characterization for Saigon-Dong Nai Delta, Vietnam

P. H. GIAO[1], T. T. THOANG[1] AND N. T. DUNG[2]

[1] Asian Institute of Technology, Bangkok, Thailand
[2] Dong-A University, Busan, Korea

Saigon-Dong Nai delta is adjoining the Mekong delta. Although it is much smaller in size comparing to the latter this delta plays an important role in development of Southern Vietnam as it hosts the biggest city of the country, i.e., Ho Chi Minh city, and its strongly industrialized and urbanized vicinity. In this study, construction of a computer-aided database of subsoil profile underlying the delta will be introduced. Main subsoil layers are geotechnically characterized. And in particular, a corrrelation between geological formations, seidmentary cycles and geotechnically-characterized subsoil layers was attempted. The results of this study are useful for infrastructure development of the HCMC city as well as for a study on the effects of groundwater exploitation and lad subsidence on the major constructed works such as hi-rises, MRT systems, roads and highways etc. in the context of the sea level rise.

Architecture of a Tidally Influenced Proterozoic Mixed Siliciclastic-Carbonate Ramp, Simla Group, Western Lesser Himalaya, India

ANANYA BISWAS[1], T.BANERJEE[1], PRIYANKA MAZUMDAR[1], ALONO THORIE[1]

[1] Department of Earth Sciences Indian Institute of Engineering Science & Technology, Shibpur, India (ananyageol@gmail.com)

Reports of accumulation of petroleum in different Proterozoic basins around the globe have inspired geoscientists to investigate the Proterozoic sedimentary basins in light of sedimentation modelling and sequence stratigraphy to assess the hydrocarbon prospects of the basins. Many of the Proterozoic basins in India are still awaited to be modelled and assessed for their hydrocarbon potentiality. The Proterozoic Simla Group of the western Lesser Himalaya, India deserves attention in this regard.

The Simla Group is characterised by a 1500m thick coarsening-upward clastic succession which bears the impress of a mixed siliciclastic-carbonate ramp topped by a regressive succession of fan-delta deposit, pronounced in the middle part of the Simla. The Simla sequence is divisible into the lower Basantpur, middle Chaaosa and upper Sanjauli Formations. Outcrop based facies analysis of the Basantpur Formation reveals deposition of a distally steepened carbonate ramp, where outer, mid and inner ramp sub-environments were identified. The outer ramp is characterized by oolitic grainstones, calcareous black shale, black shale and calcareous debrites. Mid ramp is characterised by low-energy facies affected by minor storms with abundance of fenestra fabric in dolomudstones. Inner ramp is predominant and characterized by tidal flat facies (heteroliths of limemud-dolosiltite-siltstone, flaser lenticular bedded dolosiltite) dissected by tidal channels and abundance of algal mounds. This transition from inner-mid to outer ramp is marked by a distinct slope break thereby characterising a distally steepened ramp.

Development of Highstand Systems Tract (HST) and Transgressive Systems Tract (TST) at two different stages of sea-level fluctuations has been identified. HST developed during sea level highstand condition and comprises the mixed siliciclastic ramp sequence whereas development of TST comprises a pure carbonate platform, which developed during relative sea level rise. The mid-Simla fan-delta siliciclastics cap the carbonate ramp due to normal regression and develops a Regressive system tract (RST).

Keywords: distally steepened carbonate ramp, Transgressive Systems Tract, Highstand Systems Tract

Silurian Tidal Littoral Depositional System And Hydrodynamic Characteristics In Northern Tarim Basin

ZHANG RONGHU, ZHANG HUILIANG, ZENG QINGLU AND CHEN GE

[1] Petrochina Hangzhou Research Institute of Geology, Hangzhou, China (zrh_hz@petrochina.com.cn)

The Silurian of Tarim Basin , with area of 236000 km2, oil and gas resources of 598 million tons, and sphalt sandstone area of about 15100 km2, is one of the most important marine clastic rocks exploration object. The paper was based on the digital outcrop, drilling and seismic data, comprehensive research of lithofacies palaeogeography , and showed that : Lower Silurian Kepingtage formation developed tidal flat-coastal sedimentary system controlled by paleogeomorphy in northern basin, which had nearly thousand kilometers ancient coastline from east to west. Ancient coast outward which had high energy wave action, developed foreshore, flushing and shoreface low angle wash and cross-bedding coastal sand bar, with single sand body thickness of 1.2-4m, high sandstone composition and structure maturity, fine quartz sandstone, silt-fine lithic quartz sandstone, such as YingMaiLi, Hala Ha Tang area. Ancient coast inward , gulf area which had weak energy wave action, developed high mud cuttings or boulder clay content in sandstone, with low composition and structure maturity, single sand body thickness of less than 1m, such as YueNan area. Ancient coast flat area which had tidal action, developed vertical multiphase channel sand body superimposed , with scour surface and bedding boulder at the bottom , Bidirectional, tabular cross bedding in the middle, intertidal mudflat lenticular or ripple bedding in the Upper part, single sand body thickness of 0.6-2.7m, such as KePing area. Coastal sedimentary system with stable sand distribution, large thickness, good reservoir qualities and weak heterogeneity, are favorable for oil and gas accumulation and exploration in the area.

Keywords: the Tarim basin, TaBei area, silurian, depositional systems, hydrodynamic conditions.

The diversity of tidal flats in Western Australia reflecting climate setting, hinterland setting and provenance, environmental setting, sediment variability, and oceanography

V SEMENIUK[1]

[1] Wetlands Research Association, 21 Glenmere Rd, Warwick, 6024, Australia (wra@iinet.net.au)

The coast is one of the most complex environments on the Earth's surface, being a zone of intersection and interaction of land, sea, groundwater, and atmosphere and the processes therein, and carries processes and products that are either not present or only weakly developed elsewhere. In this context, tidal flats with their low gradients provide a template where gradations in energy, oceanographic processes, grainsize partitioning, hydrochemistry, diagenesis, habitat differentiation, biota zonation, and effects of biota in terms of sedimentary structures, and contribution to sediments as particles, are amplified and made more evident. Tidal flats provide scope for much coastal diversity responding to their climate setting, hinterland setting and provenance, environmental setting, sediment variability, and oceanography. Climate influences waves, wind, cyclones, and efficency of mud transport, as well as biological effects on sediments (e.g., tropical mangroves and benthos versus temperate climate biota). Hinterland setting and provenance determine the coastal types and landform settings for tidal flats, e.g., ria coasts, estuaries, coastal plains, and deltas.

As coastal Western Australia traverses various geological provinces and coastal forms from rias and gulfs, to barriers, and estuaries, various climates from tropical humid to tropical arid, subtropical arid, and temperate humid, and environments that are selectively wave-dominated, tide-dominated, or mixed wave- and or tide-dominated, it contains a wide variety of tidal flats morphologically, sedimentologically, and stratigraphically. They vary on the bases of type of hinterland, oceanography, terrigenous versus carbonate sediments, tidal range, tropical versus temperate sedimentary and diagenetic processes, tropical versus temperate biota, and region-specific stratigraphic packages. This paper examines and compares thirty types of tidal flats along coastal Western Australia in terms of their environmental setting, sediment types, biota, and stratigraphy from the tropical humid northern part of the State, to the arid central west coast, to the temperate humid southern coast.

Keywords: tidal flats, climate, oceanography, geological setting, coastal setting, sediments, stratigraphy, Western Australia

Controls on the spatial and temporal variability of point bar architecture in the fluvial-tidal transition, lessons learned from modern (Korean tidal flats and Sittaung River, Myanmar) and ancient (Neslen Fm., Utah, USA and McMurray Fm., Alberta, Canada)

KYUNGSIK CHOI

[1] School of Earth and Environmental Sciences, Seoul National University, South Korea (tidalchoi@snu.ac.kr)

Inclined heterolithic stratification (IHS) forms in the point bar of a meandering channel along the fluvial-tidal transitions of deltas and estuaries. In the fluvial and tide-influenced fluvial channels where unidirectional flows retard and accelerate due to tidal backwater effect and tidal drawdown, IHS consists of sand beds formed during river floods and mud beds formed during waning floods. Non-tidal dune-trough muds may form at the lower part of IHS during low discharge period or dry season. In the tide-influenced fluvial channels where current reversal occurs, tidal signatures can be preserved in the more extensively developed dune-trough muds during low discharge period and mud beds of IHS during high discharge period. In the seaward tide-dominated channels with strong rectilinear currents, IHS contains more tidal bedding than seasonal bedding. The thickest and most extensive mud beds occur within turbidity maximum zone. The continuity of IHS are influenced by the intensity and timing of wave and rainfalls. Wave becomes effective in a wider tidal channel at high tide, when combined with tension cracks or desiccation cracks on the oversteepened bank surface, producing bank-normal discontinuities of IHS. Waves also facilitate bank erosion in the fluvial and tide-influenced fluvial channels during peak flood stage when strong winds commonly blow. Heavy rainfall triggers rill erosion in the fluvial and tide-influenced fluvial channels during waxing floods and in the tide-dominated channels during low tide. Rainfall is responsible for the along-bank discontinuities of IHS. IHS fines upward regardless of tidal influence. Downstream fining is notable along the meander bend of a river-dominated channel, especially where the channel migrates by downstream translation due to its proximity to a valley wall composed of basement. A counterpoint bar is likely to develop in the area. Downstream fining becomes indistinct seaward as flood currents become stronger. Instead, fining near the bend apex is obvious in the tighter meander bend of tide-dominated channel where flow separation takes place over the shoaling area by mutually evasive tidal currents. Observations of modern and ancient deposits indicate that facies and stratigraphic architecture of IHS in the transitional environments of deltas and estuaries varies spatially and temporally in response to relative importance of river and tidal currents, wind-induced waves, the intensity of rainfalls and antecedent basement topography.

Keywords: fluvial-tidal, channel, inclined heterolithic stratification, point bar, architecture

Point-bar morphodynamics and hydrodynamics in a macrotidal channel, Gomso Bay, west coast of Korea: their impact on the stratigraphic architecture of channel and abandoned channel-fills

JIHYE JEON[1] AND KYUNGSIK CHOI

[1] School of Earth and Environmental Sciences, Seoul National University, South Korea (blackshale@snu.ac.kr)

Morphodynamics and hydrodynamics of tidal channels in macrotidal Gomso Bay were investigated to understand the architecture of inclined heterolithic stratification (IHS) and facies formed in a tide-dominated channel. Channel sinuosity increases notably during summertime rainy season, when abrupt morphologic changes such as meander-bend cutoff by chute channels take place. Bend-apex trajectory transforms mainly by expansion and rotation with minor downstream-migration. Point bar migrates in response to seasonal monsoon-driven discharge fluctuation and to lesser degree tidal cycles. IHS of point bar consists of monsoonal and fair-weather layers. The former is characterized by greater thickness and sand/mud ratio, more ebb-dominance and less common counterintuitive relationship between bedforms and IHS than the latter. Abandoned channel fills are composed of IHS formed during early stage and rhythmic beddings deposited during late stage. Stratigraphic architecture of abandoned channel fills is strongly influenced by the rainfall and the dip azimuth of active channel point bar as well as tidal asymmetry. The presence of rill channels adds architectural complexity along the path of abandoned channel fills.

Keywords: macrotidal meandering channel, channel migration, meander-bend cutoff, hydrodynamic, inclined heterolithic stratification (IHS), abandoned channel fill

Spatial and temporal variation in erosion and accumulation of the subaqueous Yellow River delta (1976-2004)

NAISHUANG BI[1], GUOPAN XING[1], HOUJIE WANG[1], ZUOSHENG YANG[1], YOSHIKI SAITO[2]

[1] College of Marine Geo-sciences, Ocean University of China, China (binaishuang@ouc.edu.cn)
[2] Geological Survey of Japan (GSJ), National Institute of Advanced Industrial Science and Technology (AIST), Japan

Yellow River Delta (YRD), one of the most heavily human-influenced delta systems, had dramatic changes since 1976. The erosion and accretion pattern of the subaqueous YRD was delineated by 1) the northern abandoned delta lobe, consisted of the heavily eroded Diaokou and Shenxiangou lobes; 2) the active delta lobe, comprised of Qingshuigou (QSG) and Q8 lobes and featured with fast progradation; 3) the Laizhou Bay (LZB) with slight accumulation. Three stages were summarized based on the evolution of the northern abandoned delta lobe. During 1976-1980, the northern abandoned delta was severely eroded due to the cutoff of sediment supply. As the subaqueous slope became gentler during 1980-1996, the deeper part of the subaqueous delta turned into slight accretion state while the shallow part continued to be eroded. However, the erosion rate of the northern delta slowed down during 1996-2004. Meanwhile, the development of the active delta lobe was a product of riverine sediment supply, channel geometry and estuarine hydrodynamics. Multi-depocenter was formed along the coastal area of the active subaqueous delta during 1976-1980, when multiple channels were active for sediment transportation. As the main river channel developed, the depocenter progradated eastward with an exceptional high accumulation rate during 1980-1985. The progradation direction turned southeastward with a lower accumulation rate during 1985-1996. Then, the depocenter shifted to the newly formed Q8 river mouth after a channel diversion in 1996, leaving the QSG river mouth in severe erosion. The channel diversion also caused erosion at the offshore area in LZB, where slight accumulation dominated before 1996. The erosion and accumulation pattern of the subaqueous YRD showed significant spatial and temporal variability during 1976-2004. A comprehensive understanding of their driven mechanisms would be critical for the prediction of the evolution of the YRD in the context of global change.

Keywords: Yellow River Delta, erosion and accumulation, spatial and temporal variation, dominant factors

Uniqueness provenance proxy for the Changjiang(Yantze River) and Huanghe (Yellow River) sediments and its application to sediment supply to the East China Sea distal mud since the middle Holocene

ZUOSHENG YANG[1], BANGQI HU[2], SHUQING QIAO[3]

[1] Key Laboratory of Submarine Sciences and Prospecting Techniques, Ministry of Education, Ocean University of China, China (zshyang@ouc.edu.cn)

[2] Key Laboratory of Marine Hydrocarbon Resources and Environmental Geology, Ministry of Land and Resources, Qingdao Institute of Marine Geology, China

[3] The First Institute of Oceanography, State Oceanic Administration, China

Semi-quantitative estimation of calcite and dolomite percentages in the seven particle-size fractions (<2 μm, 2–4 μm, 4–8 μm, 8–16 μm, 16–32 μm, 32–63 μm, 63–125 μm) of 11 Changjiang (Yangtze River) and 12 Huanghe (Yellow River) sediment samples were calculated based on their x-ray diffractograms. The calcite and dolomite percentages in the <16μm particle-size fractions are 1% and 3% for Changjiang sediments, and 22% and 1% for Huanghe sediment. This large discrepancy of calcite and dolomite percentages in the fine sediments (<16 μm) was used as uniqueness provenance proxies of the riverine sediments to distinguish the fine sediment supplies from the Changjiang and Huanghe in Core B3 in the East China Sea distal mud (ECSDM) since the middle Holocene. Based on the dolomite/calcite percentages in fine fractions, the sediments in 6.8–0 kyr in Core B3 are most likely sourced from the Changjiang and Huanghe. Mixing curves of dolomite/calcite ratios reveal that the ECSDM continuously received the Changjiang sediment since 6.1 kyr with fluctuations, whereas the Huanghe sediment supply began in 6.8 kyr but abruptly stopped during 4.2–0.8 kyr and then appeared again since 0.8 kyr. The appearance of the Changjiang and Huanghe fine-grained sediment contribution to the ECSDM since 6.8 ky are closely related to the formation of modern oceanic circulation system in highstand stage. The abrupt disappearance of the Huanghe sediments in Core B3 at 4.2 ky is result of the northward shift of the lower Huanghe course due to the‘4.2 kyr’ climate event and the followed climate transition. Then the lower Huanghe course shifted back southward to the coast of the Yellow Sea due to the war in AD 1128–1855 and formed a large delta, which becomes the recent supplier of the fine Huanghe sediment to the ECSDM.

Keywords: sediment provenance proxy, Changjiang and Huanghe, calcite and dolomite, East China Sea distal mud, Holocene

Conservation of coasts of geoheritage significance in the Asian region using the Geoheritage tool-kit

M BROCX[1], V SEMENIUK[2]

[1] 1. Department of Science & Engineering, Murdoch University, South Street, Murdoch, 6151, Australia (wra@iinet.net.au)
[2] 2. Wetlands Research Association, 21 Glenmere Rd, Warwick, 6024, Australia

The coast is one of the most complex environments on the Earth's surface, being a zone of intersection and interaction between land, sea, groundwater, and atmosphere and the processes therein. It carries a multiplicity of processes and products at a number of scales that are either not present or only weakly developed on the land or in submarine environments. With other matters such as lithology, structure, or geological framework being equal, the various processes at the coast generally result in greater geodiversity than elsewhere. As with other environments, the complexity and geodiversity developed along the coast are variable according to parent rock types, sediments, and other materials, biodiversity, hydrochemical effects, diagenesis, and variable according to environmental setting and climate. As such, the coastal zone presents complicated products of erosion, sedimentation, biogenesis, and diagenesis, and well-exposed wave-washed, sediment-scoured, and salt-weathered rock sequences. With its complexity and variability, the coastal zone lends itself to developing principles, classifications, and procedures for geoconservation and geoheritage.

For purposes of geoheritage assessment, coastlines can be initially classified into one or more of four categories: (1) Reference coasts, (2) Culturally and Historically significant coasts, (3) Geologically historically significant coasts, and (4) Coasts where modern processes are active. Coastlines can be evaluated/assessed as being of international, national, State-wide to regional, or local significance, and assessed at a various scales (e.g., small scale stromatolites of Shark Bay, or the large-scale Mississippi River birds foot delta). Because they transcend diverse geological regions, numerous climate zones (from tropical to artic, and humid to arid), encompass large tracts that are rocky and erosional versus sedimentary and depositional, and front various oceanographic and coastal settings (from macrotidal to microtidal, from wave-dominated to tide-dominated to protected, to wind-dominated), coasts present a plethora of geologically significant types: e.g., various types of deltas, the diversity of estuaries, the vast variety of rocky shore types variable lithologically and geomorphologically, barrier coasts, and so on. However, to date, not enough attention has been paid to the diversity of coast types as reflective of the diversity of the Earth sedimentologically, geomorphologically, lithologically, biogenically, and diagenetically as expressed at the coast as a basis for geoconservation/geoheritage. This is very relevant to the Asian coastal systems. This paper seeks to highlight the geoheritage and geoconservation attributes of Asian coasts by systematically applying a method, termed the Geoheritage tool-kit, that identifies, categorizes,, and comparatively evaluates the coasts for purposes of recognising sites for geoconservation and geoheritage.

Keywords: coasts, coastal geoheritage, coastal geoconservation,, Geoheritage tool-kit

Measurement of the detailed evolution of the beach profile and evaluation of morphology change prediction models

BINGCHEN LIANG[1], J. WANG, Z.T. YANG, Z.Y. XU AND D.Y. LEE

[1] Ocean University of China, Qingdao, China (bingchen@ouc.edu.cn)

We have obtained the detailed time and space evolution of bottom bed profile together with water surface elevation using side-looking videos in addition to many in situ. sensors for 60 different cases at 2-D wave flume experiment. The characteristics of time and space variations of the beach profiles for different environments were investigated. Equilibrium beach profiles for the outer surf-zone, inner surf-zone and swash-zone were estimated and the different methods of estimation of sediment flux were tested and evaluated.

Different processes driving on-shore and off-shore sediment transport are evaluated using the laboratory experiment data. Numerical simulations of cross-shore sediment transport and prediction of beach profile change are compared with the laboratory experiment data. Improvement of the morphology prediction model is suggested for the practical simulation of long-term morphology change.

Keywords: laboratory experiment, beach profile, sediment transport, morphology model

Strategies to combat coastal erosion and inundation In vulnerable low deltaic coastal plain

OTTO S. R. ONGKOSONGO[1]

[1] Member, National Water Resources Council of Indonesia (DSDAN), Representing Indonesian Association of Geologists (IAGI) (ottoongkosongo@yahoo.co.id)

World populations are becoming more concentrated in coastal areas and closer to the coastlines, including in deltaic regions. Many parts of the coasts, more likely in low deltaic coastal plain, in addition to the existing permanent and intermittent wetland, have low elevation and hence very vulnerable to coastal erosion and inundation, particularly during high water level from rivers as well as during extreme high tide. Global warming and climate change that induces sea level rise will subsequently and incrementally give more frequent and severe undesirable flooding and increase erosion rate impacts which will cause risks on environmental damages and more particularly the human living.

There are many studies to counter measure the negative unpleasant impacts in the forms of general conceptual designs. The Intergovernmental Panel on Climate Change (IPCC, 2000) proposed three adaptive responses, i.e. retreat, accomodation and protection. The Eurosion Consortium which was managed by the Directorate General of Environment of the European Commission (Eurosion 2004) proposed the five generic policy options including do nothing, managed realignment, hold the line, move seaward, and limited intervention. Then coming the USACE (United States Army Corps of Engineers, 2008) concept with the four adaptive responses compose of accomodation, protection, beach nourishment, and retreat.

This paper introduces and suggests the nine responses of Ongkosongo (2011) which compose of practically do nothing, escape (give-up), business as usual, adaptation (accomodation), modification or adjustment, protection, confrontation (Dutch solution), nourishment (replenishment), and polder system, to be more deeply discussed and analysed.

Keywords: Coastal plain, erosion, inundation, sea level rise, strategy, combat

Study on chemical hydrography, chlorophyll-a and primary productivity in the Liaodong Bay, China

SHAOFENG PEI[1,2,3], EDWARD A. LAWS[4], SIYUAN YE[1,2,3], MARC T. KEMPER[4]

[1] Key Laboratory of Coastal Wetland Biogeosciences, China Geological Survey, China (peishaofeng@gmail.com)
[2] Function Laboratory for Marine Geology, National Oceanography Laboratory, China
[3] Key Laboratory of Marine Hydrocarbon Resources and Environment Geology, Ministry of Land and Resources, China
[4] Department of Environmental Sciences, School of the Coast and Environment, Louisiana State University, USA

A field study was carried out during 2013 in Liaodong Bay, China to determine the dynamics of the phytoplankton in the bay and the extent to which primary production in the bay was constrained by environmental factors. There was little or no evidence of limitation of phytoplankton production by nutrient concentrations at any of the sampling stations, with the possible exception of a few offshore stations where phosphate concentrations were less than 30 nM. This assessment was consistent with the results of nutrient enrichment experiments, the values of light-saturated photosynthetic rates, and comparisons of areal photosynthetic rates in the bay with rates off the mouth of the Mississippi River and at Station Aloha in the North Pacific subtropical gyre. Light-saturated photosynthetic rates normalized to chlorophyll a concentrations (P_M^B) were positively correlated with temperature at temperatures between 22.5°C and roughly 26–27°C but declined at higher temperatures. The estimated P_M^B values at all 66 stations averaged 10.7 ± 2.6 g C g^{-1} Chl *a* h^{-1}, and the corresponding light-saturated photosynthetic rates averaged 67 ± 42 mg C m^{-3} h^{-1}. Mean daily photosynthetic rates calculated with a depth-integrated model were 999 ± 796 mg C m^{-2}. Areal production in Liaodong Bay appears to be controlled by a combination of temperature and light limitation.

Keywords: nutrient, Chlorophyll *a*, primary productivity, phytoplankton, Liaodong Bay, Liaohe River

Fates of river-derived sediments to the East Asian marginal seas: large vs. small rivers

PAUL LIU[1]

[1] Dept. of Marine, Earth and Atmospheric Sciences, North Carolina State University, Raleigh, NC 27695 USA (jpliu@ncsu.edu)

Collectively, Asian large rivers (e.g. Yellow, Yangtze, Pearl, Red, Mekong, and Ganges-Brahmaputra, etc) and many small mountainous rivers (e.g. rivers in Taiwan, Indonesia, and Papua New Guinea, etc) discharge at least 70% of the global river derived sediments to sea.

Recent studies of the Asian large river systems (Yellow, Yangtze, Pearl, Red, and Mekong) indicate that more than 30% of river-derived sediments (mainly silt and clay) have been transported several hundred kilometers away from their river mouths along the shore, with very limited across-shelf transport or distribution. Alongshore transport and deposition, usually occurs within 60 – 70 m water depth, and are mainly controlled by local waves, tides and prevailing coastal currents during the winter season. There is very little or few percent of the total sediment discharge has been found to transport directly into the deep ocean.

In contrast, small rivers, like the Choushui, Lanyang and Kaoping in Taiwan, have dominant sand and bedload fractions, and are usually delivered during severe summer weather events, like typhoons. We found that poorly-sorted, sand-dominated riverine sediments from small mountainous rivers deposit mainly near the river mouth and are further transported across shelf, and some could go down to the shelf edge or canyons, with no major longshore transport or distribution.

Keywords: river, sediment, delta, longshore transport, depocenter, fate

Wave-driven sediment suspension during slack in the tidal channel of Gangwha tidal flat, Korea

GUAN-HONG LEE[1] AND KIRYONG KANG[2]

[1] Department of Oceanography, Inha University, Incheon, Korea
[2] National Typhoon Center, Korea Meteorological Administration, Jeju, Korea

Tidal flats of Incheon, Korea are located off the coast of the Han River mouth. The extensive macrotidal mud flats, for which tidal range exceeds 9 m, are unique in that freshwater discharge during the summer wet season influences the region, while strong waves dominate resuspension and transport processes during winter. A field campaign initiated to better understand imparting influences of these processes and a benthic pod was deployed in a tidal channel in Southern Gangwha tidal flats during November, 2006 and Septermber-October, 2007. Instrumentation on the pod includes one Acoustic Doppler Velocimeter, one Acoustic Backscatter System, and two Optical Backscatter Sensors. During the normal conditions, sediment suspension mainly occurred during the accelerating phase of flood and ebb. Thus, sediment flux is directed landward over a tidal cycle. On the other hand, when waves were stronger, wave-induced shear appeared to support sediment suspension even during the slack after the flood. The sediment flux under strong waves is offshore due to high flux right after the high slack. Considering that high waves occur only about 2% of time over the year, this mechanism of sediment flux is responsible for long-term accretion of Gangwha tidal flats.

Keywords: waves; sediment suspension; tidal flat; Gangwha

Anthropogenic impacts on suspended sediment dynamics near the tidal power plant

H.K. HA[1], J.W. KIM[1] AND S.B. WOO[1]

[1] Department of Ocean Sciences, Inha University, Incheon, Korea (hahk@inha.ac.kr)

The spatial and temporal variations of suspended sediment concentration (SSC) were investigated to understand the anthropogenic impacts of discharge in the world's largest Sihwa tidal power plant (STPP). Two mooring deployments were conducted near the STPP. Each mooring system was equipped with acoustic Doppler current profilers, sensors of Conductivity-Temperature-Depth and optical backscatter sensor, which were used to measure the velocity profiles, temperature, salinity and turbidity. Results showed the significant differences in velocity and SSC between the short-term (flood vs. ebb tides) and long-term (spring vs. neap tides) time scales. The artificial discharge from the STPP during the maximum of ebb tides produced the strong currents resulting in the instantaneous high SSC (70-2,000 mg/l) from the seabed. During the slack tide, the velocity was weakened and SSC rapidly decreased (20-60 mg/l). At the beginning of flood tide, the velocity slowly increased and the SSC showed the significant peak until maximum of flood tides. During the spring tide, the background of SSC was relatively high (15.8-26.4 mg/l) due to the strong water exchange from the STPP, whereas during the neap tide, it was low (6.8-11.6 mg/l). Mooring results suggest that the interaction of artificial discharge and tidal modulation is the most important controlling factor for determining SSC and associated sedimentary processes in the vicinity of STPP.

Keywords: Sediment transport, suspended sediment, artificial discharge, tidal power plant

Estimation of siltation rate in the Incheon North Harbour, Korea

YOUNG TAEG KIM[1], GUAN-HONG LEE[2], HYUN-JUNG SHIN[2], SOONGJI LEE[2], KUKJIN KIM[3], TIM DELLAPENNA[4], JOSH WILLIAMS[4], HO KYUNG HA[2], AND JAE IL KWON[5]

[1] Ocean Research Division, Korea Hydrographic and Oceanographic Administration, Korea (kyt5824@korea.kr)
[2] Department of Oceanography, Inha University, Incheon, Korea
[3] Ocean Research and Strategy Corporation, #1108, Halla Sigma Valley, Gasan-Dong, Seoul 153-760, Korea
[4] Department of Marine Sciences, Texas A&M University, Galveston, TX, 77554, USA
[5] Korea Institute of Ocean Science and Technology, Korea

The construction of the North Harbour, Incheon, Korea was initiated on the macro-tidal flat from 1997 and completed in 2012. The tidal flat was 2 m high above the ALLW (Approximately Lowest Low Water) before the construction, while the planning depth for the navigational safety was designed -14 m below ALLW. The dredging has been periodically performed to maintain the safe nautical depth of -14 m. As part of efforts to reduce the siltation in the North Harbour of Incheon, sedimentation rate was estimated using four hydrographic sheets (1959, 1990, 2006, and 2013) of Korea Hydrographic and Oceanographic Administration, and amounts of dredged volume obtained from Incheon Regional Oceans and Fisheries Administration. Two gravity cores were also obtained for the accurate siltation estimates. For deeper insight of siltation mechanism in the North Harbour, two ADCPs were deployed at the entrance and inner harbour over a month to measure profiles of flow velocity and suspended sediment concentration. In addition, two CTD surveys were performed twice over 13 hours at two ADCP stations. The CTD survey included OBS, LISST and water sampling at three vertical layers (surface, middle and bottom). The calculated sedimentation rates by two different methods agreed well each other and have a wide range between 20 cm/y at the inner harbour and about 100 cm/y at the harbour entrance. It is inferred that the net horizontal entrainment of the suspended sediment into the harbour occurs more dominantly at the harbour entrance than the inner harbour, resulting in the high siltation at the harbour entrance. On the other hand, the high resolution EFDC numerical model shows the clockwise eddy during the flood in spring tide, which is responsible for the high siltation at the harbour entrance.

Keywords: harbour siltation, dredging, sedimentation rate, North Harbour, Incheon

Influence of waves and currents on sediment erosion and resuspension：An analysis based on in-situ observation

CHAOQI ZHU[1], YONGGANG JIA[1,2*]

[1] Department of Environmental Science and Engineering, Ocean University of China, Qingdao, 266100, China (yonggang@ouc.edu.cn)

[2] Key Laboratory of Marine Environment & Ecology, Ministry of Education, Qingdao, 266100, China

The mechanism of sediment erosion has been investigated at a site in the Baisha Bay, China featured by a bad-graded sand bed. The wave elements, tide level, velocity and direction of the currents, seabed height variation, as well as the temperature were measured by submarine in-situ tripod system in winter. During the observations, waves and currents both lead to erosion and sedimentation, but of which, erosion is the main process. Meanwhile, observation results and bottom shear stress analysis both show that the wave is the major influencing factor in the observing site. Sediment erosion is not only related to the bottom shear stress, duration of wave action, but also the sediment compactness. The sediment is eroded during flood tides and deposited during ebb tides. The dynamics of sediment resuspension have been studied in the Chengdao seas of the Yellow River subaquatic delta featured by a slity bed. The waves, tides, currents, suspended sediment concentrations, pore water pressure, seabed height variation, as well as the temperature, salinity were measured for 4 months. The results show that wave height, current velocity and the suspended sediment concentration rise synchronously. After rising, the wave height falls sharply and stays low(~1m); current velocity falls and fluctuates in a certain range(10-40cm/s); suspended sediment concentration decreases with fluctuation.

Keywords: sediment erosion and resuspension, submarine in-situ tripod system, bottom shear stress, waves and currents

A Modelling Study of Seasonal Variation of Suspended Sediment Transport in the Changjiang Estuary

LEI ZHU[1], QING HE[1], JIAN SHEN[2]

[1] State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai 200062, China, (qinghe@sklec.ecnu.edu.cn)

[2] Virginia Institute of Marine Science, College of William & Mary, Gloucester Point, VA 23062. US

Based on the Environmental Fluid Dynamic Code (EFDC) model, a 3D hydrodynamic and sediment model was set up for the Changjiang Estuary (CJE) and its adjacent seas. The study focuses on cohesive sediment that consists of more than 90% of the total sediment in the CJE. Sediment module in the model included sediment transport, resuspension and deposition. The effect of flocculation was incorporaed into the settling process of cohesive sediment. The sediment model was validated with data from eight monitoring stations located in the estuary and the model resutls agreed well with the observations. The results reveal that the suspended sediment concentration (SSC) in the inner estuary has a significant seasonal variation in response to seasonal cycling of sediment loading from river basin. While in the outer estuary, tide current plays a dominant role for modulating resuspension and transport of sediment. Relatively high SSC can be observed in Hangzhou Bay and the southern portion of the CJE, which is induced by high resuspension rate driven by strong tide current. The huge river flux in the summer months can significantly suppress the tide current in the outer estuary, which results in lower shear stress. Consequently, resuspension rate decreases and a lower SSC can be observed in the outer estuary during summer.

Keywords: Changjiang Estuary; Sediment model; Resuspension; Seasonal variation

The Sediment Transport in Western Bohai Bay Under the Influence of Coastal Reclamation

NIE HONG-TAO[1], YUAN DE-KUI[2], TAO JIAN-HUA[2]

[1] School of Marine Science and Technology, Tianjin University, 300072, China
[2] Department of Mechanics, Tianjin University, 300072, China

Bohai Bay is located in the west of Bohai Sea, China. Nowadays the region around Bohai Sea has become a new economic development hotspot area of China. Therefore, many exploitation projects have been carried out or will be carried out along the coastline. Under this circumstance, it is of great practical significance to study the sediment transport in the Bohai Bay, because a) The sediment transport is closely related to the seabed evolution and the hydrodynamic characteristics; b) A number of contaminations are adsorbed on sediment and transport with the sediment; and c) with the re-suspension of sediment, the contaminations adsorbed on the bed sediment, such as heavy metal etc., will re-enter the water body and result in the secondary pollution.

The hydrodynamic and sediment transport models were applied to study the sediment transport in Western Bohai Bay. Two scenarios were set in the simulations to understand the impact of the high strength exploitation in recent years on sediment transport in the coastal zone of Bohai Bay.With the analysis of residual currents and deposition tendency and comparison of the field survey data of sediment radioactive isotope activities, the results show that: a) Both the numerical simulated results and the in situ investigation results of radioactive isotope show that the sediment in western Bohai Bay mainly transports in near shore and along the coastline. The sediment transport is significantly correlated with the vector distribution of residual currents. b) The trend of sediment transport to the open sea is not obvious. The main reason is that the shear stress threshold of sediment suspension rapidly increases with the increasing water depth, which results in most of the sediment deposition in the near shore area. This also indicates that the pollutants adsorbed on the sediment are easy to accumulate in the inshore area. c) The changes in geomorphology and coastal line caused by coastal zone development have resulted in some impact on sediment transport near the coastline, but the effect is not obvious in western Bohai Bay.

In-situ observations of bottom boundary layer in abyssal South China Sea

JINGPING XU[1], JIANRU LI[2], YANWEI ZHANG[2], YULONG ZHAO[2], ZHIFEI LIU[2], JOANNE FERREIRA[3], GEORGE TATE[3]

[1] Ocean University of China, Qingdao, 266100, China
[2] Tongji University, Shanghai, 200092, China
[3] United States Geological Survey, Santa Cruz, CA 95060, USA

As part of the South China Sea Deep project, we deployed a free-ascending tripod (FAT) on the sea floor of northern South China Sea at a water depth of 1900 m. During the 5-month deployment, the tripod hosted a suite of acoustic and optical oceanographic instruments that simultaneously measured time-series of 3-D velocity structure of the near bottom flows, temperature and salinity, water turbidity (sediment concentration), and particle size variations. A camera system and an acoustic altimeter closely monitored any variation of the sea floor that could have resulted from either physical processes (erosion/deposition) or biological activities. Our goal of the tripod work, first-ever such study in South China Sea, along with several subsurface moorings that were also collecting flow and sedimentological data in the area, was to investigate the bottom boundary layer (BBL) processes and the regional deep current circulation surrounding a large body of sediment deposit whose formation mechanism and origins of sediment are still unclear. In addition, the tripod instruments were set up to capture the in-situ BBL signature of passing “benthic storms” that are believed to be the most important BBL processes. This presentation also includes a brief description of the technological advances implemented in the FAT deep-water tripod.

Architecture and Depositional Model of Deepwater Sediment Dispersal System from Pearl River Delta to Submarine Fan, northern South China Sea

XINONG XIE[1], KAINAN MAO[1], HESHENG SHI[2], HUI CHEN[1] AND NANYAN CAO[1]

[1] Faculty of Earth Resources, China University of Geosciences, Wuhan, 430074, China (xnxie@cug.edu.cn)
[2] China National Offshore Oil Shenzhen Ltd. Corporation, Guangzhou, 510240, China

The Pearl River is believed to be as an important sediment source since the Oligocene in the northern continental margins of South China Sea, whose sediments have been transported from the onshore delta to the ocean basin by a sediment dispersal system, known as the Outer Pearl River canyon. The submarine sediment dispersal system is developed in the continental slope located in the Baiyun sag and the Panyu Low High. The slope canyons or channel complexes are deposited in the upper and medium slope. Submarine fans are deposited in the lower part of continental slope or abbysal plain between the Northwest and Central sub-basins. Three evolutionary phases of the Outer Pearl River canyon were classified since Early Miocene. ① During the early stage (23-21 Ma), the system is dominated by the submarine fan deposits. The shelf-marginal delta was developed and reached to the upper continental slope. Submarine fan was developed in the Baiyun sag. Two small channels appeared between them in the lower slope area. ② During the medium stage (21-11.6 Ma), the system is dominated by shallow incised complex channel - submarine fan deposits. It is composed of channels complex in the upper slope, simple canyon in the medium slope and submarine fan in lower slope - abyssal plain. Only turbidities fans and some small channels on the surface of fans occurred since 21 Ma. Until the Middle Miocene (15.5 Ma), the Pearl River delta has shifted to the shelf away from the shelf break, shallow incised channel appeared in the slope. The sediment delivered from the shelf directly to the deep sea basin through these canyons and resulted in the large scale of a turbidite fans formation. ③ During the late stage (11.6-0Ma), the system is dominated by deep-incised canyon-submarine fan deposits, in which the Pearl River delta has shifted northwards and is far away from the continental slope due to the wider shelf developed. The system constitutes deep-incised complex channels in the upper slope, slope canyon in the medium-lower slope and submarine fan in the abbysal plain.

The research results indicate that the delta shifted northwards from the continental marginal delta to the onshore delta with the enlargement of shelf width. Associated submarine sediment dispersal system changes from shallow-incised channel to deep-incised canyon, especially in global persistent fall of sea level. Hence, the formation and evolution of the submarine sediment dispersal system are affected by sediment supply, sea level change and slope geomorgraphy.

Keywords: sediment dispersal system, slope canyon, channel complex, Pearl River delta, Pearl River Mouth basin

Establishment of basic data bases for the efficient simulation of the morphology change along the coast of the South China Sea

D.Y. LEE, H.J. GAO, X.J. LIU AND B.C. LIANG

[1] Ocean University of China, Qingdao, China (lidyoung@daum.net)

To build a practical system for the prediction of morphology change, we need to prepare well organized data bases and fast but accurate methods of the calculation of various environmental forcing such as wind, wave, tide and storm surge as well as sediment transport for the coastal waters. The sediment transport and morphology change models are based on some empirical relations which require field observation data. However, the use some information on the sediment transport and morphology change available in the past is discouraging because of lots of effort in preparing the input information for the hindcasting simulation.

By means of preparing the basic data bases from the long-term simulations of basic parameters needed in simulation of morphology change such as wind, wave, tide and storm surge in advance and developing methods of fast simulation of various parameters, these problems can be solved. Following the work on the Yellow Sea and East China Sea, long-term simulations of the waves, tides and storm surges along the coast of the South China Sea have been carried out in two modes: continuous simulation for 15 years and simulation only for severe typhoons for 65 years. From the simulation output of the large scale model covering all the South China Sea, coastal information along the coast of the South China Sea are obtained from the proper down-scaling and the results are organized as data bases to be used efficiently in the hindcasting of morphology change to make most of the available data in the past and also in the long-term prediction in the future. The refinement of the data bases and their applications will be also discussed at the meeting.

Keywords: morphology prediction, South China Sea, Long-term hindcast, data bases

Impact of the sediment dredging on the spatial and temporal variation of turbidity plumes

J.Y. SEO[1], H.K. HA[1], J.H. HWANG[2], J.H. IM[3], S.J. PARK[4], N.I. WON[5]

[1] Department of Ocean Sciences, Inha University, South Korea
[2] Department of Civil and Environmental Engineering, Seoul National University, South Korea
[3] School of Urban and Environmental Engineering, Ulsan National Institute of Science and Technology, South Korea
[4] GeoSystem Research Corporation, South Korea
[5] Korea Water Resources Corporation, South Korea

The dispersion of the turbidity plumes generated by offshore sand dredging using a trailing suction hopper dredge near the exclusive economic zone (EZZ) of the South Sea of Korea were observed with time following a dredging event on 19 May 2015. Sand dredging near the EEZ leads to resuspension and deposition of bed sediment, with both bottom and surface plumes having negative effects on the environment. The acoustic Doppler current profiler was deployed at about 85 m depth for 53 days to observe the temporal variability of acoustic backscatter from the turbidity plumes nearby the dredging site. The horizontal variation of turbidity plumes and their vertical profiles were measured by the satellite (Landsat 8) and optical backscatter sensor (OBS) at center of plumes, respectively. The acoustic backscatter represents that the relatively high density of turbidity plumes was generated while the dredging was being operated. The Landsat 8 imagery showed that the turbidity plumes stretched out laterally about 22 km. The turbidity concentration obtained by OBS casting revealed that the surface plume was 6 m thick and its concentration diminishing by about 80% at the end of plumes. The highest turbidity concentration was found throughout the water column within about 0.5 km from the dredge.

Keywords: dredging, turbidity plumes, acoustic backscatter, ADCP, OBS

Mechanism of submarine sediment re-suspension considering seabed dynamics

SHAOTONG ZHANG[1] XIAOLEI LIU[1] AND YONGGANG JIA[1,*]

[1]1Department of Environment Science and Engineering, Ocean University of China, China (yonggang@ouc.edu.cn)

Sediment re-suspension has always been an important content in the study of marine dynamic process. The most widely accepted view of its mechanism is that sediment particles are re-entrained away from the surface by the joint action of wave orbital shear stress and current induced shear stress. Different areas has its own empirical formula to calculate the observed shear stress and critical shear stress (Soulsby et al., 2005). These viewpoints are generally believed that the suspended sediments originate from the seabed surface. In recent years, our research team find that sediments are massively eroded and re-suspended in the Yellow River delta area, not only from the seabed surface stirred up by waves or re-entrained by currents but also from the under-component of the seabed via "pump action". Pump action corresponds to the process where soil particles inside the seabed are vertically transported against gravity and eventually get into the overlying water and become suspended materials. It can be divided into instantaneous pump and cumulative pump according to different drive mechanisms of transient and cumulative pore-water pressure. Previous research have shown that fine grained sediments could get away from the soil skeleton and suspended in the pore-water under the cyclic loading of wave action (Tzang, 1998). On the other hand, the accumulation of excess pore-water pressure along the depth presents a non-uniform accumulation rule of fast increase and slowly decreases (Yamamoto et al., 1978). Differential pore-water pressures at different depths inevitably lead to pore-water seepage inside the seabed, carrying the internal suspended soil particles migrate upwards. Laboratory flume experiment results show that sediment pumpage were positively correlated with wave height. Pump action contribution to sediment re-suspension under 15-cm wave height can reach up to 50%. We hope that our research could make some contribution to the research of the submarine sediment re-suspension mechanism.

Keywords: sediment re-suspension, pore-water pressure, under-component, Yellow River estuary

Numerical simulation of morphodynamics in an embayed beach, Haeundae, in Korea

JESEON YOO[1*], KIDEOK DO[1], JAE-YOULL JIN[1] AND HEE JUN LEE[2]

[1] Coastal Disaster Research Center, KIOST, Korea (jyoo@kiost.ac)
[2] Marine Geology & Geophysics Division, KIOST, Korea

There many embayed beaches encountered in Korea. Natural forcings acting on the beaches vary along the three sides around the Korea peninsula, due to considerably localized characteristics of the regional seas. In this study, an embayed beach named Haeundae Beach, which is located in the south-east corner of Korea, was investigated to understand morphodynamics inside the bay through numerical simulation of waves, currents and sediment transports. The Haeundae beach is characterized by a wide (~ 100 m), long (~ 1.5 km) and sand beach with a tidal range of about 0.7 m. The bay faces the south sea of Korea, and is therefore exposed to strong storms by typhoons in summer rather than the winterly north-easters. For this reason, this study was intended to quantify sediment transports inside the bay for a typhoon event in summer and for a storm event in winter, respectively, thereby, finding differences between the two cases. The numerical simulation was carried out using the Delft3D model, which is a three dimensional morpho-dynamic model. The morpho-dynamic model was coupled with a wave spectral model, SWAN. The Delft3D and SWAN models were simulated using three different sizes of grid scale in order to derive boundary conditions for the fine grid system from the larger local and regional grid systems. A storm event in late winter, i.e. early 2014, and a typhoon event in summer of 2014 were considered in the numerical simulations. During the periods of those events, hydrodynamic data and beach profile data were collected. The measurements were used to verify the numerical simulations. As a result, in the typhoon case, waves with wave height (Hs) of about 3 m coming from SSW predominate, inducing a strong east-directed alongshore sediment transport and a strong cross-shore sediment transport as well. This causes erosion in the western part of beach and accumulation in the eastern part. In the meanwhile, waves with Hs of ~ 1.5 m and wave direction from the east derive a strong westward alongshore current but a relatively weak cross-shore sediment transport compared to the alongshore one. The comparisons between the two cases also show that the typhoon event causes larger offshore sediment transports than the winterly storm event.

Keywords: embayed beach, beach morphology, numerical simulation, Delft3D

The experimental study on wave induced pore pressure response and intensity evolution of silty seabed

ZHENHAO WANG[1] YONGGANG JIA[1,2*] SHAOTONG ZHANG[1] LIN ZHANG[1] XIAOLEI LIU[1,2] HONGXIAN SHAN[1,2]

[1] Department of Environmental Science and Engineering, Ocean University of China, Qingdao, 266100, China (yonggang@ouc.edu.cn)

[2] Key Laboratory of Marine Environment & Ecology, Ministry of Education, Qingdao, 266100, China

This study investigated wave induced pore pressure response and seabed intensity evolution using the silty soil from the Yellow River delta area. Wave loadings of 5、10、15-cm wave height was successively applied on the seabed in this wave-flume experiment, pore pressure at different depths、penetration strength and un-drained shear strength of seabed were measured synchronously. Results show that pore pressure response inside the seabed experienced the process of rapid accumulation-slow dissipation-stabilization. There was a certain depth that always showing the strongest pore pressure response and accumulating the largest excess pore pressure. Intensity attenuation and structural failure of seabed originated right here; Arc shaped sliding surface inside the seabed would appear after a certain wave loading time , with the seabed above the it in different degrees of liquefaction oscillated with waves. A hard layer developed beneath the sliding surface and eventually resulted in significant strength heterogeneity of seabed. The sliding failure of seabed directly controlled the formation and evolution of the hard layer. When the ratio of excess pore pressure and overlying effective stress exceeded 0.5, penetration strength and un-drained shear strength of seabed would decrease significantly, even lead to sliding failure, it was caused by the joint effects of wave-induced shear force on the surface and pore pressure accumulation induced internal shear strength decrease inside the seabed.

Keywords: wave loading; wave-flume experiment; silty soil from the Yellow River delta; pore pressure response; soil intensity

Distribution of carbonate content and the abundances of major carbonate components in surface sediment from northern slope to the abyssal plain in the South China Sea: implication for carbonate dissolution and deep-sea sediment process

ZHANG JIANGYONG ZHOU YANG CHEN FANG GAO HONGFANG ZHANG XIN

[1] Key Laboratory of Marine Mineral Resources, Guangzhou Marine Geological Survey, Ministry of Land and Resources, China (zjy905@hotmail.com)

Both complex processes of deep-sea sedimentation and carbonate saturation state deeply influence the distribution of carbonate in the sea floor. By studying the distribution of carbonate content, the abundance of planktonic foraminireral shells, and the abundance of calcareous nannofossils in surface sediment from northern slope to the abyssal plain in the South China Sea, calcite lysocline is recognized to be located at about 3000m water depth, while calcite compensation depth located at about 3500m water depth or shallower. Planktonic foraminireral shells and calcareous nannofossils are generally the major components of the carbonate in the surface sediment, and both the logarithm of the abundance of planktonic foraminireral shells and the abundance of calcareous nannofossils have a linear relationship with the logarithm of the abundance of carbonate content. For the surface sediment with water depth less than 3000m, both the logarithm of the abundance of carbonate content and the logarithm of the abundance of planktonic foraminireral shells generally decreases with increasing water depth, while the abundance of calcareous nannofossils increase with increasing water depth. The changes of the abundance of planktonic foraminireral shells with water depth is probably effected by the dilution of dilution of terrigenous cohesive particles, but the calcareous nannofossils have a similar sedimentological behavior, and they often take part in flocculation and anti-flocculation within the benthic boundary layer, and tend to be richer in deeper water. With water depth increasing from about 3000m, carbonate disslution becomes a strong factor affecting the carbonate distribution, and in general, the decrease of the logarithm of both carbonate content and the abundance of planktonic foraminireral shells accelerates with increasing water depth, and much sediment disappear completely or has few calcareous nannofossils. However, not all carbonates in the surface sediment are dissolved completely, and some impact of bottom currents are recognized through the carbonate distribution in the environment seriously unsaturated respect to calcite. Especially, the high abundances of both planktonic foraminireral shells and calcareous nannofossils in the abyssal plain around ZhongShaBei ridge likely results from quick sedimentation of bottom currents. Much surface sediment with carbonate content less than about 2% has the features of poor in planktonic foraminireral shells and relative rich in calcareous nannofossils, that are probably related to huge size difference of these two calcite materials, the small calcareous nannofossils have far more chances to become permanent sediment.

Keywords: canbonate dissolution, processes of deep-sea sedimentation, abundance of planktonic foraminireral shells, abundance of calcareous nannofossils, South China Sea

Late Quaternary stratigraphy of Yeochari tidal flat, Gyeonggi Bay, west coast of Korea

KYUNGSIK CHOI[1] AND JOOHEE JO[1]

[1] School of Earth and Environmental Sciences, Seoul National University, South Korea (tidalchoi@snu.ac.kr)

Up to 50-m-thick sedimentary successions are developed in the Yeochari tidal flat, near the mouth of the Han River delta in the inner Gyeonggi Bay, west coast of Korea. Lying on the high-relief basement rock, they are divisible into Late Pleistocene unit and Holocene unit. Late Pleistocene unit contains a substantial volume of fluvial deposits that alternate with tidal deposits, reflecting frequent base-level changes. Fluvial deposits are composed of upwardly-fining, cross-bedded fine to coarse sands that are capped by pedoturbated, organic-rich floodplain muds. The late Pleistocene unit tends to be thicker at the basement topographic lows. Sequence boundary that separates the two units is highly undulatory and occurs 18 to 31 m below present mea sea-level. The Holocene unit consists of lower rhythmically laminated muds and upper rippled to laminated sands, forming an overall coarsening-up succession. Yeochari tidal flat experienced a rapid sedimentation (up to 10 cm/ month) coupled with low-energy condition during early Holocene (10~8 ka), which is followed by reduced sedimentation associated with high-energy condition during mid to late Holocene when sea-level reached present position. The lower Holocene unit represents transgressive systems tract, whereas the upper Holocene unit is regarded as highstand systems tract despite overall coarsening-up textural trend. The lack of accommodation space facilitated the progradation of tidal flats. Seismic and core data from the main distributary channel, Sukmo Channel, indicate that this channel has been infilling by the progradation of the tidal flats since mid Holocene. The coarse-grained nature of upper unit is the result of the landward migration of the main channel, which caused an increase of tidal and wave energy. Relative sea-level change, sediment supply and precedent basement topography exerted a key role in the partitioning of the late Quaternary deposits in the inner Gyeonggi Bay.

Keywords: Gyeonggi Bay, Quaternary stratigraphy, Holocene transgression, sea-level change, basement topography

The tide-dominated Han River delta, Korea

DON I. CUMMINGS[1], ROBERT W. DALRYMPLE[2], KYUNGSIK CHOI[3] AND JAE HWA JIN[4]

[1] DCGeo and Carleton University, Ottawa, Ontario, Canada. (cummings1000@gmail.com)
[2] Queen's University, Kingston, Ontario, Canada.
[3] Seoul National University, Seoul, Korea.
[4] KIGAM, Daejon, Korea

An extensive dataset (cores, seismic data) was collected by a government–industry consortium in the mid 2000s to study several ~25 km wide, ~100-km long, ~25 m high sediment fingers ("large tidal bars", LTBs) that extend offshore of the Han River, Korea. The dataset compliments previous work on tidal flats near the river mouth and the tidally influenced portion of the river.

Passing through Seoul, the Han is the largest river that drains to the west coast of South Korea. Climate is monsoonal, with wet, calm summers and dry, windy winters. Summer precipitation events are intense, the catchment is steep, and floodplains limited. Fluvial sediment is readily transferred to Gyeonggi Bay, a wide-mouthed embayment with an extreme tidal range (up to 9 m) and tidal currents of 1-2 m/s. Wave energy is low in summer and moderate in winter.

The LTBs are mud-rich bodies that have prograded over 50 km onto the shelf during the Holocene, widening in the process. Together, they form the Han's subaqueous delta, a feature common to modern tide-dominated deltas (e.g., Amazon, Ganges–Brahmaputra, Fly, Changjiang). Winter waves plus tidal currents limit accommodation on top of the LTBs, preventing them from aggrading to sea level. Progradation of the LTBs has generated a ~25 m thick, architecturally complex package of low-angle (<1°) clinoform deposits composed of variably bioturbated interlaminated mud and fine sand. Tidal flats (off axis) and mouth bars (on axis) form a second, smaller clinoform (<10 m high, <1° dip) that progrades onto the top of the large subaqueous clinoform. Very large channels ("large tidal channels", LTCs) pass through the subaqueous delta clinoform and merge with the shelf. They are maintained by alongcoast variations in tidal prism: LTCs link to coastal invaginations (larger tidal prism), whereas LTBs occur in "shadow zones" between (smaller tidal prism).

Keywords: tidal bar, open-coast tidal flat, compound clinoform, tidal rhythmites

The core-recorded strata and sedimentary environments of northern Jiangsu coast and offshore areas since the last MIS 7, South Yellow Sea, China

YONG YIN[1,2,3]

[1] The Key Laboratory of Coast and Island Development of MOE, School of Geographic and Oceanographic Sciences, Nanjing University, P.R.China (yinyong@nju.edu.cn)
[2] Collaborative Innovation Center of South China Sea Studies, Ministry of Education of the People's Republic of China
[3] Xianlin Avenue 163, Nanjing, China, 210046

Since the late Quaternary, the South Yellow Sea has experienced several eustatic sea-level fluctuations. Except for the sea-level changes, source supply from nearby deltas, e.g. old Yangtze River Delta to the south and old Yellow River Delta to the north plays an important role in strata successions and long term evolution. Little progress has been made on long term evolution of the late Quaternary strata within study areas due to lack of long cores. This research aims to: 1) reconstruct the long term evolution of sedimentary environment since the last MIS 7; 2) evaluate the factors controlling the formation of the late Quaternary deposits.

Several sedimentary facies such as flood plain, fluvial channel, salt marsh, tidal flat, shallow sea have been recognized in terms of lithology, colour, sedimentary structures, fossils contained in the deposits. The evolution scenario of sedimentary environments is summarized as below.

The northern Jiangsu coast area was submerged periodically by tides during MIS7 stage and tidal flat system developed when sea level was about ten meters lower than present. The study area was broadly eroded by fluvial systems when sea level dramatically declined during MIS 6. The incised valleys probably formed along the northern Jiangsu coast areas and were successively infilled by terrestrial fluvial deposits, shallow sea deposits and salt marsh during MIS 5. The terrestrial materials were probably from old Yellow River in north of Qianggang and old Yangtze River in south of Qianggang. In offshore areas, ridge-tidal channel system was probably developed in this period.

The study area was mostly exposed on land with fluvial rejuvenation when sea-level dropped again in MIS 4 stage. The distribution range, the cut depth and the fluvial strata thickness are smaller than the counterpart in MIS 6. The thin terrestrial strata were drowned by the transgression taking place during MIS 3. The sea water invaded only into the northern Jiangsu offshore areas and the coast areas were not influenced by this transgression. As a result, the offshore area received tidal flat deposits and coast area accepted terrestrial fluvial deposits implying the sea-level during MIS 3 never reached to the position of present coastline. The sea-level fell to -150 m low and the inner shelf of South Yellow Sea exposed entirely during the last glacial maximum. The old Yangtze River migrated south almost to present position and the old Yellow River debouched to the South Yellow Sea central trough from northeast of the study area, and as a result the study area became a broad inter-river plain and received flood plain deposits.

The Holocene transgression in central Yellow Sea commenced prior to about 11.5 ka (Chough et al., 2004). The study area began to receive Holocene transgression at about 9 ka in terms of 14C datings. It received salt marsh and tidal flat deposits during the early Holocene transgression and accepted shallow sea deposits in coast and offshore areas during the Holocene transgression maximum at around 6 ka. The sea floor was stirred and embryo ridge-channel complex began to form when the sea-level began to decline after the maximum transgression. The Yellow River debouched to study area between AD 1128 and AD 1855 and promoted the growth of ridge-channel system. The results show the study area has been mainly dominated by tidal environments since the last MIS 7 stage except during the low sea-level stages. Eustatic sea-level changes and source supply are two major factors controlling the late Quaternary successions.

Keywords: sedimentary facies, core correlation, environment evolution, South Yellow Sea

Coastal environment evolution on the Southern Hangzhou Bay and its implications for human occupation

YAN LIU[1,2*], DAIDU FAN[1], XIAOHE LAI[2],ZHONGYUAN CHEN[2], QIANLI SUN[2]

[1] State Key Laboratory of Marine Geology, Tongji University, Shanghai 200092, China (yliu@tongji.edu.cn)
[2] State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai 200062, China

A 3.3-m sediment core HMD was obtained in the Yaojiang valley near the Hemudu archaeological site in the southern Hangzhou Bay. AMS 14C dating and micro-fossil analysis were applied to reveal the evolution history of paleovegetation and the human-environment interactions. The core site was inferred to be influenced by marine intrusion during 6500-6200 cal yr BP from the significant appearance of Dinoflagellate. Low proportion of Poaceae and Artemisia indicated weak human activities during the period. It was immediately followed by a zone with peak value of Pinus and Fern spores, as well as abundant freshwater algae, indicating a coastal environment with dense river channels during 6200-5800 cal yr BP. A significant change from a marine setting to a human habitable setting was reckoned to occur at ca. 5500 cal yr BP, as the Poaceae and Artemisia increased dramatically, as well as the macro charcoal influx. The rise in Pinus against Quercus-E, together with decreasing fern spores and freshwater algae, showed a relative cool and dry climate setting with a lower water table in the coastal setting, favoring rice cultivation during 5000-4000 cal yr BP. An event with dramatically rising water table was recognized immediately after 4000 cal yr BP, and the flooded region was inferred to be ever occupied by human from low charcoal influxes. The flooding event was also reported to occur in the Yangtze delta plain, having been blamed for the demise of the Liangzhu Culture. Since then, the study area has been developed into a fairyland for human society.

Keywords: coastal environment, Neolithic culture, human activity, pollen analysis, flood

Primary study on seismostratigraphy of the region around borehole NHH01, South Yellow Sea

GUANBAO LI[1], YA'NAN LIU[1], BAOHUA LIU[2]

[1] First Institute of Oceanography, State Oceanic Administration, China (gbli@fio.org.cn)
[2] National Deep Sea Center, State Oceanic Administration, China

As one of the hot-spot areas on Quaternary Stratigraphy study in the continental shelf of eastern China, the South Yellow Sea was the most densely drilled region by geologists in the past 30 years, where more than 20 boreholes has been obtained, including the recently drilled borehole NHH01. The stratigraphic framework of NHH01, with a basal age of 1.10 Ma, had been supposed mainly based on magnetic and lithologic data (Liu et al., 2014a). Here we present some primary results of seismostratigraphy of NHH01 and its adjacent area. We believe the continuous character of the high resolution seismic data will provide more information for evaluating the subsurface structure and stratigraphic architecture of NHH01 in a regional scale. The seismic survey was conducted in 2014, and more than 100km high resolution profiles were acquired within the range of 10km around NHH01, with a line space of approximately 2km. The seismic facies, seismic surface and seismic strata stacking pattern of the data were analyzed, and then correlated with the stratigraphic framework of NHH01 by Liu et al. (2014a). Some conclusions were presented as follows: (1) two types of seismic facies are dominant in the study area, one shows low to moderate amplitude, continuous laterally and parallel to low angle clinoform, representing shallow marine or delta front deposits, and the other shows moderate to high amplitude, hummocky or discontinuous reflector, interpreted as the channel fills. (2) at least seven sequences were identified above the surface corresponding to the Matuyama-Brunhes boundary defined by Liu et al. (2014a), and each sequence contains the channel fills and the overlying marine-delta front strata which is truncated by the subsequent channel fill, and shows a repeated glacial-interglacial pattern. However, the amount of these sequences is much less than that of the sea-level fluctuation cycles since middle Pleistocene. (3) an subaerial unconformity (SU) surface was observed at the depth consistent with the base of MIS5 deposits, which is located by Liu et al. (2014a) according to the correlation of clay content variation with the marine oxygen isotope record. The SU covers the whole region, and truncates the underlying marine deposits and overlain by thick channel fills. There is an apparent discrepancy to the general opinion that MIS5 deposits are mainly composed of marine sediments as revealed by other boreholes of the South Yellow Sea. (4) more than twenty faults were identified on the profiles, and most of them are active till the late Pleistocene. NHH01 located at a tectonic depression formed by the neighboring block uplift. This tectonic setting might provide a possible mechanism for the formation of greigite at the depth of 44.90~51.80mbsf of NHH01. Different from the paleo-lake occurrence suggested by Liu et al. (2014b), which is not supported by the seismic data, we prefer to the shallow gas seepage along the extensional fault nearby.

Keywords: high resolution seismic profile, stratigraphy, borehole NHH01, South Yellow Sea

Formation of depositional sequences on shelf and Pleistocene sea-level changes in New Zealand margin, western rim of Pacific Ocean

KOICHI HOYANAGI[1] AND YURI KAKUBARI[1]

[1]Department of Geology, Institute of Science, Shinshu University, Matsumoto Japan (hoya101@shinshu-u.ac.jp)

Introduction

Western Pacific rim including East Asia and eastern Oceania margins, is located on the active convergent plate boundaries. Huge amounts of material are derived from uplifting mountains and form thick piles of sediments in the active margins. Although tanspression along the Alpine Fault led to an increase in the sediment supply to New Zealand offshore since Miocene time (Lu et al., 2005), remarkable progradation of shelf edge have occurred since Pleistocene (Lu and Fulthorpe, 2004). IODP Expedition 317 drilled three sites on the continental shelf (84-122 m water depth) and one site on the upper slope (344 m water depth) on the eastern margin of the South Island of New Zealand. We analysed cores from slope Site U1352 and shelf Site U1354. Seven major core discontinuities correspond to Pleistocene sequence boundaries interpreted on the seismic profiles. We determined the age of the sequence boundaries based on isotopic analysis of benthic foraminifera (Hoyanagi et al., 2014) coupled with biostratigraphy (Fulthorpe et al., 2011).

Results and conclusions

The absence of the section from 2.7 to 1.8 Ma at U13 sequence boundary on shelf and slope sites results in a hiatus of 0.9 m.y. U16 shows missing section from 1.26 to 0.83 Ma on shelf results in a hiatus of ~0.4 m.y., however no hiatus is shown on slope. In contrast, remaining Pleistocene sequence boundaries (U14, 15, 17, 18 and 19) have no hiatus and correlate with glacial stages MIS 58, 54, 16, 12, 8 and 6, respectively. They therefore formed at global sea-level lowstands. The intervals between these sequence boundaries range from ~0.1 to 0.7 m.y. indicating that they are 4th or 5th order sequences. In contrast to these boundaries, which correlate with individual MIS glacial events, U13 and 16 are 3rd-order sequence boundaries. They formed in response to a long-term falling eustatic trend and could have occurred at the falling inflection point, as suggested in the original sequence stratigraphic concept and in contrast to the lowstand formation of the higher-order sequences.

The results therefore suggest that packages of sedimentary sequences are controlled by several millions glacial eustatic trend and hundreds of thousands years cycles of glacial eustacy, even in the active continental margin.

Keywords: depositional sequence, glacial eustacy, active margin, Pleistocene

Palaeo-environmental interpretations of microbial mat-related sedimentary structures on modern clastic coasts from western India

SANTANU BANERJEE[1]

[1] Department of Earth Sciences, Indian Institute of Technology Bombay, Powai, Mumbai-400076, India (santanu@iitb.ac.in)

Although microbial structures are well known from modern carbonates microbial mat influence is largely ignored on siliciclastic sediments. This study presents microbial mat structures on the hypersaline coastal areas of the Gulf of Cambay at the western margin of India and discusses their palaeoenvironmental implications. Growth and subsequent modification and/or destruction of the microbial mat cover by current, wave and wind actions create diverse features. Microbial mat growth on sands in the lower- to upper intertidal zone produces mm-scale positive-relief wrinkle structures. Gas domes, formed by the escape of pressurized gases through the mat cover are abundant in the lower intertidal to supratidal zones. Adjacent domes often have a tendency to merge to form elongate to irregular tunnel-like features. Gentle current actions on mat covered, cohesive sands occasionally produces torn mat flakes in the lower to upper intertidal zone. A perfectly circular variety of cm-scale wrinkle structure, 'discoidal microbial colony', may occasionally occur in the upper intertidal to supratidal zones. Swarms of inverted flute cast-like features, known as setulf, are found within the upper intertidal to lower supratidal zone. Wide variety of petee ridges, gas domes, desiccation-cracked mat surfaces and knobby surfaces characterize the lower to upper supratidal zone. The petee ridges are formed by the escape of pressurized fluids and liquefied sediments through the mud cover. The abundance of mat-related structures increases from the lower intertidal to upper supratidal zone as the current strength decreases with shallowing. The studies of the mat-related sedimentary features are particularly useful to provide high-resolution palaeonevironmental interpretations of Precambrian tide influenced coastal systems as prolific microbial mat growth is expected because of absence of grazing organisms. The close resemblance between possible meduoid-type Ediacaran fossil and 'discoidal microbial colony' needs special attention for the refinement of end-Precambrian biostratigraphy.

Influence of Changjiang Diluted Water on suspended sediment transport during the dry-flood seasonal transition at the Hangzhou Bay mouth, China

YUE ZHANG, DAIDU FAN, HUIPING XU, RUFU QIN, YANWEI ZHANG

[1] State Key Laboratory of Marine Geology, Tongji University, China (2013yuezhang@tongji.edu.cn)

Coasts and estuaries are important interfaces between continents and oceans, where terrestrial materials are regulated in before being transported to the open oceans. Hangzhou Bay is a funnel-shaped high turbid mesotidal estuary in the south of Changjiang Estuary. It is intensely influenced by Changjiang diluted water and suspended sediment. Much attention has been paid to the suspended sediment transport in and off Hangzhou Bay during dry/flood season. However, it is difficult to capture the dry-flood seasonal transition (April - May) signal due to its uncertainty and the complex weather condition. The purpose of this study is to show this signal recorded by coastal seafloor observatory at Xiaoqushan in the East China Sea, equipped with a SEB-16 CTD and RDI ADCP 1200 kHz (up-looking) at 0.8 m above the seabed (mab), and its impacts on suspended sediment transport at the Hangzhou Bay mouth. We analyse the data from April 25 to May 24 in 2009. The relationship between suspended sediment concentration (SSC) and acoustic backscatter intensity are derived by regression analysis.

The transition signal occurred on May 9, characterized by sharply salinity decrease from 23.1 to 18.5 psu within 11 hours. Then the salinity oscillation last several periods within 3 psu and disappeared until May 17. Temperature continuously increased with a periodical fluctuation started from May 5. Seven typical tidal cycles, including two spring tides (S1, S2), two neap tides (N1, N2) and three moderate tides (M1, M2, M3), were analysed in detail through current speeds, SSC, residual currents and suspended sediment flux. Comparing the two spring tides S1 (18:36 on Apr.26 - 18:50 on Apr.27) and S2 (18:19 on May 10 - 18:28 on May 11), i.e. before and after the transition signal, depth-averaged current speeds varied from 0.02 to 1.61 m/s and from 0.01 to 1.70 m/s respectively. In both of them, ebb currents were a bit stronger than flood currents. In S1, the depth-averaged SSC varied from 0.11 to 0.61 kg/m3 with a mean value of 0.31 kg/m3. While in S2, it varied from 0.18 to 0.57 kg/m3 with a mean value of 0.33 kg/m3. The SSC in S2 peaked not only at four current speeds climaxes as in S1 but also during the slack water period. The southeast residual currents at the surface layer (higher than 11 mab) in S1 and S2 indicated the Changjiang diluted water. The residual currents in S2 (40 cm/s) was a little smaller than that in S1 (53 cm/s) probably because of the variation of winds. The residual currents below 11 mab all pointed to the northeast in S1 and decreased when close to the seabed. It was the same in S2 except that the residual currents pointed to the northwest at the bottom (below 2 mab). With a reference direction in the north, the suspended sediment flux was 0.30 kg/m•s at 35 degrees in S1 and 0.11 kg/m•s at 27 degrees in S2. The results of the suspended sediment flux decomposition method suggest that the southward tidal trapping item (0.20 kg/m•s) in S2 was four times larger than in S1 (0.05 kg/m•s), while the advection item in S1 (0.53 kg/m•s at 45 degrees) was almost the same with S2 (0.48 kg/m•s at 26 degrees). Hence, the northeast suspended sediment transport was weakened.

Keywords: suspended sediment transport, seasonal transition, Changjiang diluted water, seafloor observatory, Hangzhou Bay

Centennial-scale sediment accumulation and reworking processes and flux in the Changjiang subaqueous delta based on radiochemical measurements

YIJING WU[1] AND DAIDU FAN[1, 2]

[1] State Key Laboratory of Marine Geology, Tongji University, China (walada@qq.com)
[2] School of Geoscience, Yangtze University, China

To quantitatively characterize deltaic processes, 210Pb (t1/2 = 22.26 a) and 137Cs (t1/2 =30.17 a) dating has been widely used for estimating centennial-scale sedimentation rates in coast and shelf environments. In the Changjiang delta, the complexity of regional hydrodynamic conditions and increasing human impacts perplex the interpretation of 210Pb and 137Cs dating results.

Four sediment cores were sampled in 2012 from the Changjiang subaqueous delta and its adjacent mid-shelf with palimpsest muddy-sand deposits. Activities of 210Pb and 137Cs were analysed by low background HPGe γ-ray detector in Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences. In addition, 167 short cores with 210Pbex and/or 137Cs inventories were collected from previous publications. The depth profiles of 210Pbex were re-examined and categorized into different groups to probe potential effects of sampling and interpretation strategies on calculated sedimentation rates. Accumulation flux and sediment budgets were then constructed based on these re-examined sedimentation-rate inventories.

All 210Pbex profiles can be assigned into four categories according to their characteristic decay trends: normal, sectional, uniform and inverse. Most of profiles (77.8%) fall in the normal category, those fit better with exponential trendlines tend to scatter in regions with weaker hydrodynamic energy. Other abnormal profiles mainly occur near the mouth of the North Passage (the deep dredged navigation channel), indicating a high potential influence of dispersal of dredged materials. These abormal 210Pbex profiles were then excluded in the following calculation.

Accumulation flux was calculated over different subareas and then compared with those from the DEM principle (Shen, 2001). Except two sub-regions, show a good agreement with DEM values, confirming the reliability of 210Pb inventories to calculate centennial-scale accumulation fluxes in coastal and shelf environments. In the sub-region off the North Passage, the 210Pb derived accumulation flux was much lower than the DEM value, while it was almost twice of the latter at the northern Hangzhou Bay.

Taking 4.51×108 t/a (1953-1993) or 3.85×108 t/a (1953-2011) as annual sediment discharge at Datong station in the Changjiang, about 25.62% or 30.01% of the sediment was deposited in Changjiang subaqueous delta area, respectively. Errors might be caused by the limitation of 210Pb method and uneven distributions of 210Pb inventories.

Keywords: Changjiang subaqueous delta, 210Pbex profiles, sedimentation rates, accumulation flux, sediment budgets

Late Mesozoic transgressions of eastern Asia and their significance: A review

JINGENG SHA[1]

[1] LPS, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing 210008, China.(jgsha@nigpas.ac.cn)

During the Late Mesozoic, the landmass Eastern Asia was almost completely terrestrial facies, except for the areas facing the Palaeo-Pacific, particularly the Sikhote-Alin of Far East of Russia (Sha et al., 2009) and the Outer Zone including the Tokushima and Monobe areas of SW Japan (Sha et al., 2012a) were low topographically and mainly occupied by the sea. However, there do exist Late Mesozoic marine and brackish-water deposit records in eastern Asia, such as the marine and brackish-water deposits of Callovian-Valangian, Hauterivian/Barremian-Aptian, Albian and Cennomanian-Campanian in northeastern China(including eastern Inner Mongolia) (Sha, 2007; Sha et. al, 2002, 2003; Sha et al., 2012). Hauterivian/Barremian-Aptian in the Makito/Shokawa area of northern Gifu in the Inner Zone of SW Japan (Sha et al., 2012a, b), Aptian?-Albian in eastern Taiwan, Zhejiang and Fujian (Hu et al., 2012), Late Jurassic-Early Cretaceous in Peninsular Thailand of southern Thailand (Sha et al., 2012c). Such deposits related with the sea water have distinctly demonstrated that there were at least four main transgressive interludes happened along the eastern coast of Asia. It is these transgressions/floodings that influenced even controlled the climate of the areas suffered the transgressions/floodings, modified the topography, created a number of swamps and marsh lands, changed the modified environmental parameters and even the overall ecosystem. As a result, a number of late Early Cretaceous coal basins and oil fields formed in northeast China where were frequently subjected to marine transgressions, and some bio-events happened.in eastern China (Sha, 2007; Sha et. al, 2002, 2003, 2012). The marine and brackish-water fossils constrained the age of non-marine fossils, which could be used in dating and correlating the widely distributed non-marine Late Mesozoic. All the transgressions came from the northwestern Palaeo-Pacific Ocean, and probably the Arctic Sea as well, and intruded and spread along the faults system. In addition to the eustatic sea level changes, the late Early Cretaceous transgressions of eastern Asia were closely related to the tectonic movements within the Tan–Lu fault system, the circum-Paleo-Pacific and destruction of the North China Craton, or the Yanshan Movement, which were very pronounced and went hand in hand with a strong volcanic activity and ongoing subsidence (Sha, 2007; Sha et al., 2002, 2003, 2012).

Keywords: Late Mesozoic, transgression, stratigraphy, palaeoenvironment, eastern Asia

Timing of Asian mega-rivers' accomplishing drainage reorganization in response to Cenozoic uplift of the Tibet Plateau: A review

DAIDU FAN[1, 2]

[1] School of Ocean and Earth Sciences, Tongji University, China (ddfan@tongji.edu.cn)
[2] School of Geoscience, Yangtze University, China

Uplift of the Tibetan Plateau and surrounding areas have induced gigantic changes in Asian topography, climate, drainage and terrestrial fluxes to the ocean. Major Asian river systems underwent long term reorganization by capture and reversal to reach a regime approaching to their present patterns. The timing of different rivers to complete such drainage reorganization is greatly varied. In the geologic aspect, the sedimentary sequences in the deltas and the deep-sea fans are the most important archives to decode the orogenic processes, climate changes and drainage evolution after the India-Eurasia collision. Lots of our present knowledge comes from studies of long term sedimentary sequences in the Indus Delta and its submarine Fan, the Bengal Delta and its submarine Fan. Consequently, the initiation of the Indus and the Brahmaputra draining the uplifted belt to the Indian Ocean was dated back to the Early Eocene (Clift, et al., 2001) and the Early Miocene (Uddin and Lundberg, 1999, Alam, et al., 2003), respectively.

In comparison, large rivers in Southeast and East Asia are much younger than those in South Asia. Among all S-E Asian rivers, the Yangtze is the largest both in the stream length and drainage area. Thickness and mass accumulation volume of Cenozoic deposits in the Yangtze River mouth and shelf basins including the Subei-southern Yellow Sea Basin and the East China Sea (ECS) are, however, several orders less than those in the Begal Delta and Fan (Métivier, et al., 1999). The major reason is that the Yangtze is very young. Lots of studies discussed that the initiation of the Yangtze draining the eastern Tibetan Plateau to ECS should not be prior to Pliocene (Fan et al., 2008). However, the timing of the Yangtze River formation is still open to question (Zheng et al., 2013). The ultimate establishment of present Yellow River has been considered very late, roughly in 0.15 Ma (Zhang et al., 2004).

Keywords: Asia, Tibetan Plateau, mega-river, drainage reorganization, sedimentary record

Advances in research on Sedimentology and Paleoenvironment change of Chinese Shallow Seas Since the Late Quaternary

XUEFA SHI, YANGUANG LIU, ZHENGQUAN YAO, SHUQING QIAO, SHENGFA LIU, KUNSHAN WANG, XISHUANG LI, YONGHUA WU, JIANXING LIU

[1] Key Laboratory of Marine Sedimentology and Environmental Geology, The First Institute of Oceanography, SOA, Qingdao 266061, China

Chinese shallow seas include the Bohai Sea, Yellow Sea, Eastern China Sea and South China Sea. Systematic investigations on the sedimentary geology of the above-mentioned seas have been carried out during the past ten yeas. Around 21700 surface sediment samples and 1250 sediment cores have been collected for the detailed study. Around 75300 km of seismic profiles and 15220 sites of suspended matter investigation have been completed. Major advances of our study are as follows.

1. Sedimentary distribution map of 1:25 0000 of Chinese shallow seas has been complied, with the special emphasis on the harbor, bay and delta regions at 1:50000 scale. Meanwhile, an atlas of the marine sediments has been published. Several issues related to the sediments partition and variations in suspended matters and their controlling factors have been discussed. The sedimentary classification, provenance, characteristics of mineralogy, geochemistry, microfossils, physical and mechanical characteristics, content and turbidity of suspended matter also have been addressed.

2. We also compiled seismic profiles and its interpreted images, depth of representative strata boundary for Chinese shallow seas. We have attempted to clarify the characteristics of sequence stratigraphy in these four seas since the Last Deglacial Period. Disaster geological bodies such as sea-bottom sand waves, shallow gas and buried channel/exposed rock have been delineated.

3. High-resolution Holocene stratigraphy and time series of estuary, subaqueous delta and mud deposits in the inner shelf regions of Chinese shallow seas have been established by using sedimentology, mineralogy, geochemistry and sequence stratigraphy. The possible responses of sea-level variations to environmental changes have also been clarified tentatively.

4. Based on the investigation of sedimentary cores from the Bohai and Yellow Seas, we have constructed the lithostratigraphy and magnetostratigraphy of these areas for the last 1 Ma, and recognized around nine transgression-regression cycles in this region, which is closely related with past climatic conditions and sea-level changes.

Origin, composition and reactivity of sedimentary organic matter in the eastern Yellow Sea

SUK-HEE YOON[1], JUNG-HYUN KIM[1,], HI-IL YI[2], MASANOBU YAMAMOTO[3], KYUNG-HOON SHIN[1]

[1] Department of Marine Science and Convergence Technology, Hanyang University ERICA campus, 55 Hanyangdaehak-ro, Sangnok-gu, Ansan-si, Gyeonggi-do 426-791, South Korea (jhkim123@hanyang.ac.kr)

[2] Marine Environment Research Department, Korea Institute of Ocean Science and Technology, Ansan, 426-744, Republic of Korea

[3] Graduate School of Environmental Science, Hokkaido University, Kita-10, Nishi-5, Kita-ku, Sapporo 060-0810, Japan

A significant fraction of the global carbon flux to the ocean occurs in river-dominated marginal seas. Hence, studying the origin, composition and quantities of sedimentary organic matter (OM) in these systems is a key to assessing global biogeochemical cycles. In this study, we aim to provide qualitative and quantitative assessments of OM source and composition in the eastern Yellow Sea. For this purpose, we use a multi-proxy approach on 9 riverbed sediments and 76 surface sediments, combining bulk (TOC, C/N ratio, 13CTOC, and 14C) and molecular (n-alkane and GDGTs) organic parameters. We will present the relative contributions of OM from various sources. Our preliminary results hint the importance of pre-aged OM preserved in surface sediments in the eastern Yellow Sea.

Keywords: terrestrial organic matter, lipid biomarkers, Yellow Sea

Long-distance transport of terrigenous materials in China Seas and the sedimentary record

ANCHUN LI, JIAN LU, HUANGJIE, KAIDI ZHANG AND JIANG DONG

[1] Key Laboratory of Marine Geology and Environment, Institute of Oceanology, Chinese Academy of Science, Qingdao 266071, China (acli@qdio.ac.cn)

China shelf sea are located between the Pacific Ocean and the Asian continent, which has great terrain drop and big river (the Yangtze, Yellow River, Zhujiang and others) emptying into, is one of the most abundant terrigenous flux sea on the Earth. Monsoon and alongshore current play an important role in transport and redistribution of terrigenous materials. Alongshore currents are driven by seasonal monsoon and related to sea water compensation. They are strongest in winter, weakest in summer, in the transition state during spring and fall.

Large Holocene clinoform sedimentary beddings found in the Yellow Sea and East China Sea in recent years are closely related to the Fujian- Zhejiang coastal current and Shandong Peninsula coastal current respectively, which mainly derived from Changjiang and Huanghe River. Distal sediment is about 600 km and 800 km far from Changjiang river and Huanghe river mouths. Sediment composition of grain size, mineralogy and chemistry can effectively reflects the monsoon control on the coast current, while the monsoon changes has a periods of solar and sunspot activity cycles was recorded in sediment off the Fujian0-Zhejiang coast. Occasionally also revealed important climate change events, such as 5500aBP abrupt climate change events. Those indicate that monsoon and alongshore current have close relationship with fine-grained sedimentation and clinoform formation near Shandong Peninsula coast and along the Fujian- Zhejiang coast.

Our recent Drifting buoy data show that relatively uniform water dominately flow to southwest along the Fujian- Zhejiang coast. One of them even flew to south China Sea through the Taiwan Strait and further floated to the Beibu Gulf. Average flow velocity was some 56 cm/s, being strong enough to carry silt sediments. This is consistent with changjiang signals of clay minerals in northern South China, indicating that in addition to alongshore current, wind flow also play important role in long distance transport of river fine-grained sediments.

Keywords: terrigenous materials, long distance transport, alongshore current, sedimentary record, China shelf seas

Dust transportation along with the intensification of the Indian Monsoon

HUCAI ZHANG, FENGQIN CHANG, HUAYONG LI, LIZENG DUAN, HONGWEI MENG, HAN WU

[1] Key Laboratory of Plateau Lake Ecology & Global Change, Yunnan Provincial Key Laboratory of Geographical Process and Environmental Change on the Plateau, College of Tourism and Geography Science, Yunnan Normal University, Chenggong Kunming, Yunnan 650500, China (hucaizhang@yahoo.com)

In the northern hemisphere, the dust transportation is usually intensified along with the strengthening of the wind or the winter monsoon. Furthermore, the intensity of the wind transportation is closely related to the temperature changes and the cooler the temperature makes stranger wind transportation. Studies on an 1812cm long core drilled from Lugu Lake in southeastern Tibetan Plateau reveals that the elemental contents of Si, Al, Fe and Ti increased with the intensification of the Indian Monsoon, indicating the Indian Monsoon not only transport moisture into the area, but also the materials. At the same time, the elemental contents of Si, Al, Fe and Ti also show a general decrease trend from the core bottom, which dated at about 60ka BP to the upper part of the core, even with the fluctuations. Till now we do not know the dust has been transported by the wind or together with the monsoon moisture. Detailed study on the lake sediments and also the sediments in the India Ocean and surrounding continents will absolutely necessary and such a study will deepen our understanding about the Indian Monsoon evolution and the global changes.

Keywords: dust transportation, Indian Monsoon

Changing coastlines of the Bohai Sea – interaction of natural and anthropogenic impacts

TANG, C.[1,4], DENG, J.[2,3], HARFF, J.[2], LI, Y.[1], ZHANG, H.[1], ZHAO, Y.1, LI, D.[1]

[1] Yantai Institute of Coastal Zone Research, Chinese Academy of Sciences, China (ctang@yic.ac.cn)
[2] Institute of Marine and Coastal Sciences, Faculty of Geosciences, University of Szczecin, Poland
[3] School of Earth and Environmental Sciences, University of Wollongong

Coastal zones and river mouth systems in particular play a key role for the generation of source-to-sink models describing the pathway of particulate matter discharged by the rivers and coastal erosion to the ocean. The Bohai Sea serves as a key area to study the interrelation of different factors influencing the relative sea level and coastline change: Eustatic effects determined by climate variations, vertical displacements of the surface of the rigid earth, supply of sediments discharged by rivers, wind driven currents and waves, tides, and anthropogenic effect. During the younger Holocene the Yellow River Delta and the coastal zones within the vicinity are regarded a typical river dominated system with a prograding deltas and a regressive sea in the easterly adjacent Laizhou Bay. The morphodynamic development of the river mouth system is well recorded by paleo-coastlines and for the younger history by historical maps. The progradation of the sedimentary system was even amplified by the Holocene sea regression. But, during the last decades a shift in the development of the coastal area is being recorded. The Yellow River mouth starves of sediment load since damming up-streams reduces the discharge of suspended matter to the Bohai Sea. So, the influence of wave and tide dynamics is replacing fluvial influences increasingly. Additionally sea level gauge data record a rise of the sea level simultaneously. Our investigation of waterline shifts supports the hypothesis of increasing coastal retreat at the southern Bohai Sea. According to this result, after a period of Holocene regression we are facing a new period of marine transgression. This transgression is apparently due to the recent sea level rise as a result modern global warming. As a second reason we identified the continuous decrease of riverine sediment supply. This envisaged development cause quite different conditions for the management of the delta and the coasts in its vicinity. In order to get closer to a realistic future projection new concepts in morphogenetic modelling have to be set up. Besides data about sea level change and river discharge variability, meteorological information about wind and wave climate and storm frequencies have to be involved into the analysis. Different data categories have to be made available: The scale spans from future climate modeling results to planning information about actions upstream the River's drainage basins steering the discharge of water and sediment supply. Models to reconstruct the geological history and to project future developments have been developed during the last decades, such as a general conceptual model generated within the frame of a research program SINCOS (sinking coasts) by Harff et al. (2007). Within the frame of this concept Deng et al. (2014) have elaborated the Dynamic Equilibrium Shore Model (DESM) for balancing sediment dynamics based on a generalization of the Bruun rule. The DESM has proved to provide reasonable scenarios as future projections of coastal developments of marginal seas driven by complex interaction of driving forces and was applied to display coastal changes in the Laizhou Bay. The complexity of the coastal and river mouth system to be studied requires interdisciplinary and international co-operation of coastal researchers aiming to establish effective modelling tools to generate cause-effect scenarios for coastal zone management.

Environmental reconstructions of western Japan/East Sea for last millenniums based on shelf sediment geochemical records.

ANATOLII ASTAKHOV[1], KIRILL AKSENTOV[1], ANDREY DARIN[2], IVAN KALUGIN[2], MIKHAIL MALAKHOV[3]

[1] V.I.Il'ichev Pacific Oceanological Institute, Vladivostok, Russia. (astakhov@poi.dvo.ru)
[2] Sobolev Institute of Geology and Mineralogy, Novosibirsk, Russia
[3] Northeastern Interdisciplinary Research Institute, Magadan, Russia

Bottom sediment cores from the Amur Bay of the Sea of Japan with length of 4.3-4.7 m and age up to 3-4 thousand years were studied. The bottom water of Amur Bay has low oxygen contents with seasonal anoxia. Therefore, sediments are not bioturbated, which enables very detailed of paleoenvironmental reconstructions. Age models cores based on determining the age of the sediments by isotopic methods (210Pb, 137Cs, 14C) and paleomagnetic correlation. The chemical composition of sediments has been studied by various methods; x-ray fluorescent scanning with synchrotron radiation was the most detailed (step 0.5-1.2 mm). By comparing the geochemical characteristics with historical data and results of instrumental measurements, criteria for paleoenvironmental reconstruction were adapted or developed:

- redox conditions of sea waters (Mo/Mn);
- average annual air temperature - multiple regression equation using positive (K-Ca-Fe-Br-Sr-XRD) and negative (Ti-Rb-Mo/Mn) signs;
- onshore catastrophic floods, including those caused by typhoons (Br, Br/Rb);
- catastrophic eruptions of the Pektusan (Baegdusan) volcano (Zr, Nb/Y, K/Ti).

The reconstruction of environmental parameters of the past can be used for detail and clarification of regional climate models by supplementing long cycles climatic and oceanographic changes. For this purpose it is necessary to eliminate the influence of random catastrophic events arising from geological processes. The most important of these were the series of disastrous eruptions of the volcano Pektusan (Baegdusan) in 10 century AD. At the same time intensified seismic processes, increased methane emissions from bottom sediments, which led to intensification of the sea waters anoxia.

The study was supported by the Russian Foundation for Basic Research (projects no. 15-05-06845 and 15-35-50123).

Keywords: shelf sedimentation, geochemistry, redox conditions, paleoclimatology, tsunami, Pektusan volcano, Japan/East Sea

Geochemical evidence of the indirect pathway of terrestrial particulate material transport to the Okinawa Trough

CHEN-TUNG ARTHUR CHEN[1,2], SELVARAJ KANDASAMY[3], YAN BAI[2], XIANQIANG HE[2,4]

[1] Department of Oceanography, National Sun Yat-sen University, Kaohsiung, Taiwan. (ctchen@mail.nsysu.edu.tw)
[2] State Key Laboratory of Satellite Ocean Environment Dynamics, Second Institute of Oceanography, State Oceanic Administration, Hangzhou, China.
[3] State Key Laboratory of Marine Environmental Science, Xiamen University, Xiamen, China.
[4] Institute of Oceanology, Chinese Academy of Science, Qingdao, China.

The major source of particulate matter in the East China Sea (ECS) is the Changjiang (Yangtze) River. Values of the n-alkane preference index (CPI) and the cinnamyl/vanillyl ratio (C/V) indicate that the influence of the terrestrial material initially decreases away from the Changjiang River mouth across the ECS continental shelf. However, such as influence increases again from the middle ECS shelf towards the continental slope and the Okinawa Trough. This is because when the northeast winds prevail from Sept. to April the Changjiang River plume flows southwestward along the coast of China. Part of this flow turns eastwards in the northern Taiwan Strait, then joins the northeastward flowing Kuroshio to reach the Okinawa Trough. As the central ECS is bypassed sediments there are geochemically older than those found on the coast of China and in the Okinawa Trough.

Between June and August when southwest winds prevail the Changjiang plume generally flows northeastward. Yet relatively more rapid cyclonic currents generated by typhoons passing through the ECS could move the suspended particulates and resuspended sediments from the coast of China southwestward. The turbid water then turns towards Taiwan in the northern Taiwan Strait and joins the Kuroshio before reaching the Okinawa Trough. Again, relatively younger sediments are transported to the Okinawa Trough without passing through the central ECS.

Keywords: sediments , East China Sea, Okinawa Trough, typhoons

Sr-Nd isotopic constraints on detrital sediment provenance and paleoenvironmental change in the northern Okinawa Trough during the late Quaternary

ZHAOKAI XU[1], TIEGANG LI[1], DHONGIL LIM[2], HOISOO JUNG[3] AND JINYONG CHOI[4]

[1] Key Laboratory of Marine Geology and Environment, Institute of Oceanology, Chinese Academy of Sciences, China (zhaokaixu@qdio.ac.cn)
[2] South Sea Research Institute, Korea Institute of Ocean Science & Technology, Republic of Korea
[3] Marine Environment & Conservation Research Division, Korea Institute of Ocean Science & Technology, Republic of Korea
[4] Department of Oceanography, Kunsan National University, Republic of Korea

For this study, Sr-Nd isotopic compositions of AMS 14C age-dated core sediments from the northern Okinawa Trough were investigated to reconstruct sediment provenance and transport process over the last 22.3 ka and further to trace the forcing mechanisms behind the provenance changes. The results clearly showed that large compositional variations of Sr-Nd isotopes occur in deposition, suggesting three-phases of changes in sediment source: paleo-Huanghe (Unit 3, 22.3–14.8 ka), East China Sea shelf-derived (Unit 2, 14.8–7.3 ka), and Taiwan-derived detritus stages (Unit 1, < 7.3 ka). Such provenance changes since the last glacial maximum may be closely correlated to sea-level fluctuation, the evolution of Tsushima Warm Current, as well as East Asian monsoon climate variation. At 22.3–14.8 ka, the paleo-Huanghe mouth was situated close to the study area, thus dominating sedimentation therein, especially during stronger winter monsoon periods. At the beginning of Unit 2 (14.8–12.8 ka), rapid sea-level rise and significant retreat of the river mouth overwhelmed enhanced continental weathering, leading to less detrital sediment supply from the paleo-Huanghe to the study area. Subsequently, the East China Sea shelf-derived matter dominated detrital deposition therein from 12.8 to 7.3 ka. Since 7.3 ka, the fully evolved Tsushima Warm Current has transported some detrital particles from Taiwan to the study area, especially during the strengthening period at 7.3–5.1 ka. A prominent decline in Taiwan-sourced matter supply at 5.1–2.8 ka may have been caused by suppression of the Tsushima Warm Current, possibly associated with the Pulleniatina minimum event.

Keywords: East Asian monsoon, northern Okinawa Trough, sediment provenance, Sr-Nd isotope, sea level, Tsushima Warm Current

Sediment provenance discrimination in the Yellow Sea: Secondary grain-size and REE proxy

HOI-SOO JUNG[1], DHONG-IL[1], ZHAOKAI XU[2]

[1] Korea Institute of Ocean Science & Technology, 787 Haean-ro, Ansan 426-744, Korea, (hsjung@kiost.ac.kr)
[2] Institute of Oceanology, Chinese Academy of Sciences, China

For better understanding of sediment provenance in the Yellow Sea, 91 surface sediments of the shelf, together with 37 sediments from Korean and Chinese Rivers, were analyzed for concentrations of major and rare earth elements (REEs). In this study, normalizing the element concentrations with respect to the concentration of Al (elements/Al ratios) was used to minimize sediment grain-size effect. However, a good co-relationship between the ratios (e.g., Mg/Al and Fe/Al ratios) vs. Al concentration (or mean grain size) in the Yellow Sea sediments is still appearing. Spatial distribution patterns of Fe/Al and Mg/Al ratios also display the similar distribution pattern with mean grain-size, suggesting that the ratios can give misleading information for determining the provenance of the sediments. For sediment provenance discrimination in the Yellow Sea, we calculated the difference in the two REE distribution patterns of the Chinese and Korean river sediments, expressed as δ (δ = REE*(La)-REE*(Lu)), and created maps of the spatial distribution pattern of the δ values. The δ values gradually increase from the west to the east of the Yellow Sea, except for low δ values in the southeastern part of the Yellow Sea. This result shows that most of the Chinese and Korean river sediments are deposited near to their respective coastlines, except a deposit in the southeastern part of the Yellow Sea that receives a considerable amount of sediment from the Chinese rivers. Our results support that the calculated δ value can be used as a proxy for sediment provenance discrimination in the Yellow Sea.

Keywords: provenance, rare earth elements, grain size, Yellow Sea

Pollen and sediment source of Taiwan during the mid and late Miocene and the inferred environments in SE China

CHENGYU WENG[1] , XIUDONG HAO[1]

[1] Sate Key Laboratory of Marine Geology, Tongji University, 1239 Siping Road, Shanghai 200092, China. (weng@tongji.edu.cn)

Pollen samples from mid and late Miocene marine sediments in Taiwan were analysized. Surprisingly, the pollen assemblages include abundant pollen of spruce (Picea), hemlock （Tsuga） and fir (Abies) , taxa that only growing in high mountains today, in almost all samples, suggesting that the pollen source area was much colder at that time than today. However, we know that during Miocene the region of Taiwan and the nearby seas was warmer than or at least as warm as today.

Today the surrounding regions, the most possible source regions, are not high enough to support such kind of cold vegetation, and Taiwan was still under water at that time. Based on the modern surveys we made in the nearby regions, we suggest that there were some high mountains (higher than in today) in SE China to support cold vegetation, which is only found in high mountains in Taiwan and some moutain regions in Tibet and northern China today, and the pollen and sediments were mostly carried to the then Taiwan region by rivers and streams. These high mountains were probably uplifted by the tectonic movements which also formed South China Sea.

Keywords: South China Sea, pollen, transportation, Miocene

Reconstruction of silicate weathering regime in Taiwan Island during the last glaciation

SHOUYE YANG[1], YUN ZHAO[1], LEI BI[1], CHAO LI[1], JAMES T LIU[2], YUANPIN CHANG[2]

[1] State Key Labaratory of Marine Geology, Tongji University, Shanghai, 200092, People's Repulic of China.(syyang@tongji.edu.cn)

[2] Department of Oceanography, National Sun Yat-sen University, Kaohsiung, 80424, Taiwan

As one active sediment source-to-sink system in Asia, Taiwan plays an important role in land-sea interaction, biogeochemical cycle and sedimentation in the river-dominated continental margin. Taiwan Island has thus increasingly attracted research attentions over the last decade because of its enormous sediment production within the small mountainous catchments, and fast transfer of terrigenous sediment and organic carbon from highland to ocean, in response to extreme monsoon climate and earthquake events. We investigate the sedimentary geochemical compositions of Taiwan river sediments, including the clay-separated and bulk samples collected from modern river systems and from one borehole (JRD-S) in the Zhuoshui River estuary, aiming to investigate what major factors control silicate weathering in Taiwan at present and during the late Quaternary. The analytical results suggest that the silicate weathering process in the tectonically-active Taiwan Island is greatly limited by strong physical denudation and fast sediment transfer, although the monsoon climate brings huge rainfall for weathering. The silicate weathering regime in Taiwan is different from that in China's mainland catchments where monsoon climate primarily determines the weathering intensity. During the last glacial period, the detritus could stay a longer time in Taiwan's river basins because of weak rainfall and earth surface erosion, and the silicate weathering was thus relatively stronger. However, in the Holocene, enhancing East Asian summer monsoon caused abundant rainfall and intense physical erosion, which quickly transported the detritus into the sea and thus, the sediment residence time was general short within the basin. This consequently resulted in weaker silicate weathering in the Holocene. This study reveals a unique silicate weathering pattern in Taiwan during the late Quaternary, which provides deep insights on earth surface process and sedimentary response to tectonic and climatic driving in the East Asian continental margin.

Keywords: Taiwan Island, silicate weathering, climate change, Holocene, sediment trasnport

Relationship between grain size and provenance in the Holocene sediment from the Beppu Bay, southwetern Japan

TOMOHISA IRINO[1], KEN IKEHARA[2], MASANOBU YAMAMOTO[1], MICHINOBU KUWAE[3], AND KEIJI TAKEMURA[4]

[1]Hokkaido University, Japan (irino@ees.hokudai.ac.jp)
[2] Gelogical Survey of Japan, National Institute of Advanced Industrial Science and Technology, Japan
[3] Ehime University, Japan
[4] Kyoto University, Japan

The Beppu Bay located in the northeast Kyushu Island, the southwestern Japan receives detrital materials mainly from two drainage systems, the Ohno River and the Oita River. The Ohno River has the head water region at the Mt. Kuju and Mt. Aso, flows eastward combining some tributaries from the south, and then flows northward to the Beppu Bay. Surface geology of the drainage area is roughly divided into two as intermediate to felsic volcanic area covered with andosol in the northeast and Paleozoic to Mesozoic sedimentary rocks covered with brown forest soil in the south. The drainage basin of the Oita River is located in the north of the Ohono River drainage, which is characterized by mafic volcanic rocks in the headwater region. Since the provenance of the Beppu Bay sediments has such geologically contrasted drainage systems, the temporal changes in the provenance for the sediment can be utilize to seek for the interrelationship among the western Pacific paleoceanography, East Asian monsoon, ecological response (fishery, vegetation, land use), and the erosion and sediment supply from hinterland basin. For this purpose, we examined mineral composition of BP09-3 core collected from the center of Beppu Bay as well as sediment from surface soils and river beds using X-ray powder diffraction.

As a result, quartz / feldspars ratio of the Beppu Bay sediment was within the range of surface soils in the drainage of Ohno River and Oita River. Detailed examination of peak shape of feldspar in X-ray diffractogram suggests grain size dependency of feldspar composition. Feldspars in finer materials showed more “mafic” composition suggesting that fine materials are dominantly supplied from Oita River drainage and / or mafic rock is more easily weathered and forms fine materials.

Temporal variation of mineral composition in the Beppu Bay sediment was also compared with pollen records for the last 3000 yrs, which shows stepwise increase of detrital input occurred at large vegetation change and the increase in detrital input was associated with lowering of Quartz / Feldspars and more albitic feldspars. These facts are interpreted that vegetation and / or land use change in the drainage area affected the supply of coarser materials from the Ohno River.

Keywords: provenance, grain size, mineral composition, the Beppu Bay

Spatial and Temporal Variations of Small Rivers Discharges to the China Coast

P. YIN[1] , X. KANG[2], X.Y. DUAN[1] , J.Q. LIU[2] , B. CHEN[1], F. GAO[1]

[1] Qingdao Institute of Marine Geology, China (pingyin@fio.org.cn)
[2] Ocean University of China, China

The China coast are dominated by two fluvial sediment source-to-sink systems like most of the Asian continental margins, i.e. the large rivers vs. small mountainous rivers. The main three large rivers, the Yellow River, the Yangtze River and the Pearl Rivers, carry the majority discharges of water, sediments and dissolved solids to the coast and sea. However, 60% of the China coastline are supplied by the small and medium scale rivers, even though they only bring 14% fresh water discharge and 4% sediments discharge to the coastal area. The small rivers plays a very important role in the China coastal geological evolution as well as the social development, most of the small river estuaries are linked to the coastal majoy cities or harbors. The small rivers are more sensitive to the natural driving and anthropogenic impacts, the human activities in the river drainage have strongly affected the river discharges to the coast, together with coast engineering activities have strongerly reshaped the river estuary landscape in the past century.

The river fluxes and geochemical compositions varies from the north to the south, which are the results of geological and weathering controls. Samples from the lower catchment of rivers along the coast demonstrated that the pH values, electric conductivities and dissolved solids of major and trace elements in most rivers of northern China are much higher than those in rivers of southern China, which is consistent with climate change from north to south, the dissolved solids major elements in river water are associated with soil type and chemical composition. The trace element concentrations variation may be attributed to special geological and geochemical background of drainage areas, but the extremely anomaly should mostly be account to anthropogenic activity and pollution. The lower concentrations of soluble Na, Ca, K, Zn, Se in flood season are caused by dilution under higher precipitation.

Spatial differences of PAH compositions were observed from the river estuaries between the North and the South China. The different source profiles of PAHs mainly accounted for the spatial divergences of sedimentary PAH compositions. Greater PAH emissions from domestic coal combustion and coke industry in North China than in South China may have been responsible for the general higher contribution rates in the North China coastal sediments than in the South China coastal sediments. Vehicular emissions played much more important role in the ΣPAH in those river estuaries close to the major cities, therefore, the importance of vehicular emission to PAHs levels was probably dependent on the distance from city. PAH concentrations in the sediment core of the estuary steadily increased upward and the variation was primarily due to economic development and severe floods.

River discharge have changed dramatically in the last century due to the global climate changes, but mainly account for the anthropogenic impacts. The small rivers of China have experienced the similar changes like the large rivers, i.e. the dramatically decrease of water and sediment discharges, and the small rivers are more sensitive to the anthropogenic impacts, and the small rivers of the north are more effected than the south due to the large scale water diversion and lower precipitation. Gauge data have shown that most small rivers from Hebei, Shandong and Jiangsu provinces, their water and sediment discharge almost dropped into zero level, most estuary coastline are eroded.

The sediment discharges of small mountain rivers drastically vary over seasons, the floods caused by typhoon or stronger rainfall are the mainly drive force of sediment discharge. A monitoring station was set up and in-situ data were collected from the Nandu River of Hainan during the typhoon “Seagull” in 2014, from Sept. 14th to Oct. 2nd. The data shows the flood caused by typhoon “Seagull” brought 3.45×105t suspended sediments into the sea,

Seasonal environmental variations in the Upper Gulf of Thailand

SHUQING QIAO[1], XUEFA SHI[1], NARUMOL KORNKANITNAN[2] , AIMEI ZHU[1], YAZHI BAI[1], BIN WU[1], SHENGFA LIU[1]

[1] First Institute of Oceanography, State Oceanic Administration, Qingdao, China (QIAOSHUQING@FIO.ORG.CN)
[2] Marine and Coastal Resources Research Center, Bangkok, Thailand

environment variations in the Upper Gulf of Thailand were analyzed from suspended particulate matter (SPM) and sediments collected in Nov., 2013, Jan., 2014, Jul., 2014 and Sep., 2014. Results showed that environment parameters including SPM concentration, TOC/TN, major and trace elements of sediments displayed significant seasonal differences. Approximately, environmental variables demonstrated higher amounts in dry months (Nov. and Jan.) than wet months (Jul. and Sep.). This trend was closely correlated with the rain season, when large amount of terrigenous sediment were delivered into the investigated areas. There are also some exceptions from this seasonal variation trends in a few locations and for certain variable (Na2O). The key geochemical processes governed the spatial and temporal of environmental variable in the studied area will further analyzed.

Keywords: sediment source, metals, Chao Phraya River, human activities

Source to sink processes of Yangtze River during the last 130 years, and potential climatic implications---evidence from magnetic results

Y. ZHENG[1], S. YANG[2], C. DENG[3]

[1] Insitute of Vertebrate Paleontology and Paleoanthropology, Beijing, China Peoples Republic.
[2]Tongji Universysity, Department of Marine Geology, Shanghai, China Peoples Republic
[3]Institute of Geology and Geophysics- Chinese Academy of Sciences, Paleomagnetism and Geochronology Lab, Beijing, China Peoples Republic.

Fluvial sediment is one of the best archives for the investigations of high-resolution natural environmental variability and anthropogenic impacts in catchment over the last hundreds or even thousands years when the documentary data is scarce. In this study, magnetic properties of the profile sediments from the lower Changjiang (Yangtze River) were measured for the investigation of sediment sources and climatic changes over the last 130 years. Dominant magnetic minerals in the profile sediments are magnetite, hematite and goethite. Magnetite is relatively enriched in the upper Changjiang sediment, while low magnetic concentrations and fine magnetic grains characterize the mid-lower river sediments. Both sediment grain and magnetic signals clearly indicate the flood events happened in the large Changjiang drainage basin, consistent with the documentary record over the last 130 years. Anthropogenic impacts on the sediment transportation as well as properties of suspended matters could be also observed from the data. Our study sheds new light on the application of magnetic property for high-resolution environmental study in the large drainage basin where has complicated sedimentary processes. This detailed comparison between physical parameters and documentary data is a potential new way to study ancient climate changes.

Reevaluation of rare earth element fractionation during chemical weathering and river sediment transport

NI SU[1], SHOUYE YANG[1], XIAODAN WANG[1], YULONG GUO[1], CHENGFAN YANG[1]

[1] State Key Laboratory of Marine Geology, Tongji University, PR China (syyang@tongji.edu.cn)

We reevaluated the rare-earth elements (REE) fractionation during chemical weathering and river sediment transport in Mulan River of Fujian Province, southeast China. The results indicate that the acid leachable fractions of major and trace elements account for a higher proportion compared to the residual fractions. Most of the major (e.g. Na, K, Ca, Mg, Al and Fe) and trace elements (e.g. Sr, P, Mn, Cu, Co, Zn, P, Cr, Th and REEs) have been mobilized and transferred during weathering processes. Light rare-earth elements (LREE) and heavy rare-earth elements (HREE) are identified with different geochemical behaviours through the weathering profile developed on granodiorite. In the highly-weathered zones, more LREEs are leached than HREEs, while in the weakly-weathered zones, HREEs are enriched and LREEs are leached. It is considered that infiltration and adsorption on clays are two main processes controlling the enrichment and formation of REE deposits in the weathering profiles. Remarkable Ce anomalies (2.9±4.1 in the leachable fraction; 3.4±4.3 in the residual fraction) in the profile may indicate seasonally dynamic translocation and inhomogeneous weathering patterns, consistent with prior research reporting Ce (IV) co-precipitation with Mn oxides/hydroxides. The difference in chemical composition between the weathering profile and river sediment samples suggests the importance of quantitative understanding of hydraulically controlled compositional variability. Understanding chemical variability of the weathering profile and river sediments is a fundamental pre-requisite to fully interpret the sediment source to sink processes, especially with diverse controlling factors including provenance, weathering and hydrological sorting.

Keywords: chemical weathering, sediment transport, rare-earth elements, source to sink, China

Forest Cover Change Detection of Sundarbans Mangrove Forest, Bangladesh: An Application of Landsat Satellite Images

FEROZE AHMED KANAK[1], MD MIZANUR RAHMAN[1], MOHAMMAD SHAHIDUL ISLAM[1], MD. NASRAT JAHAN[1], SUDIPTA KUMAR HORE[1], MD IMRAN HASAN[1]

[1] Center for Environmental and Geographic Information Services (CEGIS), Dhaka, Bangladesh (fkanak.cegis@gmail.com; mizanfwt04@gmail.com)

Mangroves in the tropical and subtropical coastal areas provides a multiple ecosystem services such as food and goods, first safeguard against cyclone and tidal surge, and keep an important contribution in mitigating climate change by storing large amount of carbon. These important wetlands are facing tremendous challenge to exist in the trends of infrastructure development and other land use changes. In this regards, periodic monitoring of mangrove forest cover is important. The present study in Sundarbans Mangrove forest Bangladesh used temporal Landsat images of TM, ETM+ and OLI sensors for detection of forest cover changes. Images were analyzed at five years interval basis from 1989-2014. Through unsupervised image classification the study areas were categorized into mangrove forest, non-forest land (fallow land, grassland, marshy land and char land) and water bodies. From the base year (1989) mangrove forest increased over the 25 years with a highest rate of increase (about 3.25%) in the interval of 2004-2009. On the other hand, non-forest areas decreased over the time with the exception of 2004-2009 interval when it increased by 6.6%. Moreover, water bodies decreased over the time with increase of mangrove forest area. The findings of the study would be helpful in sustainable management of the world largest mangrove forest as well as in policy making.

Keywords: Landsat imagery, mangrove forest cover, change detection

Mangrove Canopy Height Estimation over Sundarbans using global DEM TanDEM-X acquisition

SEUNG-KUK LEE[1] , TEMILOLA FATOYINBO[1], DAVID LAGOMASINO[1] AND MIZANUR RAHMAN[2]

[1] Biospheric Science Laboratory, NASA Goddard Space Flight Center, Greenbelt, Maryland, USA
[2] Center for Environmental and Geographic Information Services, Dhaka, Bangladesh

Mangrove forests are located along land-ocean interface in tropical and subtropical regions where wave energy is sufficiently low and suitable sediments are present. These unique ecosystems represent only 3% of the total forest area of the world, but they are among the most carbon-rich in the region, containing on average 1,023 Mg carbon per hectare (Donato et al., 2010). Therefore, mangrove ecosystems play an important role for global carbon storage and emissions. To quantitatively evaluate and understand mangrove ecosystems, in particular their carbon stocks, global-scale mangrove height map generation with a high spatial resolution has become important.

Polarimetric synthetic aperture radar interferometry (Pol-InSAR) is a powerful technique for the quantitative estimation of forest structure parameters using the coherent combination of polarimetric and interferometric SAR observables (Cloude and Papathanassiou, 1998). While earlier studies from airborne experiments at longer wavelength (e.g. L- and P-band) with short-term temporal baselines successfully showed quantitative forest canopy height estimation, more recently the potential of Pol-InSAR inversion at X-band has been investigated and assessed over a variety of forest test sites.

The TanDEM-X (TDX) is the first satellite SAR system at X- with horizontal polarization for 12-m resolution global digital elevation model (DEM) mapping. The TDX has additionally given us the first single-pass acquisition of polarimetric SAR interferometry (Pol-InSAR) data without temporal decorrelation effects. Recently, single- and dual-pol TDX Pol-InSAR techniques for mangrove forests have been developed and validated (Lee and Fatoyinbo, 2015). The approach indicated a great possibility for generating global-scale mangrove height and biomass maps using existing TDX acquisitions.

In the present study, we propose to generate country-scale mangrove canopy height estimates with a 12-m spatial resolution using TDX DEM acquisition. This mangrove canopy height could be used in developing carbon map for the world largest mangrove forest by using height based stand allometry in regular basis. This study focuses on the world largest mangrove forest, the Sundarbans situated in Bangladesh and India. The estimated mangrove heights are validated using field measurement data.

Keywords: mangrove, canopy height, TanDEM-X, single-pass

The Study on Change in Coral Reefs Cover Using Multi Temporal LANDSAT Imagery Data in Pangkajene Islands (PANGKEP), Spermonde Archipelago, South Sulawesi, Indonesia

LA ODE MUHAMMAD YASIR HAYA[1,2*], MASAHIKO FUJII[1]

[1] Graduate School of Environmental Science, Hokkaido University – Japan (yasir.haya@ees.hokudai.ac.jp)
[2] Faculty of Fisheries and Marine Science, Halu Oleo University- Indonesia

Pangkajene Islands (PANGKEP) in Spermonde Archipelago is a stretch of coral reef islands, situated at he west coast of South Sulawesi, Indonesia. Native people in this region have long regarded the coral reefs as sources of livelihood. Unfortunately, the pressure and threat to the coral reef has been increasing due to population growth. However, the current data and information regarding the status of coral reefs is not comprehensively available to be set as reference for management purpose. This study aims to assess the status of coral reefs and to visualize the change of coral reefs for 20 years (1994-2014) by using the multi-temporal LANDSAT Imagery integrated with field observation data in 2014. The methodology includes the Lyzenga (1981)'s transformation with the blue and green bands employed as an input, while the percentage of live coral cover was deduced from Point Intercept Transect (PIT) data observed at the sites. The results of LANDSAT image classification and spatial analysis show that the area of live coral reefs decreased from 7,716 hectares in 1994 to 6,885 hectares in 2002 and then to 4,236 hectares in 2014. This indicates that for the last 20 years coral reefs have been degraded by 3,479 hectares, or by 174 hectares per year. Analysis of coral transect data at several sites comes with "poor" category results with an average percentage of live coral cover approximately 24%.

Keywords: coral reefs, multi-temporal LANDSAT, Lyzenga's transformation, point intercept transect, coral cover

DISCUSSION ON THE FORMATION MECHANISM OF NATURAL CLAM GROUNDS IN TIDAL FLATS OF MEKONG DELTA

TONG PHUOC HOANG SON[1], NGUYEN PHI UY VU[1], BUI LAI[2]

[1] Institute of Oceanography
[2] Institute of Tropical Biology

Mekong Delta get abundance bio-resources of mollusk, in which Clam is one of sea production in tidal flats. The natural clam grounds distributed mainly on the east coast of Mekong Delta and stretch along the tidal flats of the provinces of Tien Giang, Ben Tre, Tra Vinh, Bac Lieu, Soc Trang and Ca Mau.

By mean of detail analyzing on the hydrodynamic and coastal geomorphologic processes in the tidal flats from dataset of multi temporal satellite images in combination with ecology and dynamic knowledge on live of Clam, allow us to explain the formation mechanism of the natural Clam grounds in tidal flat of Mekong Delta. The environmental and hydrodynamic characters relevance to the formation of natural Clam grounds have been analyzed in more detail, they include: the morphologic and geometric features of tidal flats, the characteristics of alongshore and tidal current system, the grain size of sediment, the exposure time and the distributed characteristics and specie component of the patches of mangrove forest. From obtained results, we divided into three main groups of natural clam grounds in Mekong Delta such as: the natural Clam's grounds in up-drift side of alongshore current, in down-drift side of alongshore current and the natural Clam's grounds in the edges of Flood Tidal Delta with difference formed mechanism and development.

Development of Cost-Effective Airborne Remote Sensing System for Coastal Monitoring

DUK-JIN KIM[1], JUNG-KYO JUNG[1], SEUNG-HEE KIM[1], KI-MOOK KANG[1], XU ZHEN[1], AARON SWAN[2], MICHAEL DUERSCH[2], SCOTT HENSLEY[3]

[1] School of Earth and Environmental Sciences, Seoul National University, Korea
[2] IMSAR LLC, USA
[3] Jet Propulsion Laboratory, California Institute of Technology, USA

Coastal lands and nearshore marine areas are productive and rapidly changing places. However, these areas face many environmental challenges related to climate change and human-induced impacts. Space-borne remote sensing systems may be restricted in monitoring these areas because of their spatial and temporal resolutions. In situ measurements are also constrained from accessing the area and obtaining wide-coverage data. In these respects, airborne remote sensing sensors could be the most appropriate tools for monitoring these coastal areas. In this study, a cost-effective airborne remote sensing system with synthetic aperture radar and thermal infrared sensors was implemented to survey coastal areas. Calibration techniques and geophysical model algorithms were developed for the airborne system to observe the topography of intertidal flats, coastal sea surface current, sea surface temperature, and submarine groundwater discharge.

Keywords: Airborne remote sensing; synthetic aperture radar; thermal infrared; coastal monitoring; interferometry

Evaluation of the Suspended Particulate Matter (SPM) analysis algorithm in the Yellow Sea

JEE-EUN MIN[1], JOO-HYUNG RYU[1], WEI XIONG[2]

[1] Korea Ocean Satellite Center, Koea Institute of Ocean Science & Technology, Korea (jhryu@kiost.ac.kr)
[2] Jiangsu Province Transportation Engineering Technology Research Center, China

The Yellow Sea is an optically complex water with the features of regional sea such as river discharge, bottom topography and sedimentary facies, etc. Furthermore, the monsoon from northwest in winter season enhance its complexity. In this area, the ocean color is influenced by lots of water constituents such as chlorophyll, suspended particulate matter (SPM), dissoved organic matter (DOM), bacteria, bubbles, and so on. Among them, SPM is the most important factor for the environmental monitoring of the Yellow Sea. One of the effective technique of SPM analysis for the large area is an ocean color remote sensing. But it is difficult to estimate the pricise values for the wide range of the SPM concentration, especially, extremely turbid values from the estuarine area of the Yangtze River (>1000 g/m^3). In this study we would like to evaluate the existing SPM algorithm using in situ. dataset obtained from the extremely turbid waters of Korea (Gyeonggi Bay and coastal area of Mokpo) and China (Yangtze Estuary and coastal waters of Jiangsu). The Geostationary Ocean Color Imager (GOCI), world's first geostationary satellite for ocean color, has been operational since July 2010. Using a large number of image data accumulated since the launch of the satellite we used the GOCI match-up dataset for SPM algorithm evaluation. In situ. bio-optical and marine environmental data obtained from 2009 to 2014 in the Yellow Sea were analzed. As a result of the algorithm performance for standard SPM algorithm on GDPS v1.3, SPM is mainly tended to be underestimated. Large amount of errors by SPM are induced for the extremely turbid area. These errors are primarily found in the coastal waters having relatively high levels of aSPM contribution of more than 60%.

Keywords: Ocean color algorithm, optical characteristics, suspended particulate matter, GOCI

Seasonal variability of the suspended sediment around the Heuksan mud belt

YOON-KYUNG LEE[1], JONG-KUK CHOI[1,2], JINAH EOM[1,3], SEOK YOON[1] AND JEE-EUN MIN[1]

[1] Korea Ocean Satellite Center, Korea Institute of Ocean Science& Technology, Korea (eunicelee@kiost.ac.kr)
[2] Marine Environmental System Science, Korea University of Science & Technology, Korea
[3] Earth System Science, Yonsei University, Korea

Suspended particulate matter (SPM) acts as an indicator of turbulent flow quantities, allowing the creation of a vertical profile of particulate settling velocities and vertical mixing processes (Pleskachevsky et al., 2011). SPM patterns observed at the water surface are affected by bathymetry, seasonal stratification, turbulence, and freshwater (Choi et al., 2014; Neil et al., 2012). Therefore, understanding the spatial and temporal distribution and variability of SPM is of great scientific interest. The purpose of this study was to explain intra-annual variabilities in remotely sensed suspended sediment distribution and surface temperature (SST) around the Heuksan mud belt (HMB) in 1 sample year, 2013. The monthly composite of SPM and SST delineated the distributional change in the HMB, indicating that intra-annual variability was primarily linked to changing meteorological inputs, such as a dominant, strong northwesterly wind from monsoons and decreasing horizontal radiation in the winter, and dominant southeasterly wind flow and increasing surface heating in the summer. The tongue-shaped thermohaline front, monsoon winds, and bathymetry limited the spread of SPM at the southern part of the HMB in winter. In conclusion, seasonal dynamics of sediment movement around the HMB can be effectively detected using GOCI.

Keywords: GOCI suspended particulate matter, Heuksan mud belt, Suspended sediment dynamics

Hourly Variability of Suspended Sediment Distribution in the Yellow River Estuary Observed by Geostationary Ocean Colour Images

TINGWEI CUI[1], JIE ZHANG[1], YANLING HAO[2]

[1] First Institute of Oceanography, State Oceanic Administration, 6 Xianxialing Road, High-Tech Park, Qingdao 266061, China (cuitingwei@fio.org.cn)

[2] Inner Mongolia University, 235 Daxuexi Road, Huhhot 010021, China

We propose a new algorithm to retrieve the suspended sediment concentration in the highly turbid waters of the Yellow River estuary from satellite data of Geostationary Ocean Color Image (GOCI). When compared with the synchronous in situ observations, the GOCI derived suspended sediment concentions show the absolute percentage of difference of less than 20%. With GOCI images and the new algorithm, the hourly variability of the suspended sediment concentration in the study area is analyzed and different patterns of the temporal variation is found. The research result demonstrates the GOCI capability and potential towards better understanding of the settling and transportation of terrestrial suspended sediment.

Keywords: suspended sediment, Geostationary Ocean Colour Image (GOCI), remote sensing

A new web-based service of value-added products derived from GOCI data

CHENG-CHIEN LIU[1,2] AND HSIAO-WEI CHUNG[1]

[1] Department of Earth Sciences, National Cheng Kung University, No 1, Ta-Hsueh Road, Tainan, Taiwan 701 R.O.C. (ccliu88@mail.ncku.edu.tw)

[2] Global Earth Observation and Data Analysis Centre, National Cheng Kung University, No 1, Ta-Hsueh Road, Tainan, Taiwan 701 R.O.C.

This paper reports a new web-based service of three value-added products derived from Geostationary Ocean Colour Imager (GOCI) data. The first product is an auto-generated mask of cloud, cloud shadow, snow and water, based on the technique developed for Landsat TM and ETM+ images. The open source C code released by the USGS EROS Centre was modified to process GOCI data. Since the water body can be clearly separated from those regions contaminated by clouds or shadows, the contrast of true colour composite can be much enhanced to improve the visual effect and generate the second product, namely the adaptive contrast enhanced composite. This new product reveals a lot of details of the fine structures of eddies and fronts near the coast. To fully exploit the advantage of high-temporal-resolution of GOCI observations, the technique of superoverlay is employed to generate a standard set of image pyramid that completely conforms with Google Earth and Google Map. Powered by cloud service, the web-based system enables the users to access the third product: an animation file to display the full-temporal and full-spatial resolution of GOCI data at any location within any time frame. These three new value-added products are now made available by Global Earth Observation and Data Analysis Centre.

Keywords: GOCI, mask, cloud, shadow, contrast enhancement, superoverlay, web-based system.

Monitoring of Volcanic Activity of Augustine Volcano in Alaska using InSAR Time-series Analysis

CHANG-WOOK LEE[1] AND SU-KYUNG KIM[2]

[1] Division of Science Education, College of Education, Kangwon National University, Korea (cwlee@kangwon.ac.kr)
[2] Department of Geoinformation Engineering, Sejong University, Korea

Augustine Volcano, located along the Aleutian Arc, is one of the most active volcanoes in Alaska and nearby islands, with seven eruptions occurring between 1812 and 2006. This study monitored the surface displacement before and after the most recent 2006 eruption. For analysis, Envisat radar satellite data were collected between 2003 and 2010 and processed the small baseline subset (SBAS) approach, one of the time-series analysis techniques using multiple InSAR data sets. We also conducted a time-series analysis on data observed at the permanent GPS observation stations in Augustine Island between 2005 and 2011 to compare surface displacements using SAR data.

According to the surface displacement analysis results based on GPS data, the movement of the surface inflation at the average speed of 2.3 cm/year three months prior to the eruption has been clearly observed, with the post-eruption surface deflation at the speed of 1.6 cm/year. . This surface deflation phenomenon observed in the northern slope of Augustine Volcano is also seen in the time-series data observed at the AV18 permanent GPS observation station.

Keywords: surface deformation, GPS, InSAR, SBAS, volcano monitoring

Three-dimensional measurement of surface deformation for the March 2011 Kamoamoa fissure eruption using multi-temporal COSMO-SkyMed images

MIN-JEONG JO[1], HYUNG-SUP JUNG[2], AND JOONG-SUN WON[1]

[1] Department of Earth System Sciences, Yonsei University, South Korea (owen009@yonsei.ac.kr)
[2] Department of Geoinformatics, The University of Seoul, South Korea

Interferometric Synthetic Aperture Radar (InSAR) is a powerful method for the quantitative measurement of surface deformation using imaging-based approaches. Despite the frequent use of the InSAR method in geologic studies, it has the main limitation that it can only measure the surface displacement along the satellite's line-of-sight (LOS) direction. Multiple-aperture SAR interferomety (MAI) method is able to compensate the deficiency of the InSAR method by measuring the along-track displacements, and it in turn enables us to retrieve the precise three-dimensional (3D) displacement of surface motion. In this study, 3D surface deformation has been retrieved for the March 6-9, 2011 (UTC dates), Kamoamoa fissure eruption along the East Rift Zone (ERZ) of Kīlauea Volcano, Hawai'i, through the integration of the conventional InSAR and MAI measurements. To measure the co-eruptive surface deformation, multi-temporal COSMO-SkyMed X-band SAR images were collected befor and after the volcanic event from the ascending and descending orbits. From the 3D deformation field, magma chamber model beneath the Kīlauea caldera was estimated. While the simple point source was suggested by the InSAR measurements in several studies, 3D measurements confirmed that the spheroid source model is more appropriate for characterizing a magma chamber at Kīlauea caldera. The performance comparison of modeling by the InSAR and 3D measurements showed that the 3D measurements allow more precise model parameter estimation. More realistic model would be beneficial for a better understanding of the magma behaviour in volcanism.

Keywords: InSAR, Three-dimensional measurements, Kīlauea Volcano, COSMO-SkyMed, magma chamber model

Coastal Zone Bathymetry Derived from Landsat-8 Satellite Imagery

SOONHO HWANG[1], YONG HWAN KIM[2 *] AND YOUN GYOUN LEE[3]

[1] Department of Research, Korea Environmental Science & Technology Institute, Inc., South Korea
[2] Managing Director, Korea Environmental Science & Technology Institute, Inc., South Korea (kimyh@kesti.co.kr)
[3] Vice chairman, Korea Environmental Science & Technology Institute, Inc., South Korea

Coastal zone (< 200 m) is used extensively and increasingly for a large number of activities like tourism, water sports, industry, trade and transport, etc. So, bathymetry information of coastal zone is a key element of management to safety for ocean activities. Landsat imagery data has been used as input data with empirical modeling of coastal zone bathymetry for a long time. Recently, USGS distributed Landsat 8 imagery data and it has new band, which is called the coastal blue band. By comparing the coastal blue and the blue bands (existing Landsat 7 blue band), because coastal blue band has much shorter wavelength than blue band, coastal blue band have further to travel through the water. To address these issues, in this study, we did empirical modeling for estimating water depth of costal zone around the Jeju Island of South Korea using Landsat 8 coastal blue band. And the purpose of this study was to confirm the usefulness of coastal blue band and find suitable method for modeling coastal zone bathymetry. For estimating water depth, we used two different methods. The first method is a single band algorithm (SBA), using either Blue band or Coastal Blue band of Landsat 8 imagery. The second method is ratio algorithms, using a pair of wavelength bands. Combinations of pair bands are green & blue band and blue & coastal blue band. Finally, we compared and analyzed the four different results and chose most appropriate method and combination for estimating water depth and producing bathymetry variation for 1-year of Jeju Island. This study results can contribute to managing bathymetry information derived from satellite imagery.

Keywords: Landsat 8 satellite, coastal blue band, satellite imagery, bathymetry, coastal zone

Classification of intertidal sediment using a two-step PCA of optical remote sensing: A case study in the west coast of Korean peninsular

DONG-JAE KWON, WOOK PARK, JOONG-SUN WON[1]

[1]Department of Earth System Sciences, Yonsei University, Republic of Korea (wintrtree@yonsei.ac.kr)

Tidal flat sediment distribution is an important factor for understanding of coastal erosion, change of ecosystem, pollution processes, and sedimentary process in coastal area. Changes of the surface sediment on tidal flats of the west coast of Korea were invesitigated by extensive research. However, the result of these researches are limited temporally and spatially because field surveys in the tidal flats are restricted due to the difficulty of acess. In this reason, the remote sensing is an effective tool for monitoring of tidal flat characteristics.

Tidal flat reflectance is sensitive to conditions that constantly change and cause varation of interstitial water contents along with exposure time, remnant water, and so on. It is difficult to retrieve sediment grain size from optical reflectance alon without correcting the tidal condition effects. In this study, the tidal flat surface reflectance model according to grain size is proposed by two-step PCA transformation to remove tidal effects. The proposed method showed a potential to classify sediment by grain size regardless of exposure time and tidal conditions. We applied the proposed method to LANDSAT-8 OLI and GOCI images. Although both images are different in terms of their spectral channel, spatial resolution, the preliminary results well demonstrated that the proposed approach is effective to monitor changes of grain size distibution at a large scale independent of tidal conditions.

Keywords: Optical remote sensing, Surface sediment, Tidal flat, LANDSAT-8, GOCI

CCOP-KIGAM New Initiative Project on Unconventional Resources: Assessment of Shale resources in Asian Region

YOUNG J. LEE [1] AND B.K SON[1]

[1] Korea Institute of Geoscience and Mineral Resources, Korea (yjl@kigam.re.kr)

Shale resources which include shale oil and shale gas are very important energy resources that humankind should develop continuously, although the development and production have recently slowed down due to a sustained decline in oil prices. The shale oil and gas revolution that was initiated in the United States has achieved great success in terms of commercialization due to the technology development such as horizontal drilling and hydraulic fracturing. Their impact has been so enormous that the framework for energy policies globally should be reshaped.

According to the analysis of Energy Information Administration (EIA) and Advanced Resources International (ARI), about 18% of the world's shale resource reserves are distributed in Asia including China, Indonesia, Thailand, and Mongolia etc. In cooperation with the CCOP, KIGAM has launched a project to evaluate the shale resources in Asia for efficient exploration and development of shale reservoirs distributed in Asia.

CCOP is an inter-governmental organization that was founded in 1966 under the auspices of the United Nations and its current membership consists of 14 Asian countries. For the past five decades, CCOP has carried out joint research programs to address key issues in the field of geological resources in the region through mutual cooperation as well as to improve the quality of life and to achieve sustainable growth in Asian countries.

The KIGAM-CCOP Unconventional Energy Resources Project is designed to gather together representatives from the 14 CCOP member countries to conduct an assessment of shale resources for the major sedimentary basins in the member countries. The eventual aim of the project is to draw up an integrated map of Asian shale energy resource reserves and explore the potential and methodologies of shale resources exploration and development in the region.

Keywords: shale resources, shale oil, shale gas, KIGAM, CCOP

Distribution of fault systems related to hydrocarbon exploration in the Ulleung Basin, East Sea (Japan Sea)

SIK HUH[1], IN-CHANG RYO[2], SEJIN PARK[3]

[1] KIOST(Korea Institute of Ocean Science & Technology), Ansan, Korea (sikhuh@kiost.ac)
[2] Kyungpook National University, Daegu, Korea
[3] KNOC(Korea National Oil Corporation), Ulsan, Korea

To identify the distribution of faults in the Ulleung Basin of the East Sea, we have conducted the multi-channel seismic reflection survey, Chirp subbottom profiler, and SeaBeam aboard the R/V Onnuri since 1996. Basin analysis is currently underway on, such as stratigraphic sequences of sediment layers, chronological and geological structures, fault distributions, seismic facies, paleo-channel distributions, and tectonic evolution. The basin shows complex fault geometries such as normal, reverse, strike-slip, and wrench faults. Generally, the region shows the NW-SE fault trends and at present an east-west maximum horizontal compressive stress in a reverse faulting tectonic regime. It is very hard to find the rift-bounding faults visible in deep seismic section before Miocene age. Regional compression in the south of the Ulleung Basin resulted in uplift and thrusting faults occurred along the Dolgorae structures in the Late Miocene. Other areas are characterised by widespread extensional normal faults confined to the shallow seismic section. Many normal fault regions show small vertical displacements in the seismic sections. Some Pliocene sections shows the crestal area of the anticlines related to fault activities. These fault systems should influence on migration and breaching of some hydrocarbon reservoirs. Fault systems will supplement the potential impact on the hydrocarbon prospects.

Keywords: Ulleung Basin, normal fault, thrust fault, strike-slip fault, hydrocarbon prospect

The evidence of the marine algae dolomite of Sinian Dengying Formation in Sichuan Basin as the effective source rocks of the Anyue giant gas field and discussion on relevant items

YOUWEI WANG[1] AND XIONGQI PANG[1,2]

[1] School of Geosciences in China University of Petroleum, Beijing,102249, China (wangyouwei950@163.com)
[2] State Key Laboratory Petroleum Resources and Prosepecting in China University of Petroleum, Beijing,102249, China

It reveals people huge exploration prospect of the deeper part of basins that the Anyue Sinian−Cambrian giant gas field was discovered in central paleo-uplift, Sichuan basin in 2013, whose reserves can be as large as 1.6×1012 m3. It is a breakthrough in the exploration of ancient stratum. However, the gas origin is still in heated discussion. Whether the marine algae dolomite can be effective is of great significance. Drilling and well-logging data are integrated to analyze the geological characteristics, which certifies its wide distribution and huge thickness. Outcrops, cores and cuttings sampled from both the field and drill core stores are used to conduct geochemical studies such as Total Organic Carbon and Rock Eval Pyrolisis which demonstrate it to be good source rocks with high abundance, good kerogen type and high thermal evolution rate. Moreover, the buried history of the algae dolomite in Well Moxi 8 is simulated, and four stages of hydrocarbon generation can be divided: hydrocarbon generation, suspension, re-generation as well as cracking and expulsion. Finally, the hydrocarbon expulsion pattern is established using generation potential method, which found the expulsion threshold corresponds to the depth of 6050m and the Ro of 3.0%. It is controversial that the period of large amount of hydrocarbon generation greatly lags behind that of hydrocarbon expulsion. Based on comprehensive analysis, it is concluded that the early generated oil was residual in the source rocks and then cracked after a long time and finally expulsed out. What we call hydrocarbon expulsion threshold here refers to the gas expulsion threshold.

Keywords: Sichuan Basin; marine algae dolomite; effective source rocks; Anyue Giant Gas Field

Sequence stratigraphy and sedimentology of the Middle to Upper Miocene strata of the southwest Ulleung Basin in the East Sea, with implications for future exploration

YONG SEOK CHOI[*1], JAE HEON SHIM[*2], CHANG LYEOL UM[*2]

[1] GeoClew E&P Consulting, Seoul
[2] Korea National Oil Corp., Ulsan, Korea

The Middle to Upper Miocene strata of the Ulleung Basin in the East Sea consist mainly of alternating beds of sandstones and mudstones. Periodic repetition of delta progradation developed upward-coarsening depositional sequences bounded by erosional unconformities, which are recognized in seismic section. In shelf strata, the upward-coarsening sequences consist of basal mudstone grading upward into sandstone-dominated top.

The Middle Miocene sequences show aggradation in stacking pattern whereas progradation is prominent in the Upper Miocene sequences showing rapid basinward-shifting of shelf edge. The stacking pattern of the sequences seems to have been controlled by the relationship between long-term change in accommodation space and sediment supply. Rapid progradation of the Upper Miocene sequences indicates that the rate of sediment supply was higher than the rate of accommodation space increase. Relatively thick vertical accumulation of the Upper Miocene sequences, however, implies that the rate of accommodation space increase was also very high during Late Miocene compared to Middle Miocene.

The high rate of sediment supply was probably related with a compressive tectonism in the Late Miocene, which resulted in uplifting and erosion of southeastern part of the Ulleung Basin. The high rate in accommodation space increase in northwestern part of the Ulleung Basin indicates that subsidence was continuous in this area despite of the overall compressive tectonism in the Late Miocene. Long-term increase in global sea level in the Late Miocene was probably another controlling factor that resulted in continuous increase in the accommodation space.

A-few-hundreds meters' erosional relief observed in the sequence boundaries along the shelf margins in the Ulleung Basin strata is possibly originated from submarine canyons developed under the sea level during periods of relative sea-level fall. Interpretation of the nature of the erosional relief leads to determine the magnitude of relative sea-level fall relative to shelf break. Determination of the magnitude of sea-level fall relative to shelf margin is very important because it is closely related with reservoir quality of submarine fan sediments deposited on basin floor during the relative sea-level fall.

In case of low magnitude fall, submarine fan sediments developed on the basin floor are mud-dominated supplied by debris-flow whereas basin floor fans developed during high magnitude fall are sand-dominated supplied by sand-rich turbidity currents. Therefore, depending on the interpretation of the origin of the erosional relief, the exploration strategy for the deep-water sediments in the Ulleung Basin should be carefully decided.

Study on the Chalk Reservoir in Deep-water Area

JIE ZHANG[1]

[1] PetroChina Hangzhou Research Institute of Geology, China (zhangj_hz@petrochina.com.cn)

The micro-porosity in chalk is one of the most important reservoirs in the world. The chalky-textured glohigerina coccolith bioclastic limestones with high porosity and low permeability were discovered in deep-water area of North Sea, Iraq and South China Sea. SEM, thin sections observing, micro-CT, capillary pressure analyses were used to study the pore structure of the chalk samples. The chalk with 5.346-60.907 billion coccoliths and pelagic foraminifers' individuals /cm3 deposited on the pelagic seafloor above the CCD interfaces. The sea level oscillations controlled the input of the siliclastics and were accordingly propitious to the sedimentation of Chalk. The pore diameters are between 0.2-7μm in Chalk. 3 kinds of pores types (coelomopores, inter-granular pores and dissolution pores) and 2 kinds of pore-throat structures (porous with very low permeability, porous with medium permeability) in chalk were discovered in deep-water area. The samples with high porosity (10-35%) and very low permeability (0.01-5md) has good pore sorting under mercury ejection. The samples with high porosity (15-35.8%) and medium permeability (10-30md) were mixed with some millimeter scale foraminiferas and from the relative higher areas. 3 kinds of diagenetic factors (penecontemporaneous dissolution, pressure dissolution and diffusion effect) were distinguished to study the porosity evolution. A comparative study suggests that the deep-water globigerina coccolith bioclastics can be transformed into high-quality reservoir through turbidity current or contour current.

Keywords: Chalk, Deep-water Area, Microporosity, Diagenetic Factors

Numerical Simulation of Petroleum Generation and Migration in the Tertiary Marine Basin, Offshore Southeastern Korea

BYEONG-KOOK SON[1] AND MEE-SOOK PARK[1]

[1] Korea Institute of Geoscience and Mineral Resources (KIGAM), Korea (sbk@kigam.re.kr)

The numerical simulation of petroleum system was conducted on the Ulleung Basin which is a Tertiary marine basin in the offshore area of southeastern Korea, from which natural gas and condensate has been produced. Effective source rocks have not been identified in the area. However, 1-D modelling and isotope data indicate that the source rock of the natural gas and condensates might be present at deeper strata than 5,000 m in the basin. Type II kerogen is also suggested for the source rock by the analysis of diamondoids in the condensates.

Based on the source rock information and other geological data, 2-D modelling was performed on two cross sections across the basin: one is a SW-NE section in the southwestern margin of the Ulleung Basin and the other is a S-N section across the main basin. In the section of the southwestern margin of the basin, the 2-D model shows that the generation and migration of hydrocarbon are constrained greatly by regional seals as well as sedimentation rate and source rock geometry. The generation starts first in the deeply buried part of the source bed at 15Ma, caused by high sedimentation rate. The expelled hydrocarbon, however, migrates and diffuses toward the surface. The generation also occurs at around 11Ma from the other pod of the source bed. This hydrocarbon migrates updip toward anticlines and accumulated into the traps of the anticlines.

In the S-N section across the deep marine area, the generation and expulsion of hydrocarbons occur at deeply buried source formations during the period of 15-11Ma. The hydrocarbons expelled from the deep pod of the source formation migrate not only updip northward toward anticline traps but also upward along the faults developed in the southern part of the basin. Accumulation is filled mainly with gas, rather than oil.

Keywords: numerical simulation, petroleum system, Ulleung Basin

Basin Evolution of Precaspian Basin and its impact on Petroleum System

YUNJI LEE*[1], WANSOO KIM[1], INYOUNG CHOI[1], NAYOUNG YEOM[1], YONGJOON PARK[1]

[1]Korea National Oil Corp., Ulsan, Korea (yunjilee@knoc.co.kr)

Precaspian Basin consists of the Devonian to Miocene strata. Carbonate platform and build-up were deposited in the southern and eastern margin of basin from Devonian to Carboniferous. Ural orogeny occurred in basin from Carboniferous to Early Permian, and Kungurian salt regionally was deposited in basin that was enveloped along Ural orogenic belt at middle Permian. After Late Permian, Clastic sediments were deposited above Kungurian salt, and they were deformed due to salt movement. At Late Triassic, southern margin area was uplifted and deformed because of Cimmerian orogeny. Basin became stabilized after Jurassic and affected mainly by eustacy, rather than tectonic event.

To study the generation and migration of hydrocarbon, the most important factor is the burial history. In Precaspian Basin, the burial history of source rocks, which were the Devonian to Carboniferous strata, was mainly affected by tectonic history and salt movement.

In the tectonic history of Basin, there is a regional distinct character. The southern margin of Basin was uplifted according to the severe tectonic movement of Ural and Cimmerian orogeny, while the central deep sub-basin was not influenced by the orogeny. Therefore southern margin of maturity and transformation ratio are lower than the central deep sub-basin.

Salt movement brought the difference of overburden strata in Basin. In case of eastern sub-basin, Kungurian salt actively moved from Permian to Triassic. Accordingly thick Permo-Triassic strata was deposited in salt minibasin. However salt in south eastern sub-basin moved less actively than in eastern sub-basin. Therefore Permo-Triassic strata in south eastern sub-basin were thinner than in eastern sub-basin. Consequently hydrocarbon generated faster by occasion of thick Permo-Triassic strata in eastern sub-basin than in south eastern sub-basin.

As listed above, basin architecture and evolution have a large impact on the Petroleum System history. Therefore to understand Petroleum System of Basin, it is important to study the basin architecture and evolution.

Keywords: Precaspian Basin, Basin architecture, Petroleum System.

Technical Evaluation Process of Unconventional Resource for Marine Organic-rich shales

*YURI LEE[1], SUKYEON, HWANG[1]

[1] Department of Strategic Resource, Korea National Oil Corporation, South Korea (yuri-lee@knoc.co.kr)

Organic-rich shale originated from marine environment is a good target for unconventional hydrocarbon reservoir because of their wide distribution in the world. Generally shales are very complex reservoir. They show significant variety in reservoir characteristics (i.e., mineralogy, porosity, permeability, gas content, and pressure). Shale (or unconventional reservoir), self-sourced reservoir, represent a unique reservoir due to their very low permeability (ex. 10-4 to 10-8 mD). Identifying whether a given shale play has good reservoir quality and where the likely sweet spots are located requires a detailed understanding and interpretation of all available geological data, from core to well logs.

Key data to find where is 'Sweet Spot' in my shale play: 1) Regional geology data (ex. structure map, thickness map, depth map, burial history, deposition environment) 2) Geochemical data (ex. Kerogen type, Source rock maturity, Total organic carbon (TOC) content, HI and OI, Chemical sensitivity of reservoir) 3) Geomechanical data for hydraulic fracturing (ex.Young's Modulus, Poisson's ratio, Brittleness Index) 5) Mineralogical composition and brittleness and 6) Pore type, Porosity, Permeability 7) Stress regime for horizontal drilling.

The reservoir characterization of my self-sourced shale reservoirs is very important key to successful production and operation in the field. It is different from that of conventional reservoir evaluation as the production rate of unconventional resource is generally influenced by well completion design. Geologist inform engineers the key reservoir parameters for their better well completion design such as brittleness, porosity, permeability, water saturation using the above geological data. It is intended to introduce the methods to get the key parameters using geological data for the evaluation of unconventional resource potential.

Keywords: Unconventional Resource, Organic-rich shales, Evaluation Process

Geological characteristics of the bituminous Grosmont carbonates, Western Canada Sedimentary Basin, Alberta

KOOKSUN SHIN*[1], YOUNGRAK CHOI[1], JINO PARK[2] AND SUK-JOO CHOH[2]

[1] Technology Development Department. Korea National Oil Corporation, Korea (kooksun.shin@knoc.co.kr)
[2] Department of Earth and Environmental Sciences, Korea University, Korea

Carbonate reservoirs are notorious for their heterogenetic properties and hence their development is often hampered by lack of comprehensive understanding of complex reservoir characteristics. Unlike siliciclastic reservoirs which are largely controlled by depositional environment and paleogeography, carbonate reservoirs are primarily affected by diagenesis and thus traditional facies analysis is only helpful in areas with minimal diagenetic overprint.

The Late Devonian Grosmont Formation is widely distributed over approximately 100,000 square kilometers in the subsurface of central to northwestern Alberta and contains low gravity (5-9°API) bitumen along the eastern erosional edge of the Devonian carbonate platform. This bituminous oil has never been commercially produced because of the high viscosity and extremely heterogeneous nature of the reservoir. Complex and irregular fractures in the reservoir are part of a main cause of failure of previous pilot productions. Potential application of SAGD method successfully deployed in many oil sand fields warrants the 3-dimensional understanding of the Grosmont reservoirs.

The Grosmont reservoir consists of four stacked carbonate units interbedded with shale and marls. The reservoir intervals are Lower Grosmont(LG) and Upper Grosmont members(UG1, UG2, and UG3) in ascending order. We combined detailed log data, core descriptions, regional subsurface mapping and reservoir characterization modeling. Heavily dolomitized UG2 Member of the Grosmont Formation is underlain by relatively thick (5-10 m) shale (SB2) and overlain by relatively thin (0-3 m) shale (SB3). Intercrystalline porosity by dolomitization and moldic and vuggy porosity by dissolution provide a main storage space for bitumen. Most important porosity is randomly oriented fractures that are conduits of oil movement as well as storage space. The fracturing and karstification are mainly developed in dolomitized lithofacies and tend to intensified toward the eastern erosional edge.

Unlike the previous exploration efforts have mainly been focused in the karstified area, the present study aims to avoid heavily fractured area in order to avoid steam leakage during in situ thermal recovery. The potential target area may be selected based on porosity, reservoir thickness, presence of seal rocks, as well as higher HC saturation, especially in the UG2 and UG3 member away from the eastern erosional edge. This new play concept of Grosmont bitumen could also be used for locating several similar targets within the Nisku and Leduc formations.

Keywords: bitumen, carbonate, Grosmont Formation, play

3D geological modeling and numerical simulation analyzing of seafloor hydrothermal sulphide resources in the Longqi hydrothermal field

JIANPING CHEN[1,2,3], MENGYI REN[1,2,3], KE SHAO[1,2,3]

[1] School of Earth Sciences and Resources, China University of Geosciences, Beijing 10083, China (3s@cugb.edu.cn)
[2] Institute of Land Resources and High Techniques, China University of Geosciences, Beijing 10083, China
[3] The Beijing Key Laboratory of Development and Research for Land Resources Information, China University of Geosciences, Beijing 100083, China

Hydrothermal sulfides have attracted more attentions, which are regarded as one of the potential seabed mineral resources for their high grade of precious metal elements such as Cu, Zn, Pb, Au, and Ag. In 2011, the China Ocean Mineral Resources Research and Development Association and International Seabed Authority signed a contract for exploration 10,000 km2 of a hydrothermal sulfides area located on the Southwest Indian Ridge (SWIR), and only 25% of the area will be permitted to retain in 2021. According to the metallogenic theory and the quantitative prediction evaluation process of seafloor sulphides, this paper takes the Longqi field as the typical study area. In 2007, Longqi field was found at 49°39′E/37°47′S, SWIR, which is the first active field found on the ultraslow spreading ridges. We collect geological data, geophysical data and some other related data to establish a 3D geological model of Longqi field including surface model, tectonic model and oceanic crust model. And then, with the existing experimental results and basic geological data, we employ the software FLAC3d to do the coupled mechanical-thermal-hydrological numerical simulation of hydrothermal metallogenic processes for sulfide deposits in Longqi field. The quantitative prediction process is based on the ore-caused anomaly while the numerical simulation is base on the ore-forming anomaly. The established 3D model for Longqi field can describe the process of hydrothermal fluid flow within the oceanic crust and simulate the development of the process affected by various factors in space and time. It can visually and scientifically reproduce the evolution of hydrothermal activity and predict possible places for the eruption of hydrothermal fluid. In this manner, we can verify the accuracy of the prospecting target location from another perspective.

Keywords: 3D geological modelling; Numerical simulation; Seafloor hydrothermal sulfides; Longqi hydrothermal field; Southwest Indian Ridge

Carriers and source of REY in the Central Indian Ocean Basin sediment

DASONG HUANG[1], XIAOYU ZHANG[2]

[1] hds@zju.edu.cn
[2] Zhang_xiaoyu@zju.edu.cn

To study the carriers and source of rare earth elements and Yttrium(REY) in the Central Indian Ocean Basin(CIOB) sediment, X-ray diffraction (XRD) test, microscopic observation, elements test, and electron probe analysis were taken on a 1.4m long sediment core located in the CIOB. The core consist of major amorphous substance, phillipsite, quartz; minor calcite, smectite, amorphous Fe-Mn oxides and fish debris(amorphous bio-apatite), though the bottom samples are Fe-rich and Ca-rich. In this sediment core, the range of total REY(∑REY) is from 685.5 to 1392.2 ppm(1072.2 ppm in average), which is higher than the reported REY-rich mud in the Wharton Basin, Eastern Indian Ocean. Normalized pattern of REY shows an enrichment in middle rare earth elements(MREEs), apparent negative Ce anomalies and slight positive Y anomalies. Strong correlations of ∑REY against P2O5 and MnO indicate the carriers of REY are likely to P-phases and Mn-phase. An electron probe micro-analysis on fish debris were made, indicating that its constituent is close to the fluorapatite. In addition, δCe in the core decreases downward seemingly representing a more oxidizing environment in the bottom part of the core, however, other redox sensitive parameters such as Mo content, U/Th and V/(V+Ni) ratios increase downward all suggesting an opposite result. Thus, in this case, δCe is inappropriate to indicate a degree of oxidation but more due to the great influence of the pore water, taking the MREE-rich normalized REY pattern that different from deep-sea water into consideration, we deduce that the source of REY in the CIOB sediment core is more the pore water than the deep-sea water during the enrichment of REY and diagenesis process.

Keywords: REY-rich sediment, rare earth elements, Central Indian Ocean Basin, deep-sea sediments

Quantitative prediction and evaluation of polymetallic sulfide mineral resources in the Indian Ocean

SHAO KE[1,2], CHEN JIAN-PING[1,2], REN MENG-YI[1,2]

[1] China University of Geosciences(Beijing), China (914709527@qq.com)
[2].Institute of Land Resources and High Techniques, China University of Geosciences(Beijing)

Seafloor hydrothermal polymetallic sulfide deposits are one of the great potential exploitation seabed mineral resources. July 2011, approved by the council of International Seabed Authority, China has obtained 10,000 km2 seabed mining areas of exclusive exploration and priority mining rights in Southwest Indian Ocean, but would only reserved 2500 km2 for exploration by the year of 2012. However, because of the special marine environment and the metallogenic conditions, it is difficult to survey and explore polymetallic sulfide mineral resources, so how to explore them rapidly and accurately has become a primary task. On the basis of analyzing and summarizing the metallogenic conditions and ore-control factors of polymetallic sulfide in Indian Ocean, we extracted 9 evidence factors, such as bathymetry, geological structure, gravity, magnetic and earthquake to establish a model of regional ore deposits, then the weights of evidence method was adopted to predict and evaluate the polymetallic sulfide in Indian Ocean. According to the value of posterior probability, six metallogenetic prospective areas were delineated and among them 4 were classified as A level and 2 as B level. The results of the research will provide a scientific basis for the further exploration of seafloor hydrothermal polymetallic sulfide resources in Indian Ocean and could also be used as a reference for exploring seafloor hydrothermal polymetallic sulfide resources in other oceans.

Keywords: Indian Ocean; Hydrothermal polymetallic sulfide; metallogenic prediction; weights of evidence

The accretional structures of the Central Indian Ridge and hydrothermal acitivity at off-axis between 7°S and 17°S

SANG-JOON PAK[1], JONGUK KIM[1], SUN KI CHOI[1], JUWON SON[1], JUNG-KEUK KANG[1] AND JAI-WOON MOON[1]

[1] Korea Institute of Ocean Science and Technology, Korea (electrum@kiost.ac.kr)

High resolution mapping with geological sampling has been carried out in the Central Indian Ridge (CIR) between 7°S and 17°S. The CIR spreading axis between 7˚S and 17˚S are majorly offeset by three prominent transform (three first-order segments); Vema fracture zone (9˚30'S), Argo fracture zone (13˚30'S) and Marie Celeste fracture zone (17˚S). These first-order segments are subdivided by non-transfrom discontinuities (NTDs), i.e., small-scale discontinuities into seven second-order segments. In particular, the various accretional structures are freqeuntly observed in the CIR. In these suvery, ocean core complexes (OCCs) which represent the dome-shaped structure with corrugations and host mantle rocks within basaltic basement at off-axis were more intensively explored for their high abundances of hydrothermal activities. In suveryed regioin, four OCCs are situated on ridge-transform intersection (RTI) and seven OCCs are adjacent to NTDs. Outcrop of the OCCs observed in 8˚S and 11˚S are the ultramafic and gabbroic rock. The OCCs at 12˚30'S and 15˚30'S recognized in the uplifted and elongated-shape NTDs where host the serpentinite and/or gabbroic rocks. The OCC at 12˚30'S represent unique septal NTD and either tip of the NTD link with other OCCs at median valley flanks. OCC at 15˚30'S shows septum structure and divides segment 6 into two sub-segments. Gabbroic rocks and serpentinite exposure in the eastern part and western part of the NTD, respectively. These septum-shaped OCC in NTD are rare because those OCCs displays so elongated and narrow features that OCC may not be formed by such long- detachment faults and following fault-turnover. The differences of exhumed rocks at both ends of OCCs at NTD may be triggered by extension between two ridge tips progression in face each others. Hydrothermal ores and/or plumes are frequently identified over OCCs. Hydrothermal sulfides from OCCs are characterized by Cu-bearing massive sulfides (or their relatives) and fragments of low-temperature Zn-Ba chimneys. Greate methane concentration (up to 45 nmol/l) was often identified at water column above OCCs but water column has little light-scattering values. High methane and little particulates in the plumes implye that those hydrotehrmal fluids might be caused by ultramafic rock and seawater interaction. In particular, the basin like NTD at 11°S showing a oblique geometry has the hydrothermal activities. This oblique NTD is controlled by by left-lateral shear strain and forms a transtensional basin. The strong and frequent hydrothermal plume signals at the NTD are reflective of fractures associated with the basin formation.

Keywords: Central Indian ridge, ocean core complex, non-tranfrom discontinuity, hydrothermal plume, ultramafic¬¬

Metallogenic information extraction and quantitative prediction process of seafloor hydrothermal sulfide resources in the Southwest Indian Ocean

MENGYI REN[1,2,3], JIANPING CHEN[1,2,3], KE SHAO[1,2,3]

[1] School of Earth Sciences and Resources, China University of Geosciences, Beijing 10083, China (renmengyi@163.com)
[2] Institute of Land Resources and High Techniques, China University of Geosciences, Beijing 10083, China
[3] The Beijing Key Laboratory of Development and Research for Land Resources Information, China University of Geosciences, Beijing 100083, China

Seafloor hydrothermal sulfide resources exhibit significant development potential. In 2011, the China Ocean Mineral Resources Research and Development Association and International Seabed Authority signed a contract for exploration 10,000 km2 of a hydrothermal sulfides area located on the Southwest Indian Ridge (SWIR), and only 25% of the area will be permitted to retain in 2021. However, an exploration of seafloor hydrothermal sulfide deposits in China remains in the initial stage. According to the quantitative prediction theory and the exploration status of seafloor sulfides, we systematically proposes a quantitative prediction evaluation process of oceanic hydrothermal sulfide resources and divides it into three stages: prediction in a large area, prediction in the prospecting region, and the verification and evaluation of targets. This paper mainly focuses on the information extraction method and the prediction process. Ore-forming factors are collected from topography, geology, geophysics, and several other related aspects in the SWIR and favourable metallogenic information are extracted to establish an ore deposit prediction model of sulfide deposit. By employing the method of weights-of-evidence, the prediction result suggests that the central region of the SWIR has the highest posterior probability, which means that it has the best mineralization prospect. Known hydrothermal areas such as Mt. Jourdanne, area A and 10°E-16°E are all located in the areas with high posterior probability value. It also illustrates that the predicted result possesses a superior reliability. The Chinese contract area of 48°–52°E has the highest posterior probability value, which can be selected as the reserved region. By narrowing the exploration area and improving the exploration accuracy, the prediction will provide a basis for the further exploration of seafloor hydrothermal sulfide resources.

Keywords: Quantitative prediction process; Prediction model; Weights-of-evidence; Seafloor hydrothermal sulfides; Southwest Indian Ridge

Economic, technical and environmental considerations for deep-sea mining

RAHUL SHARMA[1]

[1] CSIR-National Institute of Oceanography, Dona Paula, Goa - 403004, India (rsharma@nio.org)

Minerals from the deep-sea, such as polymetallic nodules, ferromanganese crusts and hydrothermal sulfides, are potential sources of metals such as Cu, Ni, Co, Mn, Fe, and others that could be mined in future by developing suitable technologies for mining as well extracting metals from them. As on date about 22 'contractors' have been allotted large areas of the seafloor in the Pacific, Atlantic and Indian Oceans under the UNCLOS. Research and development of technology for mining and extraction, environmental studies are well underway for eventual deep-sea mining.

It is estimated that a typical area of 75,000 sq km with an estimated nodule resource of >200 mi t., is expected to yield about 54 million tonnes of metals (Mn+Ni+Cu+Co) and the gross in-place value of the metals is estimated to be ~$ 21-42 billion (depending upon the annual rate of mining) in 20 years life span of a mine-site. Similarly, the economic evaluation of mining the hydrothermal sulphides and ferromanganese crusts is underway.

Being 2-dimensional deposits, the mining system for nodules would be required to scoop up the loosely strewn minerals from the seafloor, in contrast to the 3-dimensional deposits of sulphides which may have to be drilled or crusts that may have to be scraped from rock outcrops on the seafloor. Whereas, evaluation of distribution characteristics such as size, abundance and grade would be critical in case of nodules; locating black smokers and their vertical extension and mining under high temperatures would be critical for sulphides; and estimating the thickness of the oxide layer in case of crusts would determine their mine-ability as they are embedded in rocky outcrops.

. Also, some of the challenges for operation of deep-sea mining systems would be to make them operational for ~300 days / year under extreme environmental conditions such as 1-2o C temperature, ~200-500 bars pressure, total darkness, cross cutting currents at different levels in the water column, uneven micro-topography, variable seafloor characteristics and heterogeneous mineral distribution.

From the environmental point of view, the mining plan must consider separation of the minerals from the associated substrates at the seafloor, discharge of debris after initial at-sea processing below the oxygen minimum zone and 'constructive' use of unwanted material after extraction of metals from the ores, to ensure minimum impact of deep-sea mining.

Distribution, Compositional Variability, and Growth History of Hydrogenetic Ferromanganese Crusts over the Northwestern Pacific Seamounts

A. USUI[1] , K. NISHI [1], H. SATOS[1] JAMSTEC[2] AND JOGMEC[3]

[1] Geology Dept. Kochi University (a-usui@kochi-u.ac.jp)
[2] Japan Agency for Marine-Earth Science and Technology
[3] Japan Oil, Gas, and Metals National Corporation

We have observed and analyzed the hydrogenetic ferromanganese crust deposits in the NW Pacific seamounts using ROV, dredge, submersible, and drills, jointly with JAMSTEC and JOGMEC. The mode of their occurrence over the seamounts, and the compositional variability of chemistry and mineralogy in space and time, indicate that most of the rock outcrops on the slopes, shoulders, and much of flat tops are covered with several cm to 10 cm thick crusts, but the thickness, metal contents, and microstructural properties are not always uniform over the seamounts but variable in space and time. The microstratigraphic description of selected whole-rock samples proved essential to characterizing a depositional history of hydrogenetic crusts, which controls the diversity in bulk composition and abundance as a result of pile of integration of iron-manganese precipitates during variable geological, physical and chemical conditions. We conclude that hydrogenetic precipitation of iron-manganese oxide have taken place for >20 million years or more at a growth rate about 4-6 mm/m.y. at any water depths below 1000m. The results are useful in exploring mineral deposits and economic resource estimation, and designing reasonable mining system, if supported by well-combined geological and oceanographic model of formation. The results indicate a fairly continuous and constant metal deposition during the middle Miocene age to the present.

Keywords: marine minerals, seamount, ferromanganese crust, ROV, northwestern Pacific, metal deposition

Geochemical characterization of manganese deposits along the Eastern Luzon Coast, Philippines: An initial step in the exploration of potential surface minerals on the Benham Rise Area

JUSTINE PERRY DOMINGO[1], JOHN CHRISTOPHER LAWRENCE MORILLO[1], AND CARLOS PRIMO DAVID[1,2]

[1] Environment Monitoring Laboratory, National Institute of Geological Sciences, University of the Philippines, Diliman, Quezon City, Philippines 1101 (jptdomingo@yahoo.com)

[2] Philippine Council for Industry, Energy, and Emerging Technology Research and Development, Department of Science and Technology, Bicutan, Taguig City, Philippines 1631

In 2012, the Commission on the Limits of the Continental Shelf (CLCS) of the United Nations adopted the Republic of the Philippines' Submission for an extended continental shelf in the Benham Rise region. This effectively gives the Philippines economic sovereignty over a seabed area of 135,506 km2 located east of Luzon Island. However, the area remains fairly unexplored despite its potential economic gains, particularly in terms of gas hydrates and surface minerals. This study aims to obtain clues on the minerals that can be possibly found in the Benham Rise through the investigation of possible ocean floor extensions onshore and their associated mineral deposits. In particular, manganese deposits in the eastern provinces of Cagayan, Isabela, and Aurora will be sampled for geochemical analysis. Results of the study could be vital in jumpstarting the resource evaluation of a poorly explored territory and gain valuable scientific information of Philippine deep sea areas that will eventually be useful for long term utilization and management.

Keywords: minerals, manganese, Benham Rise, Luzon, Philippines

Os isotope stratigraphy and chemical speciation of elements of ferro-manganase crusts from the Western Pacific seamounts

KATSUHIKO SUZUKI[1, *], KOSUKE T.GOTO[2], TATSUO NOZAKI[1], TERUHIKO KASHIWABARA[1], KOICHI IIJIMA[1], AND AKIRA USUI[1, 3]

[1] JAMSTEC (*katz@jamstec.go.jp)
[2] Geol. Surv. Japan, AIST,
[3] Dept. Natural Sci., Kochi Univ.

Ferromanganese crusts (Fe-Mn crusts) are a kind of marine chemical sediment composed of iron and manganese oxy-hydroxides occurring on the surface of seamounts and oceanic plateaus at depths from 400 to 5000 meters below sea level (mbsl). Fe-Mn crusts possess especially high concentrations of rare metals such as Co, Ni, Te, Rare Earth Elements, and thus are expected as submarine mineral resources. Also, Fe-Mn crusts record the ocean environmental variations during last several tens million years, which would give clues to clarify the paleoenvironmental conditions at the time of crust deposition. However, occurrence, chemical compositions and growth patterns of certain Fe-Mn crusts are often locally variable. Hence, a comprehensive study on the genesis of Fe-Mn crusts, such as growth rates and enrichment processes of elements, is required to better understand their resource potential as well as their applications to paleoceanographic study.

The depositional ages of sublayers in a Fe-Mn crust sample have been determined by the 10Be isotope system (Usui et al., 2007) and ultrafinescale magnetostratigraphy (Oda et al., 2011). Though these methods can provide precise age data of the young part of Fe-Mn crusts (up to 10 million years), development of the method to determine the age of the whole layers is required. Klemm et al. (2005) applied Os isotope stratigraphy in which the Os isotopic composition of each Fe-Mn crust layer is measured and matched to the marine Os isotope evolution curve of the past 80 Ma. Following their study, we have estimated the model age of the sublayers through the Os isotope stratigraphy of the Fe-Mn crusts collected from the Takuyo-Daigo, Ryusei and MC10 (Micronesia) seamounts. The Os isotopic compositions of the surface 3mm layers of the Fe-Mn crust from the locations with various water depths of the Takuyo-Daigo seamount were obtained by Tokumaru et al. (2015), which are in the range of the present-day seawater Os isotopic compositions. It suggests that Os in the Fe-Mn crust from the Takuyo-Daigo seamount is hydrogeneous and possibly reflects the Os isotopic compositions at the time of crust deposition. The obtained results also indicate that the Fe-Mn crusts from Takuyo-Daigo and Ryusei seamonts have the growth rate of approximately 3 mm/million years in the past 15 million years. Also, it is proposed that, though the Fe-Mn crust from MC10 seamount is likely to have grown continuously (Goto et al., 2014), those from the Takuyo-Daigo seamount encountered significant reduction in growth rates between ca. 15 and 30 million years ago.

Through the elemental speciation in Fe and Mn oxides by synchrotron X-ray analyses, we have revealed that element concentration in Fe-Mn crusts are well constrained by mode of adsorption on Fe (ferrihydrite) and Mn oxides (Kashiwabara et al., 2008, 2011, 2013, 2014). As for homologous W and Mo, Fe-Mn crusts are distinctly more enriched with W than Mo compared with their relative abundance in seawater. Kashiwabara et al. (2013) conducted EXAFS analyses and proposed its mechanism based on the chemical speciation data as follows: W forms an inner-sphere complex both on Fe and Mn oxides, while Mo forms an inner-sphere complex on Fe oxide and forms an outer-sphere complex on Mn oxide. Such difference in mode of adsorption leads to difference in concentrations of W and Mo in Fe-Mn crusts: i.e., W is efficiently adsorbed onto both Fe and Mn oxides and Mo is efficiently adsorbed only onto Mn oxides. Hence, the difference in mode of adsorption may be one of the primary cause of the lower seawater W concentration than that of Mo.

Keywords: ferromanganese crust, seamount, osmium isotope stratigraphy dating, rare metal, coordination complex

Growth history and paleoceanographic implication of Fe-Mn nodules from Campbell Plateau

CHANG, S.W.[1], I.J. GRAHAM[2], H. CHOI[1], S-R. LEE[1], I.C. WRIGHT[3], R.G. DITCHBURN[2], AND A. ZONDERVAN[2]

[1] Korea Institute of Geoscience and Mineral Resources, Daejeon, 305-350, Korea (swchang@kigam.re.kr)
[2] Institute of Geological & Nuclear Sciences, P.O. Box 31 312, Lower Hutt, New Zealand
[3] National Oceanography Center, University of Southampton Waterfront Campus, European Way, Southampton SO14 3ZH, UK

Nine Fe-Mn nodules from the nodule field in the east of Campbell Plateau of southwestern Pacific Ocean beneath the Deep Western Boundary Current (DWBC) and Antarctic Circumpolar Current (ACC) were analyzed for the 10Be/9Be dating by AMS(Accelerator Mass Spectroscopy) at IGNS, New Zealand.

Several types of nodule morphology were identified including distinctive discoidal forms with overgrowths resulting possibly from overcrowding and partial sediment burial. Five principal nodule facies were also recognized by location and occurrence (Wright et al., 2005). Fe-Mn nodule show various concentric internal growth textures, such as, cuspates, large parabolic cuspates, pseudo-columnar, columnar, globular, and laminated, which vary even in a nodule with hydrogenetic, early diagenetic, or mixed genetic origin. Each texture shows micro-textural varieties and different mineralogy and/or chemistry. The genesis of each internal texture was indicated by the REE patterns, the mineralogy of Mn-oxides, and the Mn/Fe ratios.

10Be/9Be dating of Fe-Mn nodules indicates total ages from 6 Ma to more than 14 Ma. Data points for individual nodules define line segments on log-linear plots indicating significant changes in growth rate. The changes of growth rate and the internal variations of growth texture are closely related to the paleoceanographic environment during the nodule formation. The ages of the growth changes were calculated from the 10Be/9Be dating. Changes of growth rate or internal growth textures are shown at 12.7-12.6 Ma, 10.4 Ma, 8.8-8.4 Ma, 6.7-6.5 Ma, 6.2-5.0 Ma, 4.6-4.5 Ma, 2.8-2.4 Ma, 1.8-1.6 Ma, and 0.8-0.4 Ma. Several hiatuses in nodule growth were shown between 6.1 Ma and 5.1 Ma as well. The ages and the internal textures of Fe-Mn nodules indicate the environment of nodule growth related to the paleoceanographic events and/or sedimentary history in the SW Pacific. 14.2 Ma indicates the age of the initial nodule growth in the region.

Keywords: Fe-Mn nodule, Campbell Nodule Field, SW Pacific, 10Be/9Be

The enrichment of heavy iron and sulfur isotopes in authigenic pyrite as indicator of anaerobic oxidation of methane: Insight from the South China Sea

XIAOMING SUN[1,2,3], ZHIYONG LIN[1], YANG LU[1], LI XU[2,3], JUNLI GONG[1], RONGFEI LU[1], HONGFENG LU[4], JÖRN PECKMANN[5], WEIDONG SUN[6]

[1] School of Earth Science and Geological Engineering, Sun Yat-sen University, Guangzhou 510275, China
[2] School of Marine Sciences, Sun Yat-sen University, Guangzhou 510006, China
[3] Guangdong Provincial Key Laboratory of Marine Resources and Coastal Engineering, Guangzhou 510006, China
[4] Guangzhou Marine Geological Survey, Guangzhou 510760, China
[5] Institute of Geology, University of Hamburg, Hamburg 20146, Germany
[6] Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou 610640, China

Anaerobic oxidation of methane (AOM) in marine sediments commonly leads to the precipitation of authigenic pyrite with characteristic geochemical patterns. Yet, reports on the iron (Fe) isotope composition of such pyrite are limited and the processes controlling the distribution of sulfur (S) and, particularly, Fe stable isotopes in the course of AOM are still insufficiently understood. To further the knowledge on the mechanisms involved in stable isotope distribution during AOM, we analyzed the Fe and S isotope compositions of authigenic pyrite from the two seafloor sites HS148 and HS217 in the Shenhu seepage and gas hydrate area, South China Sea. The δ56Fe values of pyrite were found to vary from 0.793 to +0.267‰ (relative to average igneous rock), with a distinct trend toward higher values with increasing burial depth. The δ34S values of pyrite reveal a great variability of 94.7‰, spanning from 42 to +52.7‰. As observed for Fe isotopes, the heavy isotope (34S) becomes enriched with depth. A sequential Fe extraction procedure was applied to document the extent of pyritization (Fepy /FeHR), revealing peaks of 0.45 and 0.47 at ca. 6 and 7 m below the sediment surface, respectively. The δ56Fe values of pyrite were found to positively correlate with the extent of pyritization in the sediments. The great variability of Fe and S isotope compositions and the observed trends are best explained as a function of AOM, which produces substantial amounts of sulfide. The AOM-sourced sulfide leads to successive conversion of reactive Fe to pyrite, resulting in the accumulation of pyrite in the sulfate-methane transition zone (SMTZ). The overall trend from low to high 56Fe values with depth can be attributed to a change from pore water environments possibly affected by dissimilatory Fe reduction to deeper layers shaped by sulfate-dependent AOM and increasingly sulfide-dominated Fe cycling. The minor opposed trend to lower 56Fepy with increasing depth within the SMTZ is difficult to interpret, but may be caused by the reversible AOM under sulfate limitation in the bottom part of the SMTZ. Similarly, continuous AOM results in the enrichment of 34S in the pool of dissolved sulfate as isotopically light sulfate is preferentially consumed, leading to the formation of increasingly 34S-enriched pyrite with depth. Therefore, the enrichment of heavy stable isotopes of Fe and S in authigenic pyrite with depth is apparently a useful tracer of AOM in marine sediments, and may help to recognize fossil SMTZs.

Keywords: Iron isotopes; Sulfur isotopes; Pyrite; Anaerobic oxidation of methane; South China Sea

Microbial diversity in the hydrate-bearing and -free surface sediments in the Shenhu area, South China Sea

LU JIAO[1, 2], XIN SU[1, 2*], YUANYUAN WANG[1], HONGCHEN JIANG[3*], YONG ZHANG[1, 2], FANG CHEN[4]

[1] State Key Laboratory of Biogeology and Environmental Geology, China University of Geosciences (Beijing), Beijing 100083, China (xsu@cugb.edu.cn)

[2] School of Ocean Sciences, China University of Geosciences (Beijing), Beijing 100083, China

[3] Key Laboratory of Biogeology and Environmental Geology, China University of Geosciences (Wuhan), Wuhan 430074, China

[4] Guangzhou Marine Geological Survey, Guangzhou 510075 , China

In 2007, the China's first gas hydrate drilling expedition GMGS-1 in the Shenhu area on the northern continental slope of the South China Sea was performed (Zhang et al., 2007). Six holes (namely Sites SH1B, SH2B, SH3B, SH5B, SH5C and SH7B) were drilled, and gas hydrate samples were recovered at three sites: Sites SH2B, SH3B and SH7B. In order to investigate microbial diversity and community features in correlation to gas hydrate-bearing sediments, a study on microbial diversity in the surface sediments at hydrate-bearing sites (SH3B and SH7B) and -free sites (SH1B, SH5B, SH5C) was carried out by using 16S rRNA gene phylogenetic analysis. The phylogenetic results indicated difference in microbial communities between hydrate-bearing and -free sediments. At the gas hydrate-bearing sites, bacterial communities were dominated by Deltaproteobacteria (30.5%), and archaeal communities were dominated by Miscellaneous Crenarchaeotic Group (33.8%); In contrast, Planctomycetes was the major group (43.9%) in bacterial communities, while Marine Benthic Group-D (MBG-D) (32.4%) took up the largest proportion in the archaeal communities. Moreover, the microbial communities have characteristics different from those in other hydrate-related sediments around the world, indicating that the presence of hydrates could affect the microbial distribution and community composition. In addition, the microbial community composition in the studied sediments has its own uniqueness, which may be resulted by co-effect of geochemical characteristics and presence/absence of gas hydrates.

Keywords: microbial diversity, gas hydrate, sediments, Shenhu area, South China Sea

Geochemical signature of methane-related archaea associated with gas hydrate occurrences in the gas-chimney on the Sakhalin continental slope

DONG-HUN LEE[1], YOUNG-KEUN JIN[2], JONG-KU GAL[1], HIROTSUGU MINAMI[3], AKIHIRO HACHIKUBO[3], KYUNG-HOON SHIN[1]

[1] Department of Marine Sciences and Convergent Technology, Hanyang University, Korea (Shinkh@hanyang.ac.kr)
[2] Korea Polar Research Institute, Korea
[3] Department of Materials Science and Engineering, Kitami Institute of Technology, Japan

Only 3% of the methane (CH4) in the gas hydrate (GH) bearing sediments is released into the atmosphere as the result of the anaerobic oxidation of methane (AOM), which is a specific microbial process (methanotroph) occurring in marine sediments (Juddy, 2004). We investigate the aspect of organic geochemistry in the GH bearing sediment during the project of Sakhalin Slope Gas Hydrate 2014 (SSGH 2014) to identify the molecular and isotopic signature of gas and archaeal lipid biomarkers at the gas-chimney on the sourthwestern Sakhalin Continental Slope (SWSS). At both sites (LV67-07HC and -19HC), the Sulfate Methane Transition Zone (SMTZ) is located at a different sedimentary depth (110 cmbsf at LV67-07HC and 350 cmbsf at LV67-19HC) due to the differences in the biogeochemical sedimentary environments and upwardly CH4 flux. The carbon isotope values of methane ($\delta^{13}C_{CH4} \approx -55.3‰$ to $-39.6‰$) collected from the GH bearing sediment (LV67-07HC) suggests that CH4 is mostly produced by thermogenic sources rather than microbial carbon dioxide reduction (LV67-19HC). Moreover, the isotopic fractionation factor ($\varepsilon C = \delta^{13}C_{CO2} - \delta^{13}C_{CH4}$) near SMTZ in the GH bearing sediment is significantly lower (ca. 20). We consider that abnormally small εC values reflect the faster rate of AOM by the methanotrophic activity. Hence, the methane-related archaeal lipids (archaeol and sn-2-hydroxyarchaeol) are present in relatively high concentrations and have strongly depleted-$\delta^{13}C$ values in the SMTZ from LV67-07HC. In this core, monocyclic biphytane (BP-1; which is mainly derived from GDGT-1, produced by the Euryarchaeota) become also predominant and exhibit depleted-$\delta^{13}C$ values ($-96.4‰$ to $-89.2‰$), indicating that methanotrophs consume CH4 as carbon source. The molecular and isotopic signature of gas and methane-related archaeal lipid may thus be used as a robust indicator for the migration of CH4 flux in the gas phase and AOM processes by methanothrophs as evidence for “microbial filter”.

Keywords: Sakhalin continental slope, Gas hydrate, Methane, Archaeal lipid biomarker, Carbon stable isotope values.

Geometric variations of methane-derived authigenic carbonates associated with chimney structure in the Ulleung Basin, East Sea

SEONG YEONG KIM[1], JONG-HWA CHUN[1], YURI KIM[1]

[1] Petroleum and Marine Resources Division, KIGAM, Daejeon, Republic of Korea

Authigenic carbonates associated with chimney structure were retrieved using ROV manipulator around site UBGH2-11(2092 m water depth) in the Ulleung Basin, East Sea (Ryu et al., 2013). Based on the scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDS) observations, a 60-cm-long push core provides information of vertical geometric variations of authigenic carbonates. High negative 13C values (-40.3 to -34.1‰ PBD) of authigenic carbonates suggest that biogenic methane is carbon source (Chun et al., 2012). Age model of the push core was constructed by marker tephra (Ulleung-IIL; 10.69 cal ka) and AMS 14C dating (7, 37, and 46 cm below seafloor). On the basis of the geometry and composition, the push core can be divided into three units. Upper unit (0-16 cmbsf) includes irregular to rounded authigenic carbonate nodules, gastropods and planktonic foraminifera tests. The authigenic carbonates consist of prolate to blocky anhedral calcite, triangular-shaped calcite, and bladed anhedral calcite. Some planktonic foraminifera tests were replaced by triangular-shaped calcite. Middle unit (16-30 cmbsf) includes ichthyolith, diatom with rare authigenic carbonates. The pumiceous lapilli layer (Ulleung-IIL; 10.69 cal ka) occurs in depths of 30-36 cmbsf. Lower unit includes irregular authigenic carbonate nodules, cemented authigenic carbonate, burrow-replaced authigenic carbonate, and planktonic foraminifera tests. The authigenic carbonates are composed of prolate to tabular anhedral calcite and triangular calcite. Vertical variations of authigenic carbonates and compositions reflect differences in the flux of carbon. The three units of authigenic carbonates probably provide changes in seepage flux in the chimney structure from Termination I to late Holocene.

Keywords: authigenic carbonates, chimney structure, gas hydrate, Ulleung Basin

Gas seeps on the Eastern Sakhalin slope, Okhotsk Sea: distribution, characteristics and possible gas sourses

B.V. BARANOV[1], Y.-K. JIN[2], H. MINAMI[3], A.I. OBZHIROV[4], A.S. SALOMATIN[4], H. SHOJI[3]

[1] Institute of Oceanology, Russian Academy of Sciences, Russia (bbaranov@ocean.ru)
[2] Korean Institute of Polar Researches, Korea
[3] Kitami Institute of Technology, Japan
[4] Pacific Oceanological Institute, Far East Branch, Russian Academy of Sciences, Russia

Gas seeps on the Eastern Sakhalin Slope were found in 1987 and later on investigated in many expeditions. Most data were obtained in 2003 – 2012 in frames of two international projects: CHAOS (Hydro-Carbon Hydrate Accumulations in the Okhotsk Sea) and SSGH (Sakhalin Slope Gas Hydrates). It was established that gas seeps are spread in the northern and southern parts of the Eastern Slope and hydroacoustic anomalies (gas flares) serve as their main indicators. The most of gas flares with height of several hundred meters (~ 80%) is located on the northern part of the slope. Maximum height of gas flare (2000 m) was recorded in the southern part of the slope at maximum depth of 2200 m. Monitoring of gas seeps showed that their activity may vary significanlty in time interval from days to years. Gas seeps form specific relief forms – mounds and pockmarks with height and depth up to few tens of meters. In the north the seeps are located on open continental slope; in the south they are associated mainly with canyons and in all cases are controlled by faults. Gas hydrates were obtained by sampling on 30 stations inside gas seeps. Thus it is obvious that gas seeps are accociated with gas hydrates but it remains unclear if gas discharge occurs due to gas hydrates dissociation or during their formation. Question about sourse of the gas also remains under discussion. But taking into account that gas seeps, gas deposits and maximum thickness of sediments occur within the northern part of the slope we may suppose that they are interlinked.

Keywords: gas seepage, gas flares, gas hydrates, oil and gas deposits, Sakhalin slope

Sea floor vent communities at the active margin, offshore SW Taiwan

SAULWOOD LIN[1, #], WANYEN CHENG, NEI-CHEN, CHEN[2], I-CHIH HSIEH[1]

[1] Institute of Oceanography, National Taiwan University (swlin@ntu.edu.tw)
[2] Geosciences Department, National Taiwan University

Focus gas seeping usually generates chemosynthesis communities near or at the sea floor. Methane becomes the energy source of chemosynthesis communities. Depending on flux and compositions of gas, different scale and types of community may appear at various locations. Seismic survey is a typical tool to study and understand gas hydrate system. Based on reflection characters, location of gas hydrate could be point out, however, exact location of gas seep at and near the sea floor is difficult to pinpoint. Appearances of chemo-communities at gas seep environment become another tool to indicate where gas hydrate may locate at depth. We have employed this technique offshore in the South China Sea. Seeps in the accretionary wedge offshore SW Taiwan have been closely examined in order to understand mechanism in driving their variations. Towcam surveys and coring operation were carried out on board r/v OR1 and OR5.

A number of geochemical anomalies appeared at the seep environment, including massive authigenic carbonate buildup, bacteria mat in various size and color, patches of life and/or dead mussel, and tube worm. These usually accompanied with sediment in high concentrations of methane, dissolve sulfide, rapid depletion of sulfate, pyrite and various degree of chloride enrichment or depletion. Our results demonstrate that exploit the vent communities is a good proxy for gas hydrate exploration. However, the exact nature of vent scale and types still require further study.

Keywords: gas seeps, methane, chemosynthesis, authigenic carbonate, flare

Geochemical characteristics of Tsan Yao Mud Volcano: Source and implication of violent gas venting offshore SW Taiwan

YI-TING TSENG[1, *], SAULWOOD LIN[1, #], CHENG-TIEN CHOU[1], NEI-CHEN CHEN[2], I-CHIH HSIEH[1]

[1] Institute of Oceanography, National Taiwan University, Taiwan (r01241402@ntu.edu.tw)
[2] Geosciences Department, National Taiwan University, Taiwan

Located at the plate boundary between Eurasian plate and Philippine Sea plate, offshore southwestern Taiwan shaped massive area of accretionary prism due to the collision of active tectonic movement with the Philippine Plate moving northwestward at a rate of ~8 cm/year. Moreover, the region is receiving nearly 100 MT/year of suspension particles as a huge source of organic carbon exported from small rivers of southwest Taiwan in facilitating methane fermentation. Burial of abundant organic carbon and overpressure from the rapid accretion process are crucial factors for mud volcano development, made offshore SW Taiwan a mud volcano rich area. More than 13 sets of mud volcanoes have been recorded in the upper Kaoping slope region. We have obtained multibeam bathymetry, water column echo sounder data, together with sediment and pore water composition of methane, sulfide, sulfate, chloride, potassium, lithium, boron, and water O-18 at the TsanYao mud volcano (TYMV).

In this report, source and implication of one of the most active venting mud volcano, the TYMV, in the region will be presented. The TYMV is 300m high, sitting in surrounding water depth ranging from 400– 800m. More than 30 flares have been observed around the main dome within a perimeter of 10 square miles. δ13C values of methane extracted from sediments range from -30 to -50 ‰, and high C2+/C1 ratios indicating vent gas is mostly thermogenic in origin. Higher thermal gradient and water temperature indicating dome top is unfavorable for gas-hydrate formation. Instead, high-density mud is charged by higher concentrations of gas to maintain buoyancy upward venting to the sea floor. Furthermore, lower concentration of chloride/salinity in pore water indicating water in vent fluid was derived from clay mineral dehydration at depth. The fact that mud volcano flares could reach sea surface is indicating that methane and other gas are venting directly into the atmosphere. With mud volcano venting at the TYMV is not the only one in this region, the upper slope at the active margin could be another new important source of methane, a greenhouse gas, to the atmosphere.

Keywords: Mud volcano, South China Sea, methane, greenhouse gas.

Seismic Implications of Gas Hydrate Presence in the Frontal Ridge Area Offshore Southwestern Taiwan

LIANG-FU LIN[1], CHAR-SHINE LIU[1], CHE-CHUAN LIN[2], HO-HAN HSU[1], JIH-HSHIN CHANG[1]

[1] Institute of Oceanography, National Taiwan University, Taiwan (marcus_lflin@outlook.com)
[2] Department of Earth Sciences, National Central University, Taiwan

The Frontal Ridge is the most western contractive structure in the deep water fold-thrust belt offshore SW Taiwan. In this area, shallow strata shows folded channel-levee complexes, which are interpreted as the slope fan deposits of the paleo-Penghu canyon system. These channel-levee complexes can not only provide permeable strata for upward gas migration but also porous reservoirs for gas hydrate and free gas. Folded anticline structure plays the role for gathering and trapping fluids beneath the structural high. Bright seismic reflections shows a polarity reversal when they go across the BSR, which is an evidence of free gas move along the permeable strata to the gas hydrate stability zone to form gas hydrate. In addition to dipping strata, the frontal thrust could also be a fluid migration pathway for deep gas to move upward. Detailed velocity analyses have been applied on large offset 2D seismic data across the ridge. Low velocity zone below BSR implies that a large amount of free gases have accumulated in this area. Although there is no direct information on lithology and few geochemical anomalies, we infer that the stratigraphy and gas supply are excellent from seismic data. Based on the aforementioned, we suggest that the Frontal Ridge presents good conditions for gas hydrate formation, which could become one of the top priority sites for gas hydrate drilling investigation.

Keywords: gas hydrate, fluid migration, deepwater fold-and-thrust belt, deepwater depositional system

Pseudo 3D seismic technique on gas hydrate investigation offshore SW Taiwan

CHAR-SHINE LIU[1], HO-HAN HSU[1], JIA-CHUNG KO[1,2], WEI-CHUNG HAN[1], KUO-HAN CHAO[1], SHYE-DONQ CHIU[1], HONG-YI CHANG[1], YU-FANG MA[1] AND SONG-CHUEN CHEN[3]

[1] Institute of Oceanography, National Taiwan University, Taiwan (csliu@ntu.edu.tw)
[2] Now at CPC Corporation, Taiwan
[3] Central Geological Survey, Ministry of Economic Affairs, Taiwan

3D seismic data can play a vital role in gas hydrate exploration and reservoir characterization. The 3D seismic cube provides continuous seismic profile images which can reveal detail lateral structural and stratigraphic variations, also can image geological features in map view. However, 3D seismic survey usually requires multi-streamers and large ship to operate, and is very expensive for academic institutions. In Taiwan, 2D multichannel seismic reflection surveys have been conducted extensively for gas hydrate investigation, and several gas hydrate prospects have been identified for potential future gas hydrate drilling investigation. In order to better define the drilling targets, pseudo 3D seismic survey technique has been employed to better understand the characters of the gas hydrate reservoirs. We use a 108-channnel 2D seismic data acquisition system and collect parallel 2D lines in 50 m or 100 m spacing, then process the seismic data first in 2D lines, then to form a 3D seismic image cube by performing 2-path 3D migration. The 3D seismic cubes generated in general provide good 3D images of the geological features below seafloor, however, due to the large cross line spacing (50 to 100 m, comparing to inline spacing of 6.25 m), the resolution is not satisfactory. We further developed techniques utilizing the streamer feathering geometry to infill the large cross-line gaps, and then process the seismic data in true 3D processing. Results from this true 3D processing on the Pointer Ridge pseudo 3D data set will be presented, which demonstrates the usefulness of this 3D seismic image on gas hydrate investigations.

Keywords: 3D seismic image, gas hydrate, offshore southwest Taiwan

Comparisons between the eight sites with gas-hydrate petroleum system in the Shenhu gas hydrate drilling area, northern South China Sea

MING SU[1,2], ZHIBIN SHA[3], RUI YANG[1,2], NENGYOU WU[1,2], SHAOHUA QIAO[1,2], XIAORONG CONG[1,2], AND JIE LIU[1,2]

[1] Key Laboratory of Gas Hydrate, Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences, China (suming@ms.giec.ac.cn)

[2] Guangzhou Center for Gas Hydrate Research, Chinese Academy of Sciences, China

[3] Guangzhou Marine Geological Survey, China

The drilling results of the first marine gas hydrate drilling expedition of Guangzhou Marine Geological Survey (GMGS-1) in northern continental slope of the South China Sea revealed a variable distribution of gas hydrates in the Shenhu Area. In this study, the comparisons between the eight sites with gas-hydrate petroleum system were used to analyze and re-examine hydrate potential. In the Shenhu gas hydrate drilling area, all the eight sites were located in the suitable environment with low temperatures and high pressures. Biogenic and thermogenic gases were contributed to the formation of hydrates. Gas chimneys and some small-scale faults (or micro-scale fractures) were composed the migrating pathways for gas-bearing fluids. The results illustrated the differences between these eight sites could be concluded as the seafloor temperatures and pressures related to the water depths, the geothermal gradient, and the sedimentary conditions. Variations of seafloor temperatures and pressures related to water depths and geothermal gradient would lead to the changes in the thickness of gas hydrate stability zones. Although the lithology and grain size of the sediments were similar, two distinct sedimentary units were identified for the first time through seismic interpretation, analysis of deep-water sedimentary processes, and the Cm pattern, implying the heterogeneous sedimentary conditions above BSRs. Based on the analyses of forming mechanisms and sedimentary processes, these two fine-grained sedimentary units were characterized as different physical properties. Fine-grained turbidites (Unit I) at the bottom with thin-bedded chaotic reflectors acted as the host rocks for hydrates; whereas, fine-grained sediments related to soft-sediment deformation (Unit II) at the top with thick continuous reflectors would serve as regional homogeneous caprocks. Low-flux methane migrated along chimneys upwards could be enriched preferentially in fine-grained turbidites, resulting in the formation of hydrates within Unit I. However, overlying fine-grained sediments related to soft-sediment deformation would hinder the further migrating of gases/fluids, causing the extremely low methane concentration in Unit I. On the plane, all the three sites with hydrates from recovered core samples were located within the distribution of sedimentary Unit I, and the other five sites were not. Therefore, as the most significant difference between the eight sites, the sedimentary conditions above BSRs are suggested to be the crucial factor controlling the formation and occurrence of gas hydrates in the Shenhu gas hydrate drilling area, northern South China Sea.

Keywords: Gas hydrate; variable distribution; gas-hydrate petroleum system; Shenhu Area; northern South China Sea

Characterization of gas hydrate reservoir using 3D seismic data in the northwest Ulleung Basin, East Sea

KYOUNG JIN KIM[1], BO YEON YI[2], NYEON KEON KANG[2], AND DONG GEUN YOO[1,2]

[1] Department of petroleum Resources Technology, Korea University of Science and Technology (kjkim86@ust.ac.kr)
[2] Petroleum and Marine Research Division, Korea Institute of Geoscience and Mineral Resources

Based on the interpretation of 3D seismic data acquired in the northwest Ulleung Basin, East Sea, the sedimentary sequence including the gas-hydrate stability zone (GHSZ) consists of five seismic units separated by regional reflectors. Units 1 to 4 show low amplitude because they are dominated by homogeneous hemipelagic muds. Unit 5 is characterized with high amplitude due to the hemipelagic muds intercalated with turbidite sands including the gas hydrate occurrence zone (GHOZ). An anticline is present in the study area that documents activity of many faults. The seismic indicators for the presence of gas-hydrate include bottom simulating reflector (BSR) and acoustic blanking which is coincident with high resistivity and velocity logs. On the basis of seismic characteristics and gradient of sedimentary strata, the GHOZ is divided into four classes: (1) dipping strata with strong BSR, (2) dipping strata with no seismic indicators, (3) parallel strata with acoustic blanking and weak BSR, and (4) parallel strata with acoustic blanking. Seismic attributes such as reflection strength and instantaneous frequency are computed along the GHOZ in order to demonstrate the presence of gas-hydrate and free gas. Low reflection strength and high instantaneous frequency are identified above the BSR, indicating the gas-hydrate occurrence. A remarkable high reflection strength and low instantaneous frequency indicate the presence of free gas below the BSR. In 3D volume derived from the blending of reflection strength and instantaneous frequency, gas-hydrate overlying free gas zone is distributed on the western limb of the anticline and gas-hydrate with a little free gas zone is distributed on the crest of the anticline. Considering the 3D distribution of gas-hydrate and free gas, two gas migration processes can be suggested: (1) stratigraphic migration through the dipping, permeable strata, and (2) structural migration through the faults from below the GHSZ.

Keywords: Ulleung Basin, Gas-hydrate, Gas hydrate stability zone (GHSZ), Seismic attribute, Gas migration

Characterization of gas hydrate distribution using conventional three-dimensional seismic data in the Pearl River Mouth Basin, South China Sea

XIUJUAN WANG[1], JIN QIAN[1], TIMOTHY S. COLLETT[2], SHENGXIONG YANG[3], JINQIANG LIANG[3], SHAOYING FU[3], HESHENG SHI[4], DUANXIN CHEN[1]

[1] Institute of Oceanology, Chinese Academy of Sciences, Qingdao, 266071, China (wangxiujuan@qdio.ac.cn)
[2] U. S. Geological Survey, Denver Federal Center, Box 25046, MS 939, Denver, 80225, USA
[3] Guangzhou Marine Geological Survey, MLR, Guangzhou, 510075, China
[4] Shenzhen Branch of China National Offshore Oil Corporation Ltd., Shenzhen 518067, China

Downhole Wireline logging (DWL) and logging while drilling (LWD) data acquired during China's gas hydrate drilling expedition (GMGS-1&2) in 2007 and 2013 indicate the occurrences of gas hydrate above the base of gas hydrate stability (BGHS) and in the shallow sediment near the seafloor in the Pearl River Mouth Basin (PRMB), South China Sea. However, different types of gas hydrate morphologies were identified in Shenhu area (GMGS-1) and the east of PRMB (GMGS-2). Two gas hydrate drilling expeditions show that the pore-filling gas hydrate is widely distributed above the BGHSZ in both drilling zone. High amplitude reflections just above the bottom simulating reflectors (BSR) were interpreted to be associated with the accumulation of gas hydrate with elevated saturations in the fine-grained sediments. A new three-dimensional (3D) seismic reflection data volume acquired during the 2012 has allowed for the detailed mapping and characterization of gas hydrate distribution in the Shenhu area, South China Sea. Previous studies of core and logging data show that the gas hydrate occurrence at high concentrations is controlled by the presence of relatively coarse-grained sediment, and the upward migration of thermogenic derived gas from the deeper sediment section into the overlying gas hydrate stability zone; however, the spatial distribution of gas hydrate remains poorly defined. Seismic attributes were also extracted along the BGHSZ that were thought to indicate variations reservoir properties inferred hydrocarbon accumulations at each site. The analysis demonstrates that the gas hydrate petroleum system varies significantly across the Pearl River Mouth Basin and that variability in sedimentary properties as a product of depositional processes and the upward migration of gas from deeper thermogenic sources control the distribution of gas hydrates in this Basin.

Keywords: Gas hydrate, reservoirs, BGHSZ, Petroleum system, South China Sea

Phase behavior of gas hydrates in crystalline swelled clay

DAEOK KIM[1], YUN-HO AHN[1], SE-JOON KIM[2], JOO YONG LEE[2], JEAHYOUNG LEE[2], YOUNG-JU SEO[2] AND HUEN LEE[3]

[1] Department of Chemical and Biomolecular Engineering (BK21+ program), KAIST, 373-1 Guseong-dong, Yuseong-gu, Daejeon, Republic of Korea. (okimnim@kaist.ac.kr)
[2] Korea Institute of Geoscience and Mineral Resources (KIGAM), 124, Gwahak-ro, Yuseong-gu, Daejeon, Republic of Korea.
[3] Department of Chemical and Biomolecular Engineering (BK21+ program), KAIST, 373-1 Guseong-dong, Yuseong-gu, Daejeon, Republic of Korea.

Understanding of gas hydrates, e.g. phase equilibria, in reservoir sediments is one of the important issues in the fields of energy production and CO2 sequestration via CH4 hydrate exploitation and CO2 hydrate formation. The composition of water in clay can change their physical properties, which influences the state in which gas hydrates exist in clays. We investigated gas hydrates in crystalline-swelled Na-montmorillonite (CS-mon) having water content of less than 27 wt% and maintaining crystallinity of clay particles. Instead of a gas hydrate forming in the interlayer, gas is dissolved in the swelled interlayers of clay, acting as a favorable storage site for hydrophilic CO2. In addition, gas hydrates formed in CS-mon showed both inhibited and promoted phase behavior. This revealed that the clay surface can promote the formation of a hydrate structure but confinement in nano-sized space dominates the promotion effect and causes stronger inhibition than in the bulk phase. We believe that our results not only broaden the understanding of gas hydrates in confining systems and porous materials, but also provide a precise explanation of the behavior of gas hydrates in clay sediment.

Keywords: clay; gas hydrate; phase equilibria; sediment; confinement.

Geotechnical and Geophysical Properties of Deep Marine Sediments Recovered from the Gas Hydrate Occurrence Regions in Ulleung Basin, East Sea, Korea

HAK-SUNG KIM[1], GYE-CHUN CHO[1], JOO YONG LEE[2], AND SE-JOON KIM[2]

[1] Department of Civil and Environmental Engineering, KAIST, Daejeon, Korea (gyechun@kaist.deu)
[2] Petroleum and Marine Resource Division, KIGAM, Daejeon, Korea

The vast amounts of gas hydrate reserves have drawn scientific attentions as a potential energy resource. For gas hydrate production, gas hydrate-bearing sediments should be depressurized below the gas hydrate equilibrium pressure. The depressurization of a gas hydrate reservoir can lead to several geotechnical problems such as the destabilization of the production well, settlement of the seafloor installation, or slope failure of the production site. Thus, it is important to determine the geotechnical characteristics of gas hydrate-bearing sediments. This study determined the geotechnical and geophysical properties of deep marine sediments in Ulleung Basin, East Sea using minimally disturbed natural samples retrieved during the Second Ulleung Basin Gas Hydrate Expedition (UBGH2). Conventional geotechnical engineering test characterize the sediments highly plastic silty soils; they exhibited low hydraulic conductivities, and high compressibility when subjected to an increase in effective stress. It is expected that depressurization during gas hydrate production at the investigated sites would cause a significant amount of compaction around the production hole. In addition, the prior occurrence of gas hydrates in the samples was verified through a comparison of water content, compressibility, and electrical resistivity.

Keywords: Gas hydrate-bearing sediment, Geotechnical properties, Geophysical properties, Volume change

Numerical Simulation for the Effect of Permeability on Gas Hydrate Dissociation Behavior during Depressurization Process in the Ulleung Basin, East Sea of Korea

SUNG-MIN LEE[1], JI-SU KIM[1], HYO-JIN SHIN[1], JONG-SE LIM[1*] AND SE-JOON KIM[2]

[1] Department of Energy and Resources Engineering, Korea Maritime and Ocean University, Republic of Korea (jslim@kmou.ac.kr)

[2] Petroleum and Marine Research Division, Korea Institute of Geoscience and Mineral Resources, Republic of Korea

Due to the imbalance between supply and demand with increasing energy consumption, gas hydrate (GH) is regarded as a potentially clean energy resource having an enormous amount. In the Ulleung basin which is located in the East Sea of Korea, it is assumed that GH over 600 million tons is buried. In 2010, drilling was performed at the 2nd Ulleung Basin Gas Hydrate Drilling Expedition (UBGH2) to evaluate reserves and designate a site for field production test. In preparation for field production test, it is necessary to investigate GH dissociation behavior during the depressurization process. Also, to prepare for history matching after field production test, it is essential to apprehend the effect on the properties of GH bearing sediments. In this study, numerical simulation model reflecting geometry system and geological properties of field production test site is composed by using TOUGH+HYDRATE (T+H) developed by Lawrence Berkeley National Laboratory (LBNL). In addition, simulation is performed to figure out the dissociation behavior of GH depending on the variation of the absolute permeability and permeability anisotropy which are the main properties affecting fluid flow in the GH bearing sediments. Consequently, as absolute permeability is small, depressurization area and the amount of GH by dissociation is progressively reduced. Also, as permeability anisotropy is small, gas production tends to be increased largely, so it is possible to comprehend that permeability anisotropy is a prime values affecting gas production than water. Therefore, it is possible to predict gas and water production and interpret GH dissociation behavior of thermodynamic properties. The results of this study can be utilized as a basic analysis to design optimum production plan in the field production test.

Keywords: gas hydrate dissociation behavior, numerical simulation, depressurization, permeability, field production test

A study on the survey geometry for efficient seismic monitoring of gas hydrates production

MIN HO LEE[1], SOON JEE SEOL[1*], JOONG MOO BYUN[1], DONG GEUN YOO[2]

[1] Department of Natural Resources and Environmental Engineering, Hanyang University, Korea (ssjdoolly@hanyang.ac.kr)
[2] Petroleum and Marine Research Division, Korea Institute of Geoscience and Mineral Resources, Korea

Unconventional resources like as shale gas or gas hydrates have attracted great attention due to the fluctuation of oil price and the progress of technology nowadays. In the production stage of gas hydrates, the success largely rests on the safety assurance during the extraction of gas hydrates. Since the upper gas hydrates which play an important role as cover rocks of methane gas are also dissociated during the production of gas hydrates, the phase change of gas hydrates around the production zone has to be carefully monitored. The phase change of gas hydrates can be detected by using seismic time-lapse monitoring because the velocities of P- and S-waves are decreased as the dissociation progresses.

In this study, we conducted sensitivity analysis for two seismic survey geometries which use OBC (Ocean Bottom Cable) array and two different types of boreholes in order to suggest the optimal survey geometry. The first geometry consists of two vertical wells and OBC array and the second one consists of one horizontal well and OBC array. Using the data obtained at boreholes from sources located at sea surface, we generated the data obtained at boreholes from virtual sources located at OBC array by using seismic interferometry. For both cases, newly added data which comes from virtual sources greatly enhances the sensitivity of the upper part of monitoring region which is our main target.

Keywords: gas hydrate, time-lapse monitoring, sensitivity analysis, seismic interferometry

In situ Monitoring of Submarine Gas Hydrate Fields with the Deep-Ocean Mass Spectrometer (DOMS)

GARY M. MCMURTRY[1], LUIS A. DASILVEIRA[2] AND JONG-HWA CHUN[3]

[1] School of Ocean and Earth Science and Technology, University of Hawaii, Honolulu, Hawaii USA
[2] Microbiology Department, Univerity of Hawaii, Honolulu, Hawaii USA
[3] Petroleum and Marine Resources Division, KIGAM, Daejeon, Republic of Korea

As part of an ongoing collaboration with KIGAM to monitor effluent in situ in potential gas hydrate production test areas within the Ulleung Basin, we are test-deploying the Deep-Ocean Mass Spectrometer developed by Pacific Environmental Technologies LLC (Pace Tech Hawaii). DOMS is a compact mass spectrometer-based instrument for multi-species determination of dissolved gases and volatile organic compounds which can function autonomously, semi-autonomously or manually in water depths ranging to >4000 m. Detectable dissolved gases include: H2, He, N2, O2, Ar, NO, N2O, CO, CO2, H2S, and CH4; detectable volatile organic compounds include chloroform, toluene, benzene, chlorobenzene, dimethyl sulfide, etc. DOMS uses thin polydimethylsiloxane (PDMS)-based membrane inlet mass spectrometry (MIMS) technology proven to 6500 m water depth equivalent pressure that is patented by Pace Tech Hawaii. A laboratory-based dissolved gas calibration apparatus for the DOMS was designed and constructed. We have tested two-component dissolved gas mixtures, e.g., using CH4 or CO2 as the target gas and nitrogen as the diluent gas, but up to four or more pure gases can be simultaneously mixed in this manner, each with an independent mass flow controller. Alternatively, a pre-mixed multiple-gas standard can be used. Results at ambient lab temperature and pressure were highly linear and suggested a minimum detection limit of 5 ppb for dissolved CH4; and of 2 ppm for dissolved CO2. Dives in 2014 with the KIGAM Seafloor Observation System (KISOS) were cut short by an electrical fault, but we obtained a surface time-series of dissolved CH4 that suggested the water flow rate over the MIMS as well as water temperature were important to the detection sensitivity of the instrument, with higher flow rates and colder temperature increasing the sensitivity. We ran 44 consecutive cycles for sample-background spectral pairs, lasting about 12 minutes each. These results and plans for future instrument improvements, calibrations and deployments will be presented.

Keywords: gas hydrate, mass spectrometer, dissolved gases, methane, carbon dioxide.

Seismic chimney structures associated with gas hydrate in the Ulleung Basin

NYEON KEON KANG[1*], DONG GEON YOO[1], BO YEON YI[1]

[1] Petroleum and Marine Research Division, Korea Institute of Geoscience and Mineral Resources, Korea (nkkang@kigam.re.kr)

Seismic interpretation of multi-channel 2D/3D seismic data reveals that there are a number of seismic chimneys in the Ulleung Basin, predominantly at the basin floor region. Two drilling expeditions, UBGH1 and UBGH2, confirmed that these seismic chimneys mainly consist of fracture-filling gas hydrates. The present study describes geometry, lithology and spatial distribution of the seismic chimneys using 2D/3D seismic data and well data, and classifies seismic chimneys into two different types: Type-I and Type-II. Type-I is characterized by mound-like external shape and chaotic or transparent internal reflection pattern. Most seismic chimney of Type-I buried within the Pliocene sedimentary succession vertically, and the location of Type-I correlates with the underlying structural highs and mass transport deposits spatially. Well log interpretation and core analysis shows that Type-I consists of homogeneous mud which does not appear at adjacent same sedimentary successions. Type-II is characterized by pipe-like external shape and distorted internal reflectors. Type-II is mostly developed to the Quaternary sedimentary succession, and some of them touched the seafloor. Spatial distribution of Type-II correlates to flanks of underlying structural highs or deep-seated faults. Lithology of Type-II is similar to adjacent sedimentary successions which preserve initial sedimentary structures such as lamination or bioturbation. These findings suggest that two different types, observed in this study, were developed by different forming mechanism and geological constraints. Furthermore, the vertical and spatial distribution of two types represent that two different types of seismic chimneys in the Ulleung Basin were attributed to structural movement in different age.

Keywords: seismic chimney, classification, gas hydrate ,Ulleung Basin,

Shallow gas hydrate occurrences and its related phenomena on the Sakhalin continental slope, Russia

YOUNG KEUN JIN[1*], BORIS BARANOV[2], ANATOLY OBZHIROV[3], ALEXANDER SALOMATIN[3], ALEXANDER DERKACHEV[3], AKIHIRO HACHIKUBO[4] AND HIROTSUGU MINAMI[4]

[1] Korea Polar Research Institute, KIOST, South Korea (ykjin@kopri.re.kr)
[2] P.P.Shirshov Institute of Oceanology, FEB RAS, Russia
[3] V.I.I'lichev Pacific Oceanological Institute, FEB RAS, Russia
[4] Kitami Institute of Technology, Japan

The Sakhalin continental slope has been a well-known gas hydrate area since the first finding of gas hydrate in 1980's. This area belongs to the southernmost glacier sea in the northern hemisphere, where sea ice covers most of the area in the winter time. High organic carbon content in the sediment, cold sea environment, and active tectonic regime in the Sakhalin slope provide a very favorable condition for shallow gas hydrate accumulation and gas emission phenomena. Korean–Russian–Japanese international research expeditions (CHAOS, SSGH-I, SSGH-II projects) have been conducted from 2003 to 2015 to investigate gas hydrate occurrence and gas seepage activities on the Sakhalin continental slope, Russia.

During the expeditions, near-seafloor gas hydrate samples were retrieved at more than 30 sites and hundreds of active gas seepage structures on the seafloor were newly registered by multidisciplinary surveys. Near-seafloor gas hydrates occurred at the various water depths from about 300 m to 1000 m, which were accompanied by active gas seepage-related phenomena in the water column, on the seafloor, and in the sub-bottom: well-defined hydroacoustic anomalies of gas emissions (gas flares), side-scan sonar structures with high backscatter intensity (seepage structures), bathymetric structures (pockmarks and mounds), very shallow SMI (sulphate-methane interface) depths and high methane concentrations in seawater. Exceptional findings from the expeditions are gas hydrate occurrences around 300 m in the water depth which is nearly closed to the upper boundary of gas hydrate stability zone in the area and a 2,000 m-high gas flare emitted from the deep seafloor.

Keywords: gas hydrate; gas seepage; Sakhalin continental slope; CHAOS; SSGH

Significance of recent two publications on gas hydrates: UNEP and maribus

SUNG-ROCK LEE[1]

[1] Korea Institute of Geoscience and Mineral Resources (KIGAM), Daejeon, Korea (srlee@kigam.re.kr)

As the gas hydrates generally occur in arctic and marine environments, they have not been extensively studied until recently. Research about natural gas hydrates has increased markedly over the last two decades, and understanding about where gas hydrates occur and how they might be exploited is rapidly growing.

Under the circumstances of increasing interests in the natural gas hydrates, there were two significant reports published by the UNEP(United Nations Environment Programme) and maribus gGmbH in 2014. UNEP report titled 'Frozen Heat: A Global Outlook on Methane Hydrates' provides a basis for understanding how gas hydrates occur and emerging knowledge as to their potential environmental, economic and social consequences of their use. Mr. Achim Steiner, Executive Director of UNEP, explains the intention of this report enabling sound policy discourse and choices that takes into account a number of important perspectives. This report is comprised of 3 volumes: Executive Summary, Volume 1 and Volume 2. Volume 1 describes how and where gas hydrates formed in nature, methane generation and natural carbon cycle, response of gas hydrates to climate change and assessment of the sensitivity of global gas hydrate inventory to climate change, and so on. Volume 2 describes the significance in the aspects of potential energy resources and source of greenhouse gas, and provides information useful in evaluating future energy resource options, technologies for exploration and development, and the potential environmental, economic, social implications of gas hydrate production.

The other report, published by maribus gGmbH, is 'World Ocean Review 3: Marine resources- Opportunities and Risks'. In this book, we find information about the formation, exploration and production of marine resources: not only oil and gas but ores in the form of manganese nodules, Co-rich crusts and hydrothermal massive sulphides. A separate chapter is devoted to methane hydrate, 'energy from burning ice'. This book mentions that methane hydrates are the subject of much discussion at present, and will create not only risks, but also opportunities. The opportunities and risks will be: Could methane hydrate with great potential be a part of a sustainable energy supply for our societies? Could hydrate extraction potentially cause severe degradation of the marine environment? What kind of framework must be negotiated at the national and global political level?

In the presentation, the author will share the information and knowledge provided by the both publications. The future of the oceans is intimately linked with the future of resource extraction and with most people's future.

Keywords: gas hydrates, global outlook, UNEP, maribus gGmbH,

Temporal plume-plate and plume-slab interactions explain tectonic history of East Asia during Cretaceous

CHANGYEOL LEE[1]

[1] Faculty of Earth Systems and Environmental Sciences, Chonnam National University, Gwangju 500-757, Republic of Korea(changyeol.lee@gmail.com)

Although A-type granitoids, high-Mg basalts (e.g., picrites), adakitic rocks, basin-and-range-type fault basins and thinning of the North China Craton (NCC), and the southwest-to-northeast migration of adakites and A-type granitoids in southern Korea and Japan during the Cretaceous are thought to be attributable to the upwelling of hot asthenospheric mantle and/or ridge subduction, the genesis of these features remains controversial. Furthermore, the paucity of ridge subduction in a recent plate reconstruction model poses a problem because the Cretaceous adakites in southern Korea and southwest Japan could not have been generated by the old Izanagi plate. Here, we suggest that plume-plate (intracontinental plume-China continent) and subsequent plume-slab (dragged lobe of the intracontinental plume-subducting Izanagi plate) interactions generated the various intracontinental magmatisms and tectonics in China, southern Korea, and southwest Japan. We support our suggestion using time-evolving three-dimensional numerical subduction models designed to evaluate plume-slab interaction in southern Korea and Kyushu, Japan, and show that the pulse-like magmatism of adakites and A-type granitoids was generated by temporal migration of the plume-slab interaction. We also show that the southwest-to-northeast migration of the adakites and A-type granitoids in southern Korea and southwest Japan is correlated with the opposite migration of the East Asian continental blocks, which resulted in the temporal plume-slab interaction. The plume-plate interaction can be correlated with the A-type granitoids, high-Mg basalts, adakitic rocks, and basin-and-range-type fault basins in China. Thus, the temporal plume-plate and plume-slab interactions significantly contributed to the tectonic history of East Asia during the Cretaceous.

Keywords: plume-plate interaction, plume-slab interaction, numerical model, Cretaceous, East Asia, subduction, adakite

An insight into asymmetric development of back-arc basin based on tecto-magmatic evidences from the Ulleung Basin, East Sea (Sea of Japan)

G.B. KIM[1] AND S.H. YOON[2]

[1] School of Earth and Environmental Sciences, Seoul National University, Seoul 151-742, Korea (corona@snu.ac.kr)
[2] Department of Earth and Marine Sciences, Jeju National University, Jeju 690-756, Korea

The interplay between tectonic and magmatic processes in extensional basin is the key to understanding many of its important geological issues. Here we present a new insight into the development of back-arc basin from recent analyses of the Ulleung Basin in the East Sea (Japan Sea), which has been known to represent a rifted-continent end member among a range of back-arc basin types. Our study shows that asymmetry may be a crucial factor in the development of the back-arc basin. In the case of the Ulleung Basin, features resulting from asymmetry include: (1) the concentration of volcanism to the north, (2) presence of northward-dipping syn-extensional listric normal faults, (3) difference in fault pattern between northern and southern conjugate margins, and (4) a slight bias of mantle gravity anomaly high toward north. In the light of these evidences, we argue that the Ulleung Basin initially developed as terrestrial rift basin around 20 Ma, during which the volcanic activities also prevailed over much of the proto-Korea Plateau. However, as the basin widened, the upwelling center of magma experienced difficulty in keeping up with the migration of extension to the south, and subsequently, the widening of the basin occurred more or less amagmatically in the south where the extension was accommodated by listric faulting and crustal detachment. The final modification happened around 12 Ma when the tectonic regime of the Ulleung Basin inverted from extension to compression, and preferential sediment loading from the Japanese arc in the south further enhanced the apparent asymmetry.

Three-dimensional time-evolving plume-slab interaction for generation of Abukuma adakite, northeastern Japan

CHANGYEOL LEE[1]

[1] Faculty of Earth Systems and Environmental Sciences, Chonnam National University, Gwangju 500-757, Republic of Korea(changyeol.lee@gmail.com)

The pulse-like eruption of the Abukuma adakite, in northeastern Japan, at ~16 Ma has previously been explained by short-term and localized plume-slab interaction, where the plume ascended through a slab neck that developed in the subducting Pacific plate. However, because previous research was based on a two-dimensional (2D) model, consideration of the three-dimensional (3D) aspects of the plume blob injected into the corner of the mantle wedge was impossible, and its effects on plume-slab interaction remained unknown. In this study, we conducted a series of 3D kinematic-dynamic numerical subduction models to evaluate the effects of the 3D plume blob on partial melting of the subducted oceanic crust, by varying the duration and size of the plume blob. Our model calculations show that a 3D plume blob with a half-thickness of 30 km, a half-duration of 2.5 Myr, and a wide range of half-widths from 40 to 100 km, resulted in the pulse-like eruption of the Abukuma adakite, compared to the thicker and longer 2D plume blob (half-thickness: 35 km and half-duration: 5.0 Myr). This indicates that the 2D model experiments overestimated the thickness and duration of the plume blob compared to those from the 3D model experiments. In addition, the 'trough' of the suppressed slab surface temperatures was developed by 3D plume-slab interaction. Vigorous injection of the low viscous plume blob into the corner of the mantle wedge generated trench-parallel laterally returning mantle flow, which suppresses the incoming corner flow reaching the slab surface, and produced the trough of the suppressed slab surface. 3D plume-slab interaction thus has an important implication for Quaternary volcano spacing and the 3D flow of the mantle wedge in northeastern Japan.

Keywords: plume-slab interaction, numerical model, Abukuma adakite, slab melting, mantle plume

Cenozoic tectonostratigraphic framework and evolution of the East China Sea Shelf Basin

XIANGQUAN LI[1*], JIANYE REN[1], MAJIE FAN[2], XINONG XIE[1], YONGCHAO LU[1], DIANJUN TONG[1]

[1] Key Laboratory of Tectonics and Petroleum Resources（China University of Geosciences），Ministry of Education, Wuhan 430074, China (lxq@cug.edu.cn)

[2] Department of Earth and Environmental Sciences, University of Texas at Arlington, TX 76019, USA,

The East China Sea Shelf Basin (ECSSB) is situated in the active and complicated convergence zone of the Eurasian, Pacific and Philippine Sea Plates. The zone is important to both petroleum exploration and understanding to the western Pacific trench-arc-basin tectonic system.

The ECSSB has experienced a complex multi-episodic structural movement, with episodic and eastward shifting of rifting, overprinted by later compressional structure (Zhou et al., 1989; Lee et al., 2006; Cukur et al., 2011). Various opinions about the Cenozoic structure and evolution of ECSSB have been proposed (Chai, 1988; Zhou et al., 1989; Tao, 1994; Zhou et al., 2001; He and Yang, 2003; Liu et al., 2003; Lee et al., 2006; Cukur et al., 2011). The main reason of these controversies is lack of an affirmative and clear regional tectonographic framework of the ECSSB.

In this study, we present five deep 2D seismic profiles covering almost the entire ECSSB to document the regional stratigraphic framework of the basin. Based on deposition characteristics, structure, isopach map, and seismic reflection boundaries recorded in seismic data and seismic-well ties, we divided the Cenozoic basin fill into six tectonostratigraphic sequences, including Paleocene megasequence（MS1）, early Eocene-middle Eocene megasequence (MS2), middle Eocene-late Eocene megasequence (MS3), Oligocene megasequence（MS4）, early Miocene-middle Miocene megasequence（MS5）and late Miocene-Quaternary megasequence（MS6）. The six megasequences can be further grouped into three evolutionary phases of basin development: rifting phase(MS1 to MS3), compressional phase (MS4 to MS5) and regional subsidence phase (MS6). Finally, we discuss the connection between tectonostratigraphic sequences and the surrounding major plate events and reconstruct the tectonic evolution of the ECSSB. It is anticipated that this contribution can simple and clarify the complex structure evolution of Cenozoic ECSSB and promote to better understand of the Cenozoic continental rifting process along the eastern margin of the Eurasian Plate.

Keywords: tectonostratigraphic sequence, East China Sea Shelf Basin, western Pacific, plate event

Fault system of the South China Sea from gravity and magnetic anomalies

YA XU[1] , TIANYAO HAO[1],BAIMIN ZHAO[2], SONG HUANG[1]

[1] Institute of Geology and Geophysics, Chinese Academy of Sciences, China
[2] China Aero Geophysical Survey & Remote Sensing Center for Land & Resources, China

The fault system is closed related with the tectonic framework. We analyzed the gravity and magnetic anomalies of the South China Sea (SCS) and identified the fault system based on the interpretation of the various potential field data processing results. The wavelet analysis, Wiener filtering etc. were used to separate anomalies from different scales and different depths. The gradient, directional derivative, title angle etc. on the orginal or seperated anomalies were used to enhance the anomaly features caused by faults and igneous rocks. Assited with imaging analysis, the linear features caused by faults were abstracted from different processing results. Considering the effects of remanent magnetization, we compared the processing results of magnetic anomaly and the anomaly after the reduction to pole to identify the proper fault trend and location. With comprehensive analysis of potential field anormalies and their various processing results, we identified four major fault systems with NE(E), NW, NS and EW directions. The distribution of the fault system is compatible with the tectonic framework. The NE(E) and NW faults mainly devloped in the north and south margins of SCS. The NS faults were mainly in the east and west margins. The EW faults mainly developed in SCS basin. With geology background, the fault system developed with the tectonic evolution of SCS. The NW and NE(E) faults developed from Indosinian, and the activity of NE(E) faults became stronger in late Yanshanian. With the seafloor spreading and evolution of the SCS basin, the four major fault systems were active and acted with each other, which formed present tectonic framework.

Keywords: Fault, gravity, magnetic, the South China Sea

Tomographic evidence for a slab tear induced by fossil ridge subduction at Manila trench, South China Sea

JIANKE FAN[1], SHIGUO WU[1], GEORGE SPENCEC[2]

[1] Institute of Oceanology, Chinese Academy of Sciences, Qingdao 266071, PR China
[2] School of Earth and Ocean Sciences, University of Victoria, Victoria V8P 5C2, Canada

The Manila Trench is located on the east of the South China Sea (SCS), which was generated by subduction of the South China Sea slab (SCSs) beneath the Luzon Island since Early Miocene. Accompanying with the subduction of SCSs, a slab tear along the axis of the fossil ridge of the SCS was presented by Bautista et al. (2001), who mainly used hypocentral and focal mechanism data, plus geomorphological, geochronological, geochemical and geophysical data, but lack of adequate tomographic evidences. Therefore, we use a P-wave arrival time dataset collected from the EHB bulletin (1960-2008), to carry out the seismic tomography, and integrate the results with other geological, geophysical and geochemical data to verify the slab tear along the fossil ridge of SCS.

The data set is composed of 13087 arrival times from 1401 regional earthquakes and 8834 arrival times from 1350 teleseismic events. The seismic tomographic method of Zhao et al. (1994) for the local and teleseismic joint inversion is used to obtain the P-wave velocity perturbations beneath Luzon Island, based on an initial model, derived from CRUST2.0, IASP91 and WPSP01P model (Wright and Kuo, 2007), and a 3-D grid model, the intervals of which are 0.5°×0.5° in the longitudinal and latitudinal directions and 15-100km in the depth direction, respectively. A checkerboard resolution test with the grid spacing of 0.5° is conducted, and the results show that most of the study area has good resolution, implying the main features of the tomographic results are credible. After inversion, the root mean square of travel-time residuals is reduced from 1.46s in the initial model to 0.72s in the final model.

The results along the profile at 17°N show that the SCS slab represented by the high velocity zone subducts at a low angle of ~32°, different from that along the profile at 17.5°N, where the subducted SCS slab extends near-vertically to about 700km depth. This dramatic change in dip angle can be interpreted as a tear of the subducted SCS slab at ~17°N, where the fossil ridge of SCS is subducting. The fossil ridge may be very fragile, which is suggested by low coupling ratio derived from the trench parallel gravity anomaly at around 17°N, so that the fossil ridge in general may be a stress weak zone that can easily tear. The slab tear results in the formation of a slab window beneath the subducted SCS slab, indicated by some low velocity zones along the profiles at 17°N, 17.5°N and 18°N. The slab window produces a series of magmatic centers along tear faults where magmatism is generated by asthenospheric upwelling. Consequently, the heat flow is much higher (>100mW/m2) along the fossil ridge of the SCS east of the Manila Trench than that at the West Luzon Trough and North Luzon Trough (<50mW/m2) revealed by the heat flow data.

Adakites and adakitic rocks are regarded as the partial melting of the young subducted slab (<5Ma). However, Adakites are very common in the Luzon Arc, and most are believed to be related to the plate subduction of the South China Sea, the Sulu Sea, the Celebes Sea and the Philippine Sea. Nevertheless, the relatively old age of the subducting SCS slab makes it difficult to melt except at the edge of a torn subducting plate, suggested by some equivalent examples of older plates producing adakites found in New Zealand's South Island, Costa Rica and Kamchatka peninsula and the Aleutian islands. The slab tear along the fossil ridge of SCS produces slab window from the surface to 200 km depth, which are associated with hot mantle flowing upwards and producing partial melting of the edge of the slab and lower crust, which is consistent with previous explanations for the existence of adakites landward of the fossil ridge.

Our tomographic results indicate the slab tear along the axis of the fossil ridge of the SCS, and the formation of the slab window. A region of high heat flow in the forearc and adakites in the Northern Luzon are attributed to the tear of the SCS slab along the fossil ridge, initiating the mantle flow upward and resulting in the partial melting of the edge of the slab and the lower crust. Our results provide new insight into the interaction between South China Sea slab and Philippine Sea Plate, and help understand the tectonics and evolution of the Eurasian Plate and Philippine Sea Plate.

Keywords: Seismic tomography, slab tear, South China Sea, Manila Trench

Associations of the Early Cretaceous arc volcanic rocks and adakitic rocks in the Cebu island, Central Philippines: Its tectonic implications

JIANGHONG DENG[1], XIAOYONG YANG[1]*

[1] CAS Key Laboratory of Crust–Mantle Materials and Environments, University of Science and Technology of China, Hefei 230026, China (xyyang555@163.com)

The Philippine island arc system is a collage of amalgamated terranes of oceanic, continental and island arc affinities. We investigate a volcanic suite in the Cebu Island of central Philippines, including basalt, diabase dike, basaltic pyroclastic rock and porphyritic andesite, and adakitic diorite intrusions. LA-ICP-MS U-Pb geochronology of zircon grains from the porphyritic andesite, pyroclastic rock and diorite yielded ages of 126.2 ± 2.4 Ma, 118.5 ± 1.2 Ma and 112.5 ± 1.5 Ma, respectively, indicating an Early Cretaceous age. The age distribution of the detrital zircons from river sand in the area displays only one peak at ca. 118 Ma, close to the age of the pyroclastic rock. The early Cretaceous volcanic rocks in the central Philippines were previously regarded as parts of ophiolite complexes by most investigators, whereas the Cebu volcanics are distinct from these, and display calc-alkaline affinity and island arc setting, characterized by high LREE/HREE ratios and low HFSE contents. These features are similar to the Early Cretaceous arc basalts in the Amami Plateau and east Halmahera in the northernmost and southernmost West Philippine Basin (WPB) respectively. Zircon Hf isotopes of the porphyritic andesite show slight enrichment relative to that of the pyroclastic rocks and MORB, indicating subducted sediments as a minor end-member in the source. The Hf isotopic compositions of the volcanic rocks are also reflected in the detrital zircons from the river sands, with two pronounced peaks in the TDMI ages. Zircon Hf isotopes of the pyroclastic rocks show depleted nature similar to those of the Amami Plateau basalts, implying the subducted Pacific-type MORB as probable source.

We propose that the volcanic rocks of Cebu Island were derived from partial melting of sub-arc mantle wedge which was metasomatised by dehydration of subducted oceanic crust together with minor pelagic sediments, while the adakitic rocks are derived from the partial melting of subducted oceanic crust. Within the tectonic environment of Southeast Asia during Early Cretaceous, the combination of normal arc volcanic rocks and adakitic rocks in the area can be correlated to the subduction and slab roll back processes of paleo-Pacific plate. The Early Cretaceous volcanic suites in the Cebu Island along with the Early Cretaceous arc volcanic rocks, ophiolites and boninites in the southern- western- northern margin of West Philippine Basin are inferred to have formed within single subduction zone before the opening of the Philippine Sea Plate.

Keywords: Philippines, adakite, arc volcanic rock, paleo-Pacific plate, West Philippine Basin

Petrology and geochemical evidence of magmatic rocks on Lemukutan arcipelago, West Kalimantan relation to tectonic environment

NOOR CAHYO D. ARYANTO[1]; E. SUPARKA[2]; C.I ABDULLAH[2] AND H. PERMANA[3]

[1] Marine Geological Institute (MGI) of Indonesia (noor_aryanto@yahoo.com and cahyo@mgi.esdm.go.id)
[2] Faculty of Science and Earth Tecnology, ITB
[3] Research Center for Geotechnology, LIPI

The objective of study about the petrology and geochemical characteristics of magmatic rocks on the Lemukutan archipelago in order to know of the tectonic environment. Study area is a group of islands located on the west side of West Kalimantan; which borders the east side of Bengkayang; in the west and north it borders of the Natuna Sea, while in the south of Regency Mempawah. Consists of three main islands, namely: Lemukutan , Penata Besar and Kabung Island.

Outcrops of magmatic rocks on the islands in the Lemukutan archipelago have analyzed the major element by AAS and rare earth elements using ICP. Based on the analysis of major elements results of the 15 volcanic rock samples, showing the range of SiO2 from 48% to 72.93% with Mg# ranging from 30.1 to 68.3. At the Lemukutan island of Na2O almost always more to K2O, except at one location at LMK12-14 on dacite which Mg# value is the lowest when compared to other rocks, that are not consistent with the silica concentration. In general Lemukutan archipelago magmatic especially volcanic rocks are mostly calc-alkaline series with minor tholeiitic with lower concentrations of TiO2 (<1%) indicating rock originated from magma in a subduction zone environment.

Keywords: Petrology, geochemical, major elements geochemie, calc-alcaline, Lemukutan archipelago, and West Kalimantan

Geochemical characteristics of Cenozoic magmatic rocks in Grasberg, West Papua, Indonesia: Its tectonic implications

HUASHENG QI[1] XIAOYONG YANG[1*]

[1] CAS Key Laboratory of Crust–Mantle Materials and Environments, University of Science and Technology of China, Hefei 230026, China (xyyang555@163.com)

The island of New Guinea has been in a passive margin, evolved within the obliquely and rapidly converging Australian and Pacific plate boundary zone, since Late Paleocene. In the Central Ranges of western New Guinea, a suite of Cenozonic magmatic rocks related with Cu-Au mineralization were emplaced in host carbonate strata. We investigate porphyry rocks related with Cu-Au mineralization in Grasberg, west Papua of Indonesia. These rock series include quartz monzonite-porphyry rock and granodiorite. LA-ICP-MS U-Pb geochronology of zircon grains from the quartz monzonite-porphyry rock and granodiorite yielded ages of 2.87 ± 0.15 Ma, 2.88 ± 0.19 Ma, 2.96 ± 0.15 Ma, 2.99 ± 0.19 Ma, 3.21± 0.15Ma, respectively, indicating a Late Oligocene age. Some 1.8Ga core in inherited zircon in quartz monzonite-porphyry rock have been identified, indicating that some old Precambrian basement materials had been involved in the magmatic recycling and Cu-Au mineralization. Some Re-Os dating of molybdenite from Grasberg suggests that mineralization occurred at 2.88 ± 0.01 Ma (Mathur et al., 2005), indicating that the porphyry Cu-Au mineralization is closely related with these igneous rocks.

Igneous rocks of the Grasberg intrusion are classified as high K to shoshonite suite, the medium of SiO2, intermediate acid, Al-rich, peraluminous series rocks. Porphyry rocks showing high LREE/HREE and LaN/YbN ratios, the differentiation of light and heavy rare earth elements are obviously, light rare earth elements are enriched, Eu anomaly is not obvious, and low HFSE contents (deficted Nb, Ta, Ti), classified as being from island arc setting. Besides, intrusive rocks displayed higher Sr, Sr/Y ratios and low Y, Yb contents. These features indicated Grasberg intrusive rocks belong to adakite. Geochemical and isotopic characteristics (Housh and McMahon, 1996) of porphyry rocks suggest that Grasberg intrusive rocks may have originated from the partial melting of subuducted oceanic crust and a mixing with crust materials.

From geochemical results, we propose that the Cu-Au related igneous rock series are of adakites they may be derived from partial melting of sub-arc mantle wedge once metasomatised by dehydration of subducted oceanic crust. Subsequently, the magma had been contaminated with crust materials when crossed lithosphere.

Within the tectonic environment of the West Papua from Late Eocene to Early Miocene, the igneous rocks have been interpreted to represent an arc signature formed by south-to-southwestward subduction of oceanic lithosphere beneath the rifted AUS margin, with the arc on, or near the leading edge of, the Australian plate (Baldwin et al., 2012).

Keywords: Grasberg Igneous Complex, adakite, porphyry Cu-Au deposit, West Papua

Geological Features and Tectonic evolution in the Eastern Arctic

LI XUEJIE[1], YAO YONGJIAN[1], WANG JUN[1], YANG CHUPENG[1]

[1] Guangzhou Marine Geological Survey, Key Laboratory of Marine Mineral Resources, MLR, Guangzhou 510760, China, (xuejieli@yeah.net)

The eastern Arctic region, form east coast of the Atlantic Ocean in the west to the Bering Strait in the east, covers a large area, including arctic continent and Barents Sea, Kara Sea, Laptev Sea East Siberian Sea and Chukchi Sea, in which are characteristic with wide continental shelf, basin development and abundant petroleum resources.

3 tectonic provinces, the western Eurasia (Baltic), Siberia and Far East Asia, include in the region.

The western Eurasian, covering from western Norway to Ural Mountain and Novaya Zemlya, includes tectonic units of Baltic Craton, Svalbard-Kara Microplate, Timanides, Caledonides and Ural-Novaya Zemlya-Taimya Orogen. The main tectonic units in Siberia are Siberian Craton and Verkhoyansk Orogeny, while that in Far East Asia includes Alaska-Chukotka Microplate, Kolyma-Omolon Superterrane, South Anyui Suture and Kotel'nyi Terrene.

The eastern Arctic region should undergo the following main tectonic events in Phanerozoic: 1) Timanian Movement in Late Neoproterozoic-Early Cambrian, which resulted in Baltica Continent collided with Svalbard-Kara Microplate and formation of Timanides; 2) Caledonian Movement in mid-Ordovician to Late Silurian, which resulted in Baltica collided with Laurentia, and formation of Laurussia continent and Caledonides; 3) Main basin forming period, due to the crust extension after the orogeny; 4) Hercynidian Movement in Late Palaeozoic - Early Mesozoic, lead to collision between Baltica and Siberian Continent, and forming the Ural-Novaya Zemlya-Taimya Orogen; 5) Microplate of Alaska-Chukotka split from the north margin of Canada and the Canadian Ocean start opening, as the breakup of Pangea in Jurassic; 6) Alaska-Chukotka Microplate shifted forward to the Siberia and collided to the northern Siberia in early Cretaceous, which result in close of Anyui Ocean and formation of Verkhoyansk and New Siberian-Chukotka-Brooks Orogenic system.

Keywords: tectonic, eastern Arctic, evolution

3D seismic structure of the Zhenbei-Huangyan seamount chain in the East sub-basin of the South China Sea and its mechanism of formation

MINGHUI ZHAO[1], JIAN WANG[1], XUELIN QIU[1], JEAN-CLAUDE SIBUET[2], ENYUAN HE[1] AND JIAZHENG ZHANG[1]

[1] Key Laboratory of Marginal Sea Geology, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou 510301, China (mhzhao@scsio.ac.cn)

[2] Retired from Ifremer, France

The probably N055° oriented extinct spreading ridge (ESR) of the East Sub-basin is cut across by the post-spreading volcanic ridge (PSVR) oriented approximately EW in its western part (Zhenbei-Huangyan seamount chain). A three-dimensional (3D) Ocean Bottom Seismometer (OBS) survey covered both the central extinct spreading ridge and the Zhenbei-Huangyan seamount chain. The comprehensive seismic record sections of 39 OBSs shows clear and reliable P-wave seismic phases, such as Pg, Pn and PmP. These seismic arrivals provide strong constrains for the modeling of detailed 3D velocity structures. Here we will present the 3D results to discuss the nature of the oceanic crust near the Zhenbei-Huangyan seamount chain and the extinct central spreading ridge as well as the genetic relationship between the magma chambers beneath the Zhenbei-Huangyan seamount chain. We suggest that the thickness of upper crust is possibly due to volcanic extrusion and the thickened lower crust is mainly due to magmatic underplating. Combining previous geochemical study, the formation mechanism of the seamount chain is supposed to be explained by a buoyancy decompression melting mechanism. This research was granted by the Natural Science Foundation of China (91028002, 91428204, 41176053).

Keywords: extinct spreading ridge (ESR), Zhenbei-Huangyan seamount chain, 3D seismic structure, East subbasin of the South China Sea

Modeling wide-angle seismic survey data for the crustal structure of Bohai Sea and adjacent area

LIHUA LIU[1], TIANYAO HAO[1], CHUANCHUAN LV[1], QINGYU YOU[1], YA XU[1]

[1] Key Laboratory of Petroleum Resources Research, Institute of Geology and Geophysics, Chinese Academy of Sciences, China(liulihua@mail.iggcas.ac.cn)

In 2010 and 2011 onshore-offshore surveys along two lines in the Bohai area were carried out, This was the first time in this area to do such wide angle reflective/refractive seismic survey, using large volume air-guns and dense Ocean Bottom Seismometers at sea, combining with explosives and portable stations on land. By using first arrival tomography and ray-tracing modeling method, we got the P-wave velocity structure of the profiles. Common Middle Point stack profile of PmP phase is also presented, which is new for Ocean Bottom Seismometer data processing. Our result shows (1) The environmental noise of records from Ocean Bottom Seismometer in shallow water area is stronger than that from deep waters. (2) The thickness of sedimentary layer in Bohai Sea and surrounding area is 3-5 km, the velocity increases with depth from about 2 km/s at the seafloor to about 4.5 km/s on the sedimentary basement. (3) The velocity contours nearby the Tancheng-Lujiang and Zhangjiakou-Penglai Fault Zones are U-shaped, where the velocity changes laterally and the interface undulates significantly, velocity disturbances exist in the crust-mantle transition zone at the fault zones, the great fault zones could be the upwelling channels of deep material. (4) In the eastern part of North China Craton, the Moho gently ranges at the depth of about 30 km with local rise, lithosphere thinning occurred predominantly at the top of upper mantle, and the east boundary of lithosphere thinning is inferred to be on the east of Bohai Sea.

Keywords: Ocean Bottom Seismometer, Bohai Sea, First arrive tomography, Ray-tracing modelling, Wide-angle seismic survey.

The role of rifting in the development of the southwestern sub-basin and its continental margins, South China Sea

CHUANCHUAN LU[1], TIANYAO HAO[1], XUELIN QIU[2]

[1] Key Lab of Petroleum Resources Research, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, CHINA

[2] Key Lab of Marginal Sea Geology, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou, CHINA

We present a detailed seismic velocity transect of the crust and its upper mantle across the Southwest Sub-Basin of the South China Sea and compare this model with other deep penetrating seismic transects in the South China Sea. These results are based on data from a 2009/2011 crustal-scale, active-source seismic experiment, where multi-channel and wide-angle seismic data were acquired along this transects across the oceanic basin in the South China Sea. The transects was instrumented with 40 ocean-bottom seismometers spaced 20 km evenly. Compressional seismic velocities and gravity anomaly in the proximal margin of the southwest sub-basin in South China Sea indicates that the crust here is comprised of distinct domains shaped by rifting and seafloor spreading: (1) thinned continent-ocean transition crust with high gravity anomaly, indicating that it is intruded and possibly under-plated by mantle-derived melts, and (2) various continental crust along the proximal margins shows the discrete and drifted extensional centre. And the presence of disturbance of the necking zone suggests high mantle viscosity during early Cenozoic rifting, which are expected given the proximity making of OBS Transect to Late Eocene. (3) Comparison of OBS crustal structure to mantle-melting models supports passive mantle upwelling in the northern margin of SWSB before breakup.These observations indicate that the continental rifting before the breakup of the southwest sub-basin, South China Sea is multi-stages process, its seafloor spreading localized and occurred after the detachment faulting; and the reasons of the asymmetry rifting of southwest sub-basin margin are: the drift of the continental lithosphere necking center and the asymmetry detachment faulting.

Keywords: Amagmatics margin rifting, Ocean bottom seismometers, passive margin, South China Sea

Integrated Geophysical Study on the Deep Structure of Bohai Bay Region

TIANYAO HAO[1], QINGYU YOU[1], LIHUA LIU[1], CHUANCHUAN LV[1], YA XU[1]

[1] Key Laboratory of Petroleum Resources Research, Institute of Geology and Geophysics, Chinese Academy of Sciences, China(tyhao@mail.iggcas.ac.cn)

The North China Craton is the only place where intensive destruction of thick Archaean lithosphere on earth. It is considered by scientists as "a best example of ancient lithosphere destruction". Based on the results of two onshore-offshore deep seismic profiles across the Bohai Bay region, earthquake tomography and gravity-magnetic inversion in this region, we find that the lower crust anisotropy and small-scale high velocity zones exist in the region and no large-scale undulance of the Moho, and we propose lithosphere thinning is mainly caused by the upper mantle extension. The result indicates that lateral variation of the Moho interface and the crustal P-wave velocity are affected mostly by the existence of large-scale faults nearby, and lower crust was underplated and transformed by the Moho. There is no geophysical evidence support the "mantle plume" or "delamination" model of the North China Craton destruction in our experiment. Therefor, we suggest that the crustal structure of the region shows "a relatively normal crust and thinned mantle" and instability phenomena that shows P-wave velocity anomalies in the crust may represent a combined effect of North China Craton -Yangtze collision at the early stage and the distal effect of the Pacific plate subduction at the late stage.

Keywords: North China Craton, Bohai Bay Region, Lithosphere Destruction.

Smectite, Illite, and Early Diagenesis in South Pacific Gyre Seafloor Sediment

JINWOOK KIM[1*] ,KIHO YANG[1], TOSHIHIRO KOGURE[2], HIONSUCK BAIK[3], BRYCE HOPPIE[4], ROBERT HARRIS[5], AND IODP EXPEDITION 329 SCIENTISTS[6]

[1] Department of Earth System Sciences, Yonsei University, Seoul, Korea (jinwook@yonsei.ac.kr)
[2] Department of Earth and Planetary Sciences, Graduate School of Science, The University of Tokyo, Tokyo, Japan
[3] Korea Basic Science Institute (KBSI), Seoul center, Korea
[4] Department of Chemistry and Geology, Minnesota State University, Mankato, MN, USA
[5] College of Earth, Oceanic, and Atmospheric Sciences, Oregon State University, OR, USA
[6] IODP expedition 329 shipboard scientists

Subsea floor sediment in the South Pacific Gyre (SPG) was recovered for the first time by Integrated Ocean Drilling Program (IODP) Expedition 329 (2010.10.10-2010.12.13). Clay mineralogy from two sites (U1369 and U1365) was investigated. The comparisons of clay mineralogy and formation from the sites U1365 (margin of SPG), and site U1369 (center of SPG close to the East Pacific Rise). The sediment at the site U1369 has a young crustal age of 13.5 Ma compared with the site U1365 (84-120 Ma). Fine clay fractions less than 1 μm were analyzed by x-ray diffractometer (XRD), transmission electron microscope (TEM) with the selected area electron diffraction (SAED) pattern, and electron dispersive x-ray spectrometer (EDS). Saturation index (SI) with respect to smectite was modeled based on the pore water chemistry. The dominant phases of clay mineral in the investigated sediments are smectite and illite. The higher ordering of illite polytype (1M, 2M1, and 3T) at U1369 was distinctively compared with the disordered 1Md illite at U1365 suggesting that hydrothermal alteration influences the smectite mineral formation at U1369. The lower heat flow measurement comparing to the lithospheric cooling reference also supports the hydrothermal activity at U1369. Smectites of hydrothermal origin such as Al-rich beidellite, and saponite were observed at U1369 whereas Fe-rich montmorillonite that is likely to be associated with the basalt-seawater interaction at ambient temperature, was dominant at U1365. Fe-rich semctite (nontronite) was detected at both sites. The measurement of saturation indices with respect to smectite phases, and muscovite using pore water chemistry showed an oversaturated condition. The Red-brown to yellow-brown Semiopaque Oxide minerals (RSO) were widely distributed with Fe-rich smectite near the basaltic crust at U1365. The presence of K-nontronite at basalt-sediment interface at both sites indicates an oxidative basalt alteration; however the variations in oxidation state of structural Fe in nontronite measured by EELS may indicate that the reductive environment may persist locally at the basalt/sediment interface.

Keywords: South Pacific Gyre (SPG); K-nontronite; diagenesis; smectite formation; illite polytypism; IODP Expedition 32

Synchronous mid-Miocene upper and deep oceanic 13C changes in the east equatorial Pacific linked to ocean cooling and ice sheet expansion

JUN TIAN[1*], WENTAO MA[1], MITCHELL W. LYLE[2], JULIA K. SHACKFORD[2]

[1] State Key Laboratory of Marine Geology, Tongji University, Shanghai 200092, China
[2] Department of Oceanography, Texas A&M University, TAMU 3146, College Station TX 77840-3146, USA

We present mid-Miocene (~12.0-16.0 Ma) high-resolution (~3.8 kyr) deep thermocline planktonic foraminiferal $\delta^{18}O$ and $\delta^{13}C$ records at IODP Site U1337 from the eastern equatorial Pacific. The benthic and planktonic $\delta^{18}O$ records of Site U1337 have a similar long-term cooling trend, but display obvious amplitude differences of glacial/interglacial cycles after 13.9 Ma. Planktonic $\delta^{18}O$ cycles are usually larger than 1.0 ‰, nearly 2 times those of the benthic $\delta^{18}O$. The post-13.9 Ma change is probably caused by intensified upwelling along with ocean cooling, but may include upper ocean circulation changes. Both the benthic and planktonic $\delta^{13}C$ records at Site U1337 reveal marked 400-kyr carbon isotope cycles during the MMCO (Middle Miocene Climate Optimum) with a trend toward lower $\delta^{13}C$ from 16.0 Ma to 12.0 Ma. The similarity in response between surface and deep carbon isotopes indicates that the mid-Miocene carbon excursions in the east equatorial Pacific involved the whole ocean basin water column and thus are a global signal. Box model simulations reveal that the long eccentricity (400 kyr) paced carbon inputs from weathering changed the burial ratio of carbonates to organic carbon and helped to produce the significant 400-kyr cycles in oceanic $\delta^{13}C$. The increased weathering of carbonate, silicate and kerogen rocks are the major factors controlling the long-term decrease in oceanic $\delta^{13}C$ after 16.0 Ma.

Prelliminary investigation of the Asian Monsoons using authigenic beryllium isotopes from sedimentary cores of the Expedition 346 Site U1430

YIRE CHOI[1,2], KYEONG JA KIM[1,2*]

[1] University of Science and Technology, Daejeon, Republic of Korea (kjkim@kigam.re.kr)
[2] Korea Institute of Geoscience and Mineral resources, Daejeon, Republic of Korea

Using authigenic beryllium-10 and beryllium-9 of the sedimentary core, U1430, we will investigate the initiated time of the Asian Monsoons and paleo-marine environmental change of the East Sea for the geological time period for the past 16 Ma. For this study, we have recently investigated Be-10 records from the sedimentary core samples (35 samples of U1430-Hole A and 143 Samples of U1430-Hole B) of the Expedition 346 site U1430 (on the southern upper slope of Ulleung Basin), obtained from the East Sea of Korea (37°54.16′N, 131°32.25′E, 1072 mbsl).

The preliminary beryllium-10 record of the sedimentary core, U1430 shows a distinctive peak appears around 10 million years BP. The relative concentration of Be-10 at a depth of 22H (193 – 202.2 m) is a factor of 8 times higher than the concentrations at the depths before and after the reference depth. This may indicate a significant change in production rate of Be-10. This could be caused by some other reasons for example paleomagnetic intensity change, etc. At this time, Be-9 data are not available to address the climate change associated with sediment inflows from the land surface to the East Sea. We also investigated other proxies such as Fe, Ca, CH4, N, and etc. and compared with the beryllium-10 record. This presentation will cover our preliminary result beryllium isotopes of the sedimentary core, U1430, collected from Ulleung Basin and similar studies elsewhere.

Keywords: Asian Monsoon, Paleoclimate, Beryllium-10, Beryllium-9, Expedition 346 site U1430

Grain size distribution and salinity content influencing geotechnical and rheological characteristics in submarine mass movements

SUENG WON JEONG[1], J.J. BAHK[1], S.P. KIM[1], G.Y. KIM[1], S.H. LEE[2] AND R. URGELES[3]

[1] Korea Institute of Geoscience and Mineral Resources, Republic of Korea (swjeong@kigam.re.kr)
[2] Korea Institute of Ocean Science and Technology, Republic of Korea
[3] Institute of Marine Sciences (CSIC, Barcelona), Spain

Large sediment volume and long traveling distance of marine sediments are main features in failure and post-failure stage of submarine mass movements (Jeong et al., 2013, 2015). Failure and post-failure stage are directly related to the slide initiation and debris flow occurrence. These two characteristics are mainly examined by geotechnical and rheological properties. In subaqueous environments, influence of grain size and salinity of fine-grained sediments on their geotechnical and rheological behaviour is significant (Jeong, 2013). Grain size dependent geotechnical properties are examined in terms of volumetric concentration of solid. For the fine-grained sediments (grain size less than 0.002 mm), the ring shear tests were performed to determine the shear strength in failure and post-failure stage of mass movement. In order to select an appropriate strength parameter in debris flow dynamics, the Bingham yield stresses determined from the coaxial cylinder viscometer can be compared with the undrained shear strength determined from Swedish fall cone tests. Selecting appropriate strength parameters for debris flow simulation will be suggested. In both subaerial and subaqueous environments, the rheological properties of fine-grained sediments are significantly affected by salinity content and clay minerals. The variation in viscosity as a function of salinity (0 and 30 g/L NaCl) is emphasized in both illite-rich and montmorillonite-rich materials. Based on previous researches, the relationship between yield stress and plastic viscosity can be useful in debris flow dynamics. Ring shear strength is also useful in initiating shearing in slip surface. Preliminary analysis of landslide-induced tsunami in the Ulleung Basin will also be discussed.

Keywords: submarine mass movement, geotechnology, rheology, debris flow, Ulleung Basin

Physical Parameters of Sediments from the Continental Margin off Costa Rica

JOO YONG LEE[1], GIL YOUNG KIM[1], CHANGHO LEE[2], AND JONG-SUB LEE[3]

[1] Korea Institute of Geoscience and Mineral Resources, Marine and Petroleum Resources Division, Korea (jyl@kigam.re.kr)
[2] Chonam National University, Department of Marine and Civil engineering, Korea
[3] Korea University, School of Civil, Environmental, and Architectural engineering, Korea

Using an oedometer cell instrumented to measure the evolution of electromagnetic properties, small strain stiffness, and volume, we conducted consolidation tests on sediments recovered from the continental margin (IODP Expedition 334) off Costa Rica. The tested specimens include six undisturbed specimens (as recovered from the original core liner) from different depths. The tested specimen (depth 20.69 mbsf to 510.49 mbsf at site U1378) consists of uncemented quartzitic fine sand with a high fraction of fines. Laboratory derived index properties of natural sediments could be employed to infer more engineering design parameters based on accumulated geotechnical knowledge. Major mineral constituents compose several non-clay minerals with various clay minerals including kaolinite, chlorite, and montmorillionite. Observed microstructures are compatible with a typical marine sedimentation environment. Specimens are systematically studied by using an oedometer cell instrumented to study the evolution of small strain stiffness, electromagnetic properties, and volume change. Results indicate that the major controls on the mechanical and geophysical properties are effective stress and porosity among the vertical effective stress, stress history, porosity, fabric, ionic concentration of pore fluid. Thermal conductivity measurements reveal that effective thermal conductivity is governed by not only bulk conductivity and volumetric fraction of each component but also quality of inter-particle contacts and number of contacts per unit volume.

Keywords: mineralogy; seismic waves; permittivity; thermal conductivity; stress-volume response

D/V Chikyu 10 years operation achievements and the beyond

SHIN'ICHI KURAMOTO[1]

[1] Japan Agency for Marine-Earth Science and Technology (JAMSTEC) Center for Deep Earth Exploration (CDEX) (s.kuramoto@jamstec.go.jp)

More than 70% of the surface of our planet is covered by water and the vast oceans still represent a new frontier waiting to be explored. Because the ocean hides the mysteries of dynamics of plate movement that cause earthquakes and tsunamis, volcanic eruptions, and is one of the fundamental driving forces of global climate changes, we explore the ocean by drilling, deep and deeper. Furthermore, deep earth environment provides a new insight for exploring microorganisms below seafloor where extreme environment for keeping and feeding microorganisms exists that may or may not hold clues to the origin of life in our planet. Scientific ocean drilling is a unique technology to reveal the mysteries of our planet and its immense oceans.

Scientific Ocean Drilling Vessel Chikyu has been constructed in 2005 and started her scientific drilling operation under the international program, IODP (Integrated Ocean Drilling Program; 2003-2013, International Ocean Discovery Program; from 2013), since 2007, operated by JAMSTEC (Japan Agency for Marine-Earth Science and Technology). Chikyu has been exploring in the Nankai Trough, Okinawa Trough, Japan Trench and the continental slope off Tohoku, Japan, under the IODP. Those expeditions are focused on seismogenic zones, a hydrothermal system, marine resources and sub-seafloor biosphere which are hight priority science targets described in the IODP science plan. Chikyu equipped riser system including BOP (Blow Out Preventer) and most accurate DP (Dymnamic Position) system same as the high-end industrial drilling vessels. Chikyu's uique facility is the state-of-the-art laboratory on board. There are 4 floors and relatively large instruments like a X-CT scanner, ICP-MS, magenetic shield room are preparied for the most advanced research on board as quick as possible right after drilling/coring.

Since scientific operation started in 2007, the Chikyu has been established several world records in operation. The Chikyu drilled about 850m below sea floor from 6,900m water depth, the drill stirings was extended more than 7,750m, off Tohoku of large seismic slip was occurred during the 2011 Tohoku eathquake. The Chikyu has been reached to 3,050m below sea floor by riser drilling under high speed current circumstances in the Nankai Trough. The Chikyu drilled/logged under high temperature (over 300 degree C) environment at hydrothermal vent areas of the Okinawa Trough. Also complex borehole observatories are installed at several sites and LWD and large size wire-line logging operations were really challenging and successfully done.

Accourding to those operational challenges, the Chikyu achieved significant scientific results. The Nankai trough and the off-Tohoku seismogenic zones expeditions gave us a new insight of nature of seismic/tsunami-geneic faults near the trench axises. Our traditional understanding on "a-seismic zone" was completely request re-consider us the behavior based on our drilling results. It may force us to over write our textbooks. Subseafloor image of active hydrothermal vent area also request us to renew our traditional images according to our drilling results at the Okinawa trough. Rich biosphere are recognized at off Tohoku in coal bed zone. There are extremly long-life and interesting life style mocrobes are sampled and cultivated. This presentation will briefly show the scientific results and the engineering developments of Chikyu/IODP operations. D/V Chikyu will continue to explor the deep earth where we never reached yet. Our future scientific and engineering targets and the way to go will show in brifely based on our international wokshop results, Chikyu+10, held in Japan in 2013.

Keywords: Chikyu, IODP, drilling, seismogenic zone, hydrothermal system, microbes, marine resources

Challenges of Ocean Driling Science of Chikyu

YASUHIRO YAMADA[1], MOE KYU THU[1]

[1]1R&D Center for Ocean Drilling Science, JAMSTEC (yyamada@jamstec.go.jp)

Scientific drilling has been developed as a method to understand the past of the Earth, and applied to mechanisms of natural resources and hazards such as earthquakes. Now scientific drilling is going to further evolve as an information science by integration of different / various kinds of datasets that we can get from sub-surface. Such datasets include those obtained by techniques of exploration geophysics, core analysis, geophysical logging and drilling data. In particular, the drilling datasets that Chikyu acquires 100 different kinds in every second while drilling are extremely informative to understand subsurface geomechanics. This kind of datasets has been utilized for drilling operation purposes, but we believe that these can be used to bridge the scales of datasets between exploration geophysics (in ca 30-40 meter scale) and core analysis (in ca millimeters). The integration of subsurface datasets should bring new pictures of the dynamic nature of the Earth.

Importance of Data Integration in the Scientific Ocean Drilling

KYAW MOE[1] AND YASUHIRO YAMADA[2]

[1] R&D Center for Ocean Drilling Science, Japan Agency for Marine-Earth Science & Technology, JAPAN (moe@jamstec.go.jp)

Scientific Ocean drilling acquired and maintained huge dataset and valuable samples from the global oceans over four decades. With the expansion of program into three drilling platforms and numerous advanced measurements in drilling, sampling and measurements, systematic data integration and collaborated analyses with industry become important to succeed operations in future challenges and to lead in the deepwater and unconventional drilling science.

Keywords: scientific ocean drilling, cuttings/core-log-seismic data integration, deepwater challenges

A stochastic process of sonic velocity and breakout width logging data for in situ stress estimation at IODP Hole C0002A, Nankai accretionary prism

INSUN SONG[1]

[1] Environmental Division, Korea Institute of Geoscience and Mineral Resources, Korea (isong@kigam.re.kr)

Borehole wall images and sonic logging data obtained from the riserless-drilling of C0002A (NanTroSEIZE) show a wide distribution of breakout width and sonic velocity even at a short interval of depth. The small-scale but frequent variation in breakout width in a short section of borehole wall is due to heterogeneous rock strength rather than a correspondingly frequent change in far-field stress. In this paper we consider the probability distribution of rock strengths and breakout widths in a given section of wellbore, which is large enough to analyze the logging data in a statistical manner but small enough to make sure that the far-field stresses are to be uniform, in order to determine the magnitudes of in situ stresses. Assuming the normal distribution of uniaxial compressive strength (UCS), which is estimated empirically from sonic velocity logs (Chang et al., 2006), we calculated the probability distribution of breakout width for given sets of the maximum and the minimum horizontal principal stresses (SHmax and Shmin, respectively) for every 30m depth interval. The same procedure was repeated for various combinations of the two horizontal principal stress magnitudes. Then the objective function with two variables, SHmax and Shmin, was obtained from the total misfits between the observed and the calculated occurrence distributions of breakout width. Finally we were able to determine the best solution of SHmax and Shmin with the minimum total misfit. The results from this new approach of stress estimation are comparable with previous other results (Lee et al., 2013) which gave a wide range of in situ stress magnitudes. According to the new stochastic prediction of in situ stress, the Kumano Basin is in a subcritical state of normal faulting as a series of normal faults near the wellbore are shown in the seismic profile. Underneath the unconformity, the normal fault stress regime sharply changes to the strike-slip stress regime in the old accretionary prism by rapidly increasing in both horizontal stresses. This stochastic model is prominent because it gives not only both values of SHmax and Shmin simultaneously but also information about statistical reliability of the determined values quantified by sensitivity and uncertainty.

Keywords: stochastic process, sonic velocity, breakout width, in situ stress magnitude

Magnetic properties of sediments from Kumano Basin, Nanikai Trough and their implications for the forearc basin evolution history

MEINAN SHI[1,2], HUAICHUN WU[1,2], SHIHONG ZHANG[1], XIXI ZHAO[3], HAIYAN LI[1], XIN SU[2], TIANSHUI YANG[1], HONGQIANG WANG[4], JICHUANG FANG[1,2]

[1] State Key Laboratory of Biogeology and Environmental Geology, China University of Geosciences, Beijing 100083, China. (meinan.shi@cugb.edu.cn)
[2] School of Ocean Sciences, China University of Geosciences (Beijing), Beijing 100083, China.
[3] State Key Laboratory of Marine Geology, Tongji University, Shanghai 200092, China
[4] Key Laboratory of Seismic Observation and Geophysical Imaging, Institute of Geophysics, China Earthquake Administration, Beijing 100081, China

Kumano basin located in the Nankai margin of southwest Japan is receiving more attention as sources of great thrust earthquakes and commercial utilization of gas hydrates (Tobin et al., 2006; Toki et al., 2012).To improve understanding of environmental or sedimentary evolution of the Kumano forearc basin, a high-resolution environmental magnetic study was conducted, based on EFSED-EDS analyses of sediments at Site C0002, IODP Expedition 315, located at the southern margin of the Kumano Basin. The sedimentary sequences recovered at this site were divided into four lithologic units (Expedition 315 Scientists, 2009): Unit I (basin-plain facies), Unit II (forearc basin facies), Unit III (forearc or trenchslope deposition, basal forearc basin), and Unit IV (upper accretionary prism).

Our study showed that magnetic minerals and parameters in these four units were significantly different. (Ti) magnetite is the main magnetic mineral in the upper 120 mCSF, authigenic iron sulfides are predominant in the forearc basin sediments in Unit II, PSD magnetite is dominant components in sediments of Unit III, while rare PSD (Ti) magnetite and iron sulfides (greigite) are dominantly presented in the older accretionary prism. Consequently, a small amount of ferromagnetic minerals present in sediments of Unit IV. It was further recognized the magnetic heterogeneities might be due to variations of diagenetic degree related to the gas hydrate formation.

These results suggested that a combined study of magnetic minerals and parameters could be a promising tool for discriminating sedimentary processes in percepts dealing sedimentary genesis, source, transport and diagenesis processes.

Keywords: magnetic minerals; Nankai Trough; basin evolution; subduction zone

Japan Trench Paleoseismology: Turbidite paleoseismology along the Japan Trench

KEN IKEHARA, KAZUKO USAMI,[1] TOSHIYA KANAMATSU[2] AND MICHAEL STRASSER[3]

[1] Geological Survey of Japan, AIST (k-ikehara@aist.go.jp)
[2] JAMSTEC
[3] ETH Zurich

The 2011 Tohoku-Oki earthquake was a destructive earthquake in the Japanese history. Studies on the onshore tsunami deposits suggested the repeated occurrence of huge tsunami with similar character on Sendai and Ishinomaki plains. Deep-sea turbidite is a potential candidate to estimate the occurrence of past large earthquakes. Actually, the 2011 Tohoku-Oki earthquake induced turbidites were observed from the Japan Trench floor. Furthermore, some piston coring results suggested the repeated occurrence of fine-grained turbidites in the trench-fill sediments. High resolution seismic reflection profile indicated the occurrence of acoustically well-stratified deposits in the small depressions of the trench floor. Similar acoustic facies was recognized in the subducting graben depression. These observations highly suggest that the small elongated depressions along the Japan Trench and surrounding graben have been filled by the fine-grained turbidites of earthquake origin. High sedimentation rates in the Japan Trench supported by high primary productivity at surface water and sediment focusing depositional process effectively presrved the event deposits. Although we have many challenges to clarify the exact history of past large earthquakes, the Japan Trench may be a model field for testing the turbidite paleoseismology. We are making a IODP full proposal on the Japan Trench paleoseismology using the mission specific platform.

Keywords: earthquake, turbidite, paleoseismology, IODP, Japan Trench

Recent multidisciplinary research and 2014 IODP drilling in the South China Sea

JIAN LIN[1,2,3], CHUN-FENG LI[2], PINXIAN WANG[2], DENISE K. KULHANEK[3], EXPEDITION 349 SCIENTISTS[4]

[1] Department of Geology and Geophysics, Woods Hole Oceanographic Institution, Woods Hole, MA, USA
[2] State Key Laboratory of Marine Geology, Tongji University, Shanghai, China
[3] International Ocean Discovery Program, 1000 Discovery Drive, College Station, TX 77845, USA
[4] http://iodp.tamu.edu/scienceops/precruise/southchinasea/participants.html

The South China Sea (SCS) is the largest low-latitude marginal sea in the world. Its formation and evolution are linked to the complex continental-oceanic tectonic interaction of the Eurasian, Pacific, and Indo-Australian plates. Despite its relatively small size and short history, the SCS has undergone nearly a complete Wilson cycle from continental break-up to seafloor spreading to subduction, serving as a natural laboratory for studying the linkages between tectonic, volcanic, and oceanic processes. The last several years have witnessed significant progress in investigation of the SCS through comprehensive research programs using multidisciplinary approaches and enhanced international collaboration.

In January-March 2014, International Ocean Discovery Program (IODP) Expedition 349 drilled and cored five sites in the SCS (Expedition 349 Scientists, 2014; Li, Lin, Kulhanek et al., 2015). Three drill sites cored into oceanic basement near the fossil spreading center on the East (Site U1431) and Southwest Subbasins (Sites U1433 and U1434), respectively, whereas Sites U1432 and U1435 are located near the northern continent/ocean boundary of the East Subbasin (Fig. 1). The expedition successfully obtained the first basaltic rock samples of the SCS relict spreading center, discovered large and frequent deep-sea turbidity events, and sampled multiple seamount volcaniclastic layers. Shipboard biostratigraphy based on microfossils preserved in sediment suggests that the cessation age of spreading in both the East and Southwest Subbasins is around early Miocene. Post-cruise 40Ar/39Ar dating of basement basalt further suggests that the East Subbasin stopped spreading around 15 Ma, while the Southwest Subbasin terminated spreading around 16-17 Ma (Koppers et al., 2014).

In 2012 and 2013, high-resolution near-seafloor magnetic surveys were conducted in the SCS with survey lines passing near some of the 2014 IODP drilling sites. The deep-tow surveys revealed detailed patterns of the SCS magnetic anomalies with amplitude and spatial resolutions several times better than that of traditional sea surface measurements (Li et al., 2014; Lin et al., 2014). Inversion results reveal several episodes of magnetic reversal events that were not recognized by sea surface measurements. Together the IODP drilling and deep-tow magnetic survey results confirmed, for the first time, that the entire SCS basin might have stopped seafloor spreading at similar ages in early Miocene, providing important constraints on marginal sea geodynamic models.

The IODP Expedition 349 involves the participation and strong collaboration of scientists from the international community including scientists from countries and regions surrounding the SCS. Meanwhile, major progress in studying the SCS processes has also been made through comprehensive multidisciplinary programs, for example, the “South China Sea Deep” initiative (Wang, 2012). This eight-year-long initiative (2011-2018) investigates SCS’s evolution and interactive processes through integrated efforts of sea-going experiments, shore-based analyses, theoretical modeling, and synthesis. The three broadly defined research themes of this initiative include tectonics and magmatism, sedimentation, and biochemistry. The initiative also supports and encourages strong international collaboration through bi-lateral science collaboration, establishment of an international working group, and hosting international workshops. This presentation will highlight the recent multidisciplinary research initiatives in investigation of the SCS and the important role of international collaboration.

Asymmetry in crustal structure of the South China Sea and implications on geodynamic evolution of marginal sea basins

FAN ZHANG[1, 2], JIAN LIN[1, 2, 3], TINGTING WANG3, JIAN ZHU[1]

[1] Department of Geology and Geophysics, Woods Hole Oceanographic Institution, Woods Hole, MA 02543, USA
[2] Key Laboratory of Marginal Sea Geology, Chinese Academy of Sciences, South China Sea Institute of Oceanography, Guangzhou, 510301, China
[3] State Key Laboratory of Marine Geology, School of Ocean and Earth Sciences, Tongji University, Shanghai, 200092, China

We investigate crustal structure and lithosphere dynamics of the South China Sea (SCS) through a comprehensive analysis of geophysical and geological data, incorporating the latest constraints from IODP Expedition 349. Specific focus was placed on potential asymmetry in crustal structure between the northern and southern conjugate flanks of the SCS. We calculated residual mantle Bouguer anomaly (RMBA) by removing from free-air gravity anomaly the predicted attractions of water-sediment, sediment-crust, and crust-mantle interfaces as well as the effect of lithospheric plate cooling, using the latest crustal age constraints from IODP Expedition 349 and recent deep-tow magnetic surveys. We then calculated models of gravity-derived crustal thickness from RMBA and calibrated the model by comparison with seismically-determined crustal thickness along multiple seismic refraction profiles in the SCS. Residual bathymetry anomaly (RBA) was also calculated by subtracting from observed seafloor topography the predicted effects of lithospheric plate cooling and the observed sediment load. Our analysis reveals several anomalous features in the crustal structure of the SCS: (1) The Northwest Subbasin: Negative RMBA with an average amplitude of ~150 mGal is observed throughout the entire Northwest Subbasin, implying warmer mantle or thicker crust beneath this region. (2) Extinct Spreading Centers: Several isolated regions with negative RMBA of up to ~100 mGal in amplitude and 50-100 km in spatial dimension are observed along the extinct spreading axis of the East Subbasin between 116°-119°E as well as at the eastern end of the Southwest Subbasin just east of 115°E. Furthermore, most areas of negative RMBA anomalies are associated with local basement topographic highs, indicating areas of locally thickened crust. We interpret these anomalies to potentially reflect post-seafloor-spreading seamount volcanism and magmatic underplating along the extinct spreading center. However, the extinct spreading center of the Southwest Subbasin between 112°-115°E is associated with much subduced negative RMBA, reflecting potentially less post-seafloor-spreading volcanism. (3) Asymmetry between the Northern and Southern Conjugate Flanks: We identified significant asymmetry in RMBA and RBA between the northern and southern conjugate flanks of the SCS. Between crustal ages of 16-25 Ma, the northern flank of the East Subbasin is associated with systematically more negative RMBA and positive RBA, indicating thicker crust or lighter mantle beneath the northern flank than the southern conjugate. The average values of the difference in RMBA and RBA between the two flanks are ~-20 mGal and 120 m, respectively. Moreover, the north-south asymmetry seems to generally increase with crustal age, i.e., asymmetry is smaller near the extinct spreading axis and becomes larger further off-axis. For crustal ages older than 25 Ma, however, more negative RMBA and positive RBA appear to be associated with the some areas of the southern flank. (4) Overall Crustal Structure: The gravity-derived crustal thickness of the investigated regions of the SCS is ~5.5 km on average and can reach ~10 km locally. The overall shape of the gravity-derived crustal thickness profiles broadly match that of seismically-determined oceanic crustal thickness, although local discrepancies do exist. The continent-ocean transition zone is also reflected as relatively sharp boundaries in the calculated RMBA and RBA maps. Together the above results provide important constraints on crustal structure and geodynamic evolution of the SCS marginal basin.

Detrital zircon U-Pb ages of gravity flow deposits in central subbasin of the South China Sea and their constrains on the tectonic activities

TAO JIANG[1,2*], JINGKE HE[1], SULIN TANG[1] AND EXPEDITION 349 SCIENTISTS[3]

[1] Key Laboratory of Tectonics and Petroleum Resources of Ministry of Education, China University of Geosciences, Wuhan, China (taojiang@cug.edu.cn)

[2] Kochi Institute for Core Sample Research, Japan Agency for Marine-Earth Science and Technology, Kochi, Japan

[3] http://iodp.tamu.edu/scienceops/precruise/southchinasea/participants.html

The South China Sea (SCS) is the largest marginal sea in the western Pacific. International Ocean Discovery Program (IODP) Expedition 349 drilled and cored 5 sites in the SCS and recoverd so many cycles of gravity flow deposits (Expedition 349 Scientists, 2014; Li et al., 2015). Site U1431 locates in the central basin of the SCS and is approximately several hundreds kilometers away from portential provenances arounding the SCS, therefore, the recovered sandy gravity flow deposites should be triggered by the tectonic activities around the SCS and transported from those provenances. Detrital zircon U-Pb dating of 17 samples from Site U1431 and one sample of drilling mud have been detected. After the influence of drilling mud on the core samples is discussed and the detrital zircon U-Pb ages are compared with those of potential provenances around the SCS (Cao et al., 2015), the potential sources of the recovered event deposits will be discussed in this presentation. Preliminary results show that the potential provenances of the recoverd gravity flow deposits in the central subbasin of the SCS have been significantly changed since Middle Miocene. The Miocene sediments could be from Indochina block in responding to the epsodic uplifting of Tibetan Plateau. And more sedimentary contributions from Cathaysia since Pliocene could be related with the fromation and evolution of Taiwan Island. Detrital zircon U-Pb ages from IODP Exp. 349 should help to better understand the sources of those recovered event deposits as well as their constrains on the tectonic activities within and around the SCS.

Keywords: Zircon U-Pb dating, Gravity flow deposit, South China Sea

Preliminary Report on the Microfossil Biostratigraphy and Coccolith Flux of Late Pleistocene to Holocene deep-sea sediments from Core U1431D, IODP Expedition 349, Eastern South China Sea

JOSE DOMINICK S. GUBALLA[1], ALYSSA M. PELEO-ALAMPAY[1]

[1] Nannoworks Laboratory, National Institute of Geological Sciences, University of the Philippines Diliman, 1101 Philippines (jsguballa@up.edu.ph)

Downcore variations in coccolithophorid assemblages of the uppermost sediments of Site U1431D, Eastern South China Sea were analyzed to determine a detailed biostratigraphic record as well as to reconstruct primary productivity changes. Absolute abundances are calculated and are based on the number of coccoliths per gram of sediment. Small placoliths (Emiliania huxleyi, Gephyrocapsa, small Reticulofenestra) and the nannolith Florisphaera profunda dominate the calcareous nannofossil species, while rare occurrences of Sphenolithus and Discoaster specimens are probably reworked. The analyzed core length falls under the nannofossil zone NN21 by Martini (1971) based on the presence of Emiliania huxleyi throughout the samples. Fluctuations in the number of Gephyrocapsa species and Florisphaera profunda imply variations in the depth of the nutricline, with the dominance of the latter coinciding with a deeper nutricline. Where calcareous nannofossils are absent, spumellaria and nassellaria radiolarians, pennate and centric diatoms, and triaxon sponge spicules define the thanatocoenosis, but in fewer numbers. Changes in the level of the calcite compensation depth (CCD) may account for the microfossil assemblage shift.

Petrology and geochemistry of South China Sea crust, IODP Expedition 349

MARIA LUISA TEJADA[1], ANTHONY A. P. KOPPERS[2], XIAOLONG HUANG[3], GUOLIANG ZHANG[4] AND EXPEDITION 349 SCIENTISTS[5]

[1] DSEG, Japan Agency for Marine-Earth Science and Technology, Japan (mtejada@jamstec.go.jp)
[2] COAS, Oregon State University, Oregon, USA
[3] Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, China
[4] Institute of Oceanology, Chinese Academy of Sciences, China
[5] http://iodp.tamu.edu/scienceops/precruise/southchinasea/participants.html

Expedition 349 was the first expedition in the new International Ocean Discovery Program (IODP), which successfully drilled 5 sites in the South China Sea (SCS) [Expedition 349 Scientists, 2014; Li et al., 2015]. Three of the sites (U1431, U1433, and U1434) recovered oceanic crust basalts with a minimum age of circa 17 Ma based on paleontological dating. Volcaniclastic breccia and sandstone, with interbedded finer-grained sedimentary units were also penetrated above the oceanic basement at Sites U1431 and U1434 and are believed to represent the sedimentary apron of nearby seamounts. The recovered oceanic crust varied from mostly massive flows at Site U1431 to mainly pillowed flows at Site U1433. The massive flows at Site U1431 are fine- to coarse- grained with olivine, clinopyroxene, and plagioclase comprising the mineralogical assemblage, typical of mid-ocean ridge basalt (MORB). The igneous basement at Sites U1433 and U1434 consists of thinner, mainly pillow flows associated with hyaloclastite breccia. At Site U1433B, the upper section is composed of 38 m-thick pillow flow units followed by 23 m-thick massive flow units. Recovery at Site U1434 was poor, with only 3 m of mostly aphyric basalt with glassy to microcrystalline texture. The pillow basalts at Site U1433 are dominantly plagioclase-phyric, with minor olivine microphenocrysts, and mostly plagioclase and clinopyroxene as groundmass minerals resembling MORB mineralogy. Preliminary onboard geochemical data indicate that the oceanic basement at the three sites is composed of tholeiitic basalt similar to that of Pacific and Indian MORB. and distinct from the alkalic basalt composition of the seamounts of the SCS. Collection of additional geochemical data to test the origin of the SCS oceanic basement is ongoing and preliminary results will be presented.

Keywords: South China Sea, oceanic crust, mid-ocean ridge basalt, tholeiites

References

Expedition 349 Scientists, 2014. South China Sea tectonics: opening of the South China Sea and its implications for southeast Asian tectonics, climates, and deep mantle processes since the late Mesozoic. International Ocean Discovery Program Preliminary Report, 349. http://dx.doi.org/10.14379/iodp.pr.349.2014

Li, C.-F., Lin, J., Kulhanek, D.K., and the Expedition 349 Scientists, 2015, Proceedings of the International Ocean Discovery Program, 349: South China Sea Tectonics: College Station, TX (International Ocean Discovery Program). http://dx.doi.org/10.14379/iodp.proc.349.2015

Lithosphere Thinning During Continental Breakup: A proposal submitted to IODP for Drilling at the South China Sea Rifted Margin

ZHEN SUN[1] HANS CHRISTIAN[2] CHUNFENG LI[2] JIAN LIN[1,3] PINXIAN WANG[2]

[1] CAS Key Laboratory of Marginal Sea Geology, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou 510301 China (zhensun@scsio.ac.cn)

[2] Faculty of Ocean Sciences, Tongji University, Shanghai China

[3] Dept. of Geology and Geophysics, Wood Hole Oceanographic Institution, Woods Hole MA 02543-1050 U.S.A

South China Sea is one of the largest marginal seas in the west Pacific area. Experiencing multi-stage of rifting, the lithosphere broke up in Oligocene. However, the exact breakup pattern is still controversial. Long cable MCS profiles suggested that there is deep lithosphere layer exposed in the COT area to the south of the Pearl River Mouth basin. Examined from the high resolution 3D MCS data, low angle detachment faults associated with strong block rotation were revealed. Analogue modeling experiments suggest that horizontal lithosphere (especially ductile lower crust or mantle) flow will favor to the observed deformation. According to the velocity structures at the cross points between MCS and OBS line 1993, either lower crust or upper mantle is conjectured to be exposed in COT. In order to test this hypothesis, a proposal was submitted to IODP and the expected drilling expedition is supposed to happen in 2017. If exhumed mantle or lower crust was found in the COT, people's knowledge about lithosphere thinning process will be greatly extended through the drilling expedition and more related research works.

Keywords: Thinning process, breakup pattern, IODP drilling, South China Sea

Drilling the conjugate South China Sea continental margins

CHUN-FENG LI[1]

[1] Tongji University, Shanghai 200092, China (cfl@tongji.edu.cn)

Over the past 40 years, drilling results in the western Pacific documented very well the evolution of many marginal basins. In the South China Sea, two expeditions (ODP Leg 184 and IODP Expedition 349) have been sailed, targeted the Asian monsoon and seafloor spreading, respectively. Two more IODP expeditions (IODP Expeditions 367 and 368), to further examine the continental break at the northern South China Sea margin, have just been scheduled for the year 2017. These expeditions together will significantly deepen our views on continental margin rifting and breakup. However, in order to fully address fundamental problems on the breakup style and geometries, the conjugate southern margin must be drilled and investigated. Recent studies have revealed very thick syn-rift depositions along the southern continent-ocean boundary (Song and Li, 2015) and hyper-extended crust (Franke et al., 2011; Liu et al., 2014). These characteristics have not been fully observed in the northern margin, suggesting possibly a profound asymmetry in the early breakup and significant along-strike variations in breakup styles. Drilling in the southern continent-ocean boundary is necessary to validate these observations and build a detailed model for continental breakup and the onset of seafloor spreading. The relatively small size of the South China Sea makes the conjugate drilling much easier, if compared to the Atlantic. This presentation will also briefly outline geodynamic results from over 40 years of drilling in the western Pacific and identify other key and potential drilling targets, aimed for the future.

Keywords: South China Sea, conjugate continental margin, scientific drilling, continental breakup

Characteristic and Sediments Distributions of Seafloor Surounding Subi Island, Natuna, Riau Province, South China Sea, Indonesia

KRIS BUDIONO, GODWIN LATUPUTI, NINE, DAN UNDANG

Marine Geological Institute of Indonesia (kris_budiono@yahoo.com)
Jln : DR. Junjunan 236 Bandung, West Java, Indonesia

The Subi Island is an outer island of the Republic Indonesia bordereds with eastern part of Malaysia water. This island is located in the South China Sea and belongs to the Province of Riau Islands. In order to know the characteristic, distribution and thickness of the sediments, the geological and geophysical method such as sampling by using grab sampler and gravity corer, shallow seismic reflection survey and laboratory test were done in the study area. The result showed that the sea floor sediments were containing coral reef, clay and sand. The condition of coral reef was varieds from life to death conditions. Clay sediments were distributed scattered around the island. The sand sediment was dominated by quartz sand with variation of their color and grains size. The heavy mineral and fossil is very common contain in sand sediment. It is suggest that the abundance of quartz and heavy mineral become a prospect commodity for Subi area water.

Keywords: Subi Island, South China Sea, sediment distribution

Depositional and Sedimentoligical Features of Lacustrine Turbidite System in the Third Member (Es3) of Shahejie Formation, Dongying Sag, China

MUHAMMAD JAWAD MUNAWAR[1], CHENGYAN LIN[1], DONG CHUNMEI[1], CUNFEI MA[1], MUHAMMAD ALEEM ZAHID[1,2]

[1] China University of Petroleum, East China (jawad_munawar@outlook.com)
[2] Lasbela University of Agriculture, Water and Marine Sciences, Pakistan

Deepwater sandy turbidites are well known as moderate to excellent reservoir for hydrocarbon accumulation. Lacustrine turbidites has gained prime importance after recent discoveries in Dongying sag and other basins. The turbidites of third member (Es3) of the Eocene Shahejie Formation were deposited in rifting Dongying Basin. The target layer of Es3 display full depositional cycle starting from prograding in the bottom, aggrading in the middle and retrograding at the top in the study area. On the third order, Es3 was deposited during lowstand systems tract when the basin was rapidly subsiding due to active rifting. On the fourth order, the target layer is composed of lowstand systems tract (LST) and transgressive systems tract (TST). For the purpose of this paper, we recognized three depositional stages on the bases of facies analysis. Detailed core description helped us to identify significant sedimentary characteristics to define depositional facies. Five facies were defined by integrating data from core description wireline log and petrography; (1) Fan channels (2) Interchannel mud (3) Lobe Sand (4) Sheet sand (5) Outer fan mud. We extended these facies to seventy-one uncored wells based on SP and conductivity log response. The facies distribution was mapped in three different depositional stages i.e progradation, aggradation and retrogradation separately to develop a depositional model. The constructed model revealed the whole depositional episode of turbidites system. Deposition initiated from slumps and debris flow in very initial stage and later turned into sublacustrine fans when sediment supply outpaced the accommodation space rapidly. In second stage, the rate of sediment supply and accommodation space was near to equal that resulted in development of thick fans and turbidites. Third stage marks the rise of lake level that outpaced sediment supply and resulted in landward retreat of fan sediments and thin sheet sand deposited over fan sediments. The rate of accommodation space was mainly influenced by local tectonics as subsidence of basin was controlled by the rifting. Establishing depositional stages and mapping, the distribution of facies will enhance the understanding of reservoir architecture. In general, the definition of depositional facies will lead to comprehensive reservoir characterization in F29 area of Dongying sag.

Keywords: Turbidites, Facies, Shahejie, Dongying Sag

Evidence of extensive carbonate mounds and sublacustrine channels in shallow waters of Lake Van, eastern Turkey, based on high-resolution chirp subbottom profiler and multibeam echosounder data

DENIZ CUKUR[1], SEBASTIAN KRASTEL[2] , M. NAMIK CAGATAY[3], EMRE DAMCI[3], AYSEGUL FERAY MEYDAN[4], SEONG-PIL KIM[1], SENAY HOROZAL[1]

[1] Korea Institute of Geoscience and Mineral Resources (KIGAM), 124 Gwahang-no, Yuseong-gu, Daejeon 305-350, Korea (dcukur@kigam.re.kr)

[2] Kiel University, Institute of Geosciences, Otto-Hahn-Platz 1, 24118 Kiel, Germany

[3] Istanbul Technical University, EMCOL and Department of Geological Engineering, 34469 Maslak, Istanbul, Turkey

[4] Van Yüzüncü Yıl University, Department of Geological Engineering, 65080 Van, Turkey

In Lake Van of eastern Turkey, the fourth largest soda lake in the world, high-resolution subbottom profiles and bathymetric data acquired in 2004 and 2012 revealed several hundreds of topographic mounds in shallow waters (<130 m) off the historical town of Adilcevaz in the northern lake sector. These structures are characterized by strong top reflections of transparent internal character and are 10–300 m wide and 0.5–20 m high. They are interpreted as carbonate mounds of unknown age in accord with previous works, formed by precipitation from CO2-rich ground water discharge into the highly alkaline lake. Their alignment along faults suggests tectonic control on their growth. Several sublacustrine channel networks were observed on the eastern shelf of the lake which connects with onshore rivers. The channels are up to 500 m wide and 20 m deep, and appear to have formed by fluvial processes, probably during the major lake level drop reported to have occurred at 14 ka in earlier publications. Erosion is common on the channel walls flanked by levees. The channels are presently inactive or abandoned. At a water depth of 100 m, they all merge into a single larger channel; this channel has a sinuous course, first trending southwestward and then turning northwestward at water depth of 130 m. A large number of closely spaced small channels (~10–200 m wide, 1–10 m high) are also seen in the eastern lacustrine shelf, interpreted as denditric and parallel channel systems formed during lake level fall at ~14 ka. Bathymetric data provide evidence of numerous sublacustrine canyons on the western slope of the Northern basin, most likely remnants of relict rivers formed during a low stand of the lake level.

Sedimentology of a Neogene Mass Transport Deposit in Ilocos Trough Southern Sub-basin

JAAN RUY CONRAD P. NOGOT[1], ALYSSA M. PELEO-ALAMPAY AND JOSELITO P. DUYANEN

[1] National Institute of Geological Sciences, University of the Philippines, Diliman, Philippines (jrcnogot@gmail.com)

This study investigates a large outcropping Mass Transport Deposit (MTD) within the Neogene predominantly volcanic arc-derived deposits of the southern sub-basin of the Ilocos Trough, a forearc basin associated with the Miocene subduction of the South China Sea ocean basin along the Manila Trench. The MTD is composed of autochthonous limestone and turbidite blocks, rounded sandstone and diorite pebbles, and contemporary reef debris in a block-in-matrix fabric. The MTD exhibits three facies, based on size and internal organization of accumulated blocks. Facies A, located in the SW end of the outcrop, consists of clast-supported conglomerate with minor blocks exhibiting preferential orientation, related to previous stratification. Facies B is a block-dominated unit confined to the NE end of the outcrop. It is characterized by chaotic unsorted breccias showing no preferred stratification Paleocurrent direction inferred from turbidites distributed outside of the MTD indicate a main transport direction towards the northeast. This suggests that Facies A corresponds to a more proximal end of the MTD, and Facies B to a more distal end, and indicates the increase in plastic deformation during transport. Facies C consists of slab-sized rafted coherent blocks showing slump-like disharmonious folds, and generally found at the base of Facies A and B deposits. Paleoslope analysis from the folds suggests a southern provenance for the blocks. This facies also shows internal stratification parallel to bedding surface of the turbidites outside the MTD, suggesting a laminar state of flow. This particular MTD represents a carbonate platform collapse due to fluid overpressure conditions, shown by the presence of several fluid-escape and injection-related structures, possibly associated with a period of relative sealevel fall and tectonic activity in the basin.

Keywords: mass transport deposit, mass flow facies, slope failure, Ilocos Trough

Establishing Marine Geoscience Institute in Myanmar

KYAW MOE[1] AND WIN KHAING MOE[2]

[1] Japan Agency for Marine-Earth Science & Technology, JAPAN (moe@jamstec.go.jp)
[2] Department of Research & Innovation, MYANMAR

Myanmar is only ASEAN country without marine geoscience training and research activities even it has considerable offshore exploration and production activities. After decades of delay, process of establishing new Marine Geoscience Institute is in progress and hence once inaccessible and last remaining offshore areas will soon be studied under government-academia-industry collaborated projects.

Keywords: Myanmar, marine geoscience, geohazard, resources exploration, environment

Compressional and shear wave structure of the upper crust beneath the Endeavour Segment, Juan de Fuca Ridge

EUNYOUNG KIM[1*], DOUGLAS R. TOOMEY[2], EMILIE E. E. HOOFT[2], WILLIAM S. D. WILCOCK[3], ROBERT T. WEEKLY[4], SANG-MOOK LEE[1] AND YOUNGHEE KIM[1]

[1] Seoul National University, Korea (brilliant@snu.ac.kr)
[2] University of Oregon, USA
[3] University of Washington, USA
[3] Incorporated Research Institutions for Seismology, USA

We present tomographic images of compressional (Vp) and shear (Vs) wave velocity structure of the upper crust beneath the Endeavour segment of the Juan de Fuca Ridge, using data from the Endeavour tomography (ETOMO) experiment. This ridge segment is bounded by the Endeavour and Cobb overlapping spreading centers (OSCs) to the north and south, respectively. Near the segment center, an axial magma chamber (AMC) reflector underlies five hydrothermal vent fields. A prior study of the Vp structure [Weekly et al., 2014] shows that low velocities in the OSCs are indicative of pervasive tectonic fracturing [Detrick et al., 1993]. Above the AMC the low velocities are interpreted in terms of cracking associated with magma chamber inflation [Wilcock et al., 2009]. Anisotropy tomography shows ridge-parallel seismic anisotropy on-axis (>10%) with its percentage anisotropy decreasing in the off-axis direction over 5-10 km. Here we use crustal S-wave phases (Sg) – generated by P-to-S conversions near the seafloor – to better constrain crustal properties. We invert the Sg data separately for Vs structure. Preliminary inversions indicate that Vs and Vp/Vs vary laterally and vertically. At 0.4 km depth just northeast of the vent fields, Vs and Vp/Vs are anomalously high and low, respectively. This anomaly may be related to sheet flows characterized by thicker, more massive, and less porosity due to its slower volcanic flow rates than pillow basalts [McClinton et al., 2014]. At 1-2 km depth several kilometers north of the vent fields, Vs and Vp/Vs are anomalously low and high, respectively. We interpret this as evidence of increased porosity due to the February 2005 earthquake swarm at the OSC on the northern end of the Endeavour segment [Hooft et al., 2010]. These results imply strong heterogeneity in both the physical (e.g., crack density and aspect ratio) and chemical (e.g., hydration) properties of oceanic crust.

Keywords: mid-ocean ridge, Endeavour segment, shear wave velocity, upper oceanic crust

Marine geophysical activities of KIGAM and R/V Tamhae 2

NAM-HYUNG KOO[1,2], BYOUNG-YEOP KIM[1], WONSIK KIM[1], MOO-HEE KANG[1], KYEONG-O KIM[1], JINHO KIM[1], HO-YOUNG LEE[1], HYUN-CHUL HAN[1]

[1] Korea Institute of Geoscience and Mineral Resources(KIGAM) (nhkoo@kigam.re.kr)
[2] University of Science and Technology(UST), nhkoo@kigam.re.kr

In this paper, marine geophysical activities of KIGAM and R/V Tamhae 2 were introduced. KIGAM has been conducting petroleum and marine geophysical data acquisition, processing and interpretation to secure oil and gas, and to figure out shallow and deep marine subsurface structures of Korea jurisdictional sea area. R/V Tamhae 2, a small-capacity 3D seismic survey vessel, was built in 1996. R/V Tamhae 2 has been equipped with air-gun source arrays with a total volume of 4,578 cu. in., two 3 km long solid streamer cables and integrated 3-D navigation system. New 3D seismic exploration techniques for 3D multi-azimuth seismic survey, Ocean Bottom Seismic (OBS) survey, and 3D seismic attribute analysis have been developed and applied to oil and gas exploration and crustal studies. Gas hydrate 2D/3D seismic surveys have been conducted since 2000 in the East Sea and gas hydrate resources assessments in the Ulleung Basin were carried out. Marine near-surface geophysics for decades for mapping of shallow sedimentary layers and shallow gases, engineering and environmental applications have been studied. The coastal geohazard mapping program and small-boat 3D seismic system development have been conducted. A building project of new mid-capcitiy 3D seismic research vessel operating worldwide is currently being planned.

Keywords: marine geophysics, seismic, research vessel, 3D, Tamhae 2

Inversion and imaging of water layer using seismic reflection data in the Ulleung Basin, East Sea, Korea

SNONS CHEONG[1], NAM-HYUNG KOO[1,2]

[1] KIGAM, Korea (snons@kigam.re.kr)
[2] UST, Korea

This study presented the results of seismic inversion and imaging of water layer from the multichannel seismic reflection data of East Sea, Korea*/**. The seismic data were acquired using R/V Tamhae II of KIGAM. Weak primary reflections from the seawater column were found at the zero offset and shot display. The stacked seismic section showed detailed horizontal and vertical variation of thermohaline structure of the Ulleung Basin, East Sea. We demonstrated raw direct waves on the linear move-out gather corresponding to different water velocities. Ocean temperature profiles could be extended over entire East Sea up to the mapping of acoustic fine reflections from seismic data. Result of water velocity in the East Sea can be applied to various research fields i.e. oceanography, offshore pollution, marine biology and military science.

Keywords: seismic reflection, water velocity, East Sea

Case study of marine broadband seismic exploration in Jeju basin, Offshore Korea

SU-MIN KIM[1], NAM-HYUNG KOO[1,2], WOOHYUN SON[2], BYUNG-YEOP KIM[2], YONGHWAN JOO[2], SNONS CHEONG[2], YOUNGJUN KIM[2], HO-YOUNG LEE[2]

[1] University of Science and Technology, 217 Gajeong-ro Yuseong-gu, Daejeon, Korea (lifeisgood91@kigam.re.kr)
[2] Korea Institute of Geoscience and Mineral resources, 124, Gwahang-ro, Yuseong-gu, Daejeon, Korea

In recent years, broadband marine seismic techniques have been intensively studied and applied because it can make precise subsurface image due to several characteristics of broadband seismic data. Generally, seismic data is adversely affected by ghost notches related to free surface in amplitude spectrum and the loss of signal occur at specific frequencies. However, several techniques have recently emerged to tackle this problem. To acquire broadband seismic data, dual sensor streamers are used or conventional streamer configuration is modified. Especially, transforming streamer configuration has an advantage of easy implementation with existing marine survey equipment. In 2015, KIGAM conducted broadband seismic survey with R/V TAMHAE II by adjusting streamer depths of conventional streamer configuration in Jeju basin, South Sea, offshore Korea. Different seismic datasets using streamer depth configurations of conventional, slant and curve form were acquired. Streamer cable was 6km long and receiver depth varied as offset from 7 to 22m. Shot inverval and group interval are 25m and 12.5m respectively. With acquired seismic data from these marine seismic survey, we analyzed characteristics of broadband seismic data and processing results were compared.

Keywords : broadband seismic, streamer depth, bandwidth, ghost notch

On the Impacts of Building the 21st-Century Maritime Silk Road on the South China Sea Dispute Settlement

ZEWEI YANG[1]

[1] Luojia Distinguished Professor, Ph.D., Law School, Center for Collaborative Innovation on Territorial Sovereignty and Maritime Rights, Wuhan University, China. (fxyyzw@whu.edu.cn or 2293639101@qq.com)

building the 21st-Century Maritime Silk Road is a new form of international cooperation in international law, which will have a positive impact on the South China Sea dispute settlement, for instance, encouraging the signing of the Code of Conduct of Parties in the South China Sea between China and ASEAN countries, realizing a new breakthrough of jointly developing oil and gas resources in the South China Sea between China and ASEAN countries, promoting comprehensive cooperation between China and ASEAN countries in maritime non-traditional security field and providing a peaceful external environment for the South China Sea dispute settlement. The South China Sea dispute is the biggest challenge on building the 21st-Century Maritime Silk Road, but the pace of building won't grind to a halt because of it. In future, we shall turn the initiative of building the 21st-Century Maritime Silk Road into international consensus from the aspect of legal system, and shall improve the domestic legal system about building the 21st-Century Maritime Silk Road, providing more products to the countries along the Belt and Road, especially ASEAN members.

Key words: the building of the 21st-Century Maritime Silk Road, the South China Sea dispute, international cooperatio

Current Issues of Land Reclamation in the South China Sea

LE QUY QUYNH [1]

[1] Director General, Marine Affairs Department, National Boundary Committee, Ministry of Foreign Affairs of Viet Nam

Recently, the international community has expressed serious concerns over the massive land reclamation and construction works undertaken by China on the seven features that this country has been occupying in the Spratly islands, namely Fiery Cross Reef, Cuarteron Reef, Gaven Reef, Hugues Reef, Johnson South Reef, Subi Reef, and Mischief Reef. The speed, size the nature of these projects have provoked the biggest worries. For instance, according to satellite images released by the United States-based Asia Maritime Transparency Initiative, in a period of about 1 year, the total area of land reclamation by China is about almost 1000 hectares (and these numbers are still growing as the works have not been completed yet).

This presentation provides an analysis of the three most salient legal issues relating to these land reclamation and construction works undertaken by China in the South China Sea. Concretely, it ascertains what rules of international law these projects have violated (such as the respect of territorial sovereignty, maintenance of status quo in undelimited areas and the protection of the marine environment). The Chinese land reclaimation in the South China Sea also excites serious concern over the tensions and threatens peace, stability, maritime security as well as the freedom of navigation in and over-flight above the sea. The presentation analyzes the status and legal effects of these artificially created islands over the surrounding waters.

Maritime Cooperation Experiences in East Asia

HYUN SOO KIM [1]

[1]School of Law, INHA University, KOREA (kimhsoo@inha.ac.kr)

The UN Convention on the Law of the Sea Convention (LOSC), which was adopted in 1982, is being effective since 1994. The 3rd UN Conference on the Law of the Sea(UNCLOS III) has illustrated the fact that the traditional patterns of East-West negotiations based on ideological and power rivalry are no longer dominant in looking at the various issues of the law of the sea; they have been overturned by the increasing economic demands of the developing countries and a variety of national, regional and international conflicts in the expanding uses of the sea and its resources.

The above-mentioned conditions are all found in East Asian countries and, in addition, the East Asian region has also lots of ocean conflicts and disputes, which needs to be resolved as quickly as possible. Under the above background, this paper deals with the past experiences on maritime cooperation, current ocean issues, roles of maritime cooperation in East Asia, and finally suggests the ways for maritime cooperation in the future together with conclusions..

The East Asian countries' participation in UNCLOS III contributed to a wider acceptance of the Law of the Sea Convention and institutions which they helped to frame. This required a reflection of their views and vital interests that were put forward during the process of negotiation. As regards the Law of the Sea Convention, it would probably be true to say that the essential East Asian countries' aim was to have arrangements which are legally, politically and commercially reliable, and that a universally acceptable general agreement is regarded as only one method by which the problems of the law of the sea between nations can be solved. Therefore, the countries in East Asia would clearly retain the hope for a universal agreement, and may expect to bring to it their long-standing and deeply-felt concern for the outcome of the Law of the Sea Convention.

There is general recognition that the law of the sea must move with the times and must be dynamic if it is to endure. Moreover, it has long been recognised that state practice will be relevant and will play an important part. But, at the same time, it has also been stated that existing state practice would usually include long-standing practice in other States' waters as well as a State's practice in its own. In effecting change, it ought to be possible to proceed by way of well-established concepts as to how this should be done. This would ordinarily mean placing even greater emphasis on multi-lateral rather than unilateral action. Often such action looks towards the future rather than the present.

In the implementation of the Law of the Sea Convention, the East Asian countries must seriously consider the overall relationships and the maritime cooperation among those countries, which will facilitate the settlement of disputes and regional cooperation such as better understanding among those countries.

The resolution of the conflict on the law of the sea of the East Asian countries is no easy task. A prerequisite is an understanding of the basis of the conflict, including the geographical factors involved, and the basic economic and social background and culture of those countries. There are also serious tensions within East Asia. Obviously, no attempt has been made to examine in depth such global and East Asian tensions and conflicts; nevertheless, they are significant and should be taken into account.

The resolution of the conflict on the law of the sea in the East Asian countries will be a long and complicated process. Success will thus depend upon the positive actions and affirmative attitude of the countries in the region as well as the regional maritime cooperation. It is obvious that if a peaceful settlement of disputes on the law of the sea is to be achieved, under the UN Convention, use must be made of peaceful means.

The East Asian countries recognise the importance of effective operation of the Law of the Sea Convention to restore stability to the international legal order of the sea and to maintain the maritime cooperation to resolve current ocean matters. Hence, it is hoped that those countries will be able to provide an effective model in upholding and promoting the stable operation of the new legal order of the ocean and the continuity of the maritime cooperation.

The East Asian countries share a similar historical and cultural heritage, but differ in internal political systems, external political and economic alignments, and levels of economic development. As a result of this, regional maritime cooperation is urgently needed to resolve ocean matters. Therefore, based on the maritime cooperations, it is suggested that political will of each nation to prevent maritime disputes cased by unilateral or unlawful claims, faithful implementation of LOSC to solve the problems regarding ocean matters, and finally common understanding to share the ocean with due regard for the maritime zones of other states and peaceful usage of the ocean in East Asia.

Keywords: Maritime Cooperation, Maritime Boundary, Sovereignty over an Island, Continental Shelf, Exclusive Economic Zone, Fishing Agreement, UN Convention on the Law of the Sea.

Investigation of submarine tectono-stratigraphic features offshore of Kusadasi (West Anatolia) and surroundings by high resolution seismic methods

SAVAS GURCAY[1], GUNAY CIFCI[2], DERMAN DONDURUR[2], ORHAN ATGIN[2], HILMI MERT KUCUK[2], OZKAN OZEL[2], SEISLAB TEAM[2]

[1] Canakkale Onsekiz Mart University, Engineering Faculty, Department of Geophysics, Canakkale, Turkey (savasgurcay@comu.edu.tr)

[2] Dokuz Eylul University, Institute of Marine Sciences and Technology, Izmir, Turkey

Submarine stratigraphic and structural features of Kuşadası Gulf and surroundings, located Aegean coast of the West Anatolia, were investigated under this survey by high resolution seismic reflection methods. High Resolution multi-channel seismic reflection and Chirp data were collected by K. Piri Reis, research vessel of Dokuz Eylül University, in the study area in August-2005 and in March-2008 approximately along the 1000 km seismic lines, for this purpose. The data were processed in SeisLab, D.E.U. Marine Sciences and Technology seismic laboratory, for interpretation.

Thirteen distinct unconformities can be traced below the study area that separate thirteen progradational stacked paleo-delta sequences (Lob1-Lob13) on seismic profiles following and cutting each other. As a result of comparison with the oxygen isotopic stages (δ18), these deltas (Lob1-L13) were interpreted that they have been deposited during the sea-level lowstands within Pleistocene glacial stages.

In the study area the basement surface which observed as the lowest unconformity surface of the seismic sections was called 'Acoustic Basement'. This basement which traced approximately all of the seismic sections has generally quite wavy surface and underlain the upper seismic units. It was observed that these seismic units which terminated their formation in Pleistocene (Lob1-Lob13) and Holocene period were cut and uplifted by acoustic basement, like an intrusion. These type deformations were interpreted as a result of magmatic intrusion into these upper seismic units occurred in Late Pleistocene and Holocene period.

Tectonic and structural interpretation was carried out to constitute the submarine active tectonic map of the study area by correlated active faults identified on seismic sections. Submarine active tectonic map and, basement topography and sediment thickness map were correlated together to present the relationship between tectonic deformation and stratigraphy.

Keywords: Seismic reflection, Chirp, Kuşadası Gulf, progradational stacked paleo-delta, active faults

Analyzing GPS Observations at IEODO Ocean Research Station in Republic of Korea

DAE HYUN KIM[1] YUN SOO CHOI[1] JAE MYEONG KIM[1] AND HA SU YOON [1]

[1]University of Seoul (wangnun1228@uos.ac.kr)

Socotra rock, which is called IEODO in Korea, located about 150km from southwest of the Jeju island. The Ieodo is a submerged rock and its shallow peak is 4.6m in depth within Korea's territorial line in the EAST Sea. Importance of Ieodo ocean research stations is located as access way of typhoon to the republic of Korea and it also located as access way of Kuroshio current to the republic of Korea. The objective of this study is determination of coordinate & velocity vector, GPS meteorology in Ieodo station. Ieodo GPS data has been processed in this project together with 13 KORS and 10 IGS stations by the Bernese software; a total of 398 days of observations was analysed. The precision assessment of the daily solutions has revealed few mm level in the horizontal and mostly 5 mm in vertical component, respectively. The estimated velocity vector of the IEODO has similar trend with those in the Peninsular, which is toward southwest with magnitude of 25mm/year. A time series of the ZPD was preliminarily analysed together a trajectory of the typhoon MEARI from DoY 173 to 178 in 2011, indicating that the values increase before and during the passage of the typhoon and decrease rapidly after it passed. The spatiotemporal analysis of the ZPD revealed that the value has high sensitivity to geographical location of the typhoon. This project has focused on the ZPD itself, so that derivation of PWV from the results will be carried out in near.

Keywords: Ieodo Ocean Research Station, Global Positioning System(GPS), GPS meteorology, Zenith Path Delay of Troposphere(ZPD)

Processing of sparker seismic data to remove noise and improve resolution

BO-YEON YI[1], YOUNG-HO YOON[1], NYEON-KEON KANG[1], DONG-GEUN YOO[1]

[1]Petroleum and Marine Research Division, Korea Institute of Geoscience and Mineral Resources, Republic of Korea (byyi@kigam.re.kr)

Seismic survey with sparker source have been often used for high resolution seismic survey in shallow marine area, because of their easily deployed at relatively low coast and low post-processing requirements. A common chronic problem for sparker system is a long and complex wavelet signature and poor shot repeatability. The signature of the secondary bubbles in sparker source wavelet often produce destructive interference, which often attenuate energy of some frequencies. Moreover, a long pulse train interrupts recognition of reflections from underlying reflectors. In order to establish secondary bubble effect attenuation and lateral continuity improvement processing procedure for sparker seismic data, we applied match filter and spiking deconvolution. The seafloor reflection is used to approximate the source signature of each shot. We designed two match filter to convert seafloor reflections to spike: (1) sefloor reflections are converted to zero-phase signatures and applied zero-phase spiking deconvolution, (2) seafloor reflections are converted to minimum-phase signatures and applied minimum-phase spiking deconvolution. The result shows that the processing procedure combining of minimum-phase conversion match filter and minimum-phase spiking deconvolution is more effective to suppress bubble effect.

Keywords: Sparker, bubble effect, match filter, deconvolution

The structure characteristics of the Bac Bo Basin, Gulf of Tonkin, from gravity, seismic and gasgeochemistry data

NGUYEN NHU TRUNG[1], PHUNG VAN PHACH[1], RENAT SHAKIROV[2] , LE DUC ANH[1], DUONG QUOC HUNG[1], PHI TRUONG THANH[1], NGUYEN THI THU HUONG[1], BUI VAN NAM[1]

[1]Institute of Marine Geology and Geophysics, VAST. (nntrung@imgg.vast.vn)
[2]V.I. Il'ichev Pacific Oceanological Institute Farr Eastern Branch, Rassian Academy of Sciences.

In this paper,the authors present new results of analyzing gravity, reflection seismic and gasgeochemistry data to identify fault systems and delineate structural domains of Bac Bo basin in the Gulf of Tonkin, East Vietnam Sea (South China Sea). By applying a combination of interpretation of gravity and seismic data, sediment basement depth and three major fault systems of NW-SE, NE-SW and N-S directions were defined in the study region. A structural basement of the basin was constructed. In which, the NW-SE and NE-SW faults are defined as the deepest fault and the N-S faults as the youngest fault. The detail characteristics of the faults were defined by the characteristics of helium, methane and hydrogen componets in the study regi on. Based on the helium, methane and hydrogen components, two types of major faults (F.T-I and F.T.III) were determined in the study rgion. In addition , according to the maturity level of hydrocarbon in the catagenesis, the F.T-III faults were subdivided into two types of F.T-III-1 and F.T-III-2 in the north and south of Ha Long fault, respectively.

Keywords: satellite gravity, Gulf of Tonkin, South China Sea, gas geochemistry, basin.

Study for calibration methods of airbone bathymetry LiDAR

HOYUN KANG[1], JOONSEOK OH[2], YONGCHOL KIM[3]

[1] Korea Hydrography and Research Association, KOREA (hykang@khra.kr)

Recently, reckless development of the coast caused coastal erosion and destroying the environment. Accordingly, abiding monitoring and management will be needed for effective coastal conservation. Currently, with development of optical technology, LIDAR technic is using for Coast monitoring and bathymetry for costal area. Coastal environment of South Korea has limits to perform the survey using vessel in a Rias coast and rock with covers and uncovers. These studies examine verification methods of aerial LIDAR for accuracy and improvement of quality and show the methods of verification which is proper to domestic environment and also want to show regulation and methods for systematization.

Keywords: CZMIL, LiDAR, Bathymetric, Calibration

Multi-purpose data management system to bathymetry

MINCHOL, CHANG[1] AND SUNMI, PARK[2]

[1] Ph.D Student, Dept. of Geoinformatics, University of Seoul and Korea Hydrographic And Oceanographic Administration, Republic of KOREA (respire7@nate.com)

[2]: Ph.D Student, Dept. of Geoinformatics, University of Seoul and Chung-Ang Aerosurvery.CO.,LTD. , Republic of KOREA

Recently, bathymetry data's needs to only produce the marine chart for safety navigation before are increasing now and ICT development and marine spatial information related with marine policy decision demands of marine spatial information total management system is also increasing. In this study, analysing that bathymetry data about 46 records for 12 years in south-western area of the Republic of Korea then set the standard data as 7 categories(Latitude, longitude, Depth, Amplitude, Tide, date, time) and set the high precision 3-dimensional continuous bathymetry management system using these bathymetry data based on big data. This study establish the share base and reusability of bathymetry as making 3-dimensional analyze technology, standardization, continuation of bathymetry accumulated many years with many sensors and it will have important role in broad range of technical sciences.

Keywords: bathymetry, BIGDATA, Standard sizing, DEM, Point Cloud

Role of the intergovernmental organization, CCOP, on Capacity Building of Coastal and Marine Geology in East and Southeast Asia

ADICHAT SURINKUM[1] NGUYEN THI MINH NGOC[1] SOONTAREE RATTANASRISOPHON[1]

[1]CCOP Technical Secretariat, CCOP Building, 75/10 Rama VI Rd., Phayathai, Ratchathewi, Bangkok 10400, Thailand.(ccopts@ccop.or.th)

In the East and Southeast Asia, almost all of member countries are bordered by the sea, benefiting from the coastal and marine resource and also suffering from the frequent occurrence of geohazards, especially under intensification by global warming and climate change in recent time. Understanding on regional onshore and offshore coastal geology and establishment of a Geo-Information system/database for the subject, are the key and critical to effective coastal geological mapping and wisely coastal geohazard mitigation, and thus contribute to sustainable development of the region.

As a unique intergovernmental organization on geosciences, the Coordinating Committee for Geoscience Programmes in East and Southeast Asia (CCOP) promotes capacity building, technology transfer, exchange of information and institutional linkages for sustainable georesource development, geo-hazard mitigation and protection of the environment, develop transboundary database and management of geo-information. Founded in 1966 under the auspices of the United Nations (ESCAP) with the name 'The Committee for Co-ordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas', CCOP's initial remit was to focus on Asian offshore and geologically related areas of member countries. In the ensuing years, membership of the organization expanded to 14 participating states and its remit has been broadened to encompass activities related to prospecting onshore as well as offshore, geoscientific aspects of the development of the coastal zones of its participating states and the dissemination of geoscience information helpful for geohazard mitigation and the protection of life and property.

Activities related to marine – coastal geology and related geohazards can be namely as: CCOP-AIST/GSJ Project on Integrated Geological Assessment of Deltas in Southeast Asia (DelSEA: 2004-2016); CCOP-AIST/GSJ Research Project on Coastal Environment Management Strategy of the Asian Delta Region (2004-2007); ISGeo-KIGAM-CCOP Regular Training course and coastal geology and geohazards (annually); NGI Project on Tsunami Risk Reduction Measures with Focus on Land-use and Rehabilitation (2005-2008); CCOP-KIGAM GeoCoast Project - Geohazard Assessment in Asia and South Pacific Coasts (2008 - 2009) and several international, regional meetings on coastal geology and geohazards. In order to promote the marine-coastal geological database and mapping, CCOP is conducting the CCOP-GSJ/AIST program "Development of Geoinformation Sharing Infrastructure for East and Southeast Asia", of which, database and maps are being collaboratively established by member countries, covering layers of geohazards (G-Ever Project), coastal geology (DelSEA Project Phase III), Map of Tertiary Basin in Offshore Area in CCOP Region. OneGeology Program, a global initiative which is initially improving the accessibility of a fundamental geoscience dataset - geological map data and now expanding to encompass all digital geoscience data including 3-dimensional datasets was started since 2006. At present, the harmonized 1:2M geological map of CCOP and the 1:1M geological maps of China, Indonesia, Japan, Republic of Korea, Lao PDR, Malaysia, Myanmar, Philippines and Thailand, are accessible from the 1G Portal, http://portal.onegeology.org/. So far, CCOP has published 1:2 million digital seamless geology in CCOP region and now cooperating with ASEAN Secretariat and GSJ/AIST to implement the Harmonized Geology Project with participation by 10 countries: Brunei, Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Lao, Singapore, Thailand, Vietnam. CCOP is now working on 1M scale geologic map on land and will start to extent to Tertiary offshore next year. All geoscientists around the world are welcome for collaboration and joining us on this project.

For future strategic orientation, CCOP is developing to be a regional data-knowledge center of geoscience and play the most important role to solve societal issues for geo-resources, geo-environment and geo-hazards for sustainable development of this region and beyond.

Keywords: CCOP, East & Southeast Asia, Marine – Coastal Geology, Database

Coastal Geology and Geo-hazards: An overview of Bangaldesh

ADICHAT SURINKUM[1] SHAMSUZZAMAN MD[1] AND AHOSAN HABIB MD[1]

[1]Geological Survey of Bangladesh (mszaman_bd@yahoo.com)

Bangladesh is located in South Asia and, is bounded by India in the west, Myanmar and India in the east and the Bay of Bengal on its southern side. The total area of Bangladesh is147,570 sq km and its population is about 140 million. The population growth rate is 1.48% per year and the density is currently 928 persons per sq km. The climate is sub-tropical and can be divided into six seasons. The Geological Survey of Bangladesh (GSB) is a national geo-scientific research oriented governmental organization attached to the Energy and Mineral Resources Division in the Ministry of Power, Energy and Mineral Resources, Government of the People's Republic of Bangladesh. The main duties and responsibilities are the exploration of the mineral resources of the country and also to conduct research in various fields of geology.

Geologically, Bangladesh has been divided into four distinct regions: i) the Eastern and Northern frontier hilly regions, ii) the Pleistocene Terrace, iii) the Floodplains of the Ganges and the Brahmaputra and Meghna River systems and iv) the Delta. The coastal area amounts to 36,000 sq km with a 730 km long coastline. The coastal areas and offshore islands of Bangladesh are low-lying and very flat. The largest part of this region consists of Holocene alluvial and estuarine deposits. The maximum elevation of the coastal plain is about 3 m AMSL. Three distinct coastal plains, namely i) deltaic, ii) estuarine, and iii) intra-deltaic are recognized along the coast of Bangladesh. The deltaic area is tide dominated and covered by clayey silt to silty clay; the estuarine area is tide dominated and covered by silt, clayey silt and sandy silt; and the intra-deltaic plains are wave-dominated and covered by clayey silt to silty clay, whereas the fan, piedmont and beach-dune areas consist of silty sand to sand. The geomorphic units of the three distinct coastal plains have been grouped according to their origin into marine, aeolian, fluvio-marine and fluvio-denudational. The geomorphic units of fluvio-marine origin include lower-tidal, upper-tidal, sub-tidal and supra-tidal plains; mangrove swamps; tidal-marsh; abandoned tidal channels; active tidal channels; lower, middle and higher estuarine mouth bars; backswamps; depressions; channel bars and coastal mud-fan complexes. Landforms of fluvio-denudational origin include the piedmont plain, alluvial-colluvial plain and coastal mud fan complex. Landforms of marine origin include beaches, paleo-beaches, cheniers, spits, lagoons and offshore bars. Landforms of aeolian origin include recent beach-dune and old beach-dune complexes. The tide in Bangladesh is semi-diurnal. Successive high- and low-water levels show distinct daily inequalities.

The coastal plain of Bangladesh is vulnerable to various coastal hazards due to its position, geomorphology and funnel-shaped configuration of the bay. The coast experiences tropical cyclones and tidal surges almost every year. Both natural and anthropogenic types of hazards occur in this region. Natural hazards include- coastal and river bank erosion, landslides, sea-water intrusion, land subsidence, earthquakes, cyclones with storm surges, flooding, water logging, etc. Among these natural hazards, the tropical cyclones and tidal surges are the most devastating. On average, 2 severe cyclonic storms hit the coastal area every year. Anthropogenic hazards include water logging, saline water intrusion, low sedimentation, subsidence, etc. The mineral resources are natural gas, coal, peat, hard quarry rock, limestone, brick clay, tile manufacturing clay, white clay, glass sand, gravel, construction sand and heavy minerals. Facing the challenges of sea-level rise due to global warming involves appropriate plantation for a real green belt, the maintenance of existing embankments along the coastline and also the local construction of proper drainage infrastructure.

Keywords: Bangladesh, geology, coast, hazards, mineral resources

References

ANON, 2010. Statistical Year Book of Bangladesh, 636p.

Banglapaedia, 2006. Asiatic Society of Bangladesh, Dhaka, Bangladesh, v.1, digital copy.

BMD, 2011. Bangladesh Meteorological Department, Government of the People's Republic of Bangladesh, Dhaka.

Khan, S.R., 1995. Geomorphic characterization of cyclone hazards along the coast of Bangladesh- Reconnaissance and detailed Studies using GIS and Remote Sensing Techniques, M.Sc. Thesis, ITC, Enschede, The Netherlands.

Khan et al., 2012. The Geology and Geotechnical Characteristics of the south-western part of the Moheskhali Island, Cox's Bazar District, Bangladesh, Unpublished Report, Geological Survey of Bangladesh, 93p.

Coastal Geology and Geohazards in Cambodia

LIM VATHA[1], AND SOR SOKUN[2]

[1] Department of International Petroleum Affairs, General Department of Petroleum, Ministry of Mines and Energy (MME), Cambodia (limvatha@gmail.com)

[2] Department of Petroleum Exploration, General Department of Petroleum, Ministry of Mines and Energy (MME), Cambodia

Cambodia is a country in Southeast Asia occupying the southern part of Indochina. It covers an area of 181,035 square kilometers. The Kingdom of Cambodia is a bounded in the northeast by the people's Democratic Republic of Laos, in the east and southeast by the Socialist Republic of Vietnam, and in the west and northwest by the Kingdom of Thailand.

The Cambodian coastal zone comprises four provinces (Kampong Som "Sihanoukville", Kampot, Koh Kong and Kep), which extend for approximately 435 km along the northeastern shore of the shallow Gulf of Thailand between the Thai and Vietnamese borders. The coast consists of estuaries, bays and approximately 64 islands. The coastal climate of Cambodia is tropical monsoon and is typically hot and humid. The average annual temperature is around 27°C with an average maximum of 35°C in April and a minimum of 19°C in December. Average annual precipitation varies from 2,000 to 4,000 mm. The rainy season is from about June to October. The largest town on the coast is Sihanoukville, which is being developed as a deep seaport and considered as one of the economic growth centers of the country. Cambodia's marine and coastal zones play an increasingly important role in the country's development, supporting the industrial, agriculture, fisheries and transport sectors, and offering growing attraction for recreation and tourism.

The central plains consist mainly of Quaternary sands, loam and clay, as most of the northern mountains and the coastal region are largely composed of Cretaceous granite, Triassic sandstones and Jurassic sandstone formations. The coastal areas are characterized by geological landforms such as sandy beaches, coastal wetlands, rocky shorelines, and cliff coasts. Marine resources include coral reef (28 square kilometers) and seagrass beds (300 square kilometers). Cambodia's coral reefs are generally associated with offshore islands and rocky substrates.

Coastal erosion is observed in a number of areas and these have been classified in terms of severity, based on the degree of erosion and the economic importance or value of the land or structures affected by erosion.

The government has established a number of institutions to lead and be responsible for the management, protection and sustainable use of the resources and environment. These are The National Committee for Land Management Urbanisation and Construction, The National Coastal Steering Committee was established , The Coastal Coordinating Unit, and The Commission on Monitoring and Assessing for Suppressing Encroachment into mangrove land and coastal reclamation.

The goal of the Royal Government is to directly place a major priority on the economic development of the coastal areas. The new plans for economic development through the rebuilding of infrastructure for tourism, industrial development and expansion of ports, and oil and gas exploration and exploitation.

Keywords: coastal erosion, human impacts, shoreline management, Cambodia

The role of Tsunami Deposit Studies in Disaster Mitigation Efforts in Indonesia

IMUN MAEMUNAH[1] AND SRI HIDAYATI[2]

[1] Geological Agency (imun_m2001@yahoo.com)
[2] Ministry of Energy and Mineral Resources in Indonesia

Indonesia is an archipelago, which interacts geologically with four major tectonic plates of the world, namely the Eurasian plate, the Indo-Australian plate, the Pasific plate, and the Philippine plate. The geological conditions in much of the Indonesian region made it vulnerable to earthquakes and tsunamis, especially the coastal regions facing subduction zones. Identification of tsunami prone areas is one important mitigation activity aimed at reducing casualties, severity, and seriousness of tsunami impacts. Tsunamis can be generated at subduction zones or marine volcanos, and the closer a region lies to the tsunami source the larger the disaster area affected by a tsunami. Regions that experienced a tsunami in the past usually leave trails which, when identified as such, can serve as evidence that those area are prone to tsunami disasters. Tsunami deposits comprise material eroded and transported from the seabed or from the coast into the hinterland in the tsunami run-up phase, or material from the coast transported into the sea during the backwash phase. The vertical extent and stratigraphy of tsunami deposits indicate the intensity of a tsunami in the area. If there are several stacked tsunami deposits of different age, the repetition period of earthquakes or tsunami events in that area can be determined. On the other hand, the lateral extent of tsunami deposits are an indication of how strongly the tsunami wave penetrated into the hinterland or how extensive the tsunami inundation has been. The inundation distance is a very important parameter for the development of tsunami hazard maps, and especially the definition of a minimum risk distance of a tsunami-prone area.

As a case study, we examined the tsunami deposits exposed in shallow pits in Karapyak and Madasari, Pangandaran, in order to identify the lateral distribution of the 2006 Java tsunami deposits. The research consists of field surveys and laboratory analysis. Twentyeight shallow pits along five transects at Karapyak and Madasari have been excavated. These pits are more or less parallel to the tsunami wave propagation as confirmed by tsunami eyewitnesses. Trenches were excavated from the shoreline up to 300 m inland. Macroscopic descriptions were then made to establish the lithological cross-section and thickness of the tsunami deposit, whereas laboratory analysis involved grain-size analyses and the identification of microfauna to determine the characteristics of the 2006 Java tsunami deposits. Identification characteristics of the 2006 Java tsunami deposits are based on the model of proposed by Morton et al. (2007).

Keywords: disaster mitigation, tsunami prone, hazard map, tsunami deposits, Pangandaran, inundation, grain-size analysis

COASTAL DEFENCE IN MALAYSIA

MUHAMMAD EZWAN DAHLAN[1], OTHMAN KANGSAR[1], ABU TALIB ABU BAKAR[2]

[1]Minerals and Geoscience Department Malaysia (ezwan@jmg.gov.my)
[2]Department Of Irrigation and Drainage, Malaysia

The coasts of Malaysia consist of two distinctly different physical environments: the mangrove and nipah mud flat, and sandy beaches. The shoreline of Malaysia has experienced increased erosion over past decades. The National Coastal Erosion Study revealed that of the 4,809 km of coastline, about 1,300 km (27%) are presently subjected to erosion and are currently threatening the economic values of human activities. Coastal processes affecting sediment transport are driven by the interaction between tidal currents, river flows and vegetation, thereby continuously shaping and reshaping the coastline. Erosion has both natural and man-made causes such as the clearing of mangrove forests, which can result in greater wave impacts, muddy coasts being particularly badly impacted. The reported rates of shoreline retreat are between 2 and 4 m/year. The implementation of the Coastal Defence Strategy and Integrated Shoreline Management Plan was aimed at minimizing new erosion areas along the coastline of Malaysia, with Guidelines to control development of shoreline areas and thereby avoid negative impacts.

Keywords: coastal erosion, Malaysia

References

Abdullah, S., 1992. *Coastal erosion in Malaysia Problems and challenges.* In: H.D. Tjia and S.M.S. Abdullah (eds.), The Coastal zone of Peninsular Malaysia. Universiti Kebangsaan Malaysia, Bangi, pp. 80-92.

Sharifah Mastura Syed Abdullah . 1992 ,Background Paper on The Coastal Zone in Malaysia : Processes, Issues and Management Plant, 36 pp.

The, T.S. 1992. The Permatang System of Peninsular Malaysia: An Overview. In: H.D. Tjia and S.A. Sharifah Mastura (eds.), *The Coastal Zone of Peninsular Malaysia*, pp. 42–62.

Geological Setting Costal Geology and Mineral Resources of Myanmar

THAN OO[1], AND NYAN LIN AUNG[2]

[1] 99thanoo31@gmail.com

Myanmar is endowed with a varity of mineral resources and a long geological history spanning from the Precambrian to the Recent, including acidic, basic, volcanic and ultrabasic rocks.

The Department of Geological Survey and Mineral Exploration under the Ministry of Mines has conducted extensive geological surveys and mineral explorations throughout the country since it was founded in 1972. Seventy percent (70%) of the country has now been covered by regional geological mapping and 62 mineral commodities and more than 2000 mineral occurrences were recorded. Major minerals are jade, gemstones, copper, lead, zinc, silver, antimony, tin, tungsten, molybdenum, nickel, chromites, iron, manganese, gold, platinum, coal, limestone, baryte, heavy mineral sand, decorative stone, oil and gas.

The southern part of Myanmar is bordered by the Andaman Sea, the coastline covering about 2278 km and the shelf area to the 200 m depth contour is approximately 229,500 sq. km. The coastal area is divided into three parts, namely the Rakhine coastal area, the Ayeyaweddy Deata coastal area and the Tanintharyi coastal area.

The Rakhine coastal area is mainly composed of Eocene to Miocene folded sediments overlain by Quaternary alluvium. Most of the rocks consist of low resistant sedimentary sequences and locally scattered minor exotic limestone blocks. Heavy mineral sands, oil and gas are recorded in this region.

The Ayeyaweddy Deata area is mainly covered by Quaternary formations and recent alluvium. Oil and gas reserves are potentially present.

The Tanintharyi costal area is mainly composed of Carboniferous metasediments comprising slate, phyllite, meta-greywackes, which are intruded by Messozoic granitoid rocks along the coast. Tin-tungsten, gold, manganese, heavy mineral sand, zircon sand and decorative stones are found in this region.

Keywords: coastal geology, mineral resources, coastral area, Myanmar

Country Report of the Philippines - Coastal Geology and Geohazards

AL EMIL G. BERADOR[1]

[1]Mines and Geosciences Bureu-7, Greenplains Subdivision, Banilad, Mandaue City, Cebu, Philippines, (bgea11@yahoo.com)

The Philippines is an island archipelagic country located in Southeast Asia. It has one of the longest coastlines in the world amounting to approximately 36,289 kilometers. It is surrounded by the Philippine Sea in the east, by the West Philippine Sea in the west and by the Celebes Sea in the south, being located within the so called Pacific Rim of Fire. An average of 21 typhoons enter the Philippine Area of Responsibility (PAR) every year. The archipelago is made up of 7,107 islands, which cover an area of more than 300,000 sq km. Luzon, Visayas, and Mindanao form the main island groups of the Philippines. The terrain mostly consists of mountains with narrow but extensive coastal lowlands.

More than 45% of the population resides in coastal areas. This part of the population directly or indirectly relies on coastal resources as a source of livelihood, habitation, and recreation. Many of the coastal areas are inherently vulnerable to coastal/marine hazards (geographic, geologic setting). These hazards include tsunamis, storm surges, coastal flooding, coastal erosion, liquefaction, coastal subsidence and saltwater intrusion. It is in this context that the Philippine Government embarked on various programs aimed at addressing concerns imposed by geohazards. The Department of Environment and Natural Resources-Mines and Geosciences Bureau (DENR-MGB) is currently implementing a National Geohazards Mapping and Assessment Program and Coastal Geohazards and Impacts of Climate Change Study. The program objectives include the identification of areas that are susceptible to various geologic hazards (particularly landslides, flooding and coastal geohazards); increasing public awareness to lessen or mitigate negative impacts of natural disasters; identification of possible relocation/resettlement sites – both for those affected and future development planning; recommendation of measures to minimize if not eliminate the identified hazards; and the acquisition of new or additional geoscientifc information.

Events in the past 5 years (Typhoon Yolanda 2013, Negros Earthquake 2012, Bohol Earthquake 2013, variuos typhoons, etc.), which affected the Philippines and caused severe damage to the impacted areas inluding the coastal zones further emphasize the importance of geohazard studies (land and coastal zones).

COUNTRY REPORT OF SRI LANKA

D. P. R. WEERAKOON[1]

[1]Geological Survey and Mines Bureau, No.569, EpitamullaRd., Pitakotta Sri Lanka (dprweerakoon@gsmb.gov.lk)

Sri Lanka is an island located in the Indian Ocean bounded by the 6° and 10° North latitudes and the 80° and 82° East longitudes. It covers a total area of 65,610 km² with a 1,585 km long coastline. The population exceeds 20 million. Sri Lanka has two major monsoon seasons with humid tropical climate.

Sri Lanka is covered by Proterozoic high-grade metamorphic rocks belonging to the Wanni Complex (WC), Highland Complex (HC), and Vijayan Complex (VC), as well as Phanerozoic superficial deposits in the northern, north-western and eastern coastal belt. There are a few metallic ore minerals (iron, copper) and non-metallic minerals. The coastal zone is enriched in heavy mineral sands, while inland coral and shell beds occur in the south-western sector. Potential offshore hydrocarbon reserves are being explored off the north-western shore of Sri Lanka.

Floods, landslides and tsunamis are the main geo-hazards that generate disasters. Flooding is often reported in the lowland rivers during the monsoon rains. Sri Lanka neither experiences earthquakes nor has major volcanic events, although earth tremors of magnitude less than 5 have been reported. In 1999, the first seismic observatory station has established in Sri Lanka by the University of California, San Diego. The Geological Survey & Mines Bureau of Sri Lanka is responsible for geological, geophysical and geochemical surveys and mining activities in the country. In 2004, almost two-thirds of the coast was affected by the Indian Ocean tsunami. During the last two decades, natural processes and detrimental human practices have combined to create landslide hazards, especially along the mountain slopes of the country.

Extension of current researches would be required to elucidate and precise risk estimations and probabilities of hazard occurrence at the regional level.

Keywords: flood, landslide, tsunami, tremors

Assessment of Coastal Change in the Gulf Thailand and the Andaman Sea from 2002 to 2011

MR.SURACHED RUAMTUM[1], MS.WARAPON JITSUWAN[2], MR.EKKACHAI KAOEMART[3], MR.VISUTTIPONG KERERATTANASATHIAN[4]

[1] Bureau of Environmental Geology (geotech2521@gmail.com)
[2] Department of Mineral Reosources, 75/10, Rama VI Road,Ratchathewi, Bangkok 10400 Thailand

Thailand has a coastline stretching for 3,295 kilometers over 23 provinces. The coastal area can be divided into two major provinces, the Gulf of Thailand coast and the Andaman Sea coast.

The Department of Mineral Resources (DMR) is responsible for the study and evaluation of any coastline changes. The interpretaton of coastline change also assesses the occurrence of trees and natural vegetation. The data are analyzed using geographic information systems (ENVI 4.2 and ArcView 3.3), which are primarily based on aerial photographs (THEOS) of the Thailand Gulf Coast (2011) and the Andaman Sea (2010) using a data overlay technique. Ortho-color aerial photographs (2002) were evaluated to identify coastline changes over the past nine years. Three coastal change rates were established: erosion >1 meter/year, deposition >1 meter/year, and stable conditions of ±1 meter/year.

In the Gulf of Thailand the study evaluated a shoreline distance of 1,515 km, of which a distance of 268.56 km experienced an areal erosion of 5.04 km^2. Deposition occurred over(20.89%), affecting an area of 9.17 km^2. The remaining coast was classified as being stable, comprising a distance of 929.94 km (61.38%) of the study area. Of the coast bordering the Andaman Sea, 1,061 km of coastline were evaluated. Of this, a distance of 104.73 km (9.87%) experienced erosion, affecting an area of 1.56 km^2. Deposition occurred along a distance of 122.10 k an area of 2.21 km^2. Stable coastal conditions were established for a distance of 834.68 km, representing 78.63 % of the study area.

Keywords: Thailand, Coastal areas, Marine – Coastal Geology, The Gulf of Thailand

COASTAL GEOLOGY AND GEOHAZARDS (GEOCOAST) OF TIMOR LESTE

ANA BELA BARRETO MONIZ[1]

[1]belbaniz_2987@yahoo.com

There are numerous geohazards which affect coastal regions, including beach erosion, landslide/cliff collapse, wave attack, flooding, and tsunamis. These are always related to the landward movement of water and can either be slow or fast, and may be temporary or permanent in nature. The energies of waves, tidal currents and wind interact with the geomorphological structure and coastal sediments through processes of erosion, transport and deposition. Coastal erosion in particular, if excessive, can result in significant economical losses, social problems and ecological demage. However, estimation of coastal sediment transport rates is quite complex since many effects have to be intregated such as the co-existing wave/current regime, variations in the mean water level, (tide, wave set-up and set-down), cross-shore and alongshore components, breaking wave effects (turbulence and undertow), bathymetric influence (mean slope and forms) as well as other geomorphic influence. The total lenght of the coastline of Timor Leste is about 780 km, of which about 300 km belongs to the south coast and the remainder is mostly in the north. The coastal areas experience two monsoonal wind-wave climates with predominantly southwesterly to northwesterly winds from October-March and northeasterly to southeasterly winds from April-September. In addition there is a persistent ocean swell.

Keywords: coastal erosion, sediment, structure, wave

References

UNDP, A comprehencsive national hazard assesment and mapping in Timor Leste.
Encyclopedia of marine geoscienses

GEOLOGICAL HAZARDS ALONG THE COASTAL ZONE OF CENTRAL VIETNAM UNDER CONDITIONS OF CLIMATE CHANGE

NAM NGUYEN XUAN [1], HAI TRAN THANH [2]

[1]Vietnam Institute of Geoscience and Mineral Resources, nam_nguyen_(xuan@hotmail.com)
[2]Hanoi University of Mining and Geology

The coastal zone of Vietnam is one of the most vulnerable areas to natural hazards, especially under the conditions of a changing climate. However, this depends on many natural factors in each region, including the basement architecture, the presence of modern tectonic activities in conjunction with many exogenic processes such as climatic condition, wave action, sedimentary transport and man-made actions. The coastal zone of central Vietnam is of the marginal coastal plain type, being characterized by narrow coastal plains, short and steep rivers and streams that transport large amounts of sediment into the East Sea but is not enough to fill up the marginal basins. The continental shelf is narrow and abruptly drops to the deep sea. The coastal zone is also strongly affected by numerous neo-tectonic fault systems which occur widely in the area. The faults and associated fractures have led to the dismemberment of rocks, enhancement of weathering and increased erosion. Such processes, in association with heavy monsoon rains, have consequently resulted in the formation of an irregular coastal and inland morphologic pattern. In addition, the local uplift and subsidence have also enhanced either changes in base level or relative sea-level rise or fall, which resulted in many geological hazards, including shoreline erosion, beach loss, river levee collapse, river-mouth migration, landslides, salinization, desertification, and flooding.

Keywords: Central Vietnam, coastal zone, geohazards,.

POSTER

PRESENTATIONS

Towards reconstructing upper ocean thermal structure in the Indonesian Throughflow area

JIAN XU[1], PENG ZHANG[1] AND RINA ZURAIDA[2]

[1] Institute of Cenozoic Geology and Environment, State Key Loboratory of Continental Dynamics and Department of Geology, Northwest University, Xi'an, China (jx08@live.cn)

[2] Institute of Marine Geology, Bandung, Indonesia

The Indonesian Throughflow (ITF), as the key part of the Global Conveyor Belt in the low latitudes, connects upper oceans of the west Pacific and Indian Ocean, modulating heat and freshwater budgets between the oceans and concequently contributing to global climate change. Modern observations and modeling data indicate that upper ocean thermal structure of the ITF is intensively related to East Asian monsoon and El Niño-Southern Oscillation (ENSO) activities. Precise reconstruction of ITF thermal structure is therefore greatly helpful in understanding shaping roles of Asian monsoon and ENSO in the past. Modern prediction of ENSO involves monitoring thermocline tilt across the Pacific and depth of thermocline (DOT) is defined as the depth of 20ºC isotherm. Our ultimate purpose is to find a solution of quantitatively calculating DOT for the past ocean based on its counterparts for the modern ocean in the ITF area. At the current stage of our study, we collected and measured oxygen isotope and Mg/Ca ratio in shells of four planktonic foraminiferal species, Globigerinoides ruber, Globigerinoides sacculifer, Pulleniatina obliquiloculata and Neogloboquadrina dutertrei, from surface/coretop sediments from a total of 62 sites in the ITF area. We also predicted shell oxygen isotope from WOA05 temperature and salinity profiles at the 62 sites using a conventional oxygen isotope-temperature equation. Comparison of measured and predicted oxygen isotopes implies depth habitats of the above species: G. ruber at 0-50m; G. sacculifer at 50-75m; P. obliquiloculata at 75-100m; and N. dutertrei at 100-125m. Assuming that depth habitat of these species strictly adheres to the water depth, it is easy to reconstruct thermal structure of the upper ocean above 125m by converting Mg/Ca ratios into temperatures. It is however not feasible to reconstruct DOT since the modern 20ºC isotherm ranges depth of 125 to 150m in the ITF area. Thus, deeper dwelling species such as Globorotalia trunctulinoides are inevitable to be investigated in our near future work.

Vertical distribution of living planktonic foraminifera in the northern South China Sea and its paleoceangraphic implications

HAIYAN JIN[1], QIONGYI LUO AND ZHIMIN JIAN

[1] State Key Lab of Marine Geology, Tongji University, Shanghai 200092, China (jinhy@tongji.edu.cn)

In recent study, 65 plankton tow samples were collected and analyzed from 13 sites in the northern South China Sea during the 2013 open cruises of the National Natural Science Foundation of China. Totally 22 planktonic foraminiferal species were identified in the samples and most are tropical warm water species with few cold water species. Sea surface water dwelling species Globigerinoides ruber and Globigerinoides sacculifer mainly live in the upper 0-50m water layer, while sub-surface water dwelling species such as Neogloboquadrina dutertrei and Pulleniatina obliquiloculata live in the 0-100m and 50-150m water layer respectively. The changes of thermocline depth significantly influence the vertical distribution of Globigerinoides sacculifer and Neogloboquadrina dutertrei. When the thermocline became deeper, both of the two species migrated downward, vice versa. Based on the stable isotopic analysis of different planktonic foraminifer shells, it's found that along with the increase of living water depth, the average $\delta^{18}O$ values of G. ruber, G. sacculifer (wo), G. sacculifer (w), N. dutertrei, P. obliquiloculata are -3.08‰, -2.68‰, -2.62‰, -1.86‰ and -1.52‰ respectively, which mainly reflect the vertical temperature gradient in the upper water column. The average $\delta^{13}C$ of these species are -0.06‰, 0.71‰, 1.02‰, 0.45‰ and -0.40‰ respectively, displaying the trend that the values increase firstly with the water depth and then decrease later, which may be related to the vertical changes of nutrients such as chlorophyll in the upper ocean. Therefore, the $\delta^{18}O$ and $\delta^{13}C$ differences between surface water and sub-surface water dwelling planktonic foraminiferal species can be used to indicate the past changes of thermocline and nutrientcline depth.

Keywords: northern South China Sea, living planktonic foraminifera, vertical distribution, stable isotopic $\delta^{18}O$ and $\delta^{13}C$

The influence of environment parameters on the distribution of isoprenoid glycerol dialkyl glycerol tetraethers (iGDGTs) in surface sediments from the northern South China Sea

CHEN JIALI[1,2], LI XING[2], HU PENGJU[1], YANG YANG[1], SONG JINMING[3], LI XUEGANG[3], YUAN HUAMAO[3], LI NING[3], LÜ XIAOXIA[1,2]

[1]1State Key Laboratory of Biogeology and Environmental Geology, China University of Geosciences (Wuhan), 430074, Wuhan, China

[2] Faculty of Earth Resource, China University of Geosciences (Wuhan), 430074, Wuhan, China

[3] Institute of Oceanology, Chinese Academy of Sciences, 266071, Qingdao, China

In order to get a better understanding of the applicability of isoprenoid glycerol dialkyl glycerol tetraether (iGDGT) based proxies for reconstructing environmental change in the coast of northern South China Sea (SCS), we analyzed the iGDGT distribution in surface sediments from northern SCS. The spatial distribution of individual iGDGT concentration increased gradually eastwards. A redundancy analysis using the fractional abundance of the six major iGDGTs indicates that the iGDGTs are mainly influenced by spring SST, nitrate, water depth (WD) and salinity. However, when considering only the four iGDGTs used for the TEX86H proxy, water depth is the most significant parameter, explaining 52% of the variance, following by the nitrate and autumn SST. The low TEX86H values in our study area were mainly caused by the change of archeal communitis with different water depth.

Keywords: iGDGTs, distribution,South China Sea (SCS), water depth

Temporal and spatial variations in C_{37} alkenones of suspended particles in the East China Sea

TAE WOOK KO[1], KYUNG EUN LEE[1]

[1] Ocean Science and Technology school, Korea Maritime and Ocean University, Korea (kyung@kmou.ac.kr)

To confirm compatibility of using alkenones as a proxy of past sea surface temperatures (SSTs) in the East China Sea (ECS), we checked temporal and spatial distribution of alkenone concentrations and temperatures of suspended materials in the ECS. We used surface and subsurface seawater collected by the National Fisheries Research and Development Institute of Korea from the ECS in 2007-2010. To investigate seasonal variations, seawater samples were collected every three month interval. To investigate variations in depth, samples were also collected at 0 m, 20 m, and 30 m or 50 m at three stations. Samples were filtered immediately after collecting at every station. Alkenone concentrations of surface seawater were similar to those of 20 m, but it decreased at 50 m. These were high in spring and decreased gradually over time. In winter, they were lower than those of other seasons. Since we could not find C37:3 from some samples collected in summer, we could not calculate alkenone temperatures of those samples. Compared with in situ temperatures, alkenone temperatures were generally 1°C lower. This value was within an error range (1.2°C, Conte et al., 2006). In summer, alkenone temperatures were similar to in situ temperatures. In winter, however, alkenone temperatures were lower than in situ temperatures. We investigated variation of temperatures in depth at two stations. Alkenone temperatures corresponded to in situ temperatures at each depth within 1~2°C error range. Therefore, alkenones are can be used as a proxy of past SSTs in the ECS.

Keywords: Sea surface temperature, Alkenones, East China Sea

Applicability assessment of alkenones as a SST proxy using coretop sediments of southwestern Ulleung Basin, East Sea

NAYEON KANG[1], KYUNG EUN LEE[1], SEONG-PIL KIM[2]

[1] Ocean Science and Technology school, Korea Maritime and Ocean University, South Korea (kyung@kmou.ac.kr)
[2] Korea Institute of Geoscience and Mineral Resources, South Korea

To test the applicability of alkenones as a proxy for past sea surface temperature (SST) in the East Sea, this study investigated alkenone temperature using coretop sediments of southwestern Ulleung Basin. Sediment samples were collected from the East Sea during cruises carried out by Korea Institute of Geoscience and Mineral Resources in 2010-2012. 37 coretop samples of piston core and box core were analyzed. The results of previous study on alkenone analysis using suspended particles in the area from Lee et al. (2014) show that the alkenone concentration was high in the surface mixed layer and extremely low at depths greater than 50 m. And alkenone temperature corresponds to annual-averaged SST at the offshore station, while it corresponds to summer-to-fall averaged SST at the coastal station. In this study, coretop alkenone temperature will be compared to horizontal-vertical distribution of in situ SST in 2000-2012 observed by National Fisheries Research and Development Institute of Korea. Also the results will be compared with those of water column study. Finally, applicability of alkenones as a proxy for past SST in the East Sea will be assessed by the results above.

Keywords: alkenones, sea surface temperature, East Sea, coretop sediments

Assessing the applicability of the LDI paleothermomer in the East Sea (Sea of Japan)

JONG-KU GAL[1], JUNG-HYUN KIM[1], SU-JIN KANG[1], DONG HUN LEE[1], KYUNG-HOON SHIN[1]

[1] Department of Marine Science and Convergence Technology, Hanyang University ERICA campus, 55 Hanyangdaehak-ro, Sangnok-gu, Ansan-si, Gyeonggi-do 426-791, South Korea (shinkh@hanyang.ac.kr)

Reconstruction of sea surface temperatures (SSTs) is of utmost important to understand climate changes. Recently, Rampen et al. (2012) proposed the long chain diol index (LDI) as a novel paleothermometer based on an observation of a strong positive correlation between the LDI and SSTs. In this study, we tested the applicability of this newly proposed proxy in the East Sea (Sea of Japan). Thereby, we investigated three multicores (ARA 05, ES14-BC03, and ES14-BC01) collected on R/V ARAON along a South-North transect in the Ulleung basin. We will present the LDI data in comparison to UK'37 ones and discuss the implication of the LDI for the paleoclimate studies in the marginal seas.

Keywords: LDI, long chain diols, alkenone, East Sea, Ulleung basin

References

Rampen et al. 2012. Long chain 1,13- and 1,15-diols as a potential proxy for palaeotemperature reconstruction. Geochimica et Cosmochimica Acta. 84, 204-216.

Testing dissolved organic carbon hypothesis using intermediate complexity box model

WENTAO MA[1], PINXIAN WANG AND JUN TIAN

[1] State key laboratory of marine geology, Tongji University, Shanghai, 200092, China (wtma@tongji.edu.cn)

The long eccentricity (400-kyr) cycle is found ubiquitous in the Paleogene and Neogene records such as δ13C and δ18O. Generally, δ13C maximum (δ13Cmax) of each 400-kyr cycle corresponds to the long eccentricity minimum (Eccmin). During the recent 1.6 Ma, however, the δ13Cmax-Eccmin relationship becomes obscured. Wang et al. (2014) proposed dissolved organic carbon (DOC) hypothesis, say, the contraction (expansion) of marine DOC esp. the refractory DOC (RDOC) pool driven by decreased (increased) nutrient supply result in δ13C maximum (minimum). To test this hypothesis, we use an intermediate complexity box model which includes sophisticated biological processes. The model is adjusted after Romaniello et al. (2010), adding priming effect and particulate organic carbon inhibition term to the RDOC production. The model is reasonably constrained by modern data. Nutrient incorporating test show that adding (subtracting) terrigenous nutrient supply is able to reduce (increase) the RDOC pool and produce lighter (heavier) δ13C. We also simulate δ13C of recent 2 Ma using the X-ray fluorescence core scanning K/Al of ODP site 1143 as external nutrient forcing. The modeled 400-kyr cycle matches well with the amplitude and phase of proxy data. The weathering and nutrient supply minima correspond to δ13C maxima. This study support the DOC hypothesis in modeling aspect.

Keywords: dissolved organic carbon, microbial loop, 400-kyr cycle

References

Romaniello, S.J., Derry, L.A., 2010. An intermediate-complexity model for simulating marine biogeochemistry in deep time: Validation against the modern global ocean. Geochem. Geophys. Geosyst. 11, Q08001, doi:10.1029/2009GC002711

Wang, P., Li, Q., Tian, J., Jian, Z., Liu, C., Li, L., Ma, W., 2014. Long-term cycles in the carbon reservoir of the Quaternary ocean: a perspective from the South China Sea. National Science Review 1, 119-143

Internal Structure of Coastal Dunes along South China Sea, Revealed by Ground Penetrating Radar (GPR)

BAI YANG[1], LI ZHILONG, WEI XIA'ER

[1] Tourism Department of Huizhou University, Huizhou, Guangzhou, 516007 (baiyang@hzu.edu.cn)

The internal structure of coastal dunes along South China Sea has been detected by ground penetrating radar (GPR), and its formation and development process are analyzed. This study has carried on the data processing of GPR image, and it has found that GPR wave reflection and sedimentary facies have correlation. The internal structure of coastal dunes reflects the formation, movement and development process. The GPR image of windward slope has reflected the abundant foreset beddings, indicating that the original dunes after being corroded mix and restructure with the sand carried by the wind, and then, they have a superimposing growth and movement along prevailing wind direction. While the performance of the leeward slope is that the slumping sand mixes and restructures with the original sand on the leeward slope, and then subsidence and translation happens. Artificial digging pit changed the landform of the original dunes, but the sand and sand dunes would be quick to repair themselves under the action of wind force after the pit being abandoned. It proves that the formation of coastal dunes is not restricted by the overlying terrain, but relates to the movement rule of the sand flow.

Keywords: South China Sea, Coastal Dunes, Ground Penetrating Radar (GPR), Internal Structure, Development Process

Foraminiferal paleoceanography of Quaternary turbidite deposits from the central basin of the South China Sea, IODP Site U1433

JINGSHUANG CHEN[1] AND QIANYU LI[1]

[1] School of Ocean and Earth Science, Tongji University, China (qli01@tongji.edu.cn)

The material used in this study is from Integrated Ocean Drilling Program (IODP) Site U1433A (water depth 4390 m), located in the Southwest Subbasin near the relict spreading center. The thick Quaternary sequence (0-300 mbsf) comprises of gray clay, silty clay, clay with nannofossils of turbidite origin. Foraminifers show considerable variations in both abundance and preservation. They are abundant and well preserved in silty layers with numerous small (<150 μm) specimens. We attempt to address the following issues: (1) Site U1433 sediments were apparently deposited at depths greater than the CCD, why do they still contain abundant foraminifera and calcareous nannofossils? (2) Where did the foraminifera come from and by what ways? (3) Can we establish a model for foraminiferal accumulation in responding to turbidite buildup in the central deep sea? Our preliminary results indicate that foraminiferal assemblage is uniquely characterized by well sorted small specimens of various depths and ages. The oldest are Oligocene-Miocene planktonic forms, and the shallowest are represented by Ammonia beccarii and Elphidium spp., a group of benthic species living in waters shallow than 50 m. We suspect that the foraminiferal assemblage had been transported for a considerable distance from the northern basin margin. Our final results will shed light on the deep sea depositional process in marginal seas including the South China Sea.

Last Glacial Cycle and Seismic Stratigraphic Sequences Offshore West of Hainan Island, South China Sea

HONGJUN CHEN[1,2,3,5], JAN HARFF[3,4], YAN QIU[2,3], ANDRZEJ OSADCZUK[4], JINPENG ZHANG[2,3], MICHAL TOMCZAK[4], ZHAOGUO CUI[2,3], GUANGQIANG CAI[2,3], MINGMING WEN[2,3], LIQING LI[2,3]

[1] Guangzhou Marine Geological Survey, Guangzhou, China (chhju@163.com)
[2] CAS Key Laboratory of Marginal Sea Geology, South China Sea Institute of Oceanology, CAS, Guangzhou 510301,China
[3] Key Laboratory of Marine Mineral Resources, Ministry of Land and Resources, Guangzhou, 510075, China
[4] University of Szczecin, Institute of Marine and Coastal Sciences, Szczecin 70383, Poland
[5] University of Chinese Academy of Sciences, Beijing 100049, China

In order to investigate the relationship between sea level change during the Last Glacial Cycle (LGC) and seismic stratigraphic sequences on the northwestern continental shelf of the South China Sea (SCS), sparker single channel high-resolution seismic profiling data has been correlated with a sediment core HDQ2 drilled offshore west of Hainan Island. As a result a seismic stratigraphic model was elaborated in relation to local and global eustatic sea-level curves.

According to the age model, developed based on AMS14C, OSL datings and $\delta^{18}O$ isotope data the 88.3 m sediment core HDQ2 reflects the late Quaternary environmental change during the last 110 ka. The correlation with basinward adjacent sediment cores based on stable oxygen isotope records and the dating of HDQ2 core allows an subdivision of HDQ2 sediments into s zones from Marine Isotope Stages (MIS) 1 to 5e.

Seismic reflectors interpreted as unconformities (erosional surfaces representing low stand sea-level phases) were identified from the seismic images. A lithological correlation with sediment core HDQ2 confirm that the reflectors stand for marker horizons of sedimentary cycles driven by sea-level cyclicity. The age of the seismic reflectors have been estimated by OSL dating of HDQ2 sub-samples and numerical interpolation bounded to global eustatic sea-level curves. The results indicated that 7 sea level cycles can be distinguished in the study area during the LGC and correlated with regional and global sea level change models. Special interest is paid to delta structures formed during forced regressive sea-level stages during MIS 3.

Further research confirms that seismic stratigraphy at the NW margin of the SCS can be intimately referred to LGC sea level changes associated with the regional uplifting and sediment supply.

Keywords: Last Glacial cycle, seismic stratigraphic sequences, offshore, Hainan Island, South China Sea

Hydroclimate implications of thermocline variability in the southern South China Sea over the past 180,000 yr

LIANG DONG[1], LI LI[1], QIANYU LI[1,2], HUI WANG[1], AND CHUANLUN L. ZHANG[1]

[1] State Key Laboratory of Marine Geology, Tongji University, Shanghai 200092, China
[2] School of Earth and Environment Sciences, University of Adelaide, SA 5005, Australia

Based on core top calibration, the TEX^{H}_{86}-derived temperature has been considered as representing subsurface sea temperature (SSST), and the difference between the $U^{K'}_{37}$-derived sea surface temperature (SST) and the TEX^{H}_{86}-derived SSST can be used to reflect the depth of thermocline (DOT) in the South China Sea region (Jia et al., 2012). We evaluated the DOT dynamics in late Quaternary records using this approach on paired analysis of samples from core MD05-2896/7 in the southern South China Sea. The reconstructed DOT over the last 180,000 yr (180 ka) displays a shoaling trend in glacial period, which may be attributed to the strengthened cyclonic gyre by the enhanced East Asian winter monsoon and Walker circulation with prominent La Niña-like state, and vice versa in interglacial period corresponding to reduced winter monsoon with enhanced El Niño-like state. These upper water thermal variations testify that enhanced winter monsoon was the direct cause of an uplifted local thermocline during glacial or La Niña-like states with strengthened cyclonic gyre due to positive wind stress curl in the southern South China Sea. Our results provide insights into the relationship between monsoon and ENSO on both glacial and millennial time scales.

Keywords: $U^{K'}_{37}$, TEX^{H}_{86}, Depth of thermocline (DOT), East Asian Monsoon (EAM), South China Sea (SCS), El Niño-Southern Oscillation (ENSO)

Identification of long chain n-alcohols from the northern SCS since late Last Glacial Maximum and its implication of terrigenous input

SHENGYI MAO[1,4], XIAOWEI ZHU[2,4], NENGYOU WU[1,4], YONGGE SUN[3], HONGXIANG GUAN[1,4]

[1] The Laboratory of Gas Hydrate Formation Mechanism, Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences, China (miseraboy@126.com)

[2] Key laboratory of Marginal Sea Geology, Chinese Academy of Sciences, Guangzhou Institute of Geochemistry, China

[3] Department of Geosciences, Zhejiang University, China

[4] Guangzhou Center for Gas Hydrate Research, Chinese Academy of Sciences, China

Reconstructions of paleoclimates and paleoenvironments can help us to better understand the variation processes and mechanisms of the Earth's systems and effectively reduce the uncertainties in these predictions by providing a basis for climatic and environmental predictions. Long chain n-alcohol in marine sediments and its isotopes of C are good biomarkers for paleoenvironmental reconstructions. So the distribution and $\delta^{13}C$ composition of long chain n-alcohols from late Last Glacial Maximum (LGM) to Holocene in Site4B core sediments from the continental slope of northern SCS was detected in recent research supported from the 973 Program (2009CB219506). The distribution of carbon preference index (CPI, 10.49-24.56), average chain length (ACL, 28.91-29.99) and the average carbon isotope (-28.85±0.97‰ ~ -32.92±1.38‰) of long chain n-alcohols reflected a C_3 higher plant source, and a dominated terrigenous input of organic materials into sediments. The relatively low terrigenous input was related with the extensive Melt Water Pulse (MWP) event (19ka-MWP, MWP-1A and MWP-1B), and Bølling-Allerød (B/A) warming event from the end of LGM to the end of Late Pleistocene in Site4B sediments (65-102cm, 19.343-~11.636 ka BP) without glacial period/interglacial period cycle. However, the distribution of the terrigenous input reflected intensified/weakened winter monsoon/summer monsoon cycle during the late LGM and Holocene, with the winter monsoon maximum periods recorded during the late LGM and the summer monsoon maximum periods in ~9.940ka BP. Compared with the global glacial period/interglacial period cycle climate (Heinrich, 1988; Meyers, 2003), the distribution of the terrigenous input from the end of LGM to the end of Late Pleistocene in Site4B sediments (19.343-~11.636 ka BP) reflected ambiguous regional comparability, probably related with the regional environmental activity in low latitudes.

Keywords: the continental slope of northern SCS, long chain n-alcohol, carbon isotope, Melt Water Pulse event, monsoon climate

References

Heinrich, H., 1988. Origin and consequences of cyclic ice rafting in the northeast Atlantic Ocean during the past 130,000 years. Quaternary research, 29(2): 142-152.

Meyers, P, A., 2003. Applications of organic geochemistry to paleolimnological reconstructions: a summary of examples from the Laurentian Great Lakes. Organic Geochemistry, 34: 261-289

A rapid gas hydrate dissociation after the Younger Dryas event in the Shenhu area, northern South China Sea

LIMING YE[1], QIAN GE, DONG XU, KEHONG YANG

[1] The Second Institute of Oceanography, State Oceanic Administration, China (e-mail: lmye@sio.org.cn)

The methane released from gas hydrates has been suggested to play a great role in global warming. The Shenhu area is one of the most important Gas Hydrate Stability Zones (GHSZ) in the northern South China Sea (SCS), where the records of carbonate contents for Core 17940, MD2905 and ZHS-176 all revealed a Carbonate Minimum (CM) at 11.3-8ka BP. The CM was characterized by an asymmetric pattern of a rapid decrease of carbonate content followed by a gradual recovery. The benthic foraminifer $\delta^{13}C$ levels in the shells of *Cibicidoides wuellerstorfi* and *Cibicidoides kullenbergi* were depleted by 1.4‰ and 0.7‰, respectively, during the CM period. Meanwhile, the Mass Accumulation Rate (MAR) of the organisms suddenly increased nearly twofold on the seabed. These records may indicate the release of a large amount of methane from the gas hydrates after the Younger Dryas event (YD), which has caused a strong lysocline shoaling but no significant influence on the sea surface ecosystem. This gas hydrate dissociation may be induced by the temperature increase at the end of the YD.

Keywords: Gas hydrates dissociation, Carbonate dissolution, Younger Dryas, South China Sea.

Variations in terrigenous input to the northern Okinawa Trough (East China Sea) during the last 24,300 years: Evidence for sea-level and monsoonal climate changes

FENGMING CHANG[1], TIEGANG LI, ZHIFANG XIONG AND ZHAOKAI XU

[1] Key Laboratory of Marine Geology and Environment, Institute of Oceanology, Chinese Academy of Sciences, Qingdao 266071, China

Geochemical and sedimentological analyses of core PC-1 recovered from the northern East China Sea (ECS) provide insights into variations of terrigenous input associated with sea-level and climate changes over the past 24.3 ka. Based on high-resolution multiproxy records, our results suggest that since the late last glaciation, the delivery of terrigenous material to the northern ECS was primarily controlled by sea-level changes. Prominent dominance of terrigenous material indicate that the Last Glacial Maximum (LGM) lowstand of sea-level have occurred during the period 21.5-19.6 ka, robustly supporting the conventionally assumed LGM age (21 ka). The LGM lowstand was terminated by the rapid sea-level rise of 19-ka MWP, which is well revealed by the nearly synchronous decreases in both terrigenous detritus and Mean grain size (Mz) from 19.6 to 18.9 ka. The sea-level jump corresponding to MWP-1A is clearly depicted by the sharp drop of terrigenous input and prominently heavy $\delta^{18}O$ of G. ruber centering at around 15.0 ka, given the considerable uncertainties of the ages on deglacial marine radiocarbon samples. Slight increase in terrigenous input after 13.4 ka potentially linked to a brief sea-level fall from the inter-Allerød cold period (IACP) to the onset of the Younger Dryas (YD), which has not been constrained previously. Although MWP-1B has not left robust signatures in terrigenous input, it is explicitly captured by the obviously heavy $\delta^{18}O$ of G. ruber and decline in Mz at 18 11.5-10.9 ka. There is evidence that MWP-1c occurred in a broad millennial interval with multiple peaks of rapid sea-level rise, as presented by the sharp variations in terrigenous input at 9.7-9.1 ka. During the late Holocene, the effect of continuously weakening monsoon precipitation overwhelmed that of stable sea-level resulting in a uniform increase in proportion of marine-derived organic matter after 5.5 ka, whereas input of terrigenous detritus was less variable.

Keywords: terrigenous input; sea-level change; East Asian monsoon; East China Sea

Sediment provenance variations in the northern Okinawa Trough during last 88 ka: evidences from Sr and Nd isotopes

AIMEI ZHU[1], XUEFA SHI[1], JIANJUN ZOU[1]

[1] Key Laboratory of State Oceanic Administration for Marine Sedimentology and Environmental Geology, First Institute of Oceanography, Qingdao, China (email:zhuaimei@fio.org.cn)

$^{143}Nd/^{144}Nd$ and $^{87}Sr/^{86}Sr$ ratios of the acid-insoluble residues of the fine-grained sediments (<63μm) of core CSH1 collected from the norhtern Okinawa Trough were studied. The Sr isotopic compositionsof the sediments range between 0.707-0.721 with an average value of 0.717. εNd values vary from -12.17 to 0.14 with an average vaule of -9.86. Temporal distributions of the Sr and Nd isotopes of the sediments showed opposite trends since the last 88 ka, such as more radiogenic Nd values and lower Sr isotope ratios over the last 7 ka, decreasing Nd isotope ratios and increasing Sr isotope values during 30 – 17 ka and higher radiogenic Nd values and lower stable Sr isotope ratios during MIS 5.1. The variations in Sr and Nd isotopic compositions indicate climatically induced changes in sediment provenance from four different end-members: volcanic detritus, Yangtze River, old Yellow River and Taiwan detritus transported by the Kuroshio. Sediments were mainly from volcanic detritus after 7 ka, from the Taiwan transported by the Kuroshio during 12-7 ka and 74-88 ka, from old yellow river during 17-24 ka, and a mixing source of Yangtze and old yellow river during 26 -74 ka and 12-17 ka. The rapid change in sediment provenance is closely related to the evolution of sea level, East Asian Monsoon and the Kuroshio.

Keywords: Sr isotope, Nd isotope, sediment provenance, northern Okinawa Trough, MIS5.1

Acknowledgements: This study was supported by the National Natural Science Foundation of China (GrantNo. 41476056, 41206059) and by Basic Scientific Fund for National Public Research Institutes of China (No.2012G31, GY0213G23).

Estimated temperatures of various SST proxies and their comparisons: A case of the Okinawa Trough

RYOUNG AH KIM[1], KYUNG EUN LEE[1], SI WOONG BAE

[1] Ocean Science and Technology school, Korea Maritime and Ocean University, South Korea (kyung@kmou.ac.kr)

There have been studies on past sea surface temperatures (SSTs) reconstructed from marine sediments using four SST proxies (alkenone, foraminiferal Mg/Ca ratio, planktonic foraminiferal assemblage and GDGT) in the Okinawa Trough (OT). However, it is uncertain what temperature each proxy represents. Yet, there is no comparative study of SST proxies in the OT. First, we investigated the distribution of each proxy-related organism in water column. Then core-top sediment temperatures reconstructed using these proxies were compared with current SSTs (Japan Oceanographic Data Center dataset, 1906 - 2003). Alkenone based temperatures are considered to represent annual mean SST and Mg/Ca of Globigerinoides ruber based temperatures are regarded as summer – autumn (June − November) SST. Core-top foraminiferal assemblage summer SSTs were consistent with current summer (August) SST, but winter SSTs were ~3.6℃ warmer than current witner (February) SST. Second, paleo-temperature estimates for the late Holocene (0 − 3kyr) and the Last Glacial Maximum (LGM) (18 – 21kyr) were compared. Foraminiferal assemblage summer SSTs were warmest. Mg/Ca based temperatures were higher than alkenone based temperatures. It is possibly because foraminiferal assemblage summer SST represents August SST, Mg/Ca and alkenone temperatures represent June – November SST, annual mean SST, respectively. Foraminiferal assemblage winter SSTs seem to be affected by statistical technique and dataset used for estimation. Therefore, alkenone and Mg/Ca proxies appear to be promising for reconstructing past SSTs in the OT. There have been few studies on distribution of GDGT producer in water column, so further studies are necessary.

Keywords: sea surface temperature, alkenone, foraminiferal Mg/Ca ratio, planktonic foraminiferal assemblage, GDGT, Okinawa Trough

Late Holocene Yellow Sea Warm Current variability as revealed from a sea surface temperature record

YIQING JIANG[1], XIN ZHOU[2], YUXIN HE[3], LIGUANG SUN[2], ZHONGHUI LIU[1]

[1] Department of Earth Sciences, The University of Hong Kong, Hong Kong, China (zhliu@hku.hk)
[2] Institute of Polar Environment and School of Earth and Space Sciences, University of Science and Technology of China, Hefei, 230026, China
[3] Department of Earth Sciences, Zhejiang University, Hangzhou, 310000, China

Reconstructing past ocean current variability beyond the instrumental period is generally difficult to be achieved due to limited proxies available. Sea surface temperatures (SST) at current pathways are affected by the current strength, as well as global temperatures. Therefore, SST changes could be used to indicate past current variability if other factors could be assessed. In a previous pioneering study, we showed that SSTs in the region of Yellow Sea Warm Current (YSWC) pathways cooled toward the present over the last 2-3 centuries, opposite to the global warming trend, and thus concluded that the YSWC weakened entering in a warm climate. Here we extend the SST record from Core Site 38002, at the YSWC pathway, to cover the full late Holocene period, as well as from Site 31003 in the Yangtze River mouth, not significantly affected by the YSWC. Our results suggest that SSTs varied by 4-5℃ at Site 38002 during the late Holocene and display three periods of warm SSTs at 100-600 BP, 2200-2700 BP and 3500-4000 BP. At 600-2200 BP, including the Medieval Warm Period, SSTs were relatively low. SSTs at the YSWC pathway cooled during warm periods and vice versa, and their changes appear to correspond to solar irradiance changes, in an opposite manner. Meanwhile, SSTs at Site 31003 show similar pattern of changes to global temperature changes. Therefore our records strongly indicate that the YSWC weakened during globally warm periods and vice versa, further supporting our previous hypothesis.

Keywords: Late Holocene, , SST, Yellow Sea Warm Current

High resolution radiolarian responses of the central Okhotsk Sea to the climate oscillations during the Late Pleistocene and Holocene

ELENA YANCHENKO[1], SERGEY GORBARENKO, ALEKSANDR BOSIN, YURIY VASILENKO

[1] V.I. Il'ichev Pacific Oceanological Institute, Russia (yan@poi.dvo.ru)

The study of total radiolarian content (TRC) and species richness (SR) for radiolarian assemblage in core from the central Okhotsk Sea (OS) over last 90 kyr with previously established age model, position of millennial cycles of climatic changes and records of productivity proxies and activity of sea ices was carried out. The trends of TRC and SR in the radiolarian assemblage change synchronously on the orbital scale and are mainly determined by variations of paleoproductivity and input organic matter into the water column. In turn, the OS productivity depends on conditions of the sea ice formation and distribution and increases during the warmer MIS 5a, 3 and 1 with a shorter seasonal sea-ice cover. Ba_{ex} reflects the variations of TRC and SR of radiolarians.

Variations of TRC and SR of radiolarians on the millennial scale are also controlled by variations of productivity in the photic layer. The millennial productivity minima associated with the cold Greenland/China stadials (GS/CS) resulted in considerable sharp falls in TRC and SR of radiolarians while subsequent increases in productivity during GI/CI caused the smoother growth in TRC and SR of radiolarians. Such a pattern of changes in the species richness and quantity of radiolarians in time is more similar to variations in $\delta^{18}O$ of stalagmite carbonates from the China caves than $\delta^{18}O$ of Greenland ice core and, probably, is determined predominantly by variability of the winter monsoons in the East Asia affecting the environment and ice cover of the OS. This work was supported by the Russian Fund of Basic Research, grant No 13-05-00296a, 14-05-31364 mol_a; by the National Natural Science Foundation of China (Grant number: 41420104005; 40710069004; 40431002) and by the Far East Branches of the Russian Academy of Sciences, grant No 14-HHC-002.

Keywords: Radiolaria, Okhotsk Sea, orbital and millennial scales climate oscillations

Vegetation Change and Land-Ocean Climate Comparison around the Celebes Sea during the Holocene epoch

BIAN YEPING[1,2], LI JIABIAO[1], JIAN ZHIMIN[2], CHU FENGYOU[1], CHU ZHIHUI[2], KUHNT WOLFGANG[3]

[1] Second Institute of Oceanagraphy, State Oceanic Administration/Key Laboratory of Submarine Geoscience, State Oceanic Administration, Hangzhou, 310012, China (ping981201@163.com)

[2] State Key Laboratory of Marine Geology, Tongji University, Shanghai, 200092, China

[3] Institute of Geosciences, University of Kiel, Kiel, 24118, Germany

The climate change in the low latitude area during the Holocene is one of the most hotspot for Quaternary climate research, and the West Pacific Warm Pool (WPWP) is thought to play a key role in the propagation and amplification of the climate changes through its influence on the distribution of heat and water vapor. Meanwhile, the tropical vegetation has a good correspondence with tropical climate change, and it is an important factor controlling the climate modeling as well as the environment prediction. According to the palynological analysis and the detailed oxygen isotope records of two marine core, MD06-3075 (06.4762°N, 125.8322°E; 1878 m water depth, 30.76 m in length) in the southern Philippines and MD98-2178 (03.6200°N, 118.7000°E; 1984 m water depth, 35.6 m in length) in the northwest Celebes Sea, it provides the regional vegetation and climate history around the Celebes Sea during the Holocene. The record shows that, during the early Holocene, ~10.0-6 kyr B.P., the pollen percentage of the tropical montane forest declines, which suggests that the tropical montane forest distribute at the high altitude just like nowadays, indicating a warm condition. The pollen from mangrove group is abundant, presenting the well-development of the mangrove along the coast of the adjacent islands. In addition, the pollen from the herb is rare, but the value of the pteridophyte is much high, indicating a wet condition which is suitable for the fern vegetation, but restrict the distribution of the grassland.Meanwhile, the marine pollen record of Core MD98-2178 is considered as an indicator of the sea level change. At ~10-7 ka BP, the sharp decline in concentration of all pollen groups indicate a sea level rise. At 7 - 4 ka BP, all pollen groups suggest sustaining of a high sea level. After 4 ka BP, the marine pollen record shows a slight falling of sea level. During the mid-Holocene, 5 - 4 ka BP, significant increase in pollen percentage of the tropical montane forest suggests a much cold condition along the Celebes Sea at the time. It is implied by fluctuation in fern spores record that precipitation was at a high level during the early Holocene, but lowered after the mid Holocene, which is in a similar pattern as indicated by Indonesian the stalagmite records. That might indicate that precipitation along the Celebes Sea was affected by variation of land- ocean distribution variation and solar activities.

Keywords: Holocene, Celebes Sea, marine pollen analysis, sea-level change, temperature, precipitation

Climate changes in the Japan Sea and adjacent land during the 75 ka based on pollen data

Y.V. RYBIAKOVA[1], S.A. GORBARENKO[1], XUEFA SHI[2]

[1] V.I. Il\Ichev Pacific Oceanological Institute, Russia (rybiakova@poi.dvo.ru)
[2] First Institute Of Oceanography, China

Studied sediment core LV 53-23-1 was recovered in the central Japan Sea (northern Yamato Rise). We determined the total pollen composition in groups of plants and percentage of each pollen species in the group of trees and shrubs based on a results of study 140 sediment samples. We have identified 12 pollen zones, which indicate abrupt vegetation and climate changes. Age model was constructed on AMS radiocarbon data, on the results of oxygen isotopic composition of planktonic foraminifera. We took into account ages of several volcanic ash layers and variability of other indicators (color, total organic carbon, chlorine) as well. The pollen results showed that the vegetation of spruce, birch and alder bushes growing during glaciations. Increase in quantity of Quercus in the vegetation composition mostly associated with climate warmings. Two abrupt climate warmings occurred during MIS 4 (74-59 ka), which were defined by increase the percentage of Quercus pollen. Five abrupt warmings occurred during MIS 3 (59-29 ka) and one warming (nearly 24-23 ka) - during MIS 2 (29-15 ka). Significant climate warming occurred about 15ka (MIS 1), where the percentage of Quercus pollen greatly increased. This event is consistent with the Bølling-Allerød warm event 14.7 ka. A similar significant warming was about 12 ka BP. We have indicated changes in vegetation and climate over the last 75 ka in the surrounding area of the Japan Sea, based on the study of pollen and using the age model. This work was supported by the Russian Fund of Basic Research, grant No 13-05-00296a, 14-05-31364 mol_a; by the National Natural Science Foundation of China (Grant number: 41420104005; 40710069004; 40431002; GASI-GEOGE-03) and by the Far East Branches of the Russian Academy of Sciences, grant No 14-HHC-002.

Keywords: Pollen, Japan Sea, climate changes

A record of barite accumulation rate for marine export productivity changes in the tropical Indian Ocean during the Mid-Pliocene--Early-Pleistocene transition

LIPING ZHOU[1], ZHONGWU MA[1], XUAN DING[2]

[1] Institute of Ocean Research, Peking University, China. (lpzhou@pku.edu.cn)
[2] School of Ocean Sciences, China University of Geoscience (Beijing), China.

One of the most interesting features in the marine oxygen isotope records is the gradual shift towards heavier $\delta^{18}O$ from the Mid-Pliocene, which ends with the initiation of Northern Hemisphere glaciation (NHG) around 2.7 Ma. The lack of significant change in sea surface temperature in the tropical Indian Ocean as revealed in the previous studies does not rule out their possible contributions to this dramatic climate change during the Mid-Pliocene transition. Changing circulation systems in the region will control the supply of nutrients for the water masses which in turn determine the marine productivity. In the areas of high productivity, ocean export productivity may potentially provide a mechanism of CO_2 draw-down into the deep ocean, through which contributing to the lowering of the global temperature. In this study, we present a record of barite accumulation rate (BAR) for DSDP Site 214 drilled on the Ninetyeast Ridge. Here we use the marine barite, which is formed during the decay of organism in the twilight zone, as a proxy for ocean export productivity. Our results show that the BAR of Site 214 varies between 0.25 and 1.25 mg/cm^2/kyr during the period between 4 Ma and 2 Ma. Five intervals of increased BAR from 3.6 Ma to 2.4 Ma are identified with the most distinct peak centred around 3 Ma. The overall pattern does not follow either the oxygen isotope record for the Site or the sea surface temperature and subsurface temperature reconstructed with the Mg/Ca of foraminifera. This suggests that regional changes in ocean circulation and water masses may have played more important role than temperature in controlling the productivity change in the tropical Indian Ocean. The relative higher productivity around 3 Ma may imply a biogenetic process towards the intensification of NHGs.

Keywords: barite, Indian Ocean, export productivity, DSDP Site 214

Variations in Deep water temperature at western Equator Pacific during the Pliocene-Pleistocene transition

B. HUANG[1]

[1] School of Earth and Space, Peking University, Beijing, China (bahuang@pku.edu.cn)

Transition of the Pliocene and Pleistocene is a critical periods to study the variations in the deep ocean circulation in the global climate change. In this study, 231 downcore samples were selected to reconstruct deep water temperature (BWT) and $\delta^{18}O_{sw}$ from the Ontong Java Plateau slop Site 806 based on the Mg/Ca ratio of benthic foraminiferal species *Cibicidoides wuellerstorfi* during the Pliocene-Pleistocene transition. Results show that BWT decreased gradually from 4.0 Ma to 1.5 Ma, and the $\delta^{18}O_{sw}$ increased slowly which implied western equator Pacific deep water became colder and saltier since late Pliocene. Great changes happened at ~3.3, 2.5, and 2.1Ma. Comparison between Sites 806 and 607 suggested that pattern of deep ocean circulation changed at about 2.8Ma: before 2.8 Ma the ventilation of the South Ocean stronger than after that time, the southward deep water arrived the Site 806 was the UCDW/LCDW before 2.8 Ma; after that time, present pattern established PDW which from north Pacific reached at Site 806. At ~2.5 Ma, changes in the Site 806 is mainly reflected on increased in $\delta^{18}O_{sw}$ and $\delta^{18}O$, but not any obvious changes in BWT. The Gradient of BWT and $\delta^{18}O_{sw}$ between Sites 607 and 806 at 2.0-2.1 Ma implied that the strengthened Walker Circulation.

Teleconnection of climate system between the Kuroshio Extension and central equatorial Pacific since the last glacial maximum

YURI LEE[1,2] , INAH SEO[2,3], CHAN MIN YOO[2], SEONG-JOO LEE[1], KISEONG HYEONG[2]

[1] Department of Geology, Kyung pook National University, Daegu, South Korea (kshyeong@kiost.ac.kr)
[2] Deep-sea and Seabed Resources Research Division, KIOST, Ansan, South Korea
[3] School of Earth and Environmental Sciences, Seoul National University, Seoul, South Korea

Changes in relative sea surface temperature (SST) were reconstructed from planktic formaminiferal assemblages since the last glacial maximum (LGM) in order to understand responses of the Kuroshio extension (KE, 32ºN, 158ºW, 2500 m depth) and central equatorial Pacific regions (CEP, 7ºN, 177ºW, 3409 m depth) to a stadial (Younger Dryas, YD) and two interstadial (Bølling-Allerød, B-A, and mid-Holocene, MH) events. The result reveals the opposite responses of two regions. The KE cooled at YD and warmed at B-A and MH events, which likely resulted from the southward and northward migrations of the Kuroshio-Oyashio front on differential Northern Hemisphere (NH) cooling and warming, respectively. On the contrary, the CEP cooled at the B-A and MH and warmed at YD. Our results suggest atmospheric teleconnection between two regions, in which NH thermal forcing leads to the changes in latitudinal position of Kuroshio-Oyashio front as well as the reorganization of climate state in the tropics. We postulate that the southward advance of the westerlies by differential NH cooling pushed the Kuroshio-Oyashio front southward and resulted in cooling of KE region. Simultaneously, the migration of the convection center of the Hadley Cell (Intertropical Convergence Zone, ITCZ) toward equator led to weakening of southeast Trades, which in turn reduced equatorial upwelling. A series of these processes results in weakening of zonal SST gradient and warming of the CEP region. The opposite reactions are expected at interstadials (NH warming events). The responses of two regions to differential NH cooling and warming events are identical to those to modern El Niño and La Niña events, respectively. It might suggest similar atmospheric teleconnection mechanism between two regions at ENSO and differential NH thermal forcing.

Keywords: planktic foraminfera, Kuroshio Extension, Central Equatorial Pacific, ENSO, Stadial-Interstadial

High-resolution climate and environment changes of the far north-western Pacific (off Kamchatka) based on multi proxy studying of core LV 63-41-2

OLGA Y. PSHENEVA[1], XUEFA SHI[2], SERGEY A. GORBARENKO[1], ALEKSANDR A. BOSIN[1], MIN-TE CHEN[3], MIKHAIL I.MALAKHOV[4], JIANJUN, ZOU[2], YANGUAN, LIU[2], ALEXANDER V. IGNATIEV[5]

[1] V.I. Il'ichev Pacific Oceanological Institute, Russia
[2] First Institute of Oceanography, SOA, China
[3] National Taiwan Ocean University, Taiwan
[4] North-East Interdisciplinary Science Research Institute FEB RAS, Russia
[5] Far East Geological Institute FEB RAS, Russia

Sediment core LV63-41-2 with length of 458cm was recovered in the NW Pacific off Kamchatka peninsula (water depth 1924m) during the joint Russia-Chine expedition at 2013 year. Productivity proxies (TOC, $CaCO_3$ and chlorin content), color reflectors (b* and a*), petromagnetic properties (Jrs and Jp), $\delta^{18}O$ and $\delta^{13}C$ values of benthic foraminifera (BF) *Uvigerina(U.) akitaensis*, abundance and species assemblages of BF, sediment magnetic susceptibility and humidity were measured through the core depth with an interval of 1-2cm. An age model was constructed by the uses of AMS C^{14} dating, oxygen-isotope chronology and correlation of productivity proxies with dated $\delta^{18}O$ records of the Chinese cave stalagmites. Sediment core embraces the Last Glacial Maximum (LGM) and Holocene periods. Our lithological, geochemical and micropaleontological data show that the low primary productivity during the the LGM, associated with significant influence of sea ice and eolian fluxes. A gradual productivity increase has started since the beginning of the Heinrich 1. A strong abrupt increase in productivity occurred during the Bolling-Allerod warming, which was coincident with a decrease of sea ice influence and eolian fluxes. Suboxic species *U.akutaensis* dominated in the BF assemblages during this warming. The Younger Dryas period was characterized by a return to environmental condition typical for glacial time with low productivity. Abundances of BF were decreased and were dominated by oxic-suboxic species *Epistominella pacifica*. During termination 1B, an abrupt increase in productivity lead to a dominance of suboxic-dysoxic species *Bolivina tenuata* and *U.akutaensis*. During Early Holocene, the increases in the productivity were accompanied by the large increase of species *E.pacifica*, indicating an increase of ventilation. During the middle Holocene BF are marked by a predominance of suboxic or oxic species *E.batialis*.

This work was supported by the grants 13-05-00296a, 14-05-31364; by the NSFC (41420104005; 40710069004; 40431002; GASI-GEOGE-03) and by the grant 14-HHC-002.

A new 1 Ma oxygen isotope stratigraphy for a shallow-water sedimentary transect across three IODP 317 sites in the Canterbury Bight of southwest Pacific Ocean

X DING[1] AND YY WU

[1] China University of Geosciences (Beijing), China (dingx@cugb.edu.cn)

Sedimentary records in shallow-water environment provide unique opportunity to further our understanding on the regional relative sea level changes in relation to global climate change. Such records have advantage of high rates of sediment supply, hence likely preserve a high-frequency depositional cyclicity. However, they may also suffer high variability in sedimentation rate which could pose a challenge for stratigraphic correlation both among sites and with adjacent regions. Here we present a new 1 Ma oxygen isotope stratigraphy for a shallow-water sedimentary transect across three IODP 317 sites in the Canterbury Bight of southwest Pacific Ocean. The three sites are located on the eastern margin of the South Island of New Zealand, including a continental slope site, IODP317-U1352 and two continental shelf sites, IODP317-U1354 and IODP317-U1351. We first generated high resolution benthic foraminifers (*Nonionella flemingi*) $\delta^{18}O$ records for the three sites and a planktonic (*Globigerina bulloides*) record for the U1352B. An initial chronological framework for the benthic $\delta^{18}O$ record as well as the shipboard gamma measurements of the U1352B was constructed using 10 accelerator mass spectrometry (AMS) radiocarbon dates and 4 nanofossil biostratigraphic events. Then a refined age model was established by correlating the U1352B benthic $\delta^{18}O$ record with the EDC δD record on the AICC2012 time-scale, and the LR04 benthic $\delta^{18}O$ stack. The planktonic $\delta^{18}O$ record of U1352B was used in combination with the benthic $\delta^{18}O$ record to clarify some confusion caused by the localized reworking of the sediments. Although the U1354 and U1351 have lower sedimentation rates, their benthic $\delta^{18}O$ records correlate well with that of U1352B. The oxygen isotope stratigraphy thus established for the shallow-water sedimentary sequences in the Canterbury Basin will serve as a useful framework for palaeoceanographic study in the southwest Pacific Ocean.

Keywords: oxygen isotope, stratigraphy, 1Ma, IODP317, southwest Pacific Ocean

Bottom water evolution off the western Iberian margin over the last 900kyrs

BAOHUA LI[1],QIMEI GUO[1], JIN KYOUNG KIM[2], DAVID HODELL[3] AND IODP EXPEDITIONS 339 SCIENTISTS

[1] Nanjing Institute of Geology and Paleontology, Chinese Academy of Sciences, Nanjing, PR. China (bh-li@nigpas.ac.cn)
[2] Korea Institute of Ocean Science & Technology, Ansan, Korea
[3] Godwin Laboratory for Palaeoclimate Research, Department of Earth Sciences, University of Cambridge, UK

Detailed AMS ^{14}C dates, inaddition to *Cibicidoides pachyderma* and *Globigerina bulloides* $\delta^{18}O$ comparison with the Natural Gamma radiation, the stratigraphy was set up for IODP Site 1391. Benthic foraminiferal analyses were performed with sample intervals of 40-80cm for the 250mcd sediment core at this site. Abundant benthic foraminifera with more than 250 species were identified and counted, which provides information about the bottom water evolution of the upper slope off the western Iberian margin over the last 900 kyrs.

Higher content of Miliolids during the glacial stages since MIS 18 suggests a higher salinity existed for the glacial periods while the glacial-interglacial contrast was not evident for stages 19-22.

Elevated benthic foraminiferal "Epibenthos Group" content and decreased benthic foraminiferal $\delta^{13}C$, such as during the early MIS 9, are similar with the Holocene, reflecting a relatively stronger influence of Mediterranean outflow Water, consistent with the reduced bottom-water oxygenation index in this region. Though bottom current index---- "Epibenthos Group" content does not behave the glacial- interglacial variation, however, a stronger bottom water current during the MISs 1, 8-11, and 18-21 suggests a long-term (400 kyr) cycle, while the short-term (semi-precession) cycles is also evident, which can be observed from other bottom water indexes.

Keywords: Late Pleistocene, Benthic foraminifera, Bottom water current, Mediterranean Outflow Water

Records of terrestrial n-alkanes and carbon isotope of organic matter in Hanon-Maar sediment, Jeju Island, Korea: implications of paleovegetation and paleoclimate variations over the last 35 kyr

SANGMIN HYUN[1], KYUNG-HOON SHIN[2], SUK-CHANG LEE[3], SE WON CHANG[4], S-I NAM[5]

[1] Marine Geology and Geophysics Division, Korea Institute of Ocean Science and Technology (KIOST), Korea (smhyun@kiost.ac.kr)
[2] Department of Environmental Marine Science, Hanyang University, Korea
[3] Ja Yean Jeju, Iljudong-ro, Seogwipo-city, Jeju 697-834, Korea
[4] Petroleum and Marine Research Division, Korea Institute of Geoscience and Mineral Resources (KIGAM), Korea
[5] Korea Polar Research Institute (KOPRI), Korea

Carbon isotope of total carbon ($\delta^{13}C_{TOC}$), long-chain *n*-alkanes and their compound-specific carbon isotope ratios ($\delta^{13}C_{ALK}$) were investigated in the Hanon paleo-Maar sediment, Jeju Island of Korea to understand paleovegetation changes and their paleoclimate linkages. Based on the organic geochemical data (TOC (%), TN(%) and their $\delta^{13}C_{TOC}$ and $\delta^{15}N_{TN}$), the core column stratigraphy was divided into three units; from bottom to 12.5 ka (Unit I), 12.5 ~2.5 ka (Unit II) and 2.5 ka to core tope (Unit III), respectively. In particular, $\delta^{13}C_{TOC}$ showed marked fluctuation from -17.31‰ to -28.68‰, suggesting different organic carbon sources. Relatively narrow range of variation in $\delta^{13}C_{TOC}$ occurred in Unit III and drastic changes in $\delta^{13}C_{TOC}$ from Unit II to Unit I may indicate a mixture of C3 and C4 plants in Unit III, and drastic changes from terrestrial C4 in Unit II to C3 plants in Unit I. The distributions of *n*-alkane were characterized by a continuous predominance of odd-numbered *n*-alkanes, particularly nC_{29} and nC_{31}, and by high fluctuation of total *n*-alkanes concentration. The average chain length (ACL), carbon preferences index (CPI) and paleo plant proxy (P*aq*) showed high fluctuation with distinctive high and low ratio at about 7.5 and 12.5 ka, corresponding to the switching points of $\delta^{13}C_{TOC}$ and high concentration of *n*-alkane distribution. Individual *n*-alkane isotopes, $\delta^{13}C_{ALK}$, ranged between -18.80‰ in $\delta^{13}nC_{21}$ and -31.61‰ in $\delta^{13}nC_{30}$, suggesting different sources of *n*-alkanes. The distribution of *n*-alkanes and their individual $\delta^{13}C_{ALK}$ support paleovegetation changes and its time-dependent variations were well matched with paleoclimatic events of Holocene climatic maximum occurred around at 7.5 ka. Therefore, organic geochemical proxies (*n*-alkanes and carbon and nitrogen isotopes of organic matter) recorded in Hanon paleo-Maar sediment reflects paleovegetation as well as paleoclimate changes for the last 35 kyr in Jeju Island, Korea.

Keywords: *n*-alkane, paleovegetation, paleoclimatology, Hanon Maar, Jeju

References

Collister, J.W., Rieley, G., Stern, B., Eglinton, G.,Fry, B., 1994. Compound specific 13C analyses of leaf lipids from plant with differing carbon dioxide metabolisms. Organic Geochemistry, 21, 619-627.

Eglinton, T.L and Eglinton, G., 2008. Molecular proxies for paleoclimatology. Earth and Planetary Science Letter, 275, 1-16.

Park, Jungjae and Park Jina, 2015. Pollen-based temperature reconstructions from Jeju island, south Korea and its implication for coastal climate of East Asia during the late Pleistocene and early Holocene. Paleogeography, Paleoclimatology, Paleoecology, 417, 445-457.

Subsidence and subsurface cooling weakened reef growth in the late Miocene South China Sea constrained by lithostratigraphic and geochemistry evidence

LEI SHAO[1], QIANYU LI[1], ZHENFENG WANG[2], DONGJUN ZHANG[2], PEIJUN QIAO[1], XINYU LIU[2], LI YOU[2], YUCHI CUI[1], XIXI DONG[1]

[1] State Key laboratory of Marine Geology, Tongji University, Shanghai 200092, China
[2] China National Offshore Oil Corporation Ltd., Zhanjiang Branch, Guangdong 524057, China

The variations of lithostratigraphy, foraminifera, geochemical elements, and organic biomarkers in well XK1 from the Xisha Islands reveal the history of carbonate platform development since the early Miocene in the South China Sea. Our results indicate that reef growth was more active in the middle Miocene than in any younger periods, although active growth also occurred in the Pleistocene presumably during the interglacial periods. The Pliocene experienced moderate reef recovery, while the late Miocene was a time with very limited reef buildup.

Unlike those limestone-rich intervals, the late Miocene succession in well XK1 is characterized by dolostones or dolomitized limestones. These late Miocene rocks also feature relative high MgO (~20%), but low depositional rate (30-60 m/Myr post-compaction), very low land-sourced brGDGTs (0-0.5 ng/20g), low BIT index (0.1-0.5), and low TEX86-derived sea temperature (~20-25°C), indicating the dominance of relative cooler water environments at depths >30 m with limited active reef growth. Similar dolomitized limestones and dolostones of late Miocene age also occur in many other carbonate platform areas including the Nansha Islands in the southern South China Sea. Together, these South China Sea records provide local evidence of a contemporary recession in global carbonate platform development starting from the late Miocene. While carbonate platform reduction in other regions may have been triggered by global cooling and changing oceanic chemistry, accelerated basin subsidence coupled with monsoon cooling are considered as the main causing factors for the decline of late Miocene reefs in the South China Sea.

Keywords：South China Sea; Xisha Islands; reef carbonate platform; elements; biomarkers

Sponge spicules fossils in the Early Cambrian Gezhongwu Formation, Lianxing, Zhijin, Guizhou

XUE YUAN[1], LIN LI[1], MEN XIN[1]

[1] Chengdu University of Technology, China (linli@cdut.cn)

It was previously reported that numbers of sponge spicules have been found for the first time in the phosphorites of Gezhongwu Formation at Zhijin, Guizhou, China, and the main types are diaxon-triactins, diaxon-tetractins, pentaxon-pentactins and hexon-hexactins. Comparing with slice observation method, acid etching method could obtain intuitive tridimensional sponge spicule fossils. In this paper, stereo fossils of sponge spicule were found in thin layers of siliceous phosphorites of Gezhongwu Formation at lianxing, Zhijin, Guizhou. Besides the types mentioned above, larger amount of monacon-monactins, monacon-diactins, triaxon-pentactins, triaxon-hexactins, teraxon-tetractins were found. Meanwhile, there are a few of irregular spicules. According to the electron microprobe analysis, the fossils are composed generally of SiO2.That means these sponge spicules belong to siliceous sponge spicules. Combining with the basis of morphological characteristics, these sponge spicules are mainly assigned to Protospongia, Desmospongia and Hexactinellida. The previous discovery of massive sponge spicules in the the early Cambrian Gezhongwu Formation provides evidence suggesting that sponge animals began radiation and diversification in the early Cambrian, and large numbers of siliceous sponge spicules exist in phosphorites shows that the involvement of sponge animals in diagenesis and mineralization. And the distribution of sponge spicule fossils in the thin layers of siliceous phosphorites in Shixing section indicates that sponge animals were probably flourishing under shallow-water, aerobic conditions, implying that sponge animals probably living in shallow-water environment during the early Cambrian.

This work was financially supported by National Science Foundation of China (Grant No.41173058).

Keywords: sponge spicule, phosphorites, Gezhongwu Formation, the Early Cambrian, Guizhou

The Discovery and Geological Significance of Glauconites from the bottom of Lower Cambrian Niutitang Formation in Weng'an of Guizhou, south China

LI LIN[1], KEYU ZHU[1], ZHENG-GE DONG[1]

[1] Institute of Sedimentary Geology, Chengdu University of Technology, China (linli@cdut.cn)

Early Cambrian is important geological and biological mutation period. In the period, not only a lot of phyla metazoan with bone occurred at the same time, but also important phosphorite deposit, Ni-Mo polymetallic ore and shale gas formed. Niutitang Formation of Yangtze Platform in south China is the important stratum bearing metallic and nonmetallic resource. But the sedimentary environment and facies of Niutitang Formation has been debated. There are several opinions. 1) deep oceanic basin in Jiangnan shale basin and restrained basin with upper oxidized seawater and anoxic environment in bottom(Lehman et al., 2007; Xu et al., 2013). 2) deep water shelf. 3)shallow water shelf. Glauconite is a kind of hydrous layered aluminium silicate mineral , which is commonly refered to as a marine facies indicative mineral. Numerous studies have demonstrated that glauconites minerals usually form in modern oceans with high depths and slowly sedimentary rates . Glauconites were discovered in the sandstone from the bottom of Lower Cambrian Niutitang Formation , in Weng'an, Guizhou , which gives us a opportunity to elucidate the formation environment of the Niutitang Formation in the area . Sedimentological and petrographic studies indicate that the glauconites have low content of K2O(< 4%), showing that these glauconites belong to the primary glauconites. The characteristics of glauconites from the Niutitang Formation reflect that they formed in a environment with a slowly sedimentary rate and weakly oxidizing-reducing at the depth of 50-500m(nearly 200m) in outer shelf and upper part of continental slope.

This work was financially supported by National Science Foundation of China (Grant No.41173058).

Keywords: glauconite, sedimentary environment, Niutitang Formation, Lower Cambrian, Yangtze Platform in south China

The Preliminary Study on Sinian Doushantuo Formation sedimentary environment of the Guizhou weng'an

YANG LIU[1], LIN LI[1], XUE YUAN[1]

[1] Chengdu University of Technology, China (linli@cdut.cn)

The Weng'an Biota, where is located in the southeast edge of Sichuan—Guizhou plateau, is found in the Doushantuo Formation of the Ediacaran in Northeastern Guizhou, after the discovery of the Miaohe biota from western Hubei and the Lantian flora from southern Anhui.

The Formation of phosphorus of Doushantuo Formation includes macro algal, possible metazoan, ichnofossil, and other fossils. This biota is mainly composed of macroalgae that have holdfast and rhizoid, so it might live in an environment with lower-energy. Similarly, the wrinkled or broken and orienting specimens also show that the Sea-water was a lower-energy.

Studies on the Weng'an Biota in Doushantuo Formation northeastern Guizhou suggest that the life styles of macro biota in the Late Doushantuo Formation were mainly fixing on and attaching to the surface of seafloor, that the macro biota lived in relatively calm-water shallow sea with abundant light, poor-oxygen, and a measure of water-energy; and that the ground macrobiota living on was the unfirmed soup-soft ground with rich water.The plenty of sunlight is original power for organismic Photosynthesis and biological survival. The certain energy in water columniation due to sea- level changes take a number of Materials to the Place where the biota lived in. In addition, the tectonic movement (Earthquake and fault) maybe do so. The organismic corpse were oxidated and decomposited in oxygen. However, a large number of organismic body preserved in Poor oxygen was a good condition for the source rocks(kerogen) deposited and buried.

Keywords: Weng'an Biota, Doushantuo formation, sedimentary environment

References:

Zhang yun , Yuan xunlai, 1995. The late Proterozoic sexual reproductive structures found in multicellular red algae. SCIENCE CHINA (B Series),25(7): 749—754

Chen meng'e ,Liu kuiwu, 1986. The late Sinian Doushantuoan phosphorite in microfossils and its geological significance. Geological Sciences (1): 46—53

Yang jiedong,Xue yaosong,Tao xiancong, 1994. Chinese South Sinian Doushantuo Formation Sm-Nd isotopic age determination. Science Bulletin,39(1): 65—68

Paleoceonography changes in the Okhotsk Sea during Late Pleistocene and Holocene according to diatoms

ANTONINA ARTEMOVA[1], SERGEY GORBARENKO[1], YURIY VASILENKO[1], XUEFA SHI[2], YANGUANG LIU[2]

[1]V.I. Ii'ichev Pacific Oceanological Institute, FEB RAS, 43 Baltiyskaya Street, Vladivostok, 690041, Russia
[2]First Institute of Oceanography, SOA, P.R.China, 6 Xianxialing Road, Qingdao 266061, China

Paleontological records of six sediment cores in the central Okhotsk Sea marked regional environmental changes over the last 140 kyr on orbital time scales. Diatoms assemblages and content of diatoms frustules in the sediments during Marine Isotope Stages (MIS) 6 – 1 indicate climatic changes in the Okhotsk Sea. A small abundance and low diatoms species diversity, as well as the high percentage of near-ice species, indicate cold surface environmental during glacial time (MIS 6, 4, 2) with low values of temperature conditions with extended sea ice cover. The diatoms marked by the presence of extinct redeposit species, indicating a low standing of sea level during this time. The proportion of ice species enlarged and diatoms abundance reduced due to increase the influence of the sea ice, reflects the sharp climatic cooling on land and environmental deteriora tion.

Strong environmental changes during the warming in the Okhotsk Sea provide the subsequent increase in diatoms productivity due to surface and intermediate water mixing at 117-129.8 and 8.3–5.5 kyr BP. The diatom content is high, and abundance of the oceanic and warm-water species reflects the warm surface environmental condition during MIS 5.5, 1 and increased input of Pacific and Japan Sea waters since 8.3 kyr.

This work was supported by the Russian Fund of Basic Research, grant No 13-05-00296a, 14-05-31364 mol_a; by the National Natural Science Foundation of China (Grant number: 41420104005; 40710069004; 40431002; GASI-GEOGE-03) and by the Far East Branches of the Russian Academy of Sciences, grant No 14-HHC-002.

High resolution age model of late Quaternary sediment sequence in Prydz Bay abyssal region, East Antarctica

WU LI[1], WANG RUJIAN[1], XIAO WENSHEN[1], GE SHULAN[2] AND CHEN ZHIHUA[2]

[1] State key laboratory of Marine Geology, Tongji University, Shanghai 200092

[2] Key laboratory of Marine Deposition and Environmental Geology, First institute of Oceanography, State Oceanic Administration, Qingdao 266061

Precise age models for marine sediments from high latitudes of the Southern Ocean are hampered by poor preservation of biogenic carbonate. Previous work show efficient correlation of magnetic susceptibility to Antarctic ice core dust records as effective means for sediment stratigraphy in various Southern Ocean basins[1,2]. However, this method shows deficiencies in the Prydz Bay area, at the far end of the dust plume originated from either Patagonia or Australia. Alternatively, sea surface export productivity indicated by biogenic barium (Ba_{xs}) shows unambiguous orbital cyclicities similar to those recorded in δD of EPICA Dome C (EDC) ice core[3] and global benthic foraminifera $\delta^{18}O$ stack[4]. By tuning the Ba_{xs} signal to EDC δD, we are able to establish high resolution age models for several marine sediment cores from Prydz Bay abyssal area. The Ba_{xs} age models show good consistency with age models constructed by geomagnetic relative paleointensity (RPI) correlations, suggesting that Ba_{xs} can serve as a promising tool to establish age model of sediment sequence from the Prydz Bay abyssal region.

Keywords; Export productivity; Age model Prydz Bay

References

Pugh, R.S., McCave, I.N., Hillenbrand, C.D., Kuhn, G., 2009. Circum-Antarctic age modelling of Quaternary marine cores under the Antarctic Circumpolar Current: Ice-core dust–magnetic correlation. Earth and Planetary Science Letters 284, 113-123.

Weber, M.E., Kuhn, G., Sprenk, D., Rolf, C., Ohlwein, C., Ricken, W., 2012. Dust transport from Patagonia to Antarctica - A new stratigraphic approach from the Scotia Sea and its implications for the last glacial cycle. Quaternary Science Reviews 36, 177-188.

Parrenin, F., Barnola, J.-M., Beer, J., Blunier, T., Castellano, E., Chappellaz, J., Dreyfus, G., Fischer, H., Fujita, S., Jouzel, J., 2007. The EDC3 chronology for the EPICA Dome C ice core. Climate of the Past 3, 485-497.

Lisiecki, L.E., Raymo, M.E., 2005. A Pliocene-Pleistocene stack of 57 globally distributed benthic δ18O records. Paleoceanography 20.3445-3474

Late Holocene Paleoclimate Record of sediments near Joinville Island, northeastern Antarctic Peninsula

MIN KYUNG LEE[1] ,HO IL YOON[1], KYU-CHEUL YOO[1], YOUNG-SUK BAK[2], SOO A JEON[3], KYUNG-HOON SHIN[4]

[1] Korea Polar Research Institute, Korea Institute of Ocean Science and Technology, Incheon, 406-840, Korea
[2] Department of Earth and Environmental Sciences, Chonbuk National University, Jeonju, 561-856, Korea
[3] Marine Sciences and Convergent Technology, Hanyang University, Ansan, 426-791, Korea

A 4.76-m-long sediment core JV10-GC01 covering about 4000 years was collected near the Joinville Island, which is located on the northeastern Antarctic Peninsula in the northwestern Weddell Sea. Six AMS radiocarbon ages were determined by carbonate shells. No age inversions were observed, implying a lack of reworking during deposition. Sedimentological, geochemical, and micropaleontological parameters were analyzed to reconstruct paleoenvironmental changes. The records of total organic carbon, diatom abundance, diatom assemblage suggest that warm, stratified and stable condition lasted from 3900 to 2500 yr BP. After that, cooling condition persisted for about 1300 years from 2500 to 1200 yr BP. The onset of Neoglacial in this study is contemporaneous with James Ross Island, Bransfield Basin, and Maxwell Bay. However, the periods of Neoglacial, MWP, LIA are different from the Firth of Tay, although two sites are very close. In this core sediment, about 500 year periodicity of climate cooling is observed since 3000 yr BP. It may be correlative with 550-yr cyclicities in North Atlantic circulation patterns during the Holocene.

Paleoceanographic changes and glacial history of the Powell Basin, northern Weddell Sea

KYU-CHEUL YOO[1], HO IL YOON[1], JAE IL LEE[1], YONG IL LEE[2], KITAE KIM[1], MIN KYUNG LEE[1], YOUNG-SUK BAK[3]

[1] Korea Polar Research Institute, Korea Ocean Research and Development Institute, Songdomirae-ro, Incheon, 406-840, Korea
[2] School of Earth and Environmental Sciences, Seoul National University, Seoul 151-747, Korea
[3] The Earth and Environmental System Research Center, Chonbuk National University, Jeonju 561-856, Republic of Korea

Sedimentological, geochemical, and paleontological profiles were measured at three sediment gravity cores (GC01-PW02, 813 cm; GC03-PW2, 784 cm; GC04-G03, 592 cm) obtained from the Powell Basin (West Antarctica). These results show late Quaternary glacio-depositional environment and we present glacial and paleoceanographic changes in the basin. AMS ^{14}C age dating of planktonic foraminfera Neogloboquadrina pachyderma (sinistral) has been used for chronology of core GC01-PW02 and the chronology of other cores was inferred from the relative comparison of stratigraphy. In particular, no existence of LOD (last occurrence of diatom) Hemidiscus karstenii over all cores' sediments indicates at least the maximum core bottom age within MIS 6. The study area provides an excellent depositional setting for undisturbed, well-defined sediment records with no turbidites, suggesting that turbidity current pathways do not affect the study area. All sedimentological, geochemical and paleontological proxies reflect a clear alternating pattern according to paleoclimatic change.

Keywords: paleoclimatic change, glacial history, sediment, Powell Basin, Weddell Sea

Paleoceanographic changes of the South Scotia Sea, Antarctic Peninsula using stable isotope compositions of diatoms since the last glacial period

JIN-KYOUNG KIM[1], KYUNG SIK WOO[2], HO IL YOON[3], ALDO SHEMESH[4]

[1] Korea Institute of Science and Technology, (jink92@hanmail.net)
[2] Kangwon National University
[3] Korea Polar Research Institute
[4] Weizmann Institute of Science

A gravity core was obtained from the slop of the South Scotia Sea, Antarctia. Core sediments are mainly composed of laminated diatomaceous ooze and homogeneous silty clay. High-resolution sedimentologic and geochemical analyses, aided by AMS ^{14}C chronology of the core sediment represent the detailed record of climte changes during the transition from the last glacial to the Holocene in Antarctic Peninsula region. Oxygen isotope of diatom frustules and carbon and nitrogen isotopes of diatom-bound organic matter are analyzed. The oxygen isotope record shows that the ~1.5‰ variations in Last Glacial to Holocene reflect the isotopic composition changes of surface seawater. It also shows that the transient depleted signals during deglaciation may imply intense meltwater input. The carbon isotope values are depleted during Last Glacial relative to the Holocene, which indicate lower productivity during cold period. The anticorrelation patterns between nitrogen and carbon isotope values during Last Glacial and Neoglacial periods may result from the restricted vertical mixing due to the sea ice extension.

Keywords: diatom, isotope, sea ice, vertical mixing, South Scotia Sea, Antarctic Peninsula

Structural and chemical modification of Fe-rich smectite associated with microbial Fe-respiration by psychrophilic bacteria in King George Island, West Antarctica

JAEWOO JUNG[1], JEEYOUNG KIM[2], HYOUNSOO LIM[3], HOIL YOON[4], YOOKYUNG LEE[4], OK-SUN KIM[4], KYEONGYANG PARK[5], JUNGBAE LEE[5], JINWOOK KIM[1]

[1] Department of Earth System Sciences, Yonsei University, Seoul, Republic of Korea
[2] National Institute of Environmental Research, Incheon, Republic of Korea
[3] Department of Geological Sciences, Pusan University, Pusan, Republic of Korea
[4] Korea Polar Reseach Institute, Incheon, Republic of Korea
[5] Department of Biotechnology, Hannam University, Daegeon, Republic of Korea

The role of microbial activity in clay mineral alteration was investigated in surface soil samples for the seven sites (1226-1, 1226-2, 0101-4, 0105-1, 0105-2, 0107-2, 0107-3) from the coast to the inland at Barton Peninsula. The measured surface temperature of the sediments at each sites ranges from -15 to 15 ℃ throughout the year. Multiline of techniques for example, X-ray diffraction (XRD), Scanning Electron Microscope (SEM), wet chemistry analysis measuring the extent of Fe(III) reduction and Cation Exchange Capacity (CEC), and Pyrosequencing were performed. Furthermore, batch experiments of microbe-mineral interaction under the various temperatures (4 ℃, 15 ℃) that mimics the Antarctic condition to understand the mechanism of biogeochemical alteration of clay minerals. Various clay minerals of smectite, mica, chlorite and kaolinite were detected in the bulk sediments by XRD. After 12 months incubation of the bulk surface soil samples (0105-1) in the M1 minimal medium, the extent of Fe(III) reduction was reached up to 49% and 42 % at 4 ℃ and 15 ℃, respectively. The increase in CEC corresponds to the extent of Fe(III) reduction. Moreover, precipitations of secondary phase mineral such as vivianite were observed only in 12 months enrichment samples at 4 ℃ and 15 ℃. Sulphate reducing bacteria (Psychrosinus_fermentans and Desulfosporosinus) and Fe-reducing bacteria (Pseudomonas; not yet identified in species) capable of reducing Fe were identified by 16S rRNA pyrosequencing. In order to identify the microbial Fe reduction in the clay minerals, Nontronite (NAu-1) which contain the Fe(III) 24 % and Psychrophilic bacteria (Shewanella sp. isolated from King George Island) were incubated for 4 months. The extent of Fe(III) reduction in nontronite was reached up to 11.5 % and 11 % at 4 ℃ and 15 ℃, respectively. The structural modification of biologically Fe-reduced nontronite NAu-1 at low temperature was distinctively observed in the (001) peak shift to the lower 2 theta in the XRD profiles indicating the layer collapse associated with K-fixation. Vivianite precipitation suggesting the reductive dissolution of nontronite were observed in 4 months enrichment samples at 4 ℃ and 15 ℃. The present study, therefore, indicates the feasibility of biological effects on chemical/structural modification in clay minerals in cold environment suggesting a new pathway of Fe-supply into the Antarctic Ocean.

Keywords: Clay minerals, Fe-reducing bacteria, Bio-alteration, Extreme environment

Distributions and Sources of Organic Matter (OM) in Surface Sediments of the Northern Bering and Chukchi Seas using Bulk OM Proxies and branched / isoprenoid tetraethers (BIT index)

ZQ JI1 HY JIN[1,2,3] ,R STEIN[3], YC BAI[1], HL LI[1], Y ZHANG[1], JF CHEN[1,2]

[1] State Oceanic Administration Laboratory of Marine Ecosystem and Biogeochemistry, Second Institute of Oceanography, China (jinhaiyan@sio.org.cn)

[2] State key Laboratory of Satellite Ocean Environment Dynamics, China

[3] Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Germany

The OM sequestered in Arctic shelf sediments is important in proportion and understanding the sources and fate of these marine sediments will greatly improve the interpretation for the global carbon cycle. As the global warming, organic carbon budgets and biogeochemical cycles in the Arctic Ocean will also be affected for terrestrial organic carbon through increased river runoff, permafrost thawing, and coastal erosion. A multi-proxy evaluation for the OM sources in northern Bering and Chukchi Seas was conducted according to bulk OM parameters (i.e. C/N ratio and $\delta^{13}C$ of OC) and BIT index, as the limitation of each proxy.

Surface sediments were collected and analyzed from 19 sites in Amerasian Arctic Ocean during the summer 2008 Chinese Arctic Research Expedition(CHINARE 2008) cruise onboard the ice breaker" RV *Xuelong"*. In the study area, the BIT index was confirmed as a reliable proxy to trace terrestrial OC (mainly soil OC), and the N/C ratio was more suitable for tracing organic carbon here, as C/N ratio would underestimate the terrestrial OC by microbial degradation and the accumulation of microbial organic matter in sediments. The ternary model, using N/C ratio, $\delta^{13}C$ and BIT index, gave out a three end member sources of 12.6% for soil, 29.2% for plant and 58.3% for marine. This result exhibited an obvious higher marine souce in the west than the east side and higher terrestrial souce in the east than the west side, which was not only controlled by the OC inputs from the key water masses, Anadyr Water and Alaska Coastal Water, and the river discharge, but also the nutrient supply by the Pacific inflow which support the marine production. This study may give historical studies a modern view of the organic composition in sediments of Arctic, thus improving the interpretation of the carbon cycle.

Keywords: Terrestrial OM, northern Bering and Chukchi Seas, GDGTs, BIT index

Echo facies distribution of the Quaternary glacigenic bedforms in the Chukchi Sea, west Arctic

YOUNG-JIN JOE[1], SEOK-HOON YOON[1] AND SEUNG-IL NAM[2]

[1] Department of Marine Sciences, Jeju National University, Jeju 690-756, Korea (yjjoe011@jejunu.ac.kr)
[2] Korea Polar Research Institute, Incheon 406-840, Korea

In the recent seafloor mapping surveys in the western Arctic, the Quaternary glacigenic bedforms have been ubiquitously recognized including iceberg scours, till deposits, mega-scale glacial lineations and moraines. This study focuses on the Chukchi Sea, a part of the glacier-influenced western Arctic margins, where the high-resolution stratigraphic and echo facies analyses were carried out using the sub-bottom profiles (SBP). The SBP data were obtained during the Arctic expeditions of R/V Araon (operated by KOPRI) in 2011 and 2012. Echo facies is classified on the basis of seafloor geometry and characters of sub-bottom reflection within the high-resolution stratigraphic framework. On the SBP data, two stratigraphic units (units I and II in descending order) are recognized by two distinctive sub-bottom reflectors of which lateral continuity is more or less variable. Stratigraphic unit I consists of parallel to sub-parallel stratified (A) and transparent reflections (C) with flat or undulating topography (I). Echo facies IA is frequently observed in the Chukchi continental shelf while it is absent or very thin toward deeper water. Echo facies IC is found below ~360 m water depth. Instead, sediment infills on top of iceberg-ploughed seafloor are locally recognized in the Chukchi continental shelf. Echo facies IA and IC as well as this sediment infill are interpreted as Holocene sediments by marine transgression and hemipelagic settling. Unit II is quite variable in thickness and generally consists of echo facies IIIB and IIB that show overlapping hyperbolae and hummocks (III) and highly dissected topography (II) with random or fuzzy sub-bottom reflection (B). Echo facies IIIB and IIB dominantly occur between 150 m to 360 m in water depth. Acoustically fuzzy and unstratified reflection can be generated from subglacial tills beneath the grounded glacier. Echo facies IIIB or IIB shows distinct or erosive lower boundaries in some places, which indicates that stratigraphic unit II formed during the glacial retreat. Highly dissected topography of echo facies IIB suggests that glacial tills were reworked by iceberg scouring. Distribution of these echo facies and stratigraphic units in the Chukchi continental margin suggests that Chukchi shelf and rise areas were effected by the retreating grounded ice during last deglaciation.

Keywords: echo facies, glacigenic bedforms, Chukchi continental margin, iceberg scours, glacial tills

Neodymium isotope variability in the Chukchi Sea during the Holocene

BOROM LEE[1,2], SEUNG-IL NAM[1], YOUNGSOOK HUH[2], MI JUNG LEE[1]

[1] Arctic Research Centre, Korea Polar Research Institute, Korea (borom85@kopri.re.kr)
[2] School of Earth and Environmental Sciences, Seoul National University, Korea

The Chukchi sea is an important region to understand the oceanographic and climatic changes in the western Arctic observed on the late Quaternary glacial-interglacial cycles. Large amounts of relatively fresh water from the North Pacific flow into the western Arctic Ocean through the Bering Strait, consequently affecting the Atlantic Meridional Overturning Circulation (AMOC) according to opening or closing mode of the Bering Strait. The study area, Chukchi sea, overlies where the East Siberian Slope Current meets the Beaufort Gyre. It has been well known that the Arctic Oscillation is linked to changes in the strength of the Beaufort Gyre and the Transpolar Drift.

In order to unravel Chukchi Sea water mass composition during the Holocene, seawater-derived neodymium isotope of authigenic fraction in marine sediments has been used. A sediment core ARA02B-GC01A was collected from the northern shelf of the Chukchi Sea with a water depth of 111 m during 2nd RV Araon expedition (ARA02B) in 2011. Based on 7 AMS ^{14}C ages of molluscan shells, the age of bottom core has been extrapolated to ca. 9.31 ka BP.

The εNd results might show a general pattern of increasing radiogenic ε_{Nd} values from -7.23 ε_{Nd} at ca. 8.86 ka BP to -4.03 ε_{Nd} at ca. 0.60 ka BP. It implies that the unradiogenic source from the Atlantic Ocean (~ -11 ε_{Nd}) and Mackenzie river (~ -13 ε_{Nd}) has been overwhelmed by the radiogenic Bering Strait inflow (~ -5 ε_{Nd}) after flooding of the strait, at ca. 11 ~ 12 ka BP. The pattern of the ε_{Nd} results also resemble a quartz/feldspar ratio record of the same core which suggests a consistent decrease in the Beaufort Gyre circulation during the Holocene.

Improved stratigraphic framework for the Quaternary western Arctic Ocean and its paleoenvironmental implications

MICHAEL SCHRECK[1], SEUNG-IL NAM[1], SUNG-HO KANG[2], JENS MATTHIESSEN[3], CHRISTOPH VOGT[4], RÜDIGER STEIN[3] AND FRANK NIESSEN[4]

[1] Arctic Research Centre, Korea Polar Research Instiute, 26 Songdomirae-ro, 406-840 Incheon, Korea
[2] Division of Polar Ocean Environment, Korea Polar Research Instiute, 26 Songdomirae-ro, 406-840 Incheon, Korea
[3] Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Am Alten Hafen 26, 27568 Bremerhaven, Germany
[3] Geoscience Department, University Bremen, Klagenfurter Straße, 28334 Bremen, Germany

Constrains on the temporal occurrence and spatial extend of Amerasian ice sheets are prerequisite for understanding the boundary conditions necessary for the ice sheet build up in the western Arctic. Although an especially extensive western Arctic marine ice sheet complex has been proposed for Marine isotope stage (MIS) 6, stratigraphic constrains from the Chukchi Borderland are rare, and even missing from the East Siberian continental margin, as most glaciogenic features have not been reliably dated by sediment core data and stratigraphic correlation yet. Thus the timing of (repeated) glaciations and/or ice advances in the Beringian region is still a matter of debate.

Readily visible (dark) brown layers are a widespread feature in Late Quaternary sediments of the Central Arctic Ocean, and have been considered potentially useful stratigraphic marker beds for core correlation. Their formation, however, is still a matter of debate but it has been recently suggested that warmer interglacial/interstadial conditions with a more active hydrological cycle led to formation of these Mn-rich dark brown layers. Here we present new data from a suite of high-quality sediment cores that are aligned in two transects across the Chukchi Plateau (East – West) and Mendeleev Ridge (South – North), respectively. Using continuous high-resolution XRF scanning, colour reflectance, and physical properties data allows characterizing the dark brown layers in more detail and to improve their application for stratigraphic correlations. The proposed a supra-regional stratigraphic correlation scheme is integrating both the western Arctic basins and ridges, and will ultimately help to establish a reliable chronology for glacial activities in the Amerasian basin.

Keywords: Quaternary, western Arctic Ocean, stratigraphy, paleoenvironment, XRF scanning

Investigation of the paleoclimate of the Mendeleev Ridge in the western Arctic Ocean using beryllium isotopes

KYEONG JA KIM[1], SEUNG-IL NAM[2], A. J. TIMOTHY JULL[3]

[1] Korea Institute of Geoscience and Mineral Resources, Republic of Korea (kjkim@kigam.re.kr)
[2] Korea Polar Research Institute, Republic of Korea
[3] NSF Arizona AMS Laboratory, University of Arizona, USA

We investigated paleoclimate and environmental changes using beryllium isotopes from the 39 cm-long box core sediment obtained from the Mendeleev Ridge of the western Arctic Ocean. The age of core PS72/396-3 seems to be back < 100 kyr based on stratigraphy of beryllium isotopes and paleomagnetic data and other isotopic data of this study, AMS ^{14}C ages and oxygen and carbon isotopes of planktonic foraminifer N. pachyderma sin. The both authigenic ^{10}Be and ^{9}Be records show that there are three major cold periods during the last 100 kyr and reveals a much longer warm period after the second cold period based on ^{9}Be record. The ^{10}Be stratigraphy also reveals a paleomagetic excursion at ~45 kyr which is comparable with the record of $\delta^{18}O$. At depth from 22 to 25 cm, the lowest ^{10}Be signal may be due to the highest paleomagnetic intensity, which is indicated as an age of 75 kyr elsewhere. However, cold climate signal such as ice coverage could be possible because $\delta^{18}O$ reveals a cold period. Interestingly, ^{9}Be data show that constant input of ^{9}Be to the Mendeleev Ridge is clearly observed for this time period. This could be associated in warmer climate which provided constant ^{9}Be input to the marine environment from the land. During this time period, TOC (%) values also show a similar pattern. The record of authigenic ^{9}Be is inversely correlated to that of Ca and proportional to opal production. These observations confirm that ^{9}Be can be a good proxy for climatic tracer. This study may be a useful approach for understanding Arctic climate change for the Mendeleev Ridge as well as global paleoclimate changes during the late quaternary glacial-interglacial cycles.

Keywords: beryllium-10, paleoclimate, Mendeleev Ridge,

Oxygen isotope stratigraphy at Site U1417 and U1418 in the Gulf of Alaska (IODP Exp. 341)

ASAHI, H.[1], MIX, A.C.[2], SUTO, I.[3], GULICK, S.P.S[4], JAEGER, J.M.[5], LEVAY, L.[6], NAM, S-I[7]. KHIM, BK[8], AND IODP EXPEDITION 341 SHIP-BOARD SCIENTISTS[9]

[1] Korea Polar Research Institute, 26 Songdomirae-ro, Yeonsu-gu, Incheon, Korea (asahiro@kopri.re.kr)
[2] CEOAS, Oregon State University, Corvallis, Oregon, Usa
[3] Nagoya Univeristy, Furo, Chikusa, Nagoya, Japan
[4] University of Texas at Austin, Austine, Texas, USA
[5] University of Florida, Gainesville, Florida, USA
[6] IODP, Texas A&M, College Station, Texas, USA
[7] Korea Polar Research Institute, 26 Songdomirae-ro, Yeonsu-gu, Incheon, Korea
[8] Pusan National Univesity, 2, Busandaehak-ro, Geunmjeong-gu, Busan
[9] IODP Expedition 341

Since Pliocene, global climate has experienced gradual cooling along with enhancement of continental ice sheets. Despite widely recognized increase in erosion rates from continental ice sheets since Pliocene, direct linkage between climate and erosion from tectonic aspects are still under debate. Gulf of Alaska (Goa) is situated proximal to the St. Elias orogen, which includes part of the North Cordelleran Ice Sheets (NCIS). High quality age model for the sediment record in the GoA provides critical insights toward understanding the natural behavior of the North NCIS duing global glaciation. Here we present continuous oxygen isotope records at two sites (Sites U1417 and U1418) in GoA, collected during Integrated Ocean Drilling Expedition 341 (IODP Exp. 341), and an orbital scale age model based on these isotope records. Oxygen isotope records at two sites were established using arctic planktic foraminifera (PF) Neogloboquadrina pachyderma sinsistral (150-250 μm). Fairly reasonable presence of PF at two sites enables us to achieve the orbital scale oxygen isotope stratigraphy back to 1.2 Ma (Site U1418) and 3.0 Ma (Site U1417), respectively. According to the oxygen isotope stratigraphy, sedimentation rate at distal Site U1418 is ~10 times higher than that at proximal Site U1417, suggesting significant sediment discharge in Surveyor Fan from the continental margin of Alaska.

Paleo-environments and depositional ages of coastal sediments in Gwanpo-ri, Geoje Island

JIN CHEUL KIM[1], JAESOO LIM[1], JIN-YOUNG LEE[1], SEI-SUN HONG[1], DONG-YOON YANG[1]

[1] Quaternary Geology Research Department, Geological Research Division, Korea Institute of Geoscience and Mineral Resources, 92 Gwahang-no, Yuseong-gu, Daejeon 305-350, Republic of Korea (kjc76@kigam.re.kr)

Unconsolidated sediments exposed in the slope above the beach in Gwanpo-ri, Geoje Island, have been regarded as a climate-controlled coastal terrace deposits, which were formed during the Holocene. In this study, their paleo-environments and depositional ages are interpreted by high precision measurements of sediment elevation, radiocarbon dating, and sedimentary $\delta^{13}C$ values. The sedimentary sequence is divided into the upper pebbly mud deposit, the middle organic-rich mud deposit, and the lower slope deposit, of which carbon ages range from 4380 cal yr BP to 140 cal yr BP. The distinctive coastal pebbles and their distribution pattern in the upper deposit indicate that they were transported from pebble beach to the slope by coastal erosion during extreme coastal events such as storm surge. The $\delta^{13}C$ values ranged from -24.3‰ to -21.2‰ and were divided into five stages based on the average value (-22.5‰). A comparison with the regional climate index revealed that wet periods linked to intensified summer monsoon conditions occurred at Stage 1 (4500-3600 cal BP), Stage 3 (1350-900 cal BP), and Stage 5 (300 cal BP to present). Dry intervals were found at Stage 2 (3600-1350 cal BP) and Stage 4 (900-300 cal BP).

Keywords: Geoje Island, coastal deposit, carbon dating, paleo-environments, $\delta^{13}C$

Architectural analysis of the Holocene tidal flat sequence on the Yubu island in Keum river estuary, West Coast of Korea

SEOUNGYOUNG JU, HYEONHO YOON AND SEUNGSOO CHUN[1]

[1] Faculty of Earth system Environmental sciences, Chonnam national university, South Korea (tidalflat@gmail.com)

The tidal flat of Yubu Island located on the Keum river mouth, west coast of Korea is macrotidal, with a semi-diurnal tidal range of 4-6 m, and is generally influenced by the East Asian monsoon. In order to recognize preserved architectural characteristics, 5 vibrocores (up to 6 m long) were collected along the survey line crossing intertidal flat of Yubu island and have been analyzed with can-core peels and surface sedimentary facies.

Eleven sedimentary facies can be classified based on the grain size and primary sedimentary structures: (1) Parallel or low angle laminated sand facies (Facies Sp), (2) Parallel or low angle laminated sand with vuggy facies (Facies Spv), (3) Trough cross-laminated sand facies (Facies Stx), (4) Planar cross-laminated sand facies (Facies Spx), (5) Climbing ripple cross-laminated sand facies (Facies Scx), (6) Massive sand facies (Facies Sm), (7) Massive sand with vuggy facies (Facies Smv), (8) Mud layer interlaminated sand layer facies (Facies M/s), (9) Lenticular bedded sandy mud facies (Facies sMl), (10) Wavy bedded sand/mud facies (Facies S/Mw), (11) Wavy bedded sand/mud facies with vuggy facies (Facies S/Mwv).

Based on the correlation of the sedimentary facies, all individual facies are grouped with 3 facies associations. Facies association 1 is mixed-flat deposits characterized by the common occurrence of Facies Ml and M/s often including Facies Sw. Facies association 2 is sand-flat deposits comprising of Facies Stx, Spx and Scx as major facies. Facies association 3 consists of Facies Sp as a major facies which can be interpreted as over spit flood delta deposits. The vertical evolution of architectures suggests two different sequencial evolutions. The outer part of tidal flat (western coast of Yubu Island) has a coarsening-upward sequence with Holocene sea-level rise which is common in the open-coast tidal flats of western coast of Korean Peninsula. The inner part of tidal flat has a slight fining-upward sequence suggesting a vertical aggradation of mud-flat facies including intermittent depositions of over spit flood layers with Holocene sea-level rise. The latter shows a similar depositional pattern to that of semi-enclosed bay setting except for the interlayering of over-spit deposit.

Keywords : sedimentary structure, sedimentary facies, facies association, intertidal flat, Yubu Island

Acknowledgements: This study was supported by the research grant from the *World Heritage Promotion Project of Korean Tidal Flats*. This presentation is an interim result of the coastal research program in the study area.

Holocene coastal environment changes in the Beolgyo area, southern coast of Korea

JAESOO LIM[1], JIN-YONG LEE, JIN-CHEUL KIM, SEI-SUN HONG, JU-YONG KIM, DONG-YOON YANG

[1] Geological Research Division, Korea Institute of Geoscience and Mineral Resources, Daejeon, 305-350, Republic of Korea (limjs@kigam.re.kr)

To trace Holocene sea level change and resultant coastal evolution, we performed AMS radiocarbon dating and geochemical analyses using a sedimentary core (BSL18) recovered from the Beolgyo tidal flat in the southern coast of Korea. This coastal core is characterized by high sedimentation rates during the early to mid Holocene, which generally correspond to Holocene transgression at this site. The $\delta^{13}C_{org}$ values which represent relative inputs between terrestrial and marine organic source displayed a long-term increasing trend from -27 to -21‰, suggesting an evolutionary series of fluvial to tidal and then shallow marine environments. Total organic carbon/sulfur (TOC/S) ratios, a proxy for paleosalinity in coastal area, show negative correlation with $\delta^{13}C_{org}$ values. Especially similar fluctuations observed in $\delta^{13}C_{org}$ values and C/S ratios on multi-centennial timescales seem to be linked to change in past fluvial sediment input or summer monsoon strength, suggesting that the geochemical characteristics of the coastal sediments have been highly sensitive to the freshwater input through the Beolgyo River. This study demonstrated that a rapid rise in sea level (> 5m) was possible between 8000 and 6000 cal yr BP, based on the dating of coastal sediments coupled with analyses of C/S ratios and carbon isotopes.

Application of three instantaneous attributes in the analysis of quaternary strata from Chinese Continental Scientific Drilling Program

ZHAO WEINA[1,2], ZHANG XUNHUA[2,3], WU ZHIQIANG[2,3], MI BEIBEI[2,3], CHEN SHANSHAN[2,3]

[1] Ocean University of China, College of Marine Geosciences, Qingdao 266100, China
[2] Qingdao Institute of Marine Geology, Qingdao 266071, China

Single channel seismic data obtained in 2013, which is belong to the Southern Yellow sea, is used to analyze the Quaternary strata with instantaneous attributes. The research results show that the instantaneous phase display the contract of stratum clearly and the relationship of sequence in space better, solving a worse recognition in the seismic profile. The Quaternary sedimentary based on instantaneous attributes' partition matches well with Qc2, which is in the same location. The major sedimentary facies are devided into smaller units in the analysis, at the same time, identifying many erosion of contract surface in the sedimentary facies. The study found that the application of three instantaneous attributes could improve the ability to identify the contact surface in the profiles with the absence of drilling data and provide reference to unknown well location in the scientific drilling.

Keywords: instantaneous phase; instantaneous amplitude; instantaneous frequency; Quaternary strata division

References

Uchida, T., and Sasaki, Y., 2006, Stable 3D inversion of MT data and its application to geothermal exploration, Exploration Geophysics, 37, 223–230.

M. T. Taner, F. Koehler, and R. E. Sheriff, 1979, Complex seismic trace analysis, Geophysics, 44(6):1041-1063.

Barnes A E, 1996, Theory of 2-D complex seismic trace analysis, Geophysics, 61, 264-272.

Barnes A E, 1991, Instantaneous frequency and amplitude at the envelope peak of a constant phase wavelet, Geophysics, 56, 1058-1060.

ZHANG Yanling, YANG Changchun, JIA Shuguang, 2005, The application of the seismic attributes. Progress in Geophysics, 20(4), 1129.

Satinder Chopra Kurt J Marfurt., 2006, A historical review of seismic attributes, ZHAO Jian-min, Petroleum Geophysics, 4(3), 60-65.

LIU Cai, ZHOU Hui, YANG Baojun, et al, 1995, Analysis method of high resolution complex channel, Oil Geophysical Prospecting, 30, 24-29.

XU Huiqun, GUI Zhixian, 2006, Instantaneous information of seismic signal and its application. Inner Mongolia petrochemical, 10, 52-54.

ZHONG Tao, XIAO Hongyue, LEI Wan. 2008, The application of the seismic instantaneous attributes in the Karst exploration, Computing techniques for geophysical and geochemical exploration, 30(1), 30-33.

Robertson J M, Nogami H H, 1984, Complex seismic trace analysis of thin beds, Geophysics, 49, 344-252.

GAO Jinghuai, CHEN Feng, CHEN Shumin, 2005, Using seismic instantaneous attributes to analyze thin interbeds, Goal Geology & Exploration, 33(3), 67-70.

Seasonal characteristics of surface sediments in Yeoja Bay, Southwest Coast of Korea

SEOK HWI HONG[1] AND SEUNG SOO CHUN[1]

[1] Faculty of Earth Systems and Environmental Sciences, Chonnam National University, Korea (tidalflat@gmail.com)

Surface sediments of intertidal and subtidal flats have been obtained separately during summer and winter to understand the characteristics of sedimentary facies and sedimentation in Yeoja Bay, which locates in the south coast of Korea and is characterized as a typical semi-enclosed bay with a narrow entrance to be widened toward its middle part. Subtidal and intertidal surface sediments of Yeoja Bay consist mostly of silt and clay. Most of surface sediments can be divided into three facies: mud facies, silt, and clay facies. In summer, mud facies occurs mostly in the northern part where two main streams debouch into the bay. Dendritic tidal channels are developed commonly in this part of the bay. Mud facies occurs also in the southern part of the bay which is characterized by debouched area of flooding tidal current through the narrow inlets. Silt and clay facies occur widely in the middle part of the bay, especially on the nearby area of Jang-do. In winter, the silt facies is not developed and clay facies is somewhat moved to the northern part of the bay. These seasonal change of sediment distribution in the middle part of the bay are caused by the delicate controls of river input, tidal current and wave reworking which show slight change seasonally. Grain-size distribution curve demonstrates also a little seasonal change such as decrease in size from 7 to 8 Ø in winter, which is caused by increasing of clay fraction. Most sediment distribution patterns indicate a bimodal feature in summer season, indicative of mixing of two modes. Although much detailed hydrodynamic researches would be needed for the interpretation of these features, this seasonal change of surface sediment suggests that river input and wave reworking have played the important roles for grain distribution and redistribution in summer and winter seasons, respectively.

Keywords: intertidal deposit, subtidal deposit, mud flat facies, fine-grained sediment, Yeoja Bay

Acknowledgements: This study was supported by the research grant from the *World Heritage Promotion Project of Korean Tidal Flats*. This presentation is an interim result of the coastal research program in the study area.

Spatial variations process of sea temperature during typhoon MATSA(0509) and SAOMAI (0608)

ZHU JIONG[1], KANG JIANCHENG[1], HAN GUOQI[2]

[1] Shanghai Normal University, Urban Ecology and Environment Research Center, Shanghai 200234
[2] Fisheries and Oceans Canada, St. John's NL, A1C5X1 Canada1-709-772-4188

To understand the typhoon, the change process within a short time scale and the upper ocean thermal structure and the strength of the relationship. First, spatial and temporal changes in ocean temperature were got by using multiple sources of information and the Argo data was used to check.

Second, two typhoons: MATSA(0509), SAOMAI(0608) were selected, sea temperature was analyzed. The results show: the typhoon would cause the water upwelling or downwelling in the vertical direction. In time, when the maximum wind speed of 25m/s and 38m/s, upwelling or downwelling was most significant. In space, during typhoons, in 0-50m temperature was mainly cooling and vertical variations was small. In 50-300m there were heating and cooling, a larger vertical variation. In the 150 meters, the change was significantly.

Through the analysis of the upper ocean temperature change during typhoon in 0-300m deep, the results showed that: impact of the typhoon on the upper ocean can be divided into three;the first layer of 5-60m deep, the driving force of typhoon had an effect directly on the sea. The second layer 60-200m deep, the driving force of the typhoon weakened. The third layer of 200-300m deep, the driving force of the typhoon weakened further, may be at work inside waves. The impact of the typhoon on the sea can be divided into inner and outer layers; the center of underlying was mainly pumping which affected 300m deep.Both sides of center of underlying was mainly mixing, where there were two hot and cold water masses, the most significant change was in 160m depth.

Keywords: Typhoons, Sea Temperature, Argo, Typhoon Strength

References

Jarosz, D.A.Mitchell, D.W. Wang,et al.2007.Bottom-up determination of air-sea momentum exchange under a major tropical cyclone.Science,315:1707-1709.

Jaimes B, Shay L K.2009. Mixed Layer Cooling in Mesoscale Oceanic Eddies during Hurricanes Katrina and Rita. Mon.Wea.Rev., 137(12). 83–114.

Jiayi Pan, Yujuan Sun. 2013. Estimate of Ocean Mixed Layer Deepening after a Typhoon Passage over the South China Sea by Using Satellite Data.J.Phys.Oceanogr.,43,498–506.doi:http://dx.doi.org/10.1175/JPO-D-12-01.1

Knutson,T. R.et al. 2010.Tropical cyclones and climate change.Nature Geoscience,3(3):157–163.

Application of a Near Shore Imaging System for Spatial and Temporal Dynamics Monitoring of Shilaoren Beach in Qingdao

WEIDONG YI[1], XINSHENG YU[1,2], YANYAN WANG[1], WEI ZHANG[1], SHANGGONG CUI[1]

[1] College of Marine Geosciences, Ocean University of China, P. R. China (jkdywd@163.com)
[2] Key Lab. Of Submarine Geoscience and Prospecting Techniques, Ministry of Education, Qingdao, China

Coastal processes is one of the main issues in coastal zone management. Extreme weather conditions, such as storm events, have made great impact on the shoreline dynamics and caused risks on civil activities. Thus, the development of real-time monitoring system to map the impact of marine storm event on beach is essential. Near-shore video technology can record minutes to hours of continuous images, and provides an on-line monitoring means of rapid morph-dynamics changes of the beach during storm events. In this paper, a video system with 8~80mm optical zoom lens is implemented for morphological monitoring of the Shilaoren beach in Qingdao. A shoreline extraction algorithms is developed to process Typhoon event during the August in 2011 quantitatively. Result shows that the biggest change of beach width was 129 m and beach area was decreased by 48 percent. The dynamic change of beach shoreline was compared with the datum of tides and waves. Through correlation analysis, it is shown that tides and waves that enter the beach provoke a static change which erodes or alters the sedimentation environment while storm surges and high waves caused by typhoons bring about a rapid dynamic change in the beach. This case study demonstrates that nearshore video monitoring technology is an ideal method on researching the real-time dynamic changes of beach morphology in high spatial and temporal resolution.

Keywords: video monitoring, storm surge, image morphology, shoreline extraction, beach width

References

Splinter KD, Strauss DR and Tomlinson RB, 2011, Assessment of post-storm recovery of beaches using video imaging techniques: A case study at Gold Coast, Australia, IEEE Transactions on Geoscience and Remote Sensing, 12, 4704 – 4716.

M. Santos, L. DelRio and J. Benavente, 2013, GIS-based approach to the assessment of coastal vulnerability to storms. Case study in Bay of Cadiz(Andalusia, Spain), Journal of Coastal Research, 65, 826-831.

Yoon HS, Kang TS, Nam SY, et al, 2007, Measuring coastline morphodynamics using video-based techniques at Haeundae Beach, South Korea, Journal of Coastal Research, 1106-1111.

Variation of topography and surface sediments in the Gochang beach before and after the typhoon Kompasu in 2010, southwestern coast of Korea

WH RYANG[1] AND SI KANG

[1] Chonbuk National University, Republic of Korea (ryang@jbnu.ac.kr)

In the Gochang beach of macro-tide and open-coast, this study has focused on the typhoon effects of topography, surface sediment, and sedimentary facies, appeared before and after the typhoon Kompasu in 2010. The Gochang beach is located on the southwestern coast of Korea along the eastern part of the Yellow Sea. The typhoon Kompasu moved along the southwestern coasts and across midlands of the Korean Peninsula from 1 to 2 September in 2010. Coastal effect of the moving typhoon was investigated in terms of the surface variations of topographic elevation and surface sedimentary facies. Surface topography and sediments of before and after the typhoon (August - September 2010) were measured and sampled along three survey lines, consisting of total 137 sites at 30 m intervals in each transverse line to the coast, respectively. The surface topography in the mid-to-low beach zone became low after the typhoon rather than that before the typhoon. The lower topographic change is indicative of surface sediment erosion caused by the typhoon wave. Before the typhoon, spatial distribution pattern of sedimentary facies showed a trend of coast-parallel bands of fine sand facies and medium sand facies, whereas that after the typhoon was partly different.

Keywords: coastal effect, Typhoon Kompasu in 2010, surface sediment, macro-tide, beach

Acknowledgements: This study was supported by the research grant from the Korean Ministry of Oceans and Fisheries (PJT200538).

Short-term morphological changes revealed by the multi-beam bathymetry mapping in the southern coast of Jeju Island, Korea: a possible typhoon impact?

BANG HEE LEE[1], EUN IL LEE[2] AND TAE SU CHANG[3]

[1] Ocean Survey Division, All of Land for Human and Nature Corporation, Korea (leebh202@all4land.com)
[2] Ocean Research Division, Korea Hydrographic and Oceanographic Administration, Korea
[3] Petroleum & Marine Research Division, Korea Institute of geoscience and Mineral Resources, Korea

The southern coast of Jeju Island lies on a first front of typhoons in the Korean peninsula and almost every year the typhoons land in. In order to investigate the impact of typhoons on the Jeju coast, repeated multi-beam bathymetry surveys were carried out from nearshore to offshore in 2012. Three typhoons, such as Bolaven, Khanun and Damrey, had passed through from mid-July to the end of August 2012, and left strong impacts onshore and inland of the Jeju. Multi-beam bathymetry data, acquired before (in early July) and after (in September) the typhoons, revealed dramatic seabed changes occurring at 1km offshore from the shoreline. The deposition and erosion rates show about 0.5 to 1.5m in thickness. There was, after typhoon, severe erosional layer of 1.5m-thick from onshore to about 350m offshore in water depth of 10 m, whereas slight but sizeable deposition with 0.5 m-thick sands took place down to 20m deep. It seems that, during typhoon, the upper shoreface seabed here shallower than 10m is likely extensively eroded by storm waves, and subsequently sandy sediments transported offshore and redeposited deeper in lower shoreface. There are, however, no changes in morphology observed deeper than 20m, which is suggestive of the storm wave base in the southern coast of Jeju Island.

Keywords: submarine topography, typhoon, bathymetry, erosion, wave base, Jeju

Sedimentary records of the paleo extreme events in a beach ridge plain, east coast of South Korea

SOO YONG LEE[1] , KWANG HEE CHOI[2], SEONG-PIL KIM[3] AND SE WON CHANG[4]

[1] National Institute of Environmental Research, Incheon, 404-708, Republic of Korea (geoist@korea.kr)
[2] Korea Institute of Geoscience and Mineral Resources, Republic of Korea

Beach ridge plains occur in coastal zones where there is an abundant supply of sediment and are associated with the dynamic response to climate change and sea level fluctuations. Therefore, they can be archives to record the environmental changes in their region, including extreme events such as storm surges, tsunami and large floods. A deep (43 m) sediment core taken from the Goraebul coastal plain, Gyeongbuk Province, South Korea was analysed to reconstruct to the environmental changes in the past. A topographic survey revealed that the top of the core was situated 0.8 m above the present sea level. Grain size analyses, luminescence chronologies on quartz sands, and radiocarbon dating on charcoals and shells were employed to furnish data for the depositional history. According to the sedimentological characteristics obtained by about 10 cm intervals, the core sediment was classified into three main sedimentary units: upper (0.0 ~ 29.0 m), middle (29.0 ~ 32.8 m), and lower (32.8 ~ 43.0 m) parts. It is assumed to be deposited with rounded gravels below the bottom of the core, but the depth is unknown. The lower unit of the core was mainly composed of fine sands with muddy interbeds, which indicated comparatively stable sedimentary condition. This unit was overlaid with the middle unit which is comprised of coarse sands with rounded pebbles. The upper part is mainly composed of medium to coarse sands with coarsening upward sequences which could indicate the progradation of shoreline or delta front. Compared to the upper and lower units, the grain sizes of the middle layers with about 4 m thickness are much larger, and are very poorly sorted. Therefore, it is probable that they might be originated from abnormal events which were driven by fluvial or marine processes, and the timing of this events will be determined by absolute dating methods.

Keywords: paleo-storm, microtidal, coastal management, strandplain

Types and characters of potential hazardous features on the outer shelf of the northern South China Sea

JUN YAN[1], JIEYANG ZHANG

[1] Institute of Oceanology, Chinese Academy of Sciences, Qingdao,China (jyan@qdio.ac.cn)

On basis of the latest multibeam bathymetric data, potential hazardous features on the continental shelf of the northern South China Sea are classified and detailed described. Results indicate that sand waves, slides, uplift ridges, trenches and pockmarks are widely distributed in the study area. Sand waves in three kinds of scales (large, medium, small) have been found, which are mostly linear and mobile. The scale of sand waves increases with the enhancement of activity of sand waves and deepening water depth toward the south. The scale alternation and migration of sand waves are consistent with the internal wave activity and reveal a possible origin associated with strong currents induced by internal waves. Seven different slides were identified in the study area. Most of the modern slides stretch linearly, and some slides are step-shaped with obvious slumping characteristics. Modern slides are not active nowadays. Controlled by residual paleocoastlines, the southern terrain of the region is characterized by a series of uplift ridges. Most uplift ridges (K1-K4) are parallel in NE-SW direction, while only one uplift ridge (K5) is E-W direction. In addition, many pockmarks occur in the study area. The diameter of these pockmarks varies in a range of 30- 100m, with depth from 1.0-3.0m. Two repetitive surveys show these features except sand waves are relatively stable in two years, but they would always be risk for industry facility depending on the possible sudden triggers (such as earthquake).

Keywords: hazardous features, sand waves, slide, pockmark, northern South China Sea

Typhoon event and tracking gravel movement using RFID (Radio Frequency Identifier) tags in Yeocha beach, south coast of Korea

MIN HAN[1], DONG YOON YANG[2], JAEHYUNG YU[3], JONG WOOK KIM[4]

[1] Department of Geography education, Seoul National University (hmjjang1@snu.ac.kr)
[2] Quaternary Geology Department, Geological research Division, Korea institute of Geoscience And Mineral resources
[3] Geology & Earth Environmental Sciences, Chungnam National University
[4] Department of Geography education, Seoul National University

Gravel beach has a stable angle to the wave attack and characteristic vesicular structure, reducing the energy of wave is effective. Research about the movement processes of coarse sediment has been used the analysis of sedimentary facies and topo survey until recently, but they have the limitation of not being able to confirm gravel movement direction. Recently, studies utilizing passive tracer, particularly tracer method using RFID (Radio Frequency Identifier) technology, has been utilized extensively in tracking the coarse sediment movement. But these researches have also limitation of understanding of the most active gravel moving process under extreme event such as typhoon.. The aim of this study is to finding relationship between typhoon and response of gravel beach sediment. To do so, we insert RFID tracers into beach.

Yeocha gravel beach is located in Geoje island on the south coast of Korea. The beach scale is approximately 430 m long and 60 m wide. Thickness of gravel deposited layer is estimated nearly 3 to 5 m. The beach type is a pure gravel beach (PGB). In summer season, strong wave, originated from typhoon, influence Yeocha beach. 15th typhoon GONI influenced Yeocha beach during August 24 to 26 in 2015.

We inserted 200 tracers, using RFID (Radio Frequency Identifier) tags, on the beach in August 24. And after typhoon, we checked tracer movement. Also we measured a surface height change using RKT-GPS pre- and post typhoon.

During the typhoon, we have confirmed that many of the amount of gravel is supplied from the sea. Some points were deposited almost more 1 m of gravel. And beach profile angle became steeper. Because of heavy gravel deposit layer, recovery rates of tracer was low (37.5 %). But tracer research helped us that reveal the origin of the deposited gravel and the direction of gravel movement.

We will investigate the tracer movement monitoring and topographic change continuosly. As a result, it will be possible to discuss topographic recovery after the typhoon.

Estimation on long-term lowering rates of shore platforms developed on volcanic islands, using cosmogenic ^{36}Cl dating

KWANG HEE CHOI[1] AND YEONG BAE SEONG[2]

[1] National Institute of Environmental Research, Incheon 404-708, Republic of Korea (geoist@korea.kr)
[2] Department of Geography Education, Korea University, Seoul 136-701, Korea

The information on vertical lowering rates or downwearing rates is very important to understand the evolution of rocky shore platforms. The existing empirical measurements are, however, temporally limited by decadal scales, because of the slow evolution of rocky coasts. In particular, there is little knowledge on the hard rocky coasts composed of volcanic rocks, igneous rocks and metamorphosed rocks. This study tried to overcome the spatial and temporal limitations of the existing rocky coast research by basing itself on the surface-exposure ages of shore platforms using the cosmogenic radionuclides. This dating technique has been considered a new research tool to unravel the antiquity of rocky coastal landforms for the long-term evolution. The ^{36}Cl exposure ages of the samples collected from the shore platforms along volcanic islands in the middle of the East Sea ranged from the mid-Holocene (ca. 4 ka) to the last century (ca. 0.1 ka). The large errors in ages along the outer edges in the study area could be attributable to stochastic, differential and mechanical wave erosion. This study also found the possibility of inducing vertical erosion rates, using the apparent exposure ages of platform surfaces. The mean maximum vertical lowering rate was 0.68 mm/yr, excluding outliers, in the study area. Thus, the erosion rates inferred from the cosmogenic ^{36}Cl ages may successfully be applicable to the long-term evolution of rocky coasts, and the results could be comparable with the empirical data.

Keywords: Cliff retreat, sub-horizontal platform, sea level change, cosmogenic nuclides, Holocene.

Disturbunce of distribution and dynamics of soil nutrients by planting trees on the coastal dunes of South Korea

YOONMI KIM[1] AND KWANG HEE CHOI[1]

[1] National Institute of Environmental Research, Incheon 404-708, Republic of Korea (geoist@korea.kr)

Planting trees on coastal dunes is common in East Asia to stabilize landscapes and protect residential areas from strong winds, blown sands, and salt spray. However, this may result in adverse effects such as the invasion of non-native species and changes of the dune landscapes. Soil nutrients can also be changed by the introduction of coastal forests, because their distribution and dynamics are closely associated with blown sands and salt spray in coastal dunes. In this study, we compared the seasonal variation and distribution of soil nutrients such as Ca, Na, Cl, Mg, N, S, and organic matters between a grass-covered dune (D1) and a tree-planted dune (D2), along the west coast of South Korea. The amount of soil nutrients generally decreased as the locations were farther from the sea at both sites in all seasons. Since the wind velocity of D1 was much higher than that of D2, it is likely that salt spray occurs more frequently at D1. Accordingly, the concentrations of Na and Cl were higher at D1 than at D2. On the front side of the grass-covered dune, the concentration of nutrients increased from January to April, when heavy sedimentation was observed, whereas it decreased during the summer and autumn. On the front side of the pint forest, on the other hand, the seasonal variation in nutrients was not clear, probably because it was related with different input and output mechanisms such as less amounts of sand supply, nutrient consumption by different vegetation, and decomposition of organic matters. Therefore, planting trees should be restricted on coastal dunes to avoid disturbance to their landscapes and ecosystems.

Keywords: Pine tree, coastal forestation, salt spray, sand supply, coastal management.

Beach erosion caused by construction of artificial protection structures in the neighbouring area

JANG SOO KIM[1], KWANG HEE CHOI[2,3], JONG CHUN LEE[2]

[1] ChungNam Institute, Chungcheongnam-do 350-831, Republic of Korea (geoist@korea.kr)
[1] National Institute of Environmental Research, Incheon 404-708, Republic of Korea

Artificial structures to prevent the beach erosion following fishing ports construction can be easily found along the beaches on the southern East Coast of South Korea. Unfortunately, these structures are often built neglecting the possibilities of eroding adjacent beaches, therefore posing new problems for comprehensive beach management. Osan Coast in Gyeongbuk Province is one of such area where many of the beach erosion protection structures were put into place after the expansion of the Osan Harbour. To investigate the effect of the protection structures in that area, this study examined the shoreline changes to the south from the Osan Harbour, Deoksin Beach to Yeongsin Beach, during the last 35 years using multi-temporal aerial photographs. The estimated total beach area of 10.32 ha in 1980 have decreased to 8.72 ha in 1995 after the harbour expansion. However, thanks to the countermeasures against erosion, such as sand groins and offshore breakwaters, the area of Deoksin Beach continuously increased after 2005, but at the same time sacrificing Yeongsin Beach next to the Deoksin Beach. Therefore, despite the countermeasures, the total beach area in 2013 (8.77 ha) remained almost the same as that in 1995. In other words, even though the countermeasures with artificial structures contributed to widening the beach next to the harbour, it came at the cost of losing the next beach area to the south. These findings warn that the construction of artificial fences on one beach may cause erosion on the neighbouring beaches, merely moving the erosional hotspot to another area.

Keywords: Beach erosion, shoreline change, breakwaters, coastal disaster.

A late Holocene tidal sand ridge in a macrotidal seaway, Asan Bay, Korea: seaward progradation during transgression?

TAE SOO CHANG[1], DONG GEUN YOO[1], SEUNG-IL NAM[2], AND EUNIL LEE[3]

[1]Korea Institute of Geoscience and Mineral Resources, Republic of Korea (tschang@kigam.re.kr)
[2]Korea Polar Research Institute, Republic of Korea
[3]3Korea Hydrographic and Oceanographic Administration, Republic of Korea

Over the last three decades, modern sand ridges and their ancient counterparts in tide-dominated environments have been extensively studied, in particular for the purpose of hydrocarbon reservoir characterization. Two or three hypotheses regarding sand ridge genesis and control mechanisms have been proposed in the past, but general consensus is still lacking. This is in part due to the site-specific nature of the ridges and different preservation potentials between ancient and modern analogues. In many modern ridges, internal structures and large-scale architectures are still poorly documented, mainly because of difficulties in adequate seismic exploration under shallow subaqueous conditions and a general lack of long cores. In the present study, two ca. 30 m long drill cores were acquired on a ridge crest to document the vertical facies characteristics and highlight the sequential development in response to the fall or rise in local sea level. The elongate sand ridge, which is ~15 km long, 2-5 km wide and 15 m high, is linear in plan form and strongly asymmetrical in cross-section, the northern flank being steep, whereas the southern one has a gentle slope. In seismic profiles, the ridge itself is acoustically either semi-transparent or chaotic, its base being characterized by a relatively strong horizontal reflector. Facies analyses of the two drill-cores have revealed 4 facies assemblages, in ascending order comprising 1) a fluvial sand succession, 2) a gravel lag deposit, 3) a tidal mud facies, and 4) a ridge sand facies at the top. The stratigraphy of the ridge deposit shows an upward-coarsening succession, commencing with fluvial gravel lags, which are overlain by tidal muds and the ridge sands. The erosional bounding surface between the fluvial gravels and the tidal mud units is interpreted to be a regional late Pleistocene-Holocene unconformity. Unconformably overlying the granitic basement are basal oxidized sands and tainted gravel layers of probable alluvial origin deposited during the sea-level lowstand prior to marine transgression. The relatively thick late Holocene sand cover overlying the tidal mudflat deposit seems to have prograded seaward during the late Holocene transgression that has been firmly established for the area. Of particular interest here is the prograding nature of the ridge under conditions of a rising (i.e. transgressive) sea, although the delivery of sediment from adjacent Korean rivers is known to have been limited.

Keywords: tidal sand ridge, facies, Holocene, Asan Bay

Characteristics of tidal action sedimentary system and distribution of favorable reservoir of Silurian in Tazhong Area

ZENG QINGLU[1], ZHANG HUILIANG[1], ZHANG XIANLONG[1], JI YUNGANG[2]

[1]Hangzhou Institute of Geology, PetroChina, China (zengql_hz@petrochina.com.cn)
[2]Tarim Oilfield Company, PetroChina, China

The 3rd upper sub-member of the Silurian Kepingtage formation is an important exploration and development set in Tazhong area, of which the sedimentary system and sand body distribution have been researched in detail based on the data of core, logging, seismic, outcrop, experimental analysis and the theory of sequence stratigraphy. The results show that it was overlap and edge away layer by layer from northwest to southeast. On the background of transgression, the depositional systems of tidal flat, estuary and tidal delta were developed and controlled by palaeogeomorphology, while different types of sand bodies and sedimentary formations were developed owing to the types and energy of main action water bodies. In the depositional system of tidal flat, the main types of sand bodies are subtidal channels and intertidal sand flat, where subtidal channels show significantly banded distribution vertical to the coast with a complete three-tier structure. The sand bodies of channels and tidal bars are common in the estuary deposition system and extend far parallel to the axis of the estuary with thin layers of mudstone. The sand bodies of underwater distributary channels are developed with silica, flint gravel layers and large erosion surfaces in the tidal delta depositional system. By above research, the depositional model of tidal flat-estuary-delta in Tazhong area was established and the distribution of favorable sand bodies could be predicted.

Keywords: Tazhong area, Silurian, Tidal action, Sedimentary system, Characteristics of sand bodies

Distribution and Source Identification of PAHs and PCBs in Surface Sediments from the Nakdong River Estuary, South Korea

JUN-HO LEE[1], HAN JUN WOO[2], JEONGWON KANG[3], KAP-SIK JEONG[4]

[1] Korean Seas Geosystem Research Center, KIOST, 787 Haeanro, Ansan, 15627, Korea (leejh@kiost.ac.kr)
[2] Korean Seas Geosystem Research Center, KIOST, 787 Haeanro, Ansan, 15627, Korea
[3] Korean Seas Geosystem Research Center, KIOST, 787 Haeanro, Ansan, 15627, Korea
[4] Korean Seas Geosystem Research Center, KIOST, 787 Haeanro, Ansan, 15627, Korea

The Nakdong River, located in the southeastern region of the Korean Peninsula, is the largest river system in South Korea (river length, 510 km; drainage area, 23,384 km2, 127°29'–129°18'E, 35°03'–37°13'N). In general, over 60% of the regon's total annual precipitation (1,000–1,200 mm) falls in summer (from June to September). A survey of hazardous chemicals in the sediments of the Nakdong River estuary was conducted during the spring of 2015. We investigated the concentrations and distribution of the 16 priority polycyclic aromatic hydrocarbons (16-PAHs) and 19 priority polychlorinated biphenyls (19-PCBs) in the brackish surface sediments (Ulsukdo, Jinwoodo, and Sinjado). PAHs constitute a group of hydrophobic organic compounds (HOCs), that are related to incomplete oxidation during combustion and also to the uncontrolled environmental pollution that is present in may locations. The toxicity of PCB mixtures is low, but they pose a cancer risk in humans. Concentration of PAHs ranged from 10.76~40.21 ng/g-dry (mean value, 24.79 ng/g-dry; N = 4). The levels of PCBs ranged from 197.0~630.0 pg/g-dry (mean value, 402.5 pg/g-dry; N = 4). Concentration of PCBs approached the response level (630 pg/g-dry) at one sites. These contamination levels were far below the Sediment Quality Guidelines (SQG) of the National Oceanic and Atmospheric Administration (NOAA), which are used for environmental quality assessments. Low-molecular-weight PAHs were dominant in the sediment samples. These results were used to assess the potential sources of PAH and PCB contamination in Nakdong River estuary sediments. We determined that PAHs originated from the combustion of fossil fuel and biomass, and were related to PAH contributions in most sediment samples. The isomer patterns in sediment and PCB products were sililar.

Keywords: Estuary, Nakdong river, PAHs, PCBs, Sediments

Holocene microfossil (diatom and benthic foraminifera) records in the Nakdong River delta, South Korea

HIROYUKI TAKATA[1], KOTA KATSUKI2, ARA CHO[2,3], DAEKYO CHEONG[3], SEUNGWON SHIN[3], YONG-HEE PARK[3], BOO-KEUN KHIM[1] , HYOUN SOO LIM[1]

[1]Pusan National University, Korea; 2Korea Institute of Geoscience and Mineral Resources, Korea; (yuu@pusan.ac.kr)
[2]Kangwon National University, Korea

A delta system has developed near the mouth of the Nakdong River in the southeast Korea. Cho et al. (submitted) reported detail fossil diatom record during ~10–5 ka at core ND-01 in terms of delta development. Here, we present combined results of diatom and benthic foraminifera at the same core for better understanding of paleoenvironmental history in the Nakdong River mouth. Five diatom zones (1 to 5) were recognized. Diatom flora indicates that the influence of saline water increased from Zone 2 (44.3–39.2 m; 10–9 ka). Benthic foraminifera also occurred from this zone. Diatom flora suggests progressive increase of the marine influence into Zone 4 (29.2–22.5 m; 6-5 ka) through Zone 3 (34.6–29.2 m; 8-6 ka), reflecting sea-level rise in the early Holocene. In contrast, foraminiferal fauna shows the maximum influence of seawater in Zone 3 and successive increase of coastal water in Zone 4. Benthic foraminiferal data at another seaward borehole (ND-02) show the continuous influence of seawater both in Zones 3 and 4. Benthic foraminifera at core ND-01 likely reflected the upward shoaling rather than sea-level changes. In contrast, diatom flora was characterized by an abundance of Paralia sulcata in this period, suggesting that the pelagic water may be altered by coastal water of the East China Sea. Coarse-grained deposits (~39–35 m; ~9.5 ka) with molluscan shells were intercalated between Zones 2 and 3. Foraminiferal fauna shows rapid deepening in this period. Moreover, the transitional fauna of benthic foraminifera characterized by various preservation statuses occurred, suggesting that these deposits were formed as transgressive lag with rapid sea-level rise. The continuous occurrences of diatom and benthic foraminifera in the Nakdong River delta during ~10–2 ka have potential for further studies of Holocene paleoclimate in the East Asian margin.

Keywords: Nakdong River delta, diatom, benthic foraminifera, delta development, southeast Korea

References

Cho, A., Katsuki, K., Cheong, D., Kim, J. C., Shin, S. Park, Y.-H., submitted, Holocene sea-level change and delta formation of the Nakdong River, Korea. The Holocene.

Late Quaternary seismic stratigraphy and depositional history at the mid-eastern Yellow Sea

DONG G. YOO, TAE S. CHANG, GWANG S. LEE, SEONG P. KIM, GIL Y. KIM

[1]Petroleum and Marine Research Division Korea Institute of Geoscience and Mineral Resources, Korea (dgyoo@kigam.re.kr)

Analysis of high-resolution seismic profiles and core sediments collected from the mid-eastern Yellow Sea shows that the the shelf deposit consists of five sedimentary units formed since the LGM: incised-channel fill (SU1), estuarine deposit (SU2), thin sand veneer (SU3), tidal sand ridge (SU4), and central deltaic mud (SU5). The lowermost unit (SU1) above the sequence boundary is interpreted as channel fill deposits mainly formed during the LGM, which belongs to the lowstand systems tract. Three units (SU2, SU3, and SU4), regarded as transgressive systems tract, can be grouped into paralic and marine components separated by a ravinement surface. SU2 lying below the ravinement surface represents a paralic unit that consists of estuarine sediments left behind from shoreface erosion. The top surface of SU2 is truncated by an erosional surface and is overlain by two marine units (SU3 and SU4), which were produced by shoreface erosion that shifted landward during the transgression. SU3, mainly distributed over a wide area of the central part, is very thin, whereas SU4 on the eastern part off the Korean Peninsula forms serial sand ridges, partly modified by modern tidal currents. The uppermost unit (SU5) above the maximum flooding surface, regarded as the highstand systems tract, formed the thin deltaic mud patch derived from the Huanghe River developed after the highstand sea level approximately 7 ka BP.

Keywords: Seismic stratigraphy, Late Quaternary, Postglacial sea-level rise, Mid-eastern Yellow Sea

Suspended sediment transport in the Deepwater Navigation Channel of the Yangtze River Estuary in dry season 2009

DEHAI SONG[1], XIAO HUA WANG[1, 2], ZHENYI CAO[3], WEIBING GUAN[3]

[1] Key Laboratory of Physical Oceanography, Ministry of Education, Qingdao 266100, Chi (songdh@ouc.edu.cn)
[2] The Sino-Australian Research Centre for Coastal Management, School of Physical, Environmental and Mathematical Sciences, University of New South Wales, Canberra, ACT 2600, Australia
[3] State Key Laboratory of Satellite Ocean Environment Dynamics, Hangzhou 310012, China

The in-situ data in the Deepwater Navigation Channel (DNC), Yangtze River Estuary (YRE), China, in the dry season 2009, shows spring tides associated with greater maximum velocities, more mixing, less stratification, and diffused fluid mud; whereas neap tides are associated with smaller maximum velocities, greater stratification, inhibited mixing, and stratified fluid muds. The balance of suspended sediment flux illustrates the offshore sediment transport is dominant by fluvial flows as well, but the onshore transport is induced by tidal-pumping effects on spring tides, and shear effects on neaps. A three-dimensional wave-current-sediment coupled numerical model is developed to fully understand hydrodynamics and sediment transport patterns in the DNC. The model simulations agree with observed intra-tidal and inter-tidal variation in sediment distribution and flux in the DNC. Model results confirm the siltation occurring in the DNC, which is a joint work of sediment transport by estuarine circulation and tidal current asymmetry. Highly turbid water outside the north dike is one of the main sources of the estuarine turbidity maximum (ETM) formation in the DNC. Numerical studies are conducted to show sediment transport dynamics under different forcing in the DNC. The surface wave-current is favourable toward releasing the suspended sediment trap; whereas the bottom wave-current aggravates the bed erosion and elevates the SSC in the ETM zone. The siltation in the DNC may be strengthened under a low flow condition or a steady northwesterly wind condition.

Keywords: Yangtze River Estuary; suspended sediment transport; spring-neap variation; estuarine turbidity maximum; wave-current-sediment coupled model

Transgressive systems tract of late Quaternary deposits in South Sea shelf, Korea

DONG G. YOO, GWANG S. LEE, SEONG H. BAE, SEONG P. KIM, TAE S. CHANG, GEE S. KONG

[1]Petroleum and Marine Research Division Korea Institute of Geoscience and Mineral Resources, Korea (dgyoo@kigam.re.kr)

Late Quaternary transgressive deposits on the Korea Strait shelf were investigated using high-resolution seismic profiles and core sediments. The results show that the shelf sequence consist of five sedimentary units deposited during transgression phases of sea level changes between about 15 and 6 ka BP: ancient beach/shoreface complex (unit P1), estuarine deposits (unit P2), mid-shelf sand sheet (unit M1), sand ridge system (unit M2), and inner-shelf sand sheet (unit M3). They are paralic and marine separated by a ravinement surface. The lower paralic component below the ravinement surface consists of two sedimentary units (P1 and P2) preserved from shoreface erosion. The top surface of the paralic unit is truncated by a sharp erosional surface. This surface is overlain by three sedimentary units (M1, M2, and M3), which were produced by shoreface erosion that shifted landward during transgression.

The transgressive deposits in this area, considering geometries and distribution patterns, can be divided into three types. Type I overlying the lowstand systems tract is confined to the shelf margin, and consists of a thick paralic unit P1 and a relatively thin marine unit M1. Type II on the mid shelf has no paralic component and the marine units M1 or M2 directly overlies the sequence boundary. Type III, found in the inner shelf, includes a thick paralic (unit P2) and a thin marine (unit M3) component. It is completely covered by the highstand systems tract.

Keywords: Late Quaternary; Transgressive systems tract; Holocene sea-level rise; Korea Strait shelf

Variation in Sedimentary facies (long-drilling core) by Late Quaternary Sea-level change (after MIS6), Baeksu tidal flat, west coast of Korea

YOUNG SOOK BAEK[1], TAE SOO CHANG[2], JIN CHEUL KIM[2]

[1] Korea Institute of Ocean science and Technology, Korea (duuri@kiost.ac)
[2] Korea Institute of Geosciences and Mineral Resources, Korea

The Baeksu tidal deposits can be divided into three sequences (S1, S2, and S3, in descending order), each being separated unconformably by the major erosional bounding surfaces. The uppermost sequence (S1) can be subdivided into the upper unit displaying tidal rhythmite facies of alternating sand-mud coupletes, and the lower unit characterized by oxidized trough cross-laminated sand facies, mottled silty muds with peat and rootlets, massive sands with shell layers at base, and alternating thicker sand-mud layers. The OSL dated ages of S1 are 0.199 ± 0.02 ka in upper unit and 7.790 ± 0.04 ka in lower unit. S1 can be interpreted to be tidal deposits and supratidal flat or salt marsh formed during transgression. Sequence 2 (S2) consists of tidal rhythmite facies (upper unit) and gravels-mud couplets (lower unit). S2 can be considered to be deposited in marginal marshes and fluvial-influenced tidal channels. The lowermost sequence (S3) is composed of two units. Upper unit, interpreted as tidal rhythmites, comprises thin sand-mud cuoplets. All the features are characteristic of deposition in tidal mud flats; the OSL dated age of the base is 126.457± 8.13 ka, presumably formed during last interglacial of Eemian stage. The lower unit contains gravels, gravelly sands, and oxidized layers. This unit can be considered to be formed in fluvial environments before MIS 5e (~126 ka) in a lowstand of sea level. It is thus evident that the Baeksu coasts in the eastern Yellow Sea (Korea) have fully inundated, twice at least, in response to late Quaternary sea-level fluctuations. Each sequence is composed primarily of two depositional units commencing with more onshore, fluvial-influenced deposits overlain by tidal deposits. This sedimentation pattern reflects sea-level variation after MIS 6, the fluvial deposits formed during the lowstand and the tidal deposits formed during transgression and highstand.

Keywords: salt marsh, fluvial-influenced tidal channel, tidal deposits, oxidized zone, Baeksu tidal flats

Seasonal and spatial variation of algae effects on floc in Yangtze Estuary

ZHIRUI DENG[1], QING HE[1], CHAO GUO[1]

[1]State Key Laboratory of Estuarine and Coastal Research, East China Normal University, 3663, Zhongshan Road North, Shanghai, 200062, China.

As a peculiar phenomenon in the process of suspended sediment transport at estuary, turbidity maximum zone is a hot issue in the study of estuarine science. These works, combined with increasing biochemical substance heavily influence the flocculation process and sediment transport of the estuaries. In this paper, we analyze the impact of algae on the process of flocculation in the Yangtze Estuary, and identify mechanisms which is responsible for their changes. The phytoplankton biomass are represented by chlorophyll α concentration. Generally, organic matter which adhesions and surround suspended sediment will change in the maximum turbidity zone. In addition, the seasonal variations of organisms from the sea may lead to the changes of suspended particle matter composition, and they participate in biogeochemical processes continuously formed by flocculation and deposition. We show that the floc size of Yangtze Estuary have some significant characteristics in their spatiotemporal distribution. Furthermore, the flocs are significantly influenced by tidal dynamic, indicating that the floc size during flood tide is greater than ebb tide and the shifting position of the saline wedge which affect by tidal dynamic cause the distribution areas changes of flocs. The chlorophyll α is mainly in the form of attachment on the suspended sediment particle transport and have different forms between winter and summer. In winter, because of the weakness of biological activity, there is significant associations between the chlorophyll concentration and suspended sediment concentration, but in summer, with the increase of temperature and light intensity, the strong biological activity make the upper part of the water column acted as a large sink of chlorophyll. We consider that algae have different patterns during winter and summer seasons, algae have little impact on flocculation in winter while it is a key factor in generate large flocs in the upper part of the water column.

Keywords：Flocculation, Sediment dynamics, Microbial biomass, Floc size, Settling velocity

In Situ Study Of Sediment Resuspension Caused By Waves And Sea Currents —A Case Of Yellow River Delta

MINGZHENG WEN [1] , YONGGANG JIA [1,2]

[1]Environmental Geotechnical Engineering Institute, Ocean University of China, China (yonggang@ouc.edu.cn)
[2]Key Laboratory of Marine Environment & Ecology, Ministry of Education, Qingdao, China

Waves and currents are two main dynamic factors of sediment resuspension. This paper reveals the contributions of waves and currents to resuspension in Yellow River Delta based on in-situ observation. By shielding waves or currents, we compare the concentrations of suspended solid with only one factor and two factors simultaneously existing in Yellow River Delta. In addition this article studies the waves "pumping" effect to sediment resuspension in Yellow River Delta, through laying plastic film to collect the surface fine-grained soil samples under the membrane, The research shows that: In the resuspension events of Yellow River delta, the waves′ contributing rate to sediment resuspension is 14% to 73%, and that of currents is 27% to 86%；In the process of wave-induced sediment resuspension, the contributing rate to sediment resuspension of waves "pumping" is 11.5% to 42.8%, and that of wave shearing action is 57.2% to 88.5%.

Key words：In-situ observation; Resuspension; pumping; Yellow River Delta

Linking suspended particulate material characteristics to the plankton distribution in summer in the Yellow Sea and East China Sea

RENFU FAN[1], HAO WEI[2] AND LIANG ZHAO[1]

[1]College of Marine and Environmental Science, Tianjin University of Science and Technology, P.R. China (renfufan@163.com)
[2]School of Marine Science and Technology, Tianjin University, P.R. China

Identifying particle characteristics (i.e., concentration distribution and its size fraction) and their influencing factor through in-situ observations can be beneficial in accurately reproducing coastal chlorophyll-a (Chl-a) by using remote sensing and help understand local sediment dynamics. In this study, we defined particles with sizes of $12 < d < 63$ μm as small particles and those with sizes of $280 < d < 390$ μm as large particles. We analyzed the concentration distribution for small and large suspended particulate materials (SPMs) in the Yellow Sea and East China Sea as well as the hydrological structure and Chl-a concentration in this area in a summer cruise conducted during August 16–31, 2013. We evaluated the relationships between SPM characteristics and plankton distribution. Surface SPM comprises more plankton than inorganic particles. In the surface layer, the main part of small SPMs is composed of phytoplankton, whereas large SPMs are primarily dominated by mesozooplankton. High concentrations of SPM in the surface layer locate on the Subei Shoal and off the Changjiang Estuary overlap with the high Chl-a concentration. A high SPM subsurface concentration is observed at the same layer as where the maximum Chl-a concentration and large particle value are observed in the pycnocline. A high SPM subsurface concentration is primarily influenced by plankton, particularly mesozooplankton. Small particles are dominant in the bottom layer and mainly comprise inorganic particulate matter. SPM concentrations in the bottom layer of the Changjiang Bank are substantially higher than those in the Central Yellow Sea and middle shelf of the East China Sea because the high energetic environment in the bank induces strong sediment resuspension.

Keywords: suspended particulate materials, concentration and size distribution, plankton, Yellow Sea and East China Sea

Statistical Relationships of Winter Temperature and Atmospheric Circulation Indices Derived from Mechanism Studies in the Yellow Sea

CHENGYI YUAN[1], HAO WEI[2], YOUYU LU[3], XIAOFAN LUO[1]

[1]College of Marine Science and Engineering, Tianjin University of Science and Technology, TEDA, Tianjin 300457, P. R. China(weihao@ouc.edu.cn)

[2]School of Marine Science and Technology, Tianjin University, Tianjin 300072, P. R. China

[3]Bedford Institute of Oceanography, Fisheries and Oceans Canada, Dartmouth, Nova Scotia, B2Y 4A2, Canada

This study focuses on establishing statistical models of the water temperature anomaly with atmospheric circulation variation in the Yellow Sea (YS). Water temperature in the YS is simulated by a nested global-regional ocean model with realistic atmospheric forcing during 1958-2007. In typical sub-regions of the YS, validation of the seasonal patterns and inter-annual variations of the simulated water temperatures using satellite and in-situ observations supports their reliabilities in establishing statistical models. Derived from previous mechanism studies, statistical models for the winter water temperature in the Northern Yellow Sea (NYS) and the coastal region of the Southern Yellow Sea (SYS) have been established by linear regression using December-January-February mean Arctic Oscillation Index (AOI), which represents large-scale atmospheric circulation in boreal winter. In the Yellow Sea Warm Current (YSWC) region, statistical models are established using AOI to represent the coherent influence of large-scale atmospheric circulation on the surface heat flux and the strength of YSWC, as well as the first principal component of wind stress curl (PC1-curl) associated with the shifts of the YSWC pathway. The ratio of contributions of the wind stress curl and Arctic Oscillation (AO) suggests that the inter-annual variations of the wind stress curl has a more significant influence than AO on the water temperature in more than 60% of the years on the eastern flank of the Yellow Sea Trough (YST). In the western coastal region of the SYS and on the western flank of the YST, the role of AO is more significant on the inter-annual variations of the water temperature and the occurrence of extreme cold and warm years due to the shallower water depth. By comparing with the remote sensing temperature, the statistical models based on hindcast were proved to have the ability to estimate anomalies of the winter temperature within recent years.

Keywords: statistical model; water temperature; inter-annual variations; atmospheric circulations indices; empirical orthogonal functions analysis

Study of the dynamic variation of seabed sediment based on in-situ

MR. BOWEN LI[1]

The Yellow River carrying large amounts of sediment into the sea, and about 70-80% of the sediment into the sea deposited at the coastal region of the delta, the bed sediment will resuspend and transport continuously under the hydrodynamic force. Variability of near-bed suspended sediment concentration in the Yellow River Delta, under the effect of hydrodynamic action, is still unclear, and that the existing monitorig methods unrealized the real-time and automatical monitoring of the near-bed suspended sediment concentration profiling under field situation.

The following research was based on the existing studies of the National High Technology Research and Development Program of China (863 Program) "Marine Sediment Re-suspension Flux in-situ Monitoring Techniques during the Storm Process" (No.2008AA09Z109), and funded by the project of National Nature Science Foundation Projects "Study on Consolidated Sediment Re-suspension and Transportation in the Yellow River Estuary" (Project Number, 40876042) and "The storm against erosion control and seabed liquefaction to the Yellow River Subaqueous Delta" (Project Number, 41072215). It aimed to not only study the dynamic change of bed sediment under the effect of hydrodynamic action, but also apply the in-situ and real-time antomatic monitoring system to estimate suspended sediment concentration (SSC).And based on data on the waves, tides and currents collected from long-term observation experiment in the adjacent Bohai Sea, effect of hydrodynamic factors on the resuspension, erosion and deposition of seabed sediment is investigated. Providing a new way for the in-situ research of sea-bed sediment resuspension and transport processes.

The research is showed that: the variation of the suspended sediment concentration in ebb cycle showed a good correlation with the tidal water level and the current velocity in this survey station. In general, suspended sediment concentration will increase during spring tides, but reduce in the ebb process in certain water depths. The seabed erosion and deposition is closely related to the near seabed flow velocity. Because the wind wave is big in this area, the vertical distribution of the suspended sediment concentration in the Yellow River delta is very asymmetric.

Controls on the Morphodynamics and Stratigraphic Architecture of Compound Dunes and Point Bars on the Open-Coast Macrotidal Flat in Gyeonggi Bay, West Coast of Korea

JOOHEE JO[1] AND KYUNGSIK CHOI

[1]School of Earth and Environmental Sciences, Seoul National University, South Korea (joohe1218@snu.ac.kr)

Morphodynamics and hydrodynamic conditions of lower intertidal dune fields on the Yeochari tidal flat of Ganghwa Island in Gyeonggi Bay, western coast of Korea were investigated to understand the external controls governing the stratigraphic architecture of the compound dunes formed in the open-coast tidal environment. Morphodynamic measurement of intertidal channels and compound dunes were conducted twenty times by using RTK GPS over four years. Hydrodynamic data such as current speed, significant wave height and Suspended Sediment Concentrations (SSCs) were collected by using ADCPs, AWAC, pressure sensors and OBS in July of 2014 and March of 2015. Morphodynamic observations revealed that simple dunes on the tributary channel migrate seaward as fast as 1-4 m/ day. In contrast simple dunes on the southern channel bank migrate either landward or seaward as fast as 0.1-1 m/day during spring to fall and 1-2 m/day during winter. Compound dunes on the southern channel bank migrate either landward or seaward at much slower rates of 2-3 m/month. Tributary channels migrate at variable rates ranging from 1 m to 18 m per month with greater rates occurring during summertime rainy season. Tributary channels are ebb-dominated with pronounced tidal asymmetry, whereas tidal flats on the southern channel bank are flood-dominated with smaller tidal asymmetry. Wind-induced waves with significant wave heights over 0.4 m seem to modulate tide-induced sediment transport. Northwesterly waves during winter to spring accentuate ebbward migration of compound dunes, whereas south to southwesterly waves during summertime typhoon result in floodward migration. Combined effect of tides and waves led to coexistence of tide- and wave-induced sedimentary structures including tidal rhythmites, hummocky cross-stratification and symmetrical wave ripples with thick mud drapes. Fining-upward point-bar succession is overlain by coarsening-up compound-dune succession with mater bedding surfaces dipping nearly opposite to those of point-bar succession, which is in particular the case during winter to spring. Tidal asymmetry, seasonality in wave intensity and direction, and the migration of tributary channel are seen to exert an important control on the stratigraphic architecture of compound dunes and point bars in the intertidal environment over time and space.

Keywords: compound dunes, intertidal channel, tidal asymmetry, waves, morphodynamics, stratigraphic architecture

Estimation of critical shear stress based on a bottom tripod observation southwest of Cheju Island, East China Sea

YAJUN XU[1], LIANG ZHAO[2], YE YUAN[3]

[1] [2]College of Marine and Environmental Science, Tianjin University of Science and Technology, Tianjin, China (13821055564@163.com)

[3] National Marine Environmental Forecasting Center, State Oceanic Administration, Beijing, China

Sediment resuspension and deposition within the Bottom Boundary Layer (BBL) is the main dynamical processes that control the fate of the suspended sediment in shelf seas. Numerical study of sediment transport patterns relies on the knowledge of some critical parameters that describe sediment erosion and deposition. In the present study, critical shear stress is estimated base on field observations at the edge of mud area southwest of Cheju Island, East China Sea. Base on the simultaneous observation of velocity and suspended sediment concentrations (SSC) within the BBL by acoustic instruments including ADV and PC-ADP, settling velocity () is estimated by turbulent oscillations of SSC under the assumption of inertial-dissipation balance. This method gives a mean value of 0.91mm s-1 and standard deviation of 0.20 mm s-1, which is an order of magnitude larger than the empirical method of Soulsby (1997) and LISST-ST in-situ submersible particle size analyzer. The difference is expect due to distinct natures of two methodologies, the inertial-dissipation method is more indicative of BBL dynamics and thus believed to give reasonable in-situ estimates of , while Soulsby's method is usually suitable for still water. A novel method for estimating critical stress of erosion (τce) and deposition (τcd) based on statistical analyse of temporal variability of SSC (defined as derivative of SSC with regard to time) and corresponding bottom shear stress is proposed. Both of τce and τcd vary between 0.06-0.26 Pa with corresponding median values of 0.20 Pa and 0.17 Pa, respectively, which confirms that τce is somewhat higher than τcd. Another method of estimating critical shear stress (τws) by settling velocity is also adopted, which yields reasonable values of 0.06-0.17 Pa.

Keywords: Settling Velocity, Resuspension, Critical Shear Stress, East China Sea

ENRICHMENT MECHANISM OF REDOX-SENSITIVE AND NUTRIENT ELEMENTS IN FORAMINIFERA-RICH TURBIDITES FROM SHENHU AREA ON THE NORTHERN CONTINENTAL SLOPE OF THE SOUTH CHINA SEA

LI NIU[1] , CHEN DUOFU[1], CHEN LINYING[1] , WANG HONGBIN[2]

[1] CAS Key Laboratory of Marginal Sea Geology, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou 510640, China (cdf@gig.ac.cn)

[2] Guangzhou Marine Geological Survey, Guangzhou 510740, China

The sediments in gravity core DH-1, collected at water depth of 1805 m in Shenhu area on the northern continental slope of the South China Sea, are composed of two dark-gray clay silt layers (A1 and A3) and two foraminifera-rich layers (A2 and A4) (A1 to A4 are from top to bottom). The dark-gray clay silt layers with median grain size of 6-15 μm are mainly composed of clay minerals, quartz and feldspar, and show Ti/Al, K/Al, Fe/Al values similar to those of hemipelagic sediments of South China Sea. These indicate that the layer of A1 and A3 are background hemipelagic sediments. Unlike silt layers, the intervening foraminifera-rich layers (A2 and A4) exhibit relatively high Ti/Al, K/Al, Fe/Al and Zr/Al ratios and carbonate contents, as well as higher median grain size, suggesting a more coarse detrital materials input, and could be bottom current reworking of the turbidite. Radiocarbon dating of sedimentory planktonic foraminifera indicat that the ages of the turbidity in A4 and A2 are later than 23.1 ka BP and eariler than 23.1 ka BP, respectively. These turbidites might result from the sea level change since the last glaciation. The foraminifera-rich layers (A2 and A4) are characterized by moderate enrichment of redox-sensitive elements (Mo, As, Sb and U) and nutrient elements (Cu, Ni, Cd and Zn) with enrichment factors of 4.5-48.5 relative to the upper continental crust. However, the degree of the enrichment of these elements is less than those of the typical modern anoxic basins such as the Mediterranean sapropel, but similar to those of the Chile shelf reducing but non-sulfidic bottom water. In these foraminifera-rich turbidity sediments, Mo, As, U, Cd and Sb are likely derived from sea water and accumulated through diffusion across the sediment/water interface, while Cu, Ni, Cr and Zn accumulated via pre-concentration in biodetritus, and V could be of both machanism. All above indicated that the abundant of foraminiferal by turbidite from shallow-water and bottom current reworking induced the local bottom water to be reducing and non-sulfidic condition, which lead to the enrichment of these trace metals.

Keywords: Enrichment mechanism, Trace metals, Foraminifera-rich turbidites, Redox condition, 14C age, Northern South China Sea

Acknowledgments: This study was supported by the National Natural Science Foundation of China (91228206) and National Special Project on Gas Hydrate of China (Grant No.GZH201100305-06-07).

Different Types of the Shelf Break Zone and the controlling factors at the Qiongdongnan Basin, northwestern South China Sea

HONG-JUN CHEN[1, 2, 3] , WEN-HUAN ZHAN[1, 3], MING-MING WEN[2], LI-QING LI[2]

[1] CAS Key Laboratory of Marginal Sea Geology, South China Sea Institute of Oceanology, CAS, Guangzhou 510301, China (chhju@163.com)

[2] Key Laboratory of Marine Mineral Resources, Ministry of Land and Resources, Guangzhou Marine Geological Survey, Ministry of Land and Resources, Guangzhou, 510075, China

[3] University of Chinese Academy of Sciences, Beijing 100049, China

The shelf break zone has been known for its unique hydro-dynamic conditions and sedimentary processes. The current study explores the geomorphology of the shelf break zone and the sedimentary process involved in its formation. We chose the shelf break zone at the Qiongdongnan Basin (QDNB) as the study area. The characteristics of the shelf break zone located at the QDNB were examined using multibeam bathymetry and high resolution single-channel seismic data. We found greater variation in the water depth range of the shelf break zone running along the NE–SW direction of the QDNB. The zone is also characterized by complicated and different shapes. The shelf margin of the basin mainly developed since 5.3 Ma. The tectonic subsidence rate and sediment supply were different inside the basin. The shelf break zone was divided into three segments, namely, the eastern, middle, and western segments, according to the geomorphology and seismic characteristics. The eastern segment is characterized by deep incised canyons and gullies. The middle segment has small canyons and gullies with a gentle slope gradient. The western segment has a smooth floor, gentle gradient and progradational slope clinoforms. In addition, our findings suggest that the eastern segment of the shelf break zone belongs to an erosion-dominated type, while the middle and western segments belong to a transitional type and deposition-dominated type, respectively. The formation, development and the migration of the shelf break zone was mainly controlled by the tectonic subsidence rate and sediment supply. The above research results may be used as a scientific base for research into sedimentary processes and into deep sea oil and gas exploration.

Keywords: Shelf break zone, Geomorphology, Types, Contrlling factors, Qiongdongnan Basin, South China Sea

Regional tectonic imprints on Oligo-Miocene third-order sea level changes in the northern South China Sea

QIANYU LI [1], LEI SHAO [1], XIONG PANG [2], LILI ZHANG [2]

[1] School of Ocean and Earth Science, Tongji University, Shanghai 200092, China (qli01@tongji.edu.cn)
[2] China National Offshore Oil Corporation Ltd., Shenzhen Branch, Guangzhou 510240, China

We reconstructed sea level curves for the Oligocene-Miocene sediment sequences recovered in industrial wells from the northern South China Sea shelf and slope. The reconstructions were based on microfossil abundance and depth-specific foraminiferal species in ditch cuttings samples, constrained also by lithostratigraphic and seismic facies. These fauna-based bathymetric changes represent third order sea level fluctuations but in a good match with the global eustatic curve only on the frequency. Unlike the stepwise lowering global sea level, the regional sea level change features a stepwise rising trend from the early Oligocene to late Miocene, indicating the impacts of regional tectonics from the initial spreading to post-spreading subsidence. The first phase at 33-23 Ma corresponded to the initial spreading subsidence and affected sites now on the middle and lower slope as deep water first established in initial-breakup troughs or grabens. The second phase at 23-16 Ma corresponding to the accelerated spreading subsidence affected more sites on shelf and slope, accompanied by shelf-break quickly moving landward. The third phase at 16-5 Ma saw maximum water depth or highest sea level in the northern SCS region, with many inner shelf sites bathing in 200-500 m water depths to mark a period of post-spreading thermal subsidence. Together, at least 14 cycles can be recognized to characterize the regional third-order sea level history of the Oligocene-Miocene, shedding new lights on the sedimentary evolution of the South China Sea basin.

Keywords: sea level, Oigocene-Miocene, South China Sea, basin evolution

Temporal and spatial distribution of shallow water carbonates and their respond to tectonic evolution in Reed Bank Area, South China Sea

YUANTAO LIAO[1], YUXI GUO[1], JIANYE REN[1], YONGJIAN YAO[2], DIANJUN TONG[1]

[1]Fauclty of Earth Resources, China University of Geosciences, China (ytliao@cug.edu.cn)
[2]Guangzhou Marine Geological Survey, China

The Reed Bank area is located in the southeast part of the South China Sea(SCS), adjoining the Palawan Island. It is a structural transition zone of the south collision convergent edge and the east subduction convergent edge of the South China Sea. In the Reed Bank area, a set of prominent reflectors in seismic profile is associated with widespread Late Oligocene to Early Miocene (28-15Ma) carbonate platforms. The carbonate platforms were featured with high-amplitude continuous reflections at the top and low-amplitude subparallel reflections within which is similar to the proven carbonates in the offshore Palawan. Carbonates remain abundant but mainly as isolated reefs that grew on top of tilted fault blocks, basement highs or other structural highs to the Middle Miocene, and even to present in the Reed Bank area. This reflectors and the underlying carbonates can be used to constrain the timing of the unconformities and the rifting history of the Reed Bank area. We identify the carbonate platforms and reefs which grown upon a region unconformities (T4). It is a post-rift unconformity responds to the breakup of the South China Sea and represents the transformation from graben or half-graben basin to down-warped basin. Many reefs stopped growth beneath another region unconformity which is known as the "Red Unconformity". This in fact is an Early Miocene unconformity, which responds to the ceasing of the NW Sub-basin expanding. Synthetically the tectonic evolution mainly controls the development of carbonate platforms and reefs in the Reed Bank area. The Reed Bank area was in a relatively tectonic stable condition during the drifting stage of SCS. An everlasting shallow marine environment and low sediments input contributed to the formation of carbonate platforms. A flexural tectonic subsidence due to the collision and foredeep developed between the Reed Bank area and Palawan Island and the rapid sea level rising resulted in the regional carbonate platform drown and die. However, local reefs which grew on the forebulge have remained active up to the present.

Keywords: Carbonates, tectonic evolution, Reed bank, South China Sea

Acknowledgements

We gratefully acknowledge Guangzhou Marine Geological Survey for supporting this study. This study is partly funded by the Key Labortary of Submarine Geosciences (KLSG1405).

References

Steuer S., Franke D., Meresse F., Savva D., Pubellier M., Jean-Luc Auxietre J.-L., 2014, Oligocenee Miocene carbonates and their role for constraining the rifting and collision history of the Dangerous Grounds, South China Sea, Marine and Petroleum Geology, 58, 644-657

Steuer S., Franke D., Meresse F., Savva D., Pubellier M., Jean-Luc Auxietre J.-L., Aurelio, M., 2013, Time constraints on the evolution of southern Palawan Island, Philippines from onshore and offshore correlation of Miocene limestones, Journal of Asian Earth Sciences, 76, 412–427.

Fyhn, M., Boldreel, L., Nielsen, L., Giang, T., Nga, L., Hong, N., Nguyen, N., Abatzis, I., 2013, Carbonate platform growth and demise offshore Central Vietnam: effects of Early Miocene transgression and subsequent onshore uplift. Journal of Asian Earth Sciences, 76, 152-168

Comparison of in situ technology for benthic flux of dissolved oxygen

CUI SHANGGONG, ZIKE JIANG, XINSHENG YU

[1] College of Marine Geoscience , Ocean University of China, Qingdao 266100, China (cui_sg@126.com)

The sediment-water interface (SWI) plays a key role for mass exchange between the seafloor and the water column. It is a important place that the interaction of physical, chemical and biological process are took place in different spatial and time scale. Understanding the mechanisms that benthic dissolved oxygen consumption rates and transport process can provide critical insight into benthic ecosystem, pollution effects and biogeochemical process. For example, the consumption rate of benthic dissolved oxygen is one of the important indicators of evaluation of early benthic digenesis, and dissolved oxygen also has strong influence on the cycling of nitrogen, phosphorus, and iron etc. However, in situ measurement of benthic flux of dissolved oxygen is challenging because of the environment hostile. Many measurement techniques used in the laboratory could not be employed in the seabed. This report gives an overview of current state of art techniques used for benthic oxygen measurement. The methodology and quality of microsensor profiler, optode planar, benthic chamber, and eddy correlation techniques are evaluated. Recommendations are made regarding different experiment requirement and the emerging technologies are summarised.

Keywords: in situ monitoring technology, benthic flux, comparison

Spatial and temporal changes in the depositional processes off Fukuoka, SW Japan during the Holocene

NAOHISA NISHIDA[1] AND KEN IKEHARA[1]

[1] Geological Survey of Japan, AIST (n.nishida@aist.go.jp)

Tsushima Strait is the only gateway for the Tsushima Warm Current (TWC) into the semienclosed Sea of Japan. The evolution of depositional processes in the strait during the Holocene is not well documented. Therefore, we have investigated marine sediments off Fukuoka, southwest Japan, adjacent to the eastern channel of the Tsushima Strait. For the purpose, we used a vibrocorer to collect samples from 11 sites on the coarse-grained sandy shelf (33–68 m water depth). As a result, 1.5–4.9 m long cores were obtained. On the basis of grain size, color, sedimentary structures, bounding surface characteristics, and ichnofacies, 7 lithofacies, such as inner shelf, embayment/tidal flat, tidal channel, coastal dune (?), shoreface (?), marsh (?), and offshore mud, are recognized. Furthermore, radiocarbon dating results obtained from shell fragments indicate that these deposits formed mainly at two times, from 11.6 to 8.4 cal kyr BP and since 6.6 cal kyr BP. The main temporal changes recorded in the depositional environment off Fukuoka during the Holocene include (1) coastal and shallow-marine environments before the last glacial maximum, (2) an embayment during the period 11.6–8.4 cal kyr BP, (3) a general hiatus in deposition from 8.4 to 6.6 cal kyr BP (apart from a few tidal channel deposits in the shallower area) as a result of sediments bypassing the area because of intense TWC activity, and (4) TWC-influenced shelf deposition after 6.6 cal kyr BP. The nature of the TWC-influenced deposits changed in space and time during sea-level rise. Overall, the evolution of the TWC-influenced deposits suggests that the strait/seaway environment was controlled mainly by water depth, but also by sediment supply and the strength of the oceanic current.

Keywords: Tsushima Warm Current, Tsushima Strait, 14C dating, Holocene

Sedimet dynamics around the Okinawa-jima Island, central Ryukyu Arc, southwestern Japan

TAKUYA ITAKI [1], ATSUKO AMANO[1], NAOHISA NISHIDA 1, HAJIME KATAYAMA [1]

[1] Geological Survey of Japan, AIST, Japan, (t-itaki@aist.go.jp)

Geological Survey of Japan have carried out research cruises around the Ryukyu Arc since 2008 in order to improve geoinformation of Japan. During three cruises GH08, GH09 and GH10 by R/V Hakurei No. 2, we collected about 400 surface sediments and 13 sediment cores around the Okinawa-jima Island, central part of the Ryukyu Islands. Major component of the sediments is carbonate bioclastics mainly originated from coral, algal carbonate, shells, briozoans and foraminifers. Reefal corals and rhodolith cover the flat seafloor of the island shelf and shelf edge. Bioclastic sand including many foraminiferal tests distributes mainly on the shelf slope. Muddy sediments are recognized in continental slope east off the Okinawa-jima Island, small basins west off the island and near river mouth or bay. Regional sediment dynamics have been investigated based on results of various analysis using these samples.

Bottom photos show wide distribution of ripples (~20 cm wavelength) in water depths ranging between 200 and 1,500 m. Surface seiments from these area were characterized by well-sorted fine to medium sand mainly composed of planktonic foraminiferal tests. According to Stow et al. (2009), such characteristics of the sediment suggest influence of bottom currents such as contour current of 10 to 30 cm/sec velosity. This estimate is consistent with bottom current induced by the Kuroshio countercurrent, which is a simulation resut based on the obserbation (Nakamura et al., 2008).

Keywords: surface sediment, contourite, carbonate, paleoenvironment, Kuroshio

References

Nakamura, H., Nishina, A., Ichikawa, H., Nonaka, M., and Sasaki, H., 2008, Deep countercurrent beneath the Kuroshio in the Okinawa Trough, Journal of Geophysical Research, 113, C0630.

Stow, D.A.V., Hernández-Molina, F.J., Llave, E., Sayago-Gil, M., Díaz-del Río, V., Branson, A., 2009, Bedform-velocity matrix: the estimation of bottom current velocity from bedform observations, Geology, 37, 327–330.

Giant trochoidal sand waves in southwest Beibu Gulf: geometry and origin

XIAOCHUAN MA, CHANGAN CHEN, ZHENDONG LUAN

[1] Institute of Oceanology, Chinese Academy of Sciences, Qingdao,China (mxch@qdio.ac.cm)

From recent collected bathymetry data, some very large trochoidal and nearly symmetrical sand waves are found in Beibu Gulf, which is similar to those described on other continental shelves covering glacial sediment during LGM. The large sand waves are located at depths of 25~45 m in southwest Beibu Gulf having widths of 50~250m and heights up to 15 m, which are not corresponding to the present current regime. The height and width have a good correlation: H=0.1192 L0.901(R2=0.8766). Cross-sectional shallow seismic profiles illustrate bi-directional sets of bedding inside the sand waves, in which the north-dipping layers overlay the south-dipping layers. Erosion in the trough of sand waves provide sediment for their growth and also increase their heights. The widespread inclination reverse of beddings indicates that the direction of sediment transport in the study area might be widely reversed in the past. Seeing that the present sea level is very close to that in 6ka BP and the study area were subaerial before 9ka BP, we simulated paleo- near-bottom tidal currents in a spring-neap period during 6-9 ka BP with intervals of 500 years to document temporal variations of currents during the sea level rise from LGM. Results show that the residual currents in the study area began reversing their directions from southwest to northeast in 7 ka BP. The sea rise from LGM and the open of Qiongzhou Strait may be responsible for the reverse of currents, sediment transport, thus formation of giant sand waves.

Keywords: sand waves, sediment transport, bedding, current, Beibu Gulf

Monitoring sediment transport using the combined data from ADCP and LISST-HOLO: coastal to Polar Oceans

H.K. HA[1]

[1] Department of Ocean Sciences, Inha University, Incheon, Korea (hahk@inha.ac.kr)

Short-term (1-5 days) mooring measurement has been conducted to investigate the dynamic behavior of suspended particulate matters (SPM) using the combined data from an acoustic Doppler current profiler (ADCP) and digital holographic particle imaging system (LISST-HOLO). Main objective is to measure the concentration and the settling flux of SPM within the upper (< ~80 m) water column under the sea ice. Mooring observation of hydrography, hydrodynamics and suspended particles distribution revealed the mixing and entrainment pattern of SPM in the upper mixed layer, and the SPM concentration increased up to about 100 mg/l. The SPM flux was significantly fluctuated upward or downward by turbulent motions. During the presentation, the application LISST-HOLO, mostly recently commercially released, to the determination of the particle size and settling flux will be dealt. In particular, the preliminary in-situ data collected in the offshore sand dredging site will be beneficial for the sediment dynamics community that is seeking a new technique and method to measure the properties of sediments in suspension.

Keywords: Suspended particulate matter, sediment transport, ADCP, LISST-HOLO

Impact of marine salinity on the critical shear stress of fine-grained sediments

LIU JIAO [1], SHANHONGXIAN[1], ZHANG HONG[1], ZHANG SHAOTONG[1], JIAYONGGANG[1,2]

[1]College of Environmental Science and Engineering, Ocean University of China, Qingdao 266100, China;(yonggang@ouc.edu.cn)

[2]Key Laboratory of Marine Environment and Ecology Ministry of Education, Ocean University of China, Qingdao 266100, China

The Yellow River runoff into the sea, climate and ocean dynamic conditions always affect the salinity environment in the Yellow River estuary area. Meanwhile the dynamic behavior of estuarine sediments is closely related to the Yellow River estuary salinity environment. In order to study the impact of different salinity environment on the erosion-resistence of estuarine sediments, in-situ measurement about the erosionresistance of fine-grained sediment were conducted using CSM(Cohesive Strength Meter)on the tidal flat of the modern Yellow River delta, simulating different salinity sedimentary environment. The results show that the critical erosion shear stress of fine-grained sediments varies between 0.728Pa-1.581Pa, with the increase of salinity sedimentary environment, the critical shear stress of fine sediments linearly increases. When the salinity sedimentary environment increased by 1 ‰, corresponding critical shear stress increases about 0.02Pa.

Keywords: fine-grained sediments; salinity environment; critical shear stress; erosion-resistance; shear strength

Sediment dynamics by interactions between waves and currents on an intertidal mudflat along the southern flank of the Yangtze River Delta, China

JUN LU AND DAIDU FAN

[1]State Key Laboratory of Marine Geology, Tongji University, Shanghai 200092, China (junloo@126.com)

Wave-current interactions over different scales are deemed to exert critical impacts on sediment transport and morphological evolution of tidal flats, especially for those along the open coast. Intratidal variation in wave-current interactions was monitored through deploying one ADV (Acoustic Doppler Velocimetry) and one OBS (Optical Back Scatter) on a stainless-stain frame at the lower intertidal flat along the southern flank of the Yangtze River Delta on Sept. 5 to 7 in 2013 (spring tides). They were both set to work in a continuous operation mode, and the ADV sampling frequency was set at 32 Hz. Their detecting volumes were located at 0.68 m and 0.52 m above the bed, respectively. The raw ADV velocity data were examined for signal quality, and some abnormal values were consequently eliminated if the signal noise ratio (SNR) is less than 5 dB or the correlation coefficient is less than 70%. High frequency ADV pressure data were converted into surface wave spectra through a transfer function.

The result showed that average tidal currents were 0.3 m×s-1, and suspended sediment concentrations changed from 0.8 to 2.8 kg×m-3 over the observation period. The significant wave height varied from 0.03 to 0.51 m, and bottom orbital velocities spanned from 0.03 to 0.13 m×s-1. Several peaks of suspended sediment concentrations were observed during each tidal cycle, particularly at the flooding front and the late ebbing stage. These peaks reflected strong currents and/or intense wave-current interactions. Bed shear stress by currents, waves, and combined wave-current action, were calculated. The results showed bed shear stress by wave-current interactions were generally larger than the critical shear stress for erosion over most of tidal cycle. Most of fine-grained sediments could be transported as suspend loads. Asymmetric sediment transportation of flood and ebb tide were apparent, leading to net landward sediment transport. This accounts for continuous accretion over the study tidal flat even after large-scale land reclamation and significant decrease in sediment discharge of the Yangtze River after the Three-Gorges Dam.

Keywords: wave-current interactions, sediment dynamics, shear stress, mudflat, Yangtze River Delta

Post-LGM (Last Glacial Maximum) Stratigraphic Sequence and Environmental Evolution in the Yangtze Subaqueous Delta

SU JIANFENG[1] AND FAN DAIDU[1,2]

[1]School of Ocean and Earth Science, Tongji University, China (385715061@qq.com)
[2]School of Geoscience, Yangtze University, China

The Yangtze River, one of the largest rivers in the world, has developed a broad tide-dominated delta at its mouth since the Holocene sea-level highstand. Two cores (YD0901 and YD0903) were retracted from the Yangtze sub-aqueous delta in 2009 to clarify the characteristics of stratigraphic sequence and environmental evolution history in this area. Detailed analyses of sedimentary facies, grain-size compositions and elemental ratios (Cl/Ti、Zr/Rb) reveal two different facies associations in respect of transgression and regression since the Last Glacial Maximum (LGM). They are vertically stacked in turn from fluvial facies at the bottom, through tidal-fluvial facies, estuarine facies, and shallow-marine facies, to deltaic facies at the top. According to AMS 14C dating results, post-LGM transgression reached the coring area roughly in 14.8 cal ka BP. The rate of shoreline retreatment was up to 71.9 km/ka during 14.8 ~ 13 cal ka BP with the deposition center shifting from YD0903 to nearby CX03, resulting from rapid sea-level rise by the MWP-1A event. Since then, a high deposition rate in CX03 had been maintained at 7~8 mm/a until 7 cal ka BP when the maximum transgression occurred. In the early regression period, the deposition rate of the boreholes was low. It increased significantly even doubled since 2 cal ka BP, presumably linked with delta progradation and increasing human activity. The sedimentary facies of core CX03 combined with dating results indicate that the Changxing river-mouth sand bar has been developed since the 4 cal ka BP.

Key words: Yangtze sub-aqueous delta, LGM, AMS 14C dating, sedimentary facies, sequence stratigraphy, sedimentation center

Detrital zircon U-Pb age spectra of Late Cenozoic sediments in the Yangtze delta and its implication for the catchment evolution

DAIDU FAN[1,2] AND YANGYANG WANG[1]

[1]School of Ocean and Earth Sciences, Tongji University, China (ddfan@tongji.edu.cn)
[2]School of Geoscience, Yangtze University, China

The river is main route for terrigenous material flowing into the sea. Formation and evolution of a river and its sediment flux are majorly influenced by climate change, tectonic activities. Strata of sedimentary basins along the river and around the river mouth are potential to record the history of these evolution processes. As the longest river in Asia, the Yangtze River annually transports a large quantity of sediments into the East China Sea. Its evolution in response to the uplift of Tibetan Plateau and Asian monsoon has attracted great attention from the geologists. The widely used methodology is provenance analysis including the single-grain zircon U-Pb geochronology, which is recently developed but rapidly become predominant method of provenance analysis with great advance in micro-analysis technology. Due to the large area, complex source-rock composition and distribution in the Yangtze catchment, it has been questioned to distinguish provenance singly based on zircon U-Pb age. In this study, 11 samples of different depositional ages from a borehole in the Yangtze delta were selected for zircon U-Pb dating, to explore feasibility of the methodology and reconstruct the evolution history of the Yangtze River in late Cenozoic.

The results show that 3 samples from the Pliocene (> 2.6Ma) have similar age spectrum with an obvious peak at 100~200 Ma, and the others present in 700~900 Ma and 1700~1900 Ma. They are completely different from those of the other 8 samples from the Pleistocene, which share similar distribution pattern of ages clustering at the periods of 100~300 Ma, 350~550 Ma, 600~1000 Ma, 1400~2000 Ma, and 2200~2800 Ma. Some typical evidences for provenance discrimination are summarized. ① Cenozoic zircons are only present at the strata younger than 2.6 Ma with small content less than 0.67% in each samples, commonly considered to source from the Tibetan plateau in the upper reach. ②The percentages of Cretaceous zircons sharply decrease from more than 60% in the Pliocene deposits to less than 15% in the Pleistocene sediments, and their source rock is majorly distributed in the lower reach. ③The 8 Pleistocene samples have higher content of Late Paleozoic, Early Paleozoic and Neoproterozoic zircons than the 3 Pliocene′s, conceivably sourced from Emei basalt LIP, Qinling tectonic belts and the Cathaysia Block, and the Yantze block, respectively.

It was therefore indicated that the sedimentary provenance of the Yangtze delta changed dramatically near 2.6 Ma. Sediments were mainly derived from the middle and lower reaches of the Yangtze River before 2.6 Ma, while after that the contribution from the upper reach increased abruptly and take the predominant role, denoting the Three Gorges should have already been cut through in 2.6 Ma. Considering that the paleo-Yangtze River might firstly flow into the northern Jiangsu Basin and then gradually shifted south to the present location, the cutting-through time of the Three Gorges should be earlier than 2.6 Ma. It is worth noting that there are still some important, similar sources couldn't be distinguished effectively by zircon U-Pb ages.

Keywords: Late Cenozoic, Tibetan Plateau, Yangtze River, provenance study, zircon, U-Pb age

Stratigraphic Framework and Tectonic Evolution Process of the Middle Uplift Zone in the South Yellow Sea

PAND YUMAO[1], ZHANG XUNHUA[2], WEN ZHENHE[3]

[1] Institute of Oceanology, Chinese Academy of Science (IOCAS), China (pangyumao@126.com)
[2] Qingdao National Laboratory for Marine Science and Technology, China
[3] Qingdao Institute of Marine Geology (QIMG), China

The middle uplift zone lying on eastern sea area of Jiangsu province west of 124°E and stretching from 35°15′N to 33°40′N is the biggest stable tectonic units of the South Yellow Sea basin in lower-Yangtze block. Based on the research of latest seismic data of high quality, together with drilling results in adjacent region, four discernible effective seismic reflections are initially tracked out below the T2 reflection which represents the subsurface of Neogene strata in the middle uplift zone of the South Yellow Sea. However, the sedimentary stratum framework is still in the phase of inference due to no actural drilling data in the middle uplift zone. The continental scientific drilling plan (CSDP) conducted by QIMG is implementing a scientific drilling well located in the middle uplift zone, which is very significant for detecting stratum and calibrating seismic reflection. The seismic reflection characteristics and analysis of regional gravity and magnetic data indicate that the South Yellow Sea Basin where the middle uplift zone locates is the Yangtze block's extension to sea. The faults are mainly NE strike, NNE strike and EW strike which can be classified into thrust faults, facing thrust faults, reversed faults and normal faults, but mainly are compressive shear faults. Several faults later experienced structural inversion. Referring to the tectonic evolution process of Yangtze block, together with seismic reflection characteristics, contact relationship between stratums and structural styles analysis, the tectonic evolution process of the middle uplift zone can be subdivided into four stages including basement formation phase, marine craton evolution phase, collision uplift and denudation phase and extensional subsidence phase.

Keywords: The South Yellow Sea; Stratigraphic Framework; Faults Characteristics; Tectonic Evolution

References

Zhang Haiqi, Chen Jianwen, Li Gang, et al. Discovery from Seismic Survey in LaoShan Uplift of the South Yellow Sea and the Significance. Marine Geology & Quaternary Geology, 2009(03): 107-113.

Zhang G W, Guo A L, Wang Y J, et al. Tectonics of South China Continent and its Implications. Science China: Earth Sciences, 2013, 56: 1804-1828.

Li Huijun, Lin Niantian, Jin Xing, et al. The Fracturing Characteristics of Mesozoic and Paleozoic Eras in Laoshan Uplift of South Yellow Sea Basin. Journal of Shandong University of Science and Technology(Natural Science), 2012, 31(6): 69-75.

Ou Yangkai, Zhang Xunhua, Li Gang. Characteristics of Stratigraphic Distribution in the Middle Uplift of South Yellow Sea. Marine Geology & Quaternary Geology, 2009(01): 59-66.

Yang Changqing, Dong Heping, Li Gang. Formation and Tectonic Evolution of the Central Uplift of the South Yellow Sea Basin. Marine Geology Frontiers, 2014(07): 17-21.

Sun Jing, Wang Jianqiang, Xiao Guolin, et al. Distribution Pattern of Marine Upper Structural Layer and Fault System on the Central Uplift of the South Yellow Sea Basin. Marine Geology Frontiers, 2014(10): 18-25.

Wang Feng, Li Huijun, Zhang Yinguo. Stratigraphic Geologic Attribute and Hydrocarbon Geology in LaoShan Uplift of South Yellow Sea. Marine Geology & Quaternary Geology, 2010(02): 95-102.

Hypoxia in the Yangtze Estuary and East China Sea : a review

XIANGTONG HUANG[1] , SHOUYE YANG[1]

[1]State Key Labaratory of Marine Geology, Tongji University, Shanghai, 200092, People's Repulic of China.(corresponding xiangtong@tongji.edu.cn)

Dissolved oxygen is very important for estuarine and coastal marine ecosystems to sustain the life of all fishes and invertebrates. However, it appears that the phenomenon of hypoxia and anoxia is increasing around the world, and to date more than 550 so-called "Dead Zones" have been identified. Although the occurrence and acceleration of many of hypoxic zones can be considered as the consequence of human activity, such as excess nutrient loading, pollution, eutrophication, etc., it is still unclear when and why it occurred, and there is a challenge to distinguish natural and anthropogenic effects on hypoxia. Particularly, little is known on the effects of hypoxia on bio-geochemical processes of marine systems. Here, we make an effort to review the history of and progress on the hypoxic zone of the Yangtze Estuary and East China Sea inner shelf, and to address opportunity for marine geologists to explore further in this cross-discipline.

As mentioned in literature, the oxygen minimum zone in the Yangtze and East China Sea was first noticed in 1950-60s. However, until the dawn of this century, it has drawn a lot of attentions in marine and environmental sciences. A series of investigations, mainly focused on dissolved oxygen measurements, were conducted to understand the spatial distribution and formation mechanisms. It is found that hypoxia of this region is a summertime phenomenon that mainly initiates in July, matures in August and disappears in September, and is quite variable spatially and monthly. The extent of mid-summer hypoxic water exceeds 13,700 km2. Apart from nutrient loadings, other natural factors, such as sea water temperature, salinity, stratification of water column, topography and circulation, work synergistically to the form hypoxic zone. Obviously, it is a quite complicated system and more investigations are needed, particularly there are few studies from long-term (centennial to millennial scale) perspective. This will shed lights on timing and evolution of hypoxia in the region, and be conductive to distinct and assess natural and anthropogenic impacts. Nevertheless, the successful reconstruction of long-term variability of hypoxia depends on high-quality cores and suitable indicators of low-oxygen event. Clearly, the method of multi-proxy is required, and the combination of total organic carbon, nitrogen, trace mental elements (Mo, Cu, V, Cr, Mn) and isotopes is most promising.

Key words: hypoxia, Yangtze estuary, East China Sea, natural and anthropogenic impacts

Sources, dispersal and decay of sedimentary organic matter across the East China Sea continental margin

PENG YAO[1, 3], BIN ZHAO[1, 2], JINPENG WANG[1, 2], TINGTING ZHANG [1, 2], HUIHUI PAN [1, 2], DONG LI [1, 2], LIMENG GAO[1, 2]

[1]Key Laboratory of Marine Chemistry Theory and Technology, Ministry of Education, China (yaopeng@ouc.edu.cn)
[2]College of Chemistry and Chemical Engineering, Ocean University of China, China

River-dominated Ocean Margins (RiOMars) are major depocenter of terrestrial organic matter (OM) in the ocean (McKee et al., 2004). Knowledge of the sources, composition, distribution and fate of sedimentary OM (SOM) in RiOMars is critical for understanding the global carbon cycle and the role of RiOMars. Fifty three surface sediments collected from the East China Sea (ECS) shelf were analyzed for grain size composition, specific surface area (SSA), dry bulk density (DBD), elemental composition (C, N), stable carbon isotopic composition (δ13C), and lignin-phenols to investigate spatial variability of the sources, dispersal and decay of SOM, and to discriminate between the extent of hydrodynamic sorting versus degradation. Fine particles (silt and clay) with low DBD and high SSA and total organic carbon (TOC) were mainly distributed in the Changjiang Estuary, Zhe-Min Coast and the distal mud area southwest of the Cheju Island, while the ECS shelf was characterized by sandy sediments with high DBD and low SAA and TOC, indicating that hydrodynamic sorting processes play an important role in the dispersal of OM. Bulk and molecular data indicated a mixed marine/terrestrial OM sources across the ECS shelf. Most of the terrestrial OM delivered by the Changjiang deposited near the estuary and transported southward along the Zhe-Min Coast, whereas offshore transport was limited. Enriched 13C of TOC (~-21‰) in sediments southwest of the Cheju Island was observed, indicating high OC contribution from marine phytoplankton. SOM in sediments off the Zhe-Min Coast was characterized by relatively negative δ13C, suggesting possible inputs from the mountainous rivers of Taiwan (Xu et al., 2009). Lignin-phenol composition parameters (such as the ratios of syringyl to vanillyl phenols (S/V) and cinnamyl to vanillyl phenols (S/V) and the lignin phenol vegetation index (LPVI)) in most sediments reflected predominately woody angiosperm sources, but in sediments southwest of the Cheju Island non-woody angiosperm sources (e.g. grasses and needles) were more important. A three end-member mixing model using lignin contents (Λ8) and δ13C as parameters and based on Monte-Carlo (MC) simulation showed that marine OC was the predominant OC source across the whole shelf, accounting for an increasing fraction along the coast and seaward (51% to 88%, avg. 74%), with the highest contribution found in the mud area southwest of the Cheju Island. OC from lignin-rich C3 vascular plants concentrated in the Changjiang Estuary and decreased sharply off the estuary (5% to 22%, avg. 7%), while high soil-derived OC was found not only in the Changjiang Estuary but also in the Zhe-Min Coast (15% to 36%, avg. 19%), indicating that lignin-poor soil OC could transport a longer distance along the coast compared to the C3 vascular plant-derived OC, which further proved the significant role of hydrodynamic sorting on the selective transport of terrestrial OM since soil materials are usually bound in fine particles while vascular plant detritus are usually found in coarser sediments (Li et al., 2014). Although high TOC contents were found in the mud areas of the Zhe-Min Coast and southwest of the Cheju Island, distinctively low TOC/SSA loadings (<0.40 mg m-2) were observed in these mud deposits, indicating an inefficient OC preservation, consistent with the high lignin decay parameters (such as the acid to aldehyde ratio of vanillyl phenols ((Ad/Al)v) and 3,5-dihydroxybenzoic (3,5-Bd)) contents. Considering the labile nature of marine phytoplankton, priming effects might stimulate degradation of terrestrial OC in the mud deposits (Yao et al., 2014). Finally, the 3,5-Bd to vanillyl phenols ratio (3,5-Bd/V) and p-hydroxybenzenes to the sum of S and V phenols ratio (P/(S+V)) exhibited a clear across-shelf increasing trend, suggesting either increasing degradation with distance from the coast or hydrodynamic sorting of terrestrial OC along the sediment dispersal system (Yao et al., 2015). This study highlighted the need of multi-proxy approach to differentiate the transport and fate for different autochthonous and allocthonous OC sources in RiOMar sediments.

Keywords: East China Sea, sedimentary organic matter, source, dispersal, decay

References

Li, D., Yao, P., Bianchi, T.S., Zhang, T.T., Zhao, B., Pan, H.H., Wang, J.P., Yu, Z.G., 2014, Organic carbon cycling in sediments of the Changjiang Estuary and adjacent shelf: Implication for the influence of Three Gorges Dam, Journal of Marine Systems, 139, 409–419.

Mckee, B.A., Aller, R.C., Allison, M.A., Bianchi, T.S., Kineke, G.C., 2004, Transport and transformation of dissolved and particulate materials on continental margins influenced by major rivers: benthic boundary layer and seabed processes, Continental Shelf Research, 24, 899–926.

Xu, K.H., Milliman, J.D., Li, A.C., Liu, J. P., Kao, S.J. and Wan, S.M., 2009, Yangtze- and Taiwan-Derived Sediments in the Inner Shelf of East China Sea, Continental Shelf Research, 29, 2240–2256.

Yao, P., Zhao, B., Bianchi, T.S., Guo, Z.G., Zhao, M.X., Li, D., Pan, H.H., Wang, J.P., Zhang, T.T., Yu, Z.G., 2014, Remineralization of sedimentary organic carbon in mud deposits of the Changjiang Estuary and adjacent shelf: Implications for carbon preservation and authigenic mineral formation, Continental Shelf Research, 91, 1–11.

Yao, P., Yu, Z.G., Bianchi, T.S., Guo, Z.G., Zhao, M.X., Knappy, C.S., Keely, B.J., Zhao, B., Zhang, T.T., Pan, H.H., Wang, J.P., Li., D., 2015, A multi-proxy analysis of sedimentary organic carbon in the Changjiang Estuary and adjacent shelf, Journal of Geophysical Research: Biogeosciences, http://dx.doi.org/10.1002/2014JG002831.

Assessment of Metals Pollution in Water and Sediments of the Danang Bay, Vietnam

VAN DUC NAM[1], NGO THI THUY HUONG[2]

[1]Marine Natural Resources Environment Survey Center, Vietnam (ngothithuyhuong@gmail.com)
[2]Vietnam Research Institute of Geoscience and Mineral Resources

Danang is the largest city and the most important economic growth centers in the central region of Viet Nam. The economic development also exerts the adverse impacts on both public and environmental health. In Danang, most of the city's wastewater is collected in coastal interceptor sewers, river, lakes; and often discharged to the Danang Bay, causing environmental pollution and degradation, and potentially affecting human health. The question raised is how the pollution of sea water and sediment in Danang Bay change during the period of more than 10 years of development.

In this study, the investigation of the water and sediment quality in terms of selected metals' concentration of Danang Bay, i.e. Hg, As, Cd, Pb, Cu, Zn, Mn, was carried out. The results from this investigation (taken in 2007-2009) were compared with the data from Danang Initial Risk Assessment (DOSTE, 1995-2001), the national monitoring program (DOSTE-NEA, 1995-2001), the results of Danang Bay environmental monitoring and Tram environmental monitoring (VCEP, 1998b), and the EIA Report of Danang City's Sanitation Project (URENCO, 1997).

The anthropogenic activities in the Danang city contribute to the contamination of metals in the Danang Bay, especially in the sediment. The water showed a risk of Pb pollution, especially in the northern part of Danang Bay. In sediment, Hg and As were highly exceeded the Canadian Soil Quality Guidelines for the Protection of Aquatic life up to 3 to 5 times, respectively. One or some anomaly sites were observed for each investigated metals due to the influence of anthropogenic activities. However, the change in concentrations of these metals during the period of more than 10 years of development are not statistically significant.

The results of this study might be helpful for evaluation of metals pollution impacts, and for assessing past contamination events.

Keywords: metals, water pollution, sediments, Danang Bay, Vietnam

Total mercury (THg) concentrations in the Yellow Sea sediments: distribution, accumulation, and pollution history

J.H. KIM[1] , D.I. LIM[1]

[1] Korea Institute of Ocean Science & Technoloyg, Korea (oceanlim@kiost.ac.kr)

The Yellow Sea, one of the highly contaminated marginal seas being inflowed by large river systems (especially the Yangtze river), is experiencing rapid environmental changes after last 100 years. Particularly, mercury contamination in the sea has been concerned seriously because of continuous increasing of Hg discharge from the rivers and its potential adverse health effects on ecosystem and human. However, few studies have been done on the source, transport and accumulation processes of anthropogenic Hg in the Yellow sea. Here we present the first comprehensive data set for total mercury (THg) in the whole Yellow Sea shelf system including the Korean and Chinese rivers to document the present-day distribution of THg and furter to investigate accumulation budget and pollution history. Concentrations of THg, Al (as sediment grain-size normalizer) and total organic carbon (TOC) were analyzed using 494 surface sediments and three box cores sampled from the shelf, coastal zones and the rivers.

THg, Al and TOC concentrations showed a large variation in their spatial distributions, representing their concentrations ranged from 0.7 to 215.7 ng/g (26.1±28.4 ng/g), 1.63 to 10.41% (6.43±1.55%) and 0.02 to 2.66 (0.58±0.42%), respectively. In particular, high THg concentrations (> 30 ng/g) are prominent in the central Yellow Sea mud zones, especially around the Korea's Yellow Sea disposal site, and the coastal zones around the Yangtze and small Korean rivers. Overall, spatial distribution patterns of THg coincide with those of Al and TOC; high concentrations of THg in the Yellow Sea mud zones and the Yangtze coast. Such coincidence is certainly supported by high positive correlation of Al (r2=0.64) and TOC (r2=0.73) with THg concentrations, except some samples with high THg concentrations (> 50 ng/g) in sediments from the Yangtz coast and the sea disposal site. It revealed that THg concentrations are strongly controlled by sediment grain-size and/or TOC.

In this study, natural background value of THg was estimated using the linear regression line (THg=4.25×Al-11.08) between THg and Al, after removing all the outliers. Based on such estimation, high anthropogenic Hg enrichment occurred in the coastal area of the Yangtze, ocean disposal site and the southwest Jeju Island mud (SWCIM) area. Interestingly, relatively high Hg accumulation in the SWCIM may be correlated with the Yangtze-derived fine-grained sediments with high Hg concentrations.

Mass accumulation rates of Hg in the Yellow Sea are estimated to be ranged between 0.01 and 61.3 x 10-5 g/m2/yr. Overall, the values are low (1.3×10-5 g/m2/yr in average) in the eastern part and central part of the shelf, but are highest (19.7×10-5 g/m2/yr in average) in the Yangtze coast, followed by the western part of the sea (8.3×10-5 g/m2/yr in average), the ocean disposal area (6.2×10-5 g/m2/yr in average), and then the northern shelf of East China Sea (6.0×10-5 g/m2/yr in average). The averaged annual accumulation flux of THg in the Yellow sea is 25.34 ton/yr (2.74 to 97.74 ton/yr), which is similar with that of the previous report (Yuan et al., 2012). Most of the sedimentation fluxes of THg are concentrated in the Yangtze coast (section IV), accounting for 43.6%, followed by the western part (Chinese offshore, section I) of the sea and the northern part of East China Sea (section V), for 22.7% and 21.5%, respectively. Although the sea disposal site has the highest THg concentrations, the annual accumulation flux is practically low (0.40 ton/yr in average), probably due to low sedimentation rate and restricted area.

On the basis of 210Pb-derived sedimentation rates, meanwhile, anthropogenic Hg accumulation was possibly started from around 1920-1930 year. Hg concentration increased about 2~3-fold over background values after 1930 year, probably in response to coal burning. Such Hg accumulation history coincides well with that from the coastal core sediments of the Yellow Sea.

Keywords: total mercurry, flux, pollution histroy, Yellow Sea sediments

Early chemical diagenesis and sediment-water solute diffusion in mud deposits of the Changjiang Estuary and adjacent shelf

BIN ZHAO [1, 2], PENG YAO [1], HUI LIU [1, 2]

[1]Key Laboratory of Marine Chemistry Theory and Technology, Ministry of Education, China (yaopeng@ouc.edu.cn)
[2]College of Chemistry and Chemical Engineering, Ocean University of China, China

Mobile muds found in River-dominated Ocean Margins (RiOMars) are one of the major alternative diagenetic facies and play a significant role in biogeochemical cycling (Mckee et al., 2004). In this study, we used dissolved inorganic carbon (DIC), nutrients (NH4+, NO3-, NO2-), major cations (K+, Ca2+, Mg2+) and anions (SO42-, Cl-) in sediment pore water to investigate the early chemical diagenesis and sediment-water solute diffusion in mud deposits of the Changjiang Estuary and adjacent inner shelf of the East China Sea (ECS). Vertical profiles of DIC and NH4+ concentrations in pore waters had similar trends with depth at most sites, showing a significant increase with depth near the Changjiang Estuary and relatively constant in offshore sites. The simple seasonally-averaged DIC diffusive flux in the Changjiang Estuary mud area (CEMA) was 2.77 mmol m-2 d-1, which was obviously higher than that in the Zhe-Min coastal mud area (ZMMA) (1.89 mmol m-2 d-1) indicating the sedimentary organic carbon (SOC) in CEMA experienced a strong remineralization process. Higher diffusive fluxes of DIC and NH4+ were observed in the ECS inner shelf during winter, which indicated that intense physical reworking of sediments in winter was likely to be the primary factor controlling remineralization of SOC (Aller et al., 2004a). Little or no depletion of SO42- at most sites with significant increase of DIC and NH4+ reflected apparent dominance of suboxic diagenesis such as iron and manganese reduction rather than sulfidic decomposition pathway (Aller et al., 2004b; Alongi et al., 2012). The sites in mud deposits of the ECS inner shelf had more depletions of porewater SO42- in winter than in summer, possibly attributed to seasonal variation of hydrodynamic conditions. The lower porewater DIC/SO42- and DIC/NH4+ ratios coupled with apparent negative diffusive fluxes of Ca2+, Mg2+ and K+ in CEMA indicated the authigenic mineral formation (Aller et al., 2004b; Alongi et al., 2012). Negative diffusive fluxes of major cations matched well with positive diffusive fluxes of DIC and NH4+, indicating that the rapid formation of authigenic minerals was occurred along with strong remineralization of OC in the ECS inner shelf during winter. In a word, seasonal hydrodynamic conditions in mobile-mud environment have great effect on diagenetic process and sediment-water solute exchange and play an important role to carbon cycling and biogeochemical cycling of other biogenic elements in the Changjiang Estuary and adjacent shelf.

Keywords: Changjiang Estuary, East China Sea, mud deposits, pore water, early chemical diagenesis, solute diffusion

References:

Aller, R. C. 2004a, Conceptual models of early diagenetic processes: The muddy seafloor as an unsteady, batch reactor, Journal of Marine Research, 62(6): 815-835.

Aller, R. C., Hannides, A., Heilbrun, C and Panzeca, C. 2004b, Coupling of early diagenetic processes and sedimentary dynamics in tropical shelf environments: the Gulf of Papua deltaic complex, Continental Shelf Research, 24(19): 2455-2486.

Alongi, D. M., Wirasantosa, S., Wagey, T and Trott, L. A. 2012, Early diagenetic processes in relation to river discharge and coastal upwelling in the Aru Sea, Indonesia. Marine Chemistry, 140-141: 10-23.

McKee, B. A., Aller, R. C., Allison, M. A., Bianchi, T. S. and Kineke, G. C. 2004, Transport and transformation of dissolved and particulate materials on continental margins influenced by major rivers: benthic boundary layer and seabed processes. Continental Shelf Research, 24(7-8): 899-926.

Provenance of fine-grained sediments since the LGM in the southeastern Yellow Sea

IK UM[1] AND MS CHOI[2]

[1]Korea Institute of Geoscience and Mineral Resources, Korea (ikum@kigam.re.kr)
[2]Chungnam National University, Korea

Despite of the well-reconstructed seismic stratigraphy of the Holocene mud deposit in the southeastern Yellow Sea called the Heuksan mud belt (HMB), provenances of sediments and their depositional environment are still remain unclear, especially for fine-grained sediment proportions. In order to discriminate the provenance of the fine-grained sediments in the HMB since the Last Glacial Maximum (LGM), fine-grained sediment samples (<15μm) were obtained by wet-sieving from two drilled cores taken from the middle and southern part of the HMB and analysed for major and REEs. Specifically, the provenances of the fine-grained sediments were realized based on the REE fractionation factor and sedimentary environments were reconstructed with regard to acoustic seismic sequences. Possible provenances such as discharged sediments from Korean river (KRS) and Chinese river (CRS) could be successfully discriminated using REE fractionation factors suggested in the previous studies (Um et al., 2013; Lim et al., 2014). The HMB consisted of several sedimentary units based on the seismic data (unit III-b, unit III-a, unit II-b, unit II-a, and unit I). From the REE fractionation factors, fine-grained sediments of all sedimentary units can be regarded as mixtures of CRS and KRS. The proportions of CRS were constant and higher than those of KRS in all units. The units III-b and III-a, which formed in the middle and northern part of the HMB, might be formed under the intertidal environment during 13,000-9,500 a by direct transport from both rivers. The units II-b and II-a might be formed under the tidal shelf environment during 9,500-6,000 a, which might be suggested that the erosion and transport from units III-a and III-b might be the sources of these units. The provenance of the unit I sediments might be reworked sediment from nearby mud deposits driven by wind and the Yellow Sea Warm Current (YSWC). The results of this study indicate that CRS is the primary provenance of fine-grained sediments in the HMB even though its location is close to Korea.

Keywords: rare earth element, Heuksan mud belt (HMB), fine-grained sediment, provenance

References

Lim, D., Jung, H.S., and Choi, J.Y., 2014, REE partitioning in riverine sediments around the Yellow Sea and its importance in shelf sediment provenance, Marine Geology, 357, 12-24.

Um, I.K., Choi, M.S., Bahk, J.J., and Song, Y.H., 2013. Discrimination of sediment provenance using rare earth elements in the Ulleung Basin, East/Japan Sea, Marine Geology, 346, 208-219.

Sediment record of paleoenvironment of the central mud of the South Yellow Sea and its response to the East Asian Monsoon during Holocene

WANG LINMIAO[1] AND LI GUANGXUE[2]

[1] Institute of Oceanology, Chinese Academy of Sciences, China (estuary@ouc.edu.cn)
[2] College of Marine Geoscience, Ocean University of China, China

The South Yellow Sea (SYS), a marginal sea in the northwestern Pacific, is a unique location, accepting huge amount of materials (sediments) from Changjiang and Huanghe Rivers. The changes in this area are influenced by the interactions of the Yellow Sea Warm Current (YSWC), the East Asian Monsoon (EAM) and the Kuroshio Current (KC); which develops a typical circulation system at the centre, and forms a unique sediment body of fine particles, thereby concealing rich information on Paleoclimate change. The study of the central mud in SYS is very important, because it elucidates the impact of sea level change and the global climate change. Moreover, it reveals Paleoceanology changes that had occurred on the continental shelf sea of the low latitude. Currently, the Paleoclimate studies of the continental seas mainly focus on the East China Sea. However, studies on the SYS are both limited and superficial. Few studies have been carried on the provenance and evolution stages of marine environment.

The YSWC plays a key role in the formation of the central circulation of the SYS and the evolution of marine sediment environment; however, previous studies lacked continuous high-resolution paleoenvironment indicators: mostly limited to discussions on its formation time. It is very important to mention that dating has been considered a bottleneck due to lack of foraminifera in the central mud of SYS, which results to lack of continuous precise time scale in SYS.

Two key scientific questions in studying the SYS are: (1) how does the sedimentary record under unique circulation responds to the EAM change; and (2) what are the factors responsible for the Paleoenvironment and Paleoceanology changes in the central mud of SYS?

Answers are provided to the abovementioned questions in this study. Core YS01 and Core YSZ05 are taken and sub-sampled. Analyses of Grain size, XRF element, BSi, SST and datings, which provides the most precise and continuous dating record when compared with the previous studies in SYS, are carried out. On the basis of these analyses, the outcomes are summarized as follows:

(1) Using AMS 14C dating, Grain- size and XRF - geochemical data for core YS01 to reconstruct the history of the East Asian Winter Monsoon (EAWM) since the mid-Holocene, continuous history of the EAWM over the past 7300 years are provided; and the EAWM can be divided into four periods: strong and highly fluctuation during 7.3 ~ 4.6 ka B.P.; moderate and relatively stable during 4.6 ~ 2.8 ka B.P.; weakened during 2.8 ~ 1.4 ka B.P.; and the transfer period during 1.4 ~ 0ka B.P.

(2) The EAM presents cycles of 1471 a，420 ~ 490 a，65a，40a，28 a，21 a, which correspond to the solar activity cycles. During the period between 10 ~ 3ka, thermohaline circulation in the high latitude controls the paleoclimate change of the East Asia. During the period between 3 ~ 0 ka, ENSO mainly impacts the EAM evolution.

(3) During the period between 6.8 ~ 2.8ka, SST was mainly affected by global climate change, while the YSWC is the controlling factor of SST during the period between 2.8 ~ 0ka.

(4) Nutrient salt, ENSO and EAWM are main factors that impact the productivity of SYS. Due to lower deposition rate, the productivity record of YSZ05 is limited owing to insufficient supply of nutrients from land sources. Productivity evolutionary record of YS01 is controlled by ENSO on millennial time scales, while the productivity improves owing to the strengthened EAWM on short time scales. Paleoproductivity is consistent with the modern strengthened ENSO since 3ka, as well as with SST change of the SYS.

Keywords: South Yellow Sea; East Asian Monsoon; High-resolution; Paleoenvironment

Temporal and spatial differences in sediment depositional patterns in the northern South China Sea over the last 50,000 years

JIANGUO LIU[1,2], STEPHAN STEINKE[2], CHRISTOPH VOIGT[3], RICARDO DE POL-HOLZ[4], MAHYAR MOHTADI[2], DIERK HEBBELN[2]

[1]Key Laboratory of Marginal Sea Geology, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou, China.(jgliu@scsio.ac.cn)
[2]MARUM – Center for Marine Environmental Sciences, University of Bremen, Bremen, Germany.
[3]ZEKAM/Department of Geosciences, University of Bremen, Bremen, Germany.
[4]Department of Oceanography, University of Concepcion, Concepcion, Chile.

Late Quaternary climate variations combined with eustatic sea-level changes, in particular during the last deglaciation, have significantly affected the sediment depositional patterns along continental margins worldwide. The objective of this study is to investigate the temporal and spatial variations in sediment depositional patterns along the upper continental slope of northern South China Sea (SCS) over the past 50,000 years. To this end, two sediment cores (GeoB16601-6, 20°09.07'N, 116°14,38'E, 1012 m water depth and GeoB16602-4, 18°57.12'N, 113°42.64'E, 951 m water depth) during RV SONNE cruise SO-221 "INVERS" from two survey areas in the northern SCS were analyzed for bulk sediment elements by X-Ray Fluorescence (XRF) core scanning and clay mineral assemblages by X-Ray Diffraction (XRD). The bulk sediment compositions of two cores suggest a higher terrigenous material supply at site GeoB16602-4 than at site GeoB16601-6 between ~29-14 kyr BP. The results of clay mineral analysis of these two cores reveal an almost identical clay mineral composition during the Holocene and before ~29 kyr BP, whereas the glacial and deglacial (~29-14 kyr BP) deposits of both cores exhibit a clear difference in clay mineral composition. Between ~29-14 kyr BP, higher kaolinite percentage at core GeoB16602-4 in comparison to core GeoB16601-6 are interpreted to reflect a higher contribution of terrigenous material supplied by the Pearl River at core GeoB16602-4, whereas core GeoB16601-6 received less Pearl River supplied material during glacial lowstand in sea level. Similar to today, most of the detrital fine-grained materials supplied by the Pearl River were transported by coastal currents to the southwest during last glacial lowstand in sea level, resulting in a higher contribution of Pearl River discharged material at site GeoB16602-4 than at site GeoB16601-6 at that time. We suggest that sea-level induced modifications of the land-ocean distribution together with changes in the palaeo-physiographic conditions, such as the proximity of the palaeo-rivers to the individual core sites, coastline and river reorganizations on the continental shelf, are responsible for the different sediment depositional patterns in the study area between ~29-14 kyr BP.

Keywords: South China Sea; Holocene; last glacial maximum; sea level; Pearl River; clay minerals

Stable Strontium Isotope in the Suspended Sediments of the Changjiang (Yangtze) River as a Tracer of Sr sources and geochemical cycling

XIAODN WANG[1], SHOUYE YANG[1], GANGJIAN WEI[2], JINLONG MA[2]

[1]State Key Lab. Of Marine Geology, Tongji University, Shanghai 200092, China (syyang@tongji.edu.cn)
[2]State Key Lab. of Isotope Geochemistry, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou 510640, China

Remarkable stable strontium fractionation has been found in many geological and biological processes such as chemical weathering and carbonate precipitation most recently. The stable strontium isotope (δ88/86Sr) compositions in various natural materials have been studied, yet its behaviour in river water and sediment remains to be clarified. The Changjiang is the largest river originating from the Tibetan Plateau, and bridges the Eurasian continent and East Asian marginal sea by delivering a large volume of dissolved and particulate materials into the sea. It makes an ideal river for the study of sediment weathering, recycling and source-to-sink transport processes.

In this study, spatial and seasonal suspended sediments were collected from the Changjiang mainstream by filtering with 0.45 μm Millipore membrane in the field. The seasonal samples were taken from Datong hydrological station in the lower reaches during a whole hydrological year. All these samples were dissolved with 4N HNO3 to separate them into two different phases: leachate and residue. The stable strontium isotope ratios in these two phases were analysed using SSB method described in Ma et al. (2013) with MC-ICP-MS. The reference material was SRM 987. The external precision of our method is ±0.013‰ (1SD).

The results show that δ88/86Sr values in the residue phase are much higher (0.071−1.172‰) than those in the leachate phase (0.133−0.281‰). Based on radiogenic Sr isotope and elemental result under different acid treatment, we suggest that heavy Sr prefers to enrich in silicates, rather than carbonate minerals, during the fractionation process. Regular variations of δ88/86Sr are observed in the spatial samples, with the leachates showing overall decreasing trends towards the lower reaches. The values of δ88/86Sr are higher in flood season than in dry season. Parent rock types, sediment dynamic sorting and chemical weathering processes may all contribute to the spatial and seasonal variations of δ88/86Sr.

Keywords: stable strontium isotopes, Changjiang (Yangtze River), seasonal and spatial Variations, SPM

References

Ma, J., Wei, G., Liu, Y., Ren, Z., Xu, Y., & Yang, Y., 2013, Precise measurement of stable (δ 88/86Sr) and radiogenic (87Sr/86Sr) strontium isotope ratios in geological standard reference materials using MC-ICP-MS. Chinese Science Bulletin, 58(25), 3111-3118.

A review on grain size and hydrodynamic sorting effects on chemical weathering indices based on river sediment chemistry

YULONG GUO, SHOUYE YANG, YUN ZHAO, LEI BI, NI SU

[1]State Key Laboratory of Marine Geology, Tongji University, Shanghai, 200092, China (1410834@tongji.edu.cn)

Weathering of the continental crust is a key geological process because it can greatly alter the Earth's landscape and affect global carbon cycle and climate as well. Weathered terrigenous matters transported by rivers contain important information of chemical weathering and climate change. The chemical weathering indices of sediments reflect the superposition of chemical weathering of the river basins and hydrodynamic sorting during sediment transport. Understanding of the combined effects of weathering and sorting on the geochemistry of sediments and disentangling the weathering signals is one of the most essential problems for sedimentary geochemistry. We investigated the sediments of three river systems representative of various hydrogeological settings and climate patterns: the Changjiang River, small rivers of Zhejiang and Fujian Province and Zhuoshui River as the representative of small mountainous rivers (SMRs) of Taiwan Island. We present mineralogical and geochemical data of sediments from these rivers, aiming to investigate the effects of weathering, sorting and recycling on the geochemistry and mineralogy of river sediments. Geochemistry and mineralogy of sediments in a given river varies greatly from sample to sample. For better revealing the control of strong hydrodynamic sorting on weathering indices of sediments, multiple chemical weathering indices were examined as functions of Al2O3/SiO2, which is a good proxy for mineral sorting, most reflecting the enrichment of clay mineral or quartz. Feldspar and quartz are enriched in the coarse bedload sediments, suggesting weak chemical weathering, while clay minerals are enriched in fine suspended sediments, diagnostic of strong chemical weathering. The correlation of weathering proxies CIA and WIP show the effect of quartz dilution of polycyclic Zhuoshui sediments. The comparison of chemical weathering between Changjiang, small rivers in Zhejiang and Fujian Provinces and Zhuoshui River in Taiwan suggests climate, tectonics and lithology exert different controlling effects on chemical weathering in these river basins with variable tectonic and climate settings.

Keywords: silicate weathering, hydrodynamic sorting, recycling, river sediment, Taiwan

Distributions of rare earth elements in the suspended particular matter of the Oujiang Estuary and provenance indication

XIAOLONG LIANG, SHAOUYE YANG

[1]State Key Laboratory of Marine Geology, School of Ocean and Earth Science, Tongji University，Shanghai 200092, China

We collected suspended particular matter (SPM) at different layers of station M1 within a tidal cycle from the Oujiang Estuary on 15-16 March 2014, and measured the concentrations of SPM, major and trace elements including rare earth elements (REEs). Based on the CTD data and sedimentary geochemical results, the elemental compositions in the SPM and their controlling factors and sediment provenance indication are reported in this study. The results show that from surface to bottom, the water temperature is 10.0-12.8℃ and salinity is 28.6-32.2‰. The flood and ebb current directions indicate reciprocating flow near NW-SE, suggesting the dominance by tidal current and Zhejiang and Fujian coastal current. The SPM concentration and the contents of most elements overall increase towards the bottom and display regular fluctuations with changing tidal currents. The bottom layers, however, show hardly variations in the concentrations of SPM and most elements, due to resuspension of surface sediments. The UCC-normalized REE patterns of SPM from different layers are overall similar, showing relative enrichments of LREE and HREE and depletion of MREE. The total REE concentration is higher in the Changjiang sediment, especially LREE and MREE, relative to that of the Oujiang sediment. Combined CTD current direction data with geochemical data, the SPM samples of surface and middle layers may be mostly derived from the Oujiang River, while the bottom SPM has a mixing source of the Changjiang and Oujiang sediments. The elemental geochemical composition in the SPM is predominantly determined by the tidal process and Zhejiang and Fujian coastal current.

Keywords: Oujiang Estuary; suspended particular matter; rare earth elements; provenance

Provenance discrimination of late Quaternary sediments at the mouth of Zhuoshui River

YUN ZHAO[1], SHOUYE YANG[1], LEI BI1, JAMES LIU[2]

[1] State Key Lab. Of Marine Geology, Tongji University, Shanghai, 200092, China (yzhaogeo@foxmail.com)
[2] Sun Yat-sen University, Kaohsiung, Taiwan

Two kinds of terrigenous sediment "Source to Sink" systems characterize the sedimentary process in East China's marginal seas. One is represented by the Changjiang (Yangtze River) and Huanghe (Yellow River) as "large river-big delta-broad continental shelf-strong effect by human activities-slow sediment transfer", and another is featured by small mountainous rivers in Taiwan as "small river-instantaneous large flux-extreme climate influence-fast sediment transfer". In Taiwan, abundant precipitation and active tectonics produce several hundred million tons of sediments into the surrounding sea area. Thus, Taiwan is an important part of "Source to Sink" system in the East China Sea and South China Sea.

In this study, we collect sediments samples from the rivers on the mainland of China, small mountainous rivers in Taiwan and a core JRD-S near the mouth of Zhuoshui River with the depositional age back to about 86 ka. We measure mineralogical and elemental compositions of these sediments. The major and trace elements and rare earth elements suggests that the sediment provenance of JRD-S is overall stable since 86 ka, without obvious contamination from the neigbouring other rivers such as the Changjiang, Min and Ou Rivers. In the marine facies stage at 11~3 ka, the enhanced East Asian summer monsoon results in increased rainfall in the Chuoshui River basin and the increased sediment discharge from the tributaries of Chenyoulan River.

KeyWords: Late Quarternary, Zhuoshui River, Element geochemistry, Silicate weathering

Stream Sediment Geochemical Characteristics of Jinda Exploration Area in Tibet

LIU KEXIN[1] , ZHANG YONGQIANG[2,] LIN LI[2]

[1] Chengdu University of Technology, China (357253568@qq.com)

Based on collection and management of the regional geological data, the predecessor research results, the latest exploration achievements and 1:200000 stream sediment survey, to filtrate, analyze and summarize the collection data of main ore-forming element and classic companion elements. The methods of R-type clustering analysis and factor analysis to identify prospecting indicator composite-elements: ①Ag-Cu-Pb-Zn,②W-Sn-Mo-Bi. The abnormal iteration methods（X ±3S） to caculate 8 elements of regional background value and anomaly threshold, and according this data to divided into three -level concentration zoning of the catchment basins geochemical, to superposed mine figure to analysis effectiveness of the methods.

The deposits in the exploration area have been discovered mainly dominanted by Pb-Zn deposit, which mainly contains metallic elements for lead, zinc,copper and so on. There are two main mineral types in the ara: the one is low-to-moderate temperature ore-forming element for Ag、Cu、Pb、Zn, the other is high temperature ore-forming element for W、Sn、Mo、Bi. The former type having been demonstrated more than 30 economic deposits, represented by Meng ya′a and Dong zhongla Pb-Zn deposit. The later type having been demonstrated by Shang rang molybdenum deposit.

The single element map can retain more information from the primary data, to show the overall distribution of all element anomalies and the anomaly area are obviously. The effect of Ag、Cu、Pb、Zn、W、Sn、Mo、Bi element anomolies are fairly good, the general trend in NW-SE direction. All known mineraliztion point in single element anomolies area, especially in concentration area. Moreover, sampling point control sediment flowing region, refine sample's geological environment. Therefore, the author considered use the stream sediment geochemical anomalies method to couple with known mineralization point, geological and geochemical characteristicscan be reflected more truly.

Keywords: stream sediment, metallic elements, element geochemistry

References

Xuanxue Mo., Yaoling Niu., Guochen Dong., 2008, Contribution of syncollisional felsic magmatism to continental crust growth：A case study of the Paleogene Linzizong volcanic Succession in southern Tibet，Chemical Geology, 250, 49-67.

David B S., William F C., Laurel G W., 2011, A national-scale geochemical and mineralogical survey of soils of the conterminous United States, Applied Geochemistry， 3, 1-6.

Barry W S., 1998, A new theory to explain the formation of soil geochemical responses over deeply covered gold mineralization in arid environments, Journal of Geochemical Exploration，69, 149-172.

Monitoring of coral reef habitat changes using high-spatial-resolution satellite images

JONG-KUK CHOI[1], YOON-KYUNG LEE[2], JINAH EOM[3], SEONG-BEEN CHO[4]

[1] Korea Ocean Satellite Centre, Korea Institute of Ocean Science & Technology, 787 Haean-no, Ansan, 426-744, Korea (jkchoi@kiost.ac)
[2] Korea Ocean Satellite Centre, Korea Institute of Ocean Science & Technology, 787 Haean-no, Ansan, 426-744, Korea
[3] Korea Ocean Satellite Centre, Korea Institute of Ocean Science & Technology, 787 Haean-no, Ansan, 426-744, Korea
[4] Asia Aero Survey Co., Ltd., 583 Yangcheon-ro, Seoul, 157-779, Korea

We present quantitative estimations of changes in the areal extent of coral reef habitats at Weno Island, Micronesia, using high-spatial-resolution remote sensing images and field observations. Coral reef habitat maps were generated from Worldview-2 satellite images for September 2008 and September 2010, yielding classifications with 78.6% and 72.4% accuracy, respectively, which is a relatively high level of agreement. The difference between the number of pixels occupied by each seabed type was calculated, revealing that the areal extent of living corals decreased by 8.2 percentage points between 2008 and 2010. This result is consistent with a comparison of the seabed types determined by field observations. This study can be used as a basis for remediation planning to diminish the impact of changes in coral reefs.

Keywords: Coral reefs; High spatial resolution satellite image; Habitat mapping; Monitoring changes in habitat coverage; Federated States of Micronesia, Weno Island.

Ruditapes philippinarum habitat mapping in a Korean tidal flat using remote sensing and GIS

SARO LEE[1], JONG-KUK CHOI[2], BON-JOO KOO[3], JOO-HYUNG RYU[2], YOON-KYUNG LEE[2]

[1] Geoscience Information Centre, Korea Institute of Geoscience & Mineral Resources (KIGAM), Daejeon 305-350, Korea (leesaro@kigam.re.kr)

[2] Korea Ocean Satellite Centre, Korea Institute of Ocean Science & Technology, 787 Haean-no, Ansan, 426-744, Korea

[3] Biological Oceanography & Marine Biology Division, Korea Institute of Ocean Science & Technology, 787 Haean-no, Ansan, 426-744, Korea

Remonte sensing technique combined with geographic information system (GIS)-based models was applied to the mapping of the potential Ruditapes philippinarum (Korean littleneck clam) habitat area in the Geunso Bay tidal flat, Korea. The mapping of potential habitat was completed and eight controlling factors relating to the distribution of tidal macrobenthos were determined. The spatial relationships between the distribution of R. philippinarum and each control factor were calculated using a frequency ratio, logistic regression, and artificial neural networks combined with GIS data. The relationships were overlaid to produce a potential habitat map with a R. philippinarum habitat potential (RPHP) index value. These maps were validated by comparing them to surveyed habitat locations such as those in the validation data set. From the validation results, the frequency ratio model showed prediction accuracy of 82.88%, while the accuracy of the logistic regression and artificial neural networks models was 70.77% and 80.45%, respectively. Thus, the frequency ratio model provided a more accurate prediction than the other models. It implies that frequency ratio, logistic regression, and artificial neural networks models based on GIS analysis are effective for generating potential habitat maps of R. philippinarum species in a tidal flat. The results of this study will be useful for conserving and managing the macrofauna of tidal flats.

Keyword: Remote sensing, GIS, Geunso Bay tidal flat, Potential habitat mapping, Ruditapes philippinarum

The thematic mapping of the Vietnamese tidal flat based on the in-situ and remotely sensed data

DEUK-JAE HWANG[1,2], JONG-KUK CHOI[1,2], HAN-JUN WOO[3], BON-JOO KOO[4], SARO LEE[5], TÔNG PHƯỚC HOÀNG SƠN[6]

[1] Korea Ocean Satellite Centre, Korea Institute of Ocean Science & Technology, 787 Haean-no, Ansan, 426-744, Korea (jkchoi@kiost.ac)

[2] University of Science & Technology, 217 Gajeong-ro Yuseong-gu, Daejeon, 305-350, Korea

[3] Marine Geology & Geophysics Division, Korea Institute of Ocean Science & Technology, 787 Haean-no, Ansan, 426-744, Korea

[4] Biological Oceanography & Marine Biology Division, Korea Institute of Ocean Science & Technology, 787 Haean-no, Ansan, 426-744, Korea

[5] Geoscience Information Centre, Korea Institute of Geoscience & Mineral Resources (KIGAM), Daejeon 305-350, Korea

[6] GIS & Remote sensing Department, The Institute of Oceanography, Vietnam Academy of Science and Technology(IO-VAST), 01 Cau Da, Vinh Nguyen ,Nha Trang City, Khanh Hoa Province, Viet Nam

Binh dai tidal flat is located in the Mekong River estuary that is one of the largest rivers in Southern Asia. Meretrix lyrata, dominant species in the study area, population has decreased drastically because of the unknown reason. Prior to investigate the reason, potential habitat map was created for identifying the inhabited environment of M. lyrata. In Feb 2014, Field survey was performed to collect macrobenthos and surface sediment samples from the study area in Feb. 17, 2014. Elevation of tidal flat was also meaured using RTK-GPS. The surface sedimentary facies map was generated using field survey data based up to high resolution WorldView-2 satellite data. The DEM of tidal flat was constructed from the Landsat TM/ETM+ satellite images using the waterline method. Slope gradient of tidal flat was generated using the DEM. The tidal channel network were extracted from the WorldView-2 satellite image. A map of distance from the tidal channels and density of tidal channels was generated. Then, using WorldView-2 image, all study area's sedimentary facies map was created. Habitat potential index of the matured and young M.lyrata was calculated by processing the frequency ratio model using these control factors. Potential habitat map of the matured and young M.lyrata was created. As a result, the habitat of M. lyrata was influenced mainly by NIR band reflectance and distance from tidal channel.

Keywords: Remotely sensed data, Habitat mapping, Frequency ratio method, the Mekong River, DEM

Application of Unmanned Aerial Vehicle to the mapping of a tidal flat Digital Elevation Model

JONG-KUK CHOI[1], BUMJUN KIM[2], YOON-KYUNG LEE[3]

[1] Korea Ocean Satellite Centre, Korea Institute of Ocean Science & Technology, 787 Haean-no, Ansan, 426-744, Korea(jkchoi@kiost.ac)
[2] Korea Ocean Satellite Centre, Korea Institute of Ocean Science & Technology, 787 Haean-no, Ansan, 426-744, Korea
[3] Korea Ocean Satellite Centre, Korea Institute of Ocean Science & Technology, 787 Haean-no, Ansan, 426-744, Korea

In order to demonstrate the suitability of UAVs to the tidal flat study, we tested fixed-wing UAV mounted with Canon S95 and rotary-wing UAV mounted with Canon 6D. For the accurate geometric correction, it is necessary that pre-processing and post-processing of the obtained image. The interior and exterior orientation parameters were obtained based on the lens distortion model. For the accurate mosaic image generation, the topographic height of the tidal flat was measured using RTK-GPS and flight plans were prepared to obtain 70% image overlap to the azimuth direction and 40% to the range direction. For the mosaic image based on the rotary-wing UAV, waterlines were extracted from each image, and DEM was generated using a waterline method. For the mosaic image based on the fixed-wing UAV, DEM was obtained by aerial triangulation when tidal flat was fully exposed. The accuracy of DEM from fixed-wing UAV was higher than that from rotary-wing UAV. The Fixed-wing UAVs have a limitation to mount various cameras such as DSLR. However, the rotary-wing UAVs can mount not only high-resolution optical cameras such as DSLR but also multispectral, hyperspectral and thermal sensors. In conclusion, the fixed-wing UAVs are advantageous for the analysis on topographic changes, and the rotary-wing UAVs are advantageous for the analysis on surface characteristics such as vegetation and sedimentary facies along with various multispectral and hyperspectral sensors.

Characteristics of mineral components of black shale in Longmaxi Formation of Silurian in southern Sichuan Basin and its periphery

XUE YUAN[1], LIN LI[1], MEN XIN[1], WANG XIUPING[2]

[1]Chengdu University of Technology, China (linli@cdut.cn)
[2]Chengdu Institute of Geology and Mineral Resources, China

In order to analysis physical characteristics of mineral components in shale gas reservoir and influence on the exploration and development, black shale in Longmaxi Formation of Lower Silurian in southern Sichuan Basin and its periphery were taken as the main study object. According to the results of polarizing microscope, scan electron microscope, backscattered electron and X-ray diffraction, the relationship between characteristics of mineral components and total organic carbon (Toc) in black shale rocks were revealed. The siliceous shale is with higher Toc, clayey shale and carbonate shale with lower Toc. In this paper, siliceous shale is the most developed in the study area, with biogenic quartz, authigenic carbonate and inherited clay minerals. According to the type and content of clay minerals, we can find out that Longmaxi Formation had experienced arid-semiarid climate during sedimentation, buried water medium was with higher salinity, alkaline and K+. Based on the distribution characteristics of Toc, the siliceous component content of >30%、clay minerals of <50%、carbonate minerals of <30% were chosen as the basic evaluation criteria of mineral composition for the favourable hydrocarbon source rock in the study area. The vast area opening from Suijiang Sichuan northeast to Shizhu Chongqing (I) is primary favourable area for shale gas; Changning-Xuyong (II) and Luding-Hanyuan (III) regions are secondary favourable areas; Jinyang-Daguan area and the region on the edge of the uplift with the tidal flat sedimentary facies, are rich in carbonate type shale, but not favourable for shale gas.

Keywords: mineral composition, shale gas, Longmaxi Formation, Silurian, southern Sichuan Basin

CO_2 storage potential of incised valley fills in the southwestern continental margin of the East Sea

SEUNGYEON LEE[1], YI KYUN KOWN[2]

[1] Geological institute, Korea (sylee@kigam.re.kr)
[2] Kongju National University, Korea

Late Miocene strata in the southwestern continental margin of the East Sea have been highlighted as the best geologic formation for offshore CO_2 storage in South Korea. The shelf sequences are repetitions of transgressive sand sheets and highstand mud drapes. The sand sheets have been considered as the target interval for CO_2 storage. On the other hand, the incised valley fills were interpreted as mud-dominated successions which can act as a seal for CO_2 storage. Through detailed seismic analysis, however, this study recognizes systematic arrangement of infill seismic facies from lower stratified to upper discontinuous chaotic reflections. The stratified infill facies predominantly occurs in relatively small-sized incised valleys, whereas the discontinuous chaotic facies is common in larger incised valleys. This facies distribution suggests that stratified infill facies is indicative of alternation of sand and mud beds with relatively good lateral continuity formed in relatively small-sized incised valleys or lower part of the valleys. Contrarily, the discontinuous chaotic infill facies probably reflects mud-dominated deposition in larger-sized incised valleys or upper part of the valleys. Consequently, the infill successions with stratified facies can be utilized for CO_2 storage formations, whereas the infill successions with discontinuous chaotic facies would act as a seal formation.

Keywords: carbon geological storage potential, incised valley, seismic facies

History Matching using Selective Measurement Data for Channelized Resservoirs

KYUNGBOOK LEE[1], SEUNGPIL JUNG[2], TAEHUN LEE1, AND JONGGEUN CHOE[3]

[1] Korea institute of geoscience and mineral resources, Korea (kblee@kigam.re.kr)
[2] SK innovation, Korea
[3] Seoul National University

History matching is essential for reservoir management and decision making. However, it is a difficult to make reliable reservoir characterization since reservoir parameters have a highly non-linearity with dynamic data. Ensemble-based methods have researched for inverse modelling problems due to lots of advantages: uncertainty quantification, real time updating, easy-coupling with forward simulator. Ensemble smoother (ES) assimilates model parameters fastly because it uses all available measurement data at a time. However, it has two typical problems: overshooting and filter divergence, especially in the case of channelized reservoirs. In this paper, we use selective measurement data concept for the standard ES to control the two problems.

EnKF, ES and the proposed method are applied to channelized reservoirs. EnKF shows stable inverse modeling regardless of type of measurement data. However, ES is quite sensitive for observed data, which are used for assimilation step. When well production rates (WOPR) from eight wells are used for ES, uncertainty ranges from updated ensembles cannot predict reservoir performances properly. It causes from confused information of WOPR. For example, high permeability between production well and injection well affects high WOPR in early production time, but WOPR becomes reduced after high well watercut (WWCT) due to early water breakthrough time (BT). Therefore, selective measurement data, WOPR before BT and WWCT after BT, are suitable for consistent information during history matching. The proposed method shows reliable uncertainty quantification and reduces simultion time sharply as contrasted with it of EnKF.

Keywords: ensemble smoother, ensemble Kalman filter, selective measurement data, history matching, channelized reservoir

Acknowledgments

The authors thank to research project supported by KIGAM (Development of carbonate reservoir characterization and integrated modeling technique: 15-3312). Also, this study was supported by project of The Ministry of Trade, Industry, and Energy (20142520100440, 10042556, 10038618, Korea Energy and Mineral Resources Engineering Program).

The Development of Digital Holographic System for Study of Oil Droplet

WEI ZHANG[1], YANYAN WANG[1], XINSHENG YU[1,2]

[1]College of Marine Geosciences, Ocean University of China, P. R. China (luziasilazi@163.com)
[2]Key Lab. Of Submarine Geoscience and Prospecting Techniques, Ministry of Education, Shangdong, China

Understanding the process of oil spill from the seabed sediment, eg. pipeline failure or marine oil platform damage, is crucial to predict the outcome of an eventual blowout. For example, how long does it take for oil droplet to reach the surface? How will it behave in the water column? How far and how fast are they transported by the oceanic dynamics? Many of the questions are not well documented so far and the main difficulty in studies of the characteristics of oil droplet is the need to understand the distribution and their 3-D trajectories in real time. In this report, we provide a brief review of in situ oil droplet monitoring technique presently available and current research activity occurring in this field. We then described our newly developed in line holography system as a means for measuring oil droplet distributions in the laboratory. A simulating experiment is performed in a controlled chamber. Measurement and results are presented to show the effectiveness and limits of the technique in monitoring oil droplet in spatial and temporal movement in real time.

Keywords: oil droplet, holography, in situ, spatial and temporal distribution

References

Arnason, K., and Flovenz, O. G., 1992, Evaluation of physical methods in geothermal exploration of rifted volcanic crust, Geothermal Resources Council Transactions, 16, 207–214.

Maruyama, T., Saito, E., Azuma, T., Taniguchi, K, Yoshimi, M., and Hayashida, T., 2011, Report on emergency field surveys at the earthquake fault appeared along Itozawa Fault by the 11 April 2011 Earthquake in eastern Fukushima Prefecture (in Japanese), Active Fault and Earthquake Research Center, AIST, 22p.

Uchida, T., and Sasaki, Y., 2006, Stable 3D inversion of MT data and its application to geothermal exploration, Exploration Geophysics, 37, 223–230.

ENRICHMENT MECHANISM OF REDOX-SENSITIVE AND NUTRIENT ELEMENTS IN BOTTOM CURRENT REWORKING FORAMINIFERA-RICH TURBIDITES FROM SHENHU AREA ON THE NORTHERN CONTINENTAL SLOPE OF THE SOUTH CHINA SEA

LI NIU1 CHEN DUOFU[1], CHEN LINYING[1], WANG HONGBIN[2]

[1]CAS Key Laboratory of Marginal Sea Geology, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou 510640, China (cdf@gig.ac.cn)

[2]Guangzhou Marine Geological Survey, Guangzhou 510740, China

The sediments in gravity core DH-1, collected at water depth of 1805 m in Shenhu area on the northern continental slope of the South China Sea, are composed of two dark-gray clay silt layers (A1 and A3) and two foraminifera-rich layers (A2 and A4) (A1 to A4 are from top to bottom). The dark-gray clay silt layers with median grain size of 6-15 μm are mainly composed of clay minerals, quartz and feldspar, and show Ti/Al, K/Al, Fe/Al values similar to those of hemipelagic sediments of South China Sea. These indicate that the layer of A1 and A3 are background hemipelagic sediments. Unlike silt layers, the intervening foraminifera-rich layers (A2 and A4) exhibit relatively high Ti/Al, K/Al, Fe/Al and Zr/Al ratios and carbonate contents, as well as higher median grain size, suggesting a more coarse detrital materials input, and could be bottom current reworking of the turbidite. Radiocarbon dating of sedimentory planktonic foraminifera indicat that the ages of the turbidity in A4 and A2 are later than 23.1 ka BP and eariler than 23.1 ka BP, respectively. These turbidites might result from the sea level change since the last glaciation. The foraminifera-rich layers (A2 and A4) are characterized by moderate enrichment of redox-sensitive elements (Mo, As, Sb and U) and nutrient elements (Cu, Ni, Cd and Zn) with enrichment factors of 4.5-48.5 relative to the upper continental crust. However, the degree of the enrichment of these elements is less than those of the typical modern anoxic basins such as the Mediterranean sapropel, but similar to those of the Chile shelf reducing but non-sulfidic bottom water. In these foraminifera-rich turbidity sediments, Mo, As, U, Cd and Sb are likely derived from sea water and accumulated through diffusion across the sediment/water interface, while Cu, Ni, Cr and Zn accumulated via pre-concentration in biodetritus, and V could be of both machanism. All above indicated that the abundant of foraminiferal by turbidite from shallow-water and bottom current reworking induced the local bottom water to be reducing and non-sulfidic condition, which lead to the enrichment of these trace metals.

Keywords: Enrichment mechanism, Trace metals, Foraminifera-rich turbidites, Redox condition, 14C age, Northern South China Sea

Acknowledgments

This study was supported by the National Natural Science Foundation of China (91228206) and National Special Project on Gas Hydrate of China (Grant No.GZH201100305-06-07).

Hydrothermal plume along the northern Central Indian Ridge, 8°S–17°S: Magmatic and tectonic control on hydrothermal activity at slow-spreading ridge

JONGUK KIM[1], JUWON SON[1], SANG-JOON PAK[1], JAI-WOON MOON[1], SEUNG-KYU SON[1]

[1]Deep-sea and Seabed Mineral Resources Research Center, KIOST, 787 Haeanro Ansan 426-744, KOREA (jukim@kiost.ac.kr)

CTD/MAPR profiles collected on 118 vertical casts on the slow-spreading Central Indian Ridge (8°S–17°S) reveal that hydrothermal plumes were most commonly associated with the asymmetric ridge sections where ultramafic massifs formed along one ridge flank near ridge-transform intersections or nontransform offsets (NTOs). Evidence for hydrothermal activity (particle and methane plumes) was found on each of the seven spreading segments, with most plumes found between 3000 and 3500 m, generally <1000 m above bottom. The combined plume incidence for axial and valley wall casts, ph=0.30, is consistent with the existing global trend. This agreement confirms that the long-term magmatic budget of the CIR is the primary control on the spatial frequency of hydrothermal venting at this slow spreading ridge. Because plume frequency was higher along asymmetrical than symmetrical ridge sections, permeability likely controls where venting is expressed. The occurrence of hydrothermal plumes at six locations on the axial flanks indicates that such cooling can also produce vent sites far off axis, perhaps fed by fluids channeled along detachment faults. Hydrochemical plumes, identified by methane anomalies without corresponding particle anomalies, were found at 15 sites. These plumes primarily (80%) occurred at shallow depths corresponding to the flanks of the axial valleys, indicating that serpentinization associated with ultramafic rocks exposed on seafloor also contributes methane not originating from hydrothermal cooling. Multiple instances of plumes over the valley walls imply that using near-axial sampling techniques, such as tows, might underestimate hydrothermal activity along slow-spreading and ultraslow-spreading ridges.

Keywords: Hydrothermal plume, Central Indian Ridge, Slow spreading ridge

Mineralogy of polymetallic sulfide from the seafloor hydrothermal field near 15°S Southern Mid-Atlantic Ridge

WANG SHUJIE[1], ZHAI SHIKUI[1], YU ZENGHUI[1], LI HUAIMING[2]

[1] Key Lab of Submarine Geosciences and Prospecting Techniques, Ministry of Education, College of Marine Geosciences, The Ocean University of China, Shandong, Qingdao, 266100 (jie017jie@163.com, zhaishk@public.qd.sd.cn)

[2] Key Laboratory of Submarine Geosciences, second Institute of Oceanography, State Oceanic Administration, Zhejiang, Hangzhou, 310012

A new seafloor hydrothermal field near 15°S Southern Mid-Atlantic Ridge (SMAR) was found during the 22th Chinese COMRA (China Ocean Mineral Resources Research & Development Association) cruise. Sulfide samples from this marine hydrothermal field were collected at three stations during the 26th Chinese COMRA cruise in 2012. This paper describes comprehensively the mineralogical characteristics of the sulfide samples by microscope , X-ray diffractometry , scanning electron microscope and electron probe microanalysis, and aims to study the crystallization sequence and the process of hydrothermal mineralization. The study indicates that sulfide samples from the seafloor hydrothermal field near 15°S SMAR can be divided into three types: Fe-rich sulfide, Fe-Cu-rich sulfide, Fe-Zn-rich sulfide. Fe-rich sulfide contains mainly pyrite and chalcopyrite. Fe-Cu-rich sulfide consists predominantly of pyrite, chalcopyrite and isocubanite with lesser amounts of sphalerite and marmatite. Fe-Zn-rich sulfide is dominated by pyrite, sphalerite, marmatite with variable amounts of chalcopyrite, isocubanite, marcasite, galena and gratonite. The species of metal minerals is limited in Fe-rich sulfide and Fe-Cu-rich sulfide. In contrast, Fe-Zn-rich sulfide has more kinds of minerals. The sequence of mineral precipitation in hydrothermal sulfide is pyrite → chalcopyrite (isocubanite) → sphalerite (marmatite) → galena and gratonite. At all sulfide samples, pyrite occurs in two morphologically distinct generations with inclusions of sphalerite. Sphalerite of Zn-rich sulfide samples is characterized by the so called "chalcopyrite disease" phenomenon. The Mineralogy feature of sulfide samples shows that a series of high-temperature (200~350℃) hydrothermal sulfide minerals are forming, which are a result of high-temperature venting of metal-rich hydrothermal fluids. Mineral paragenetic relationships and wide range of chemical composition suggest that environment of hydrothermal mineralization was changing severely and repeatedly. In comparison, Fe-rich sulfide formed under stable and high-temperature environment, but the formation conditions of Fe-Cu-rich sulfide were variable. Fe-Zn-rich sulfide was precipitated in relative low-temperature active hydrothermal vent.

Keywords: Mid-Atlantic Ridge; new seafloor hydrothermal field near 15°S; polymetallic sulfide; Mineralogy

Growth textures, mineralogical and geochemical compositions of phosphatized ferromanganese crusts in the northwest Pacific seamounts

KEISUKE NISHI[1], AKIRA USUI[2], HISAAKI SATO[1], HIKARI HINO[1], YOSHIO NAKASATO[3], AND IAN J. GRAHAM[4]

[1] Studies in Sciences, Graduate School of Integrated Arts and Sciences, Kochi University, Japan (b14d6a01@s.kochi-u.ac.jp)
[2] Faculty of Science, Kochi University, Japan
[3] Sumiko Resources Exploration and Development, Japan
[4] The Institute of Geological and Nuclear Science, New Zealand

Hydrogenetic ferromanganese crusts (hereafter, Fe–Mn crusts) occur widely on the floor of the northwest Pacific. Fe–Mn crusts contain useful elements such as Co, Ni, Pt, and REEs, and have grown at several mm/Myr. Therefore, Fe–Mn crusts are expected as prospective resources and as potentially record of paleoceanographic conditions. Most Fe–Mn crusts in the northwest and central Pacific consist of two growth generations: a phosphatized older growth generation and a non-phosphatized younger growth generation. In this study, we call layer 1 (non-phosphatized generation) and layer 2 (phosphatized older generation). The purposes of this study are: (1) to describe growth textures, mineralogical and geochemical compositions in layer 2, (2) to show the age of the layer 1–layer 2 boundary using 10Be/9Be dating and suggest the formation environment of layer 2.

Layer 2 is divided into two layers: layer 2–a and layer 2–b. Layer 2–a is black, dense, and often include the microfossil. Layer 2–b is laminated and lustrously black because of more dense nature. Layer 2–b is observed above the substrate rock, but it doesn't occur all samples. The textural characteristics of layer 2 are observed more clearly under the microscope. Layer 2 shows dense columnar, mottled, and layer texture. The including detritus in layer 2 are obviously lower than layer 1. The dominant ferromanganese mineral component of layer 2 is vernadite: a poorly crystallized iron–manganese oxide, but layer 2 contains occasionally the texture similar to buserite. The selected element concentrations in layer 2 compared to layer 1 are poor in Fe, Al, Ti and Co, and are enriched in Mn, Ni, Cu, and Zn. The growth rates from present to Pliocene are relatively uniform at 1.8–3.6 mm/Myr. The growth rates of layer 2 are the same or faster than layer 1, but the growth curves are continuous. The age of the layer 1 and layer 2 boundary concentrates at Miocene and the estimated boundary age shows 7.6 ± 0.2 Ma at the water depths of ca 1000 m and 18.0 ± 0.6 Ma at water depths of ca 2200 m.

Layer 2 is abundant in Ni, Cu, and Zn which are essential to diagenetic manganese nodules. The estimated boundary age seems to vary positively with water depth. These results indicate layer 2 might be formed suboxic environment which be related to the oxygen minimum zone and the phosphogenesis changes the water depths from deep to shallow.

Keywords: ferromanganese crust, northwest Pacific, paleoceanography

Magnetostratigraphy of the ferromanganese crust in the northwest equatorial Pacific

WONNYON KIM[1,*], SARAH P. SLOTZNICK[2], JIYOUNG SHIN[1], CHEONG KEE PARK[1], JAE-WOON MOON[1]

[1] Deep-sea and Seabed Mineral Resources Research Center, KIOST, Ansan 426-744, Korea (WKIM@KIOST.AC.KR)
[2] Department of Geological and Planetary Sciences, California Institute of Technology, CA 91125, USA

In the northwest equatorial Pacific, around 20 °N, a lot of seamount and guyot covered by ferromanganese (Fe-Mn) crust are distributed. In particular, Fe-Mn crusts in this region are mainly observed in water depths of <3,000 m and show high Co contents. Because of the wide surface area (e.g., surface area of MnO2 ~325 m2/g) and slow growth rate (several mm/My), significant quantity of valuable metals are efficiently absorbed from seawater and Fe-Mn crust is regarded as the archive recording a longest history of deep-sea environmental changes since the Late Cretaceous or Paleogene. To decipher the crust growth related deep-sea environmental changes, hence, a high resolution age dating method is essential, which can trace continuous growth rate. Recently, Oda et al. (2011) proposed an ultrafine-scale magnetostratigraphy of Fe-Mn crust with <0.1 mm resolution and the accuracy of <40 ky, using a scanning superconducting quantum interference device magnetometer (SSM). In the present study, we collected Fe-Mn crusts in the Magellan Seamounts (~20 °N) and selected a well-laminated crust with a thickness of ~10 cm. Upper layers of the crust, above the phosphate precipitated layer, was prepared and attempted to trace growth rate using magnetostratigraphy by SSM measurements. Natural remanent magnetization perpendicular to the growth lamella of the Fe-Mn crust shows more than 30 ancient geomagnetic field reversal events. Comparison with the reference geomagnetic polarity time scale reveals ~10 Ma at the depth of 40 mm, indicating an average growth rate of ~4 mm/My. The growth rate is relatively slower than those observed in the higher latitude (~30 °N). For the full-scale crust in the study area, the empirical formulae on the Co flux into crust revealed ~2 mm/My growth rate. Such discrepancy, even in the same latitude, is probably caused by the change in the oceanic environments and mineralization mechanism as well as a growth termination between lower and upper layers by phosphte precipitation. Regards on the mineralization, the lower layers of the crust might be slowly fed by hydrogenic and/or biogenic processes since the Late Cretaceous or Early Paleogene. After the crust covered seamounts were located near the Asian continent in the Miocene, the crust might be bloomed additionally by terrestrial flux as identified by the presence of terrestrial minerals such as titano-magnetite.

Keywords: northwest equatorial Pacific, ferromanganese crust, magnetostratigraphy, growth rate

Multi-Beam Echo Sounding survery in the guyot, Magellan seamounts; distribution characteristics of Co-rich ferromangese crust

JONGMIN JOO, SANG JOON PAK, JONGUK KIM, JU WON SON, SEUNG KYU SON AND JAI-WOON MOON[1]

[1] KIOST, Korea (joojongmin@kiost.ac.kr)

Korea Institute of Ocean Science & Technology has carried out the survey to secure Co-rich ferromangese crust resource on Magellan Seamounts for last 3 years. Major elements for exploitation of Co-rich ferromangese crusts are to narrow down the high potential area where crust is thick and to screen the site where accessibility of miner is good. Here we report the results of Multi-Beam Echo Sounding (MBES) survey and discuss the distribution characteristics of ferromangnese crust. In MBES survey, Konsberg Simard EM 120 12 kHz Multi-Beam Echo Sounder were used. The surveyed seamounts could be categorized into two types based on the size of the summit of mount and acoustic backscattering intensity (ABS) over the area: Type 1 is characterized by > 300 km2 of summit size and bimodal distribution of ABS mode. Whereas type 2 is featured by less than 300 km2 of summit size with normal distribution of ABS mode. Of four mounts, 3 seamounts of type 1 reveal a relatively low ABS in center part of guyot but high ABS in guyot rims. Deep Sea Camera (DSC) observation over the type 1 shows carbonate-bearing unsolidified sediments cover in the central part of guyot but Mn-crust exposure along the peripheral guyot. These observation is indicative of that high ABS well match to distributions of ferromangese crust. Type 2 seamount represent the high ABS with normal distribution mode. This seamount has not been done in DSC observation. The camera towing and geological sampling will be conducted in up-coming campaign.

Keywords: Multi-Beam Echo Sounding survey, Co-rich ferromangese crust, acoustic backscattering intensity, deep sea camera observation

The discovery and significance of exhalative rock in Ni-Mo sulfide deposits in the early Cambrian Niutitang Formation in South China

LI LIN[1], YUHUA ZHOU[1,4], YUAN XUE[1], KEXIN LIU[1], YANCHUN PAN[1], YEQIN MA[2], LIYAN MA[3], XIUHUA LI[1], KEYU ZHU[1]

[1]Institute of Sedimentary Geology, Chengdu University of Technology, China (linli@cdut.cn)
[2]Gansu Industry Professional Technology College, China
[3]College og Geosciences, Guilin University of Technology, China
[4]Guizhou Wengfu Phosphate Ore, China

In South China, the Early Cambrian black rock series is rich in Ni, Mo, V, U, PGE and REE elements and receive much attention by ore deposit scientists and geochemist. Meanwhile the Early Cambrian not only belongs to the first period of the Phanerozoic, but also become the one of the most important geological period in biogenetic derivation. A large surge of metazoans appears in this period aroused significant attention. Geologists investigating and analyzing the causes not only from Paleontology and sedimentology (Steiner et al. , 2001; Lott et al., 1999; Yang et al., 2008) , but also in geochemistry and geology of mineral deposits (Jiang et al., 2007) to looking for the genesis of black shale-hosted mineral deposit and related biological events. A lot of stratiform and lenticular baritic rock was discovered in the lower Ni-Mo sulfide bed in the early Cambrian Niutitang Formation in south China. There is a large amount of barite phenocryst in different sizes, with this occurs, it represents petrological characteristics of exhalative rock. The content of Ba in baritic rock up to 5.52%. Ree distribution patterns is manifested as LREE enrichment, Eu positive anomaly, Ce negative anomaly. It's similar with ree distribution patterns of black and white chimneys in SER region. The feature of petrology and geochemistry illustrates the Ni-Mo sulfide bed belongs to submarine hydrothermal exhalation sedimentation.

This work was financially supported by National Science Foundation of China (Grant No.41173058).

Keywords: exhalative rock, Ni-Mo sulfide bed, Nititang Formation in Early Cambrian, south China

Microorganisms' mineralization in the Ni-Mo polymetallic orebed in Lower Cambrian Niutitang Formation of Yangtze Platform in south China

LI LIN[1], KEYU ZHU[1], YUHUA ZHOU[1,2], YANCHUN PAN[1]

[1] Institute of Sedimentary Geology, Chengdu University of Technology, China (linli@cdut.cn)
[2] Guizhou Wengfu Phosphate Ore, China

Early Cambrian is important geological and biological mutation period. In the period, not only a lot of phyla metazoan with bone occurred at the same time, but also important phosphorite deposit and Ni-Mo polymetallic ore formed. Focusing on the Ni-Mo polymetallic orebed in Lower Cambrian Niutitang Formation, Yangtze Platform, south China, a lot of research has done in ore forming origin (Lott et al.,1999 ; Jiang et al.,2007; Orberger et al., 2007; Kříbek et al., 2007; Pašava et al., 2008; Shi et al.,2014; Han et al., 2015; Xu et al.,2015). These opinions include 1) normal oceanic sedimentation in anoxic environment, 2) up-welling oceanic flow, 3) hot spring deposit or exhalative process in submarine, 4) organic metallogensis or biomineralization. The paper analysis the contents of organic carbon, Ni, Mo, V in Ni-Mo polymetallic orebed in Lower Cambrian Niutitang Formation, Yangtze Platform, south China and demonstrate that the contents of TOC reach up to 13% and there are normal correlation between organic carbon and metal ore-forming elements. Biomarkers in polymetallic beds show the dominance of lower-molecular n-alkanes, the presence of a great amount of tricyclic terpanes and hopanes as well as the C27 over C29 steranes in the relative abundance. The biomarkers indicate the origins of organic matter in ores were the main contribution of microorganisms including algae and bacteria in ocean. A lot of fossils of algae and bacteria was discovered in thin slices in ores and rocks. All of these illustrate microorganisms including algae and bacteria played a role function in metal ore-forming deposit in Niutitang Formation, Yangtze Platform, south China.

This work was financially supported by National Science Foundation of China (Grant No.41173058).

Keywords: Ni-Mo polymetallic orebed, microorganisms mineralization, Niutitang Formation, Lower Cambrian, south China

Korea Mn-nodule program

SANG-BUM CHI, WONNYON KIM*, CHAN MIN YOO, CHEONG KEE PARK

[1] Deep-sea and Seabed Mineral Resources Research Center, KIOST, Ansan 426-744, Korea (WKIM@KIOST.AC.KR)

To secure the future supply and self-sufficiency of major strategic metals including Cr, Cu and Ni, the Korean government launched a deep-sea research program in early 1990s. In 1994, Korea registered 150,000 km^2 Mn-nodule field in the Clarion-Clipperton fracture zone, the north-east equatorial Pacific, to the international sea-bed authority (ISA). Following the ISA exploration code, the final exclusive exploration area of 75,000 Km^2 was assigned in 2002, based on results of eight-year researches of chemico-physical properties of nodules, bottom profiles and sediment properties. Since 2002, the research program was categorized to four technical parts: geophysical exploration to acquire detailed bathymetric information and to map the minable area; environmental exploration to archive biologic, chemical, geologic and physical environmental base line data; development of the integrated mining system; and development of a smelting process system. At this time, all of the foundation techniques for commercialization are prepared. In particular, we prepared 25,000 scale mining maps of <5 m horizontal resolution in the priori area. Pre-pilot mining test was also successfully performed in water depth of ~1,500 m in 2013. In next five years, Korea Mn-nodule program will focus on the commercialization based on three strategic approaches: maintenance of exploration contract area; acquisition of exploitation right; and preparation of industrialization.

Keywords: Mn-nodule, mining map, environmental assessment, mining system, smelting system

Organic geochemical characteristics of source rocks in Lower Silurian Longmaxi formation, South of Sichuan basin and its periphery

MEN XIN[1] , LIN LI[1], XUE YUAN[1]

[1] Chengdu University of Technology, China (linli@cdut.cn)

In the south of Sichuan basin and its periphery, effective hydrocarbon source rock include dark gray, black, gray shale. The dark shale of lower Silurian longmaxi formation mainly distribute in the center of basin, including Suijiang-Luding-Qijiang area. The average organic carbon contents of the lower parts of the Longmaxi Formation are 2% and 4% , respectively. Kerogens of the lower part of the Longmaxi Formation are mainly of type Ⅰ , and part of them are of type Ⅱ1 , Pr /Ph ratio which illustrates depositional environment is low and gammacerane content is high. Organic matter maturity values (Ro) range from1.63% to 4.45%, indicating for oil generation stage with current threshold depth of approximately 1820m. In the southern steep slope and deep depression, and the corresponding depth and temperature are 2500m and 100℃. having entered the mature threshold to the early stage of overmature threshold.

Keywords: geochemical characteristics ; source rock ; Longmaxi formation ; Sichuan basin

Formation mechanism for authigenic gypsum associated with authigenic pyrite and methane hydrate: evidence from GMGS2 expedition, northern South China Sea

QI LIN[1,2], JIASHENG WANG[1,2*], FEI SUN[2], RONGXIAO LIN[2], QINGTAO BU[2], JUNXIA YANG[2], JUNYU YU[2]

[1] State Key Laboratory of Biogeology and Environmental Geology (China University of Geosciences), Wuhan, Hubei, P. R. China (yiyanglinqi@126.com)

[2] School of Earth Science, China University of Geosciences, Wuhan, Hubei, P. R. China

Gypsum ($CaSO_4 \cdot 2H_2O$) is mainly found in sedimentary and evaporitic environments as one of typical evaporites (Chang et al., 1998), however, there have been increasing discoveries of gypsum formation in marine methane hydrate-bearing sediments during the last decade (e.g., Sassen et al., 2004; Wang et al., 2004; Chen et al., 2007; Pierre et al., 2012; Kocherla et al., 2013). Nevertheless, gypsum formation seems to be controversial to the evaporitic environment if the gypsum precipitated as authigenic mineral by evaporation. Meanwhile, there is little discussion about the relationship between gypsum formation and authigenic pyrite in recovered sediment from the marine methane hydrate geo-system.

The GMGS2 expedition was carried out in 2013 by the Guangzhou Marine Geological Survey (GMGS) as the second China exploration to gas hydrate purpose in northern South China Sea, during which nine sites containing natural gas hydrates were confirmed and five sites were sampled from total thirteen drilling sites (Zhang et al., 2014, 2015; Sha et al., 2015). Here, we carry out morphology observations of gypsum, stable sulfur isotope of gypsum and authigenic pyrite in the drilling cored sediments from the Site GMGS2-08. Combing the distributions and sulfur isotopic compositions of gypsum formation and authigenic pyrite with the information of methane hydrate, we propose the formation mechanism for the authigenic gypsum and reconstruct the formation processes of the authigenic gypsum for the first time. Accordingly, the main conclusions are as flows: (1) The gypsum observed in the drilling cored sediments essentially precipitated in situ as an authigenic mineral rather than developed during the sample preservation or processing via the concentration of interstitial solutions and/or the oxidation of authigenic pyrite; (2) The SO_4^{2-} ions of authigenic gypsum mainly could be proportional mixture of sea water sulfate and partial oxidation of authigenic pyrite based on the sulfur isotopic composition; and the Ca^{2+} ions of authigenic gypsum are mainly induced by the formation of methane hydrate below; (3) The formation mechanism for aughigenic gypsum involves mainly partial oxidation of former authigenic pyrite precipitated within SMTZ, and the evolution of underlying methane hydrate.

Keywords: authigenic gypsum, formation mechanism, authigenic pyrite, methane hydrate, South China Sea

Vertical distribution of archaeal communities in cold seep sediments from Jiulong Methane Reef area in the South China Sea

HONGPENG CUI [1,2], X SU [1,2 *], FANG CHEN [3], SHIPING WEI [2]

[1] State Key Laboratory of Biogeology and Environmental Geology, China University of Geosciences（Beijing）, Beijing 100083,China (xsu@cugb.edu.cn)

[2] School of Ocean Sciences, China University of Geosciences（Beijing）, Beijing 100083,China

[3] Guangzhou Marine Geological Survey, Guangzhou 510075, China

Jiulong Methane Reef, a large cold seep area on the continental slope of the South China Sea, was firstly discovered by the joint Chinese-German RV Sonne cruise 177 in 2004 (Suess, 2005). It was featured by chemosynthetic fauna, bacterial mats, methane-derived carbonate structures, and very shallow depths of the sulfate-methane-interface (SMI) in gravity cores. To get an insight about microbial diversity and variation in correlation to methane venting and shallow SMI in this cold seep area, a geomicrobiological study on Archaea in sediments of the gravity Core DH-CL11 (767 cm in length, water depth of 1607 m) located on the southern slope of Jiulong methane reef was carried out, by means of analyzing 16S rRNA gene clone libraries, denaturing gradient gel electrophoresis (DGGE) and sediment grain sizes. Sediments of this core are mainly composed by silt (> 68%) and clay (>20.85%). Relative higher percentage (up to 2.06%) of sand occurred only in the upper interval (90 – 440 cm) depths. Methane concentration was not detectable in upper interval of 0- 650 cm and sudden changed into high value (1247μL/kg) at the core bottom, indicating methane venting from underlying sediments and SMI near this depth level.

Archaeal sequences obtained belong to Crenarchaeota (69.41%) and Eurarchaeota (25.26%). Dominated to very common lineages in the archaeal community are Marine benthic group B (MBGB) (28.17%), Miscellaneous Crenarchaeotic Group (MCG) (23.36%), C3 (11.84%), South African Gold Mine Euryarchaeotic Group (SAGMEG) (17.37%). Analysis of DGGE profile suggested that MBGB was the predominated component（86%）in methanogenic archaeal community, and the rest components, such as MCG, Methanosarcinales, Methanomicrobia, MBGE and SAGMEG, are presented in low abundance.

Evidences of microbial variation in response to methane concentration and SMI were recognized. For example, cell concentration in sediments was higher in the interval of high methane concentration; dominated to common lineages in archaeal communities varied in the intervals above and below SMI; ANME-1 occurred mainly in the interval above SMI. In addition, variation in cell concentration and archaeal community composition in correlated to sediment intervals containing sand was also noted.

Keywords: archaeal community, PCR-DGGE, cold seep sediments, South China Sea

Wiggled surface around the top of gas hydrate stability zone in the northeastern Sakhalin Slope, Okhotsk Sea: Is this present-day example for slope failure initiation associated with gas hydrate dissociation?

YOUNG-GYUN KIM[1*], YOUNG KEUN JIN[1], BORIS BARANOV[2], ANATOLY OBZHIROV[3], AND HIROTSUGU MINAMI[4]

[1] Korea Polar Research Institute, KIOST, South Korea (ygkim@kopri.re.kr)
[2] P.P.Shirshov Institute of Oceanology, FEB RAS, Russia
[3] V.I.I'lichev Pacific Oceanological Institute, FEB RAS, Russia
[4] Kitami Institute of Technology, Japan

One of important geological process related to the gas hydrate in the continental margins is the slope failure induced from increase of slope instability due to gas hydrate dissociation. The continental margins has experiences long-term global warming up to now since the Last Glacial Maximum and accordingly the gas hydrate stability zone (GHSZ) in there has shrunk. However, very few candidate sites for slope failure associated with gas hydrate dissociation have been found on the present-day ocean floor. In the northeastern Sakhalin Slope (Okhotsk Sea) numerous gas hydrate-related manifestations on and below the seafloor as well as in the water column have been reported. The bottom of the GHSZ estimated with 35 mK/m in geothermal gradient is consistent with the observed bottom-simulating reflector (BSR) depths on continental slope. From several sparker seismic profiles across the continental slope we found that the BSR depth shoals toward the shore and finally intersects the seafloor nearly at the top of the GHSZ, and also that wiggled surface only occurs in the limited interval around the top of the GHSZ. We speculate the wiggled surface stems from deformation related with gas hydrate dissociation at the top of gas hydrate stability zone. This is because internal sedimentary features are not consistent with those of well-reported sedimentary wave, and sedimentary strength of the sediment core retrieved from the shallower depth than the top of the GSHZ is significantly higher than that from the deeper. At this stage limitation in observation, i.e., low resolution of the sparker seismic profile and small number of sedimentary strength measurements, cannot lead us to the firm conclusion, however, further surveys unravelling characteristics of such wiggled surface may provide a good chance to understand the nature of ongoing slope failure process associated with shrink of the gas hydrate stability zone.

Keywords: gas hydrate dissociation, sediment strength, slope failure, Northeastern Sakhalin Slope, Okhotsk Sea

Forming mechanism of the slope-confined submarine canyons in the Baiyun Sag, Pearl River Mouth Basin

LIU JIE[1,2], SU MING[1,2*], QIAO SHAOHUA[1,2] , YANG RUI[1,2]

[1] Key Laboratory of Gas Hydrate, Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences, Guangzhou 510640, China (liujie1@ms.giec.ac.cn)

[2] Guangzhou Center for Gas Hydrate Research, Chinese Academy of Sciences, Guangzhou 510640, China

[3] Guangzhou Marine Geological Survey, Guangzhou 510760, China

The bathymetric chart shows that there are 17 approximation NNW-SSE trending submarine canyons which characterized by the heads of the canyons terminate on the slope, so-called “slope-confined canyons”, in the northern slope of Baiyun Sag, the Pearl River Mouth Basin.Based on the high resolution 2D seismic profiles, the Quaternary sequence stratigraphic framework is established by external morphology, internal structure and other reflection characterization. Then, the depositional filling sequence can be divided into three systems domains, namely LST (lowstand systems tract, LST), TST (transgressive systems tract, TST) and HST (highstand systems tract, HST). According to progradation style of the slope, the vertical stacking pattern, the change of erosion characteristics, the continuity of high-amplitude-phase axis of recognition and space tracking, the HST is further divided into two sedimentary cycle units, respectively HST1, HST2. The results show that the slope-confined canyons slope of Baiyun Sag developed in the late HST sedimentary cycles (HST-II). Based on the above analysis, the factors,which have influence on the formation and evolution of canyons, are discussed, such as the sediment supply, sediment instability, terrain features and fluid leakage. The canyons have been the main conduits for transporting terrigenous materials from the paleo-Pearl River to the lower slope and abyssal basin, since the Quaternary. Due to negative terrain forming in the early HST, erosion and sediment sedimentation instability during the process which sediment were transported from north to south along the slope direction, the slope-confined canyons developed Gas chimney are widely distributed in the study area, suggesting containing gas fluid vertically migrated and leaked, which may contribute to the further evolution of submarine canyons.

Keywords: slope-confined canyons; sediment supply; sediment instability; Baiyun Sag; Pearl River Mouth Basin

The association between submarine canyons and the accumulation of gas hydrates in the Pearl River Mouth Basin

XIAORONG CONG[1] MING SU[2] NENGYOU WU[3] RUI YANG[4] SHAOHUA QIAO[5] JIE LIU[6]

[1] Key Laboratory of Gas Hydrate, Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences (suming@ms.giec.ac.cn)

The Pearl River Mouth Basin in the northern continental slope of the South China Sea is an important area for gas hydrate exploration, lots of geological, geophysical and geochemical anomalies related with gas hydrate about having been identified. There are 17 submarine canyons developed in the water depth ranging from 500 to 1600 m in the northeast part of the Pearl River Estuary Canyon. The submarine canyons are generally 1 to 8 km wide, 30-50 km long, with topographic relief of about 450 m, distributed parallelly in the line of NNW-SSE. The gas hydrate expedition (GMGS-1), which was organized by Guangzhou Marine Geological Survey, was conducted in April 18 to June 11, 2007 in the Shenhu area, where the submarine canyons are developed. The 8 sites investigated during GMGS-1 were located on the crest of two prominent seafloor ridges. Gas hydrates were identified from the down hole wire line log and in the cores recovered at Sites SH2, SH3, and SH7, locating on the westernmost ridge. From pre-drilling forecasting and previous drilling results, the geophysical anomaly (such as bottom simulating reflector, high-amplitude reflector, blanking zone, etc) associated with the occurrence of gas hydrate should be located on ridges of submarine canyons, and based on these data the actual drilling stations were selected. Intensive geophysical anomaly, indicative of methane leakage, was recognized near the canyon wall. All of above imply close relation between gas hydrate distribution and submarine canyons. Investigations have revealed that the association between submarine canyons and the accumulation of gas hydrates can be summaried as : 1. The erosion of submarine canyons will lead to changes in stability conditions of gas hydrate, being characterized by a significant migration of the BSR, 2. The submarine canyons reconstructed the reservoirs of gas hydrates, breaking the gas hydrate-bearing sedimentary body and driving gas hydrate to occur especially around the canyon ridges. 3. The erosion and re-deposition of sediments in submarine canyons may induce the decomposition and reformation of gas hydrate, facilitating a dynamic condition for hydrate accumulation.

Keywords: gas hydrates, submarine canyons, erosion and sedimentation, Pearl River Mouth Basin

The occurrence of the submarine canyons and mass movements in the Shenhu area along the northern continental slope of the South China Sea: A possible relationship with gas hydrate?

HONG-JUN CHEN[1, 2, 3*], WEN-HUAN ZHAN[1, 3], JIN-LIANG[2], LI-QING LI[2], JIN-QIANG LIANG[2], YUE-HUA GONG[2], MING-MING WEN[2]

[1] CAS Key Laboratory of Marginal Sea Geology, South China Sea Institute of Oceanology, CAS, Guangzhou 510301, China (chhju@163.com)

[2] Key Laboratory of Marine Mineral Resources, Ministry of Land and Resources, Guangzhou Marine Geological Survey, Ministry of Land and Resources, Guangzhou, 510075, China

[3] University of Chinese Academy of Sciences, Beijing 100049, China

High-resolution multi-beam bathymetry and shallow seismic sequence surveys at the Shenhu area along the northern slope of the South China Sea (SCS) reveal detailed geomorphology and seismic stratigraphy characteristics of 7 canyons and mass movements at the flat and smooth sea floor. The modern canyons are roughly elongated NNW-SSW, with U-shaped in cross section. and have lengths of 9–25 km, widths of 1.2–5 km, incise up to 175 m into the Quaternary slope deposits in water depths of 400–1000 m. The mass movements including slide complexs, slide scars and debris/turbidity flows. The slide complexs and slide scars are oriented in NE-SW direction, covers an area ca. 1790 km^2 and 926 km^2, respectively. The debris/turbidity flows developed at the lower slope. A detailed facies analysis suggests that four seismic facies are recognized, and the Late Cenozoic stratigraphy above the acoustic basement can be roughly subdivided into three sequences (1–3) that are separated by regional unconformities (Tg, T2, and T1) in the study area. The gas hydrate occurrence is marked by methane in the headspace gases of the sediment, seismic velocity anomaly, Bottom Simulating Reflectors (BSRs), gas chimneys, pockmarks in the study area. Seismic observations suggest that the formation of the modern canyons, mass movements in the study area took place around the transition between the last glacial period and the current interglacial period. The existence and dissociation of gas hydrate combined with regional tectonic setting may trigger the instability and the mass movements of the sea floor. Canyons are possible the final results of gas hydrate dissociation and major routes for the gas to escape into sea water. Our results are important to the understanding of gas hydrate exploration in such a sensitive slope area, and they must be taken into account geological hazards associated with the dissociation of gas hydrate.

Keywords: South China Sea, canyons, mass movements, gas hydrate, continental slope

Ionic and isotopic analyses of pore waters from gas hydrate-bearing sediment cores retrieved at Tatarsky trough off Sakhalin Island, Russia

HIROTSUGU MINAMI[1*], AKIHIRO HACHIKUBO[1], HIROTOSHI SAKAGAMI[1], SATOSHI YAMASHITA[1], NOBUO TAKAHASHI[1], HITOSHI SHOJI[1], YOUNG KEUN JIN[2], BORIS BARANOV[3] AND ANATOLY OBZHIROV[4]

[1] Kitami Institute of Technology, Japan (minamihr@mail.kitami-it.ac.jp)
[2] Korea Polar Research Institute, KIOST, South Korea
[3] P.P.Shirshov Institute of Oceanology, RAS, Russia
[4] V.I.I'lichev Pacific Oceanological Institute, FEB, RAS, Russia

The sediment core sampling operations at Tatarsky trough were conducted as an international collaborative research project (Sakhalin Slope Gas Hydrate Project: SSGH and SSGH II) organized by scientists from Japan (Kitami Institute of Technology), Korea (Korea Polar Research Institute) and Russia (V.I. Il'ichev Pacific Oceanological Institute, FEB, RAS and P.P. Shirshov Institute of Oceanology, RAS) to study shallow gas hydrate (GH) that have accumulated off Sakhalin Island. Four GH-bearing sediment cores (1.9-3.7 m long) were retrieved from the seafloor (ca. 322 m W.D.) during the project (2012-2014). The ionic analyses of anions and cations in sediment pore waters and the isotopic analyses of hydrogen and oxygen of the pore waters were conducted to investigate geochemical feature of the GH-bearing cores and adjacent cores of them. The fact that the chloride concentration decreased with depth within the gas-saturated sediment interval of many cores suggests occurrence of ascending gas as well as water in this interval, but it remains unclear whether they ascended as gas-saturated/low-chloride water or individually. Also it is unclear that if chloride concentration gradient in the gas-saturated interval formed by diffusion or advection process. The observations of enriched δD and δ18O pore water signatures in a few cores suggest that those pore waters were originated from GH dissociation since GH emits low chloride water with enriched isotopic composition when it dissociates. The finding that a lot of gas flares (hydroacoustic anomalies) were observed at the GH-bearing sites does not contradict this explanation since large quantities of gas emits when GH dissociates. However, the fact that the pore water containing low chloride in combination with depleted δD and δ18O was detected at the GH-bearing interval does not fit with the forementioned interpretation but suggests complicated geochemistry at the GH-bearing sites.

Keywords: international collaborative research project; gas hydrate; pore water; ionic and isotopic analysis; Tatarsky trough

Characteristics of natural gas hydrates retrieved from Tatarsky Trough, off the south western Sakhalin Island

A. HACHIKUBO [1], Y. K. JIN [2], S. TAKEYA [3], O. VERESHCHAGINA [4], H. SAKAGAMI [1], H. MINAMI [1], S. YAMASHITA [1], N. TAKAHASHI [1], H. SHOJI [1] AND A. OBZHIROV [4]

[1] Kitami Institute of Technology, 165 Koen-cho, Kitami 090-8507, Japan (hachi@mail.kitami-it.ac.jp)
[2] Korea Polar Research Institute (KOPRI), 26 Songdomirae-ro, Yeonsu-gu, Incheon 406-840, Korea
[3] National Institute of Advanced Industrial Science and Technology (AIST), Central 5, 1-1-1 Higashi, Tsukuba 305-8565, Japan
[4] V.I. Il'ichev Pacific Oceanological Institute FEB RAS, 43 Baltiyskaya St., Vladivostok 690041, Russia

Gas hydrates have been recovered off Sakhalin Island in the framework of Sakhalin Slope Gas Hydrate (SSGH) project onboard R/V Akademik M. A. Lavrentyev. In this report, we would like to focus on the characteristics of gas hydrate retrieved from the Tatarsky Trough, off the south western Sakhalin Island. In the recent three cruises (2012-2014), we discovered a lot of gas plumes ascend from the sea floor, where hydrocarbon gases were rich in the sub-bottom sediment. Gas hydrate crystals in sediment cores were recovered from the sites of gas plumes, where water depth was only 322 m and the pressure of water was close to the equilibrium pressure of methane hydrate in sea water. Calorimetric and Raman spectroscopic analyses were done for the gas hydrate samples. Dissociation heat of gas hydrates was almost the same as that of pure methane hydrate. Raman spectra showed that the hydrate crystals belonged to the cubic structure I, and the hydration number was estimated about 6.0. Ethane and hydrogen sulfide were also detected in the Raman spectra, indicating that these gases were encaged with methane in the crystal. We obtained hydrate-bound and headspace gas samples on board and measured their molecular and stable isotope compositions. According to an empirical classification of the methane stable isotopes, $\delta^{13}C$ and δD of the headspace gases indicated that the methane in the study area was mainly microbial origin via carbonate reduction; however, methane in some sediment cores showed larger $\delta^{13}C$ and δD, suggesting their thermogenic origin. We retrieved three sediment cores with gas hydrate at the same site, and their $\delta 13C$ of hydrate-bound methane were from -47.5‰ to -41.6‰. On the contrary, a hydrate-bound microbial methane ($\delta^{13}C$: -68.6‰) was obtained only 12 km apart from the above thermogenic site.

Keywords: gas hydrate, stable isotope, Raman, thermogenic methane

The stability of gas hydrate field in the northern continental slope of South China Sea as inferred from analysis of heat flow data

RUI YANG[1,3] , NENGYOU WU[1,2,3] , MING SU[1,3] , ZHENG SU[1,3] , SHAOHUA QIAO[1,3] , JIE LIU[1,3] , JINQIANG LIANG[4] , PAN GUO[5] , YUANYUAN HUO[6]

[1] Key Laboratory of Gas Hydrate, Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences, China (yangrui@ms.giec.ac.cn)
[2] Qingdao Institute of Marine Geology, China
[3] Guangzhou Center for Gas Hydrate Research, Chinese Academy of Sciences, China
[4] Guangzhou Marine Geological Survey, China
[5] Shaanxi Tiandi Geological Co., Ltd., China
[6] Research Institute of Exploration and Development, Northern China Branch, Sinopec Zhengzhou, China

Gas hydrate formated in submarine sediments under low temperature and high pressure condictions. The gas hydrate stability zone, which related to stability conditions, is widely identifitied around continental margine in the world, including South China Sea. In 2007, the China Geological Survey (CGS) carried out the first gas hydrate drilling expedition in the Shenhu Area, northern continental slope of South China Sea. A total of eight boreholes were drilled and gas hydrate was revealed in the core samples from 3 sites(SH2, SH3, SH7). Numerous gas hydrate-related data have been reported, including 2D and 3D seismic data, log well data, geochemical in situ test data and heat flow data. In this study, we modeled the gas hydrate stability zone (GHSZ) with the Tishchenko's equation (2005) using methane gas composition, water temperature, seafloor temperature and geothermal gradient to see if it is consistent with the observed depth of the BSR. However, the background heat flow at northwest (where SH2 located) and southeast (where SH5 located) are different significantly. It is higher at southeast. According to the calculation, the depth of the BSR matches well with the base of GHSZ estimated from the background heat flow (geothermal gradient) at both northwest and southeast. We tried to discuss, under comparison of gas hydrate stability conditions and gas fluid flow at SH2 (which gain gas hydrate samples) and SH5 (which do not gain gas hydrate samples), especially the absence of gas hydrate at site SH5 even there is GHSZ absolutely, various factors about gas hydrate distribution in the northern slope of South China Sea. We infered that gas fluid flow and sediments may more effective than other factors.

Keywords: gas hydrate, gas hydrate stability zone, heat flow, BSRs, South China Sea

Influence factor of forming gas hydrate chimney in the Ulleung Basin, East Sea

DONG-HYO KANG[1], JONG-HWA CHUN[1], NAM-HYUNG KOO[1], WON-SIK KIM[1], BO-YEON YI[1], HO-YOUNG LEE[1]

[1] Petroleum & Marine Research Division, Korea Institute of Geoscience & Mineral Resources (KIGAM), Daejeon 305-350, Korea (dhkang@kigam.re.kr)

Seismic chimneys ranging in width from 200 m to 1,000 m are observed in the seismic sections obtained in the Ulleung Basin, East Sea. In consequence of Ulleung Basin Gas Hydrate Expedition 1 and 2, concentrations of gas hydrates were discovered within the seismic chimneys. Through the interpreting seismic section, three factors affect the forming gas hydrate chimney; mass transport deposit, fault, igneous intrusion. These three factors result in three case of forming gas hydrate chimney. Firstly, gas hydrate chimney appears predominantly in the fault zone. Deep-rooted fault reach to mass transport deposit and gas hydrate chimney which is mostly rooted in mass transport deposit is formed. Secondly, Gas hydrate chimney appears linked to igneous intrusion. Igneous intrusion result in forming fault in overlying strata. Similar to first case, this fault traverses mass transport deposit and gas hydrate chimney rooted in mass transport deposit is created. Thirdly, gas hydrate chimney is formed at thick mass transport deposit without fault. In this case, chimney is not reach to seabed in contrast with first and second case. The thickness of mass transport deposit is 0.2 second in two-way travel times. Overburden load cause to pressure at the upper part of mass transport deposit. This leads to fracture in overlying sediments and form gas hydrate chimney.

Keywords: hydrate, chimney, igneous intrusion, mass transport deposit, fault, Ulleung Basin

Geophysical evidence for the occurrence of gas hydrate and associated gas in the Ulleung Basin, East Sea

DONG D. YOO[1], NYEON K. KANG[1], BO Y. YI[1], GIL Y. KIM[1], YOUNG J, KIM[1], BYONG J. RYU[1]

[1] Petroleum and Marine Research Division Korea Institute of Geoscience and Mineral Resources, Korea (dgyoo@kigam.re.kr)

Multi-channel seismic reflection and well-log data from the Ulleung Basin, East Sea reveal several seismic signatures indicative of gas-hydrate occurrence in the Ulleung Basin that are associated with vertically and/or laterally stacked mass-transport complexes. The seismic indicators include (a) a bottom simulating reflector (BSR), (b) a seismic chimney, (c) high amplitude reflections within the gas hydrate stability zone (GHSZ), (d) acoustic blanking, (e) enhanced reflections below the BSR, and (f) seafloor gas-escape features. The BSR, associated with enhanced reflections below, is most commonly found over much of the basin indicating a physiochemical boundary of gas hydrates overlying free gas. Seismic chimneys are characterized by velocity pull-up and reduced reflectivity on the seismic sections, which appear to be caused by active migration of fluid gas vertically into the GHSZ. The logging data retrieved from the seismic chimneys showed elevated electrical resistivity (>80 Ohm-m) and P-wave velocity (>2000 m/s), indicating the presence of gas hydrate. Another seismic characteristic observed in gas hydrate bearing sediments is the strong amplitude reflections, defined by the relatively high reflectivity within the GHSZ. Acoustic blanking is likely to be the result of hydrate accumulation in the sediments causing a significant reduction of acoustic impedance contrast between sedimentary layers. Where the upward migrating gas seeps into the deep water column, seafloor pockmarks and mud mounds may be formed.

Keywords: Seismic indicators of gas hydrate; mul-tichannel seismic data; Ulleung Basin

Studies on gas hydrates in the deep-water Ulleung Basin, East Sea of Korea

BYONG-JAE RYU[1]

[1]Korea Institute of Geoscience and Mineral Resources, Daejeon, Korea (bjryu@kigam.re.kr)

Studies on gas hydrates in the deep-water Ulleung Basin, East Sea of Korea have been conducted to secure the future energy resources since 1996. Gas hydrate study in the Ulleung Basin was initiated by the Korea Institute of Geoscience and Mineral Resources (KIGAM) in 1996. Gardner et al. (1998) also reported an initial reconnaissance study of gas hydrates in the basin mainly using 12 KHz side-scan sonar images, core samples and 3.5 kHz sub-bottom profiling records. To understand the potential for the presence of gas hydrate in the Ulleung Basin, KIGAM collected the geophysical data and sediment samples in the southwestern part of the basin from 1997 to 1999. Bottom simulating reflectors (BSRs) were first identified on seismic data collected in 1998 and 1999 (Ryu et al., 1999). Regional geophysical surveys, geological studies and experimental studies of gas hydrates in the basin have been also carried out by the KIGAM from 2000 to 2004. This 5-year gas hydrate research project was supported by the Ministry of Commerce, Industry and Energy, and the Korea Gas Corporation (KOGAS). Based on the results from the preliminary studies on gas hydrates in the Ulleung Basin, the "Korean National Gas Hydrate Program" was launched in 2005 with the support of the Ministry of Knowledge Economy (currently Ministry of Trade, Industry and Energy). The program has been carried out under the management of Gas Hydrate R&D Organization (GHDO) with the participation of a R&D consortium governed by the KIGAM, the Korea National Oil Corporation (KNOC) and the KOGAS. The program has undertaken geophysical survey programs and drilling for the identification of gas hydrate occurrences, the assessment of gas hydrate resources in the Ulleung Basin, and the development of appropriate production technologies. As a part of this national program, 6690 km of 2D multi-channel reflection seismic lines and 900 km2 of 3D seismic data were acquired. Together with multi-beam back-scatter, Chirp- and EK-60 echo-sounder data, sediment samples were also collected using piston corer and the portable remotely operated drill (PROD) system. In addition, two gas hydrate drilling expeditions were performed in 2007 and 2010, respectively. Environmental impact studies for the production test have been also conducted using the KIGAM Seafloor Observation System (KISOS). Currently, researches are being carried out for successful production of gas hydrates in the basin.

Keywords: gas hydrate, Ulleung Basin, East Sea, bottom simulating reflector, seismic data

Fracture analysis from borehole log data in the Ulleung Basin, East Sea

GIL YOUNG KIM[1], BUYANBAT NARANTSETSEG[2], DONG GEUN YOO[1], BYONG JAE RYU[1]

[1] Korea Institute of Geoscience and Mineral Resources (KIGAM), Daejeon, Korea (gykim@kigam.re.kr)
[2] Mongolian University of Science and Technology, Mongolia

The LWD (Logging-While-Drilling) logging (including wireline logging) and coring (including pressure coring) were conducted during UBGH2 (Ulleung Basin Gas Hydrate) expedition. The LWD data from 13 logged sites were obtained and most of the sites showed typical log data indicating the presence of gas hydrate. In particular, prominent fractures were clearly identified on the resistivity borehole images from the seismic chimney structures. The strike and dip of each fracture in all sites was calculated and displayed on the stereographic plot and rosette diagram. Fracture orientations on the stereographic plot are more broadly distributed, indicating that the fracture pattern is not well-ordered on the rosette diagram, although the maximum horizontal stress dominates NW-SE direction at most sites. This indicates that accurate horizontal stress directions cannot be completely resolved from the fractures. Moreover, the fractures may be developed from overburden (e.g., gravitational effect) compaction associated with sediment dewatering after deposition. Thus we should consider various factors affecting formation of fractures in order to interpret the origin of fractures. Nevertheless, the results of fracture analysis can be used to interpret distribution pattern and type of gas hydrate in the Ulleung Basin.

Estimation of gas hydrate saturation using 3D seismic data in the Ulleung Basin, East Sea

BO-YEON YI[1], NYEON-KEON KANG[1], DONG-GEUN YOO[1], GWANG-HOON LEE[2]

[1] Petroleum and Marine Research Division, Korea Institute of Geoscience and Mineral Resources, Republic of Korea (byyi@kigam.re.kr)

[2] Department of Energy Resources Engineering, Pukyong National University, Republic of Korea

After the second Ulleung Basin gas hydrate drilling expedition (UBGH2), analysis of extensive seismic data and UBGH2 drilling data suggest that site UBGH2-6 have relatively good quality reservoir of pore-filling type gas hydrate in terms of total thickness of sand bearing gas hydrate. We estimated the gas hydrate saturation around site UBGH2-6 in the Ulleung Basin, East Sea from 3D seismic data and well log data together with core measurement data, using rock physics model and seismic inversion. The gas-hydrate saturation and S-wave velocity at the well were estimated from the simplified three-phase Biot-type equation (STPBE) and effective medium theory (EMT). The results obtained from STPBE show more comparable values than those computed from EMT. The core X-ray diffraction data were used to compute the elastic properties of solid components of sediment, which are the key input parameters to the rock physics model. The simultaneous inversion was carried out to obtain P-wave impedance and S-wave impedance volume of 3D seismic data. To reveal the variation of gas hydrate saturation away from the well, the relation between gas hydrate saturation and P-/S-wave impedance were derived from rock physics model. The results of gas hydrate saturation from the seismic data were compared with gas hydrate saturation from the well log.

Keywords: Gas hydrate, Second Ulleung Basin Gas Hydrate Drilling Expedition (UBGH2), saturation, inversion

A non-destructive method for additional CH4 recovery from gas hydrates

YOUNG-JU SEO[1,2], DAEOK KIM[2], DONG-YEUN KOH[2], JOO YONG LEE[1], TAEWOONG AHN[1], SE-JOON KIM[1], JAEHYOUNG LEE[1*], HUEN LEE[2*]

[1] Petroleum & Marine Research Division, Korea Institute of Geoscience & Mineral Resources (KIGAM), 124 Gwahang-no, Yuseong-gu, Daejeon, 305-350, Korea

[2] Department of Chemical and Biomolecular Engineering, Korea Advanced Institute of Science and Technology (KAIST), 291 Daehak-ro, Yuseong-gu, Daejeon, 305-701, Korea

Replacement technique as one of a promising method for gas hydrate production has received recent attention because of its potential role in energy development and CO_2 gas sequestration into the deep ocean sediments. Consequently, in order to apply for this method, sufficient understandings and results analysis should be considered for obtaining additional methane gas by using flue gas. In this paper, we have focused on the previous results of swapping process on the replacement research fields and ongoing experimental results. This study will suggest that the non-destructive method for obtaining CH_4 gas by injecting CO_2/N_2 gas mixture in order to be applicable for a large-scale methane hydrate production under the deep-sea sediments.

Keywords: Replacement technique, hydrate, CO_2/N_2 gas mixture

X-ray computed tomography observations of hydrate-bearing porous media under hydrate formation and dissociation process

TAEWOONG AHN[1], JAEHYOUNG LEE[1], JOO YONG LEE[1], SE-JOON KIM[1]

[1]KIGAM, Korea (twahn@kigam.re.kr)

The recovery schemes for natural gas caged in the solid state have not been commercialized. Depressurization has been known as a promising method due to its economic feasibility according to previous lab-scale experiments and simulation studies. However, the results of few field tests showed that the production characteristics of real field differed from that of predicted results. To reliably predict the production performance of real fields, it is necessary to understand quantitative changes of phase distribution and fluid flow in sediments in response to hydrate dissociation by depressurization. In this study, we observed and analyzed the phase distribution and flow behavior during core flooding and hydrate formation and dissociation using X-ray computed tomography which provides high-resolution density distribution. Artificial particles having similar grain size distribution of sandy layers found in real hydrate fields were packed into X-ray transparent aluminum vessel. Information on pore distribution within a sediment sample was achieved by comparing CT images between dry condition and fully water-saturated condition. Dynamic changes of phase saturation were observed during gas flooding, through which potential flow pathway was estimated. It was inferred that hydrate formation and dissociation significantly affected phase saturation and flow pathway. Severe changes of fluid distribution through whole sample occurred during hydrate formation. The relation between hydrate saturation and gas production behavior during dissociation was investigated based on pressure and production data as well as CT images.

Keywords: hydrate formation, hydrate dissociatioin, depressurization, x-ray, computed tomography

Using an improved IMPES formulation on numerical simulation of methane hydrate-related porous media

JINAN GUAN, DEQING LIANG[1*], LIHUA WAN[1]

[1] Key Laboratory of Gas Hydrate, Guangzhou Institute of Energy Conversion, Chinese Academy of Science, Guangzhou China (liangdq@ms.giec.ac.cn)

As one of the highly anticipated new clean energy resources in the near future, methane hydrate and corresponding marine hydrates system have been widely concerned. Generally, the formation、accumulation and decomposition of methane hydrate in seafloor sediments pore is a comprehensive multiphase process which includes methane transportation、fluids flow and molecule reaction. The hydrate reaction heat changes local thermodynamic conditions and then influences this process. Based on Darcy law, in order to deal with this type of non-adiabatic multiphase flow-reaction problem, in this paper an improved IMPES formulation has been presented. In this method the saturations of gas、water and hydrate in the pore have been designed to alter with the pressure in the same iteration time. Three different situations about hydrate-related porous media, depressurization/ heat injection/drilling mud invasion, have been adopted to test the stability and convergence of this difference scheme. The results show that this improved IMPES method can adequately solve these types of scientific and industrial issues.

Keywords: methane hydrate, hydrate-related porous media, IMPES method, numerical difference scheme, multiphase process

Geomechanical responses of marine gas hydrate-bearing sediments in the Ulleung basin induced by a depressurization method

AH-RAM KIM[1], GYE-CHUN CHO[1], SE-JOON KIM[2], AND JOO-YONG LEE[2]

[1] Department of Civil and Environmental Engineering, KAIST, Daejeon, Republic of Korea (gyechun@kaist.edu)
[2] Petroleum and Marine Research Division, KIGAM, Republic of Korea

Methane gas hydrate deposits in the Ulleung Basin of the Korean East Sea were identified by the Korea Institute of Geoscience and Mineral Resources in the early 2000s, and a pilot production project is being planned for 2017 as the world's second offshore hydrate production project. There are three main production methods of methane recovery from hydrate-bearing sediments: depressurization, thermal stimulation, chemical stimulation, and combinations of these methods. Depressurization, in which the hydrate is dissociated by lowering the well pressure until it is less than the equilibrium pressure, is considered as the most productive and effective method. However, the higher pressure difference between the production well and reservoir sediments induces simultaneously greater effective stress as well as greater geomechanical destabilization in the hydrate-bearing sediments. Especially in the Ulleung basin, the seawater depth is approximately 1500-2300 m; however, the depth of the hydrate occurrence zone is relatively shallow (about 100-200 mbsf) for methane hydrate production. Therefore, there is a high risk of geomechanical stability problems such as differential settlement, seafloor subsidence, and wellbore instability. In this study, numerical modelling using the finite difference method is conducted to simulate methane hydrate production from the Ulleung Basin by the depressurization method. A coupled mechanical-hydraulic-thermal model incorporates the processes of hydrate dissociation, pore fluid flow, thermal advection, and the geomechanical behaviours of hydrate-bearing sediments. The results show firstly the spatial distribution of the pore pressure and hydrate saturation, secondly the volumetric strain in the area of the well head, and finally the degree of subsidence at the production well and at the seafloor by different depressurization methods during the production period (14 days).

Keywords: methane production, hydrate-bearing sediment, subsidence, settlement, depressurization

3-D magnetic inversion modelling analysis in TA19-1 seamount of the Lau basin by the iterative reweighted least square method

SOONYOUNG CHOI[1], CHANGHWAN KIM[1], HYUNGRAE KIM[2], HYEON-YEONG PARK[1] AND CHANHONG PARK[1]

[1] Dokdo Research Center, East Sea Research Institute, Korea Institute of Oncean Science & Technology, South Korea (sychoi@kiost.ac.kr)

[2] Department of Geoenvironmetal Science, Kongju National University, South Korea

The Lau basin is one of the youngest back–arc basins in the Southwest Pacific. This region was a lot of hydrothermal activities and hydrothermal deposits. In particular, TofuaArc(TA) in the Lau basin consists of various and complex stratovolcanos(from Massoth et al., 2007). We performed the marine magnetic and the bathymetry survey in the Lau basin for finding the submarine hydrothermal deposits in October 2009. We acquired magnetic and bathymetry datasets by using Overhouser Proton Magnetometer SeaSPY(Marine Magnetics Co.) and Multi-Beam Echo Sounder EM120(Kongsberg Co.). We conducted the data processing to obtain detailed seabed topography, magnetic anomaly and reduction to the pole(RTP). By 3-D magnetic inversion from Jung's prevous study(2013), we calculated the magnetic susceptibility distribution of the TA19-1 seamount area using the RTP data. Based on 2D 'compact gravity inversion' by Last & Kubik(1983), we expend it to the 3D algorithm using iterative reweighted least squares method with some weight matrices. The used weight matrices are two types: the minimum gradient support(MGS) that controls the spatial distribution of the solution from Porniaguine and Zhdanov(1999); the depth weight that are used according to the shape of subsurface structures. From the modeling, we derived the appropriate scale factor for the use of depth weight and setting magnetic susceptibility. Compared between the final modeled result and RTP values in this study, they are generally similar to the each other. But the input values and the modeled values are have slightly little difference. This difference is expected to have been caused by various and complex stratovolcanos, misunderstanding of regional geology distribution, modeling design(various scalar factor, depth weight and magnetic susceptibility), limited vertical resolution from non-uniqueness in potential field and etc. We can expect to have the better results of advanced modeling design with more geological survey data.

Keywords: Southwest Pacific, Lau basin, magnetic anomaly, 3-D inversion, least square method

Consideration of Crustal Structure of the Ulleung Basin in East Sea (Japan Sea) by Thermal Evolution

YOON-MI KIM[1] AND SANG-MOOK LEE[2]

[1] Korea Institute of Geoscience and Mineral Resources, Korea (ymkim1@kigam.re.kr)
[2] School of Earth and Environmental Sciences, Seoul National University, Korea

The East Sea bounded by the southeastern Korean Peninsula and the southwestern Japan Islands and northeastern China has been considered as a backarc generated by the rollback of the subducting Pacific plate occurred from early to middle Eocene. In the East Sea, there are several backarc-like basins such as Japan, Yamato and Ulleung basins. Among the basins, the crustal structure of the Ulleung basin has not been well constrained though seismic refraction/reflection studies suggested that the crustal thickness of the Ulleung Basin is about 13-25 km, thicker than ordinary thickness of oceanic crust. In addition, thermal effect on the gravity anomaly in the basin has not been evaluated even though the thermal anomaly by the backarc rifting may remain. Thus, we investigated the crustal structure using bathymetry, gravity and sediments thickness in the basin. To evaluate the effect of thermal structure on the gravity anomaly, we constructed two-dimensional time-dependent thermal model including crustal thinning by rifting. Our preliminary results show that thermal structure by rifting affects the gravity anomaly of the Ulleung basin; thermal gravity anomaly by the rifting remains post-rifting stages, indicating that the constrains of the Moho depth requires consideration of the thermal evolution of the Ulleung basin after its opening. Our results imply that thermal evolution of the oceanic crust by rifting plays an important role in the evaluation of the crustal structure, especially, in the evaluation for the relatively young backarc. Our results can be tested through further studies including seismic reflection/refraction, magnetic anomaly and heat flow studies.

Keywords: Ulleung Basin, gravity, crustal structure, rifting, thermal structure

Deposition architecture patterns and evolution of continental slope and their controlled factors in the Qiongdongnan Basin, South China Sea

XIAOMEI DU[1], HUAWANG[1], JINFENG REN[1] AND XINONG XIE[1]

[1] Faculty of Earth Resources, China University of Geosciences, Wuhan, 430074, China (908709195@qq.com)

The Qiongdongnan basin is a Cenozoic expanding basin located in the northern continental margins of South China Sea. The deep water slope depositional system is developed along the northern margins of the Central depression of the basin when the basin entered the accelerated subsidence of the basin since the late Miocene. A number of slope prisms extending nearly east-west direction occur evidenced from seismic profiles and drilling data. The research results show the slope system in the Qiongdongnan basin is divided into four types from west to east: progradational slope, slump-slope, channelized slope, and wide slow-gradient slope. Based on the depiction analysis of depositional architectures and internal seismic facies of the slope, different types of slope wedges in different slope types have an obvious difference. Progradational slope occurs in the western basin resulting in the rapid migration of the shelf break due to the abundant sediment supply. Slump slope and channelized slope is presented in the medium basin resulting in the formation of nearly vertical accretion of slope wedges due to lack of sediment supply. Wide slow-gradient type does not form a clear progradational wedge due to gently slope. Formation and evolution of slope system is controlled by sediment supply, faulting and sea-level change. Faulting in the basin constrains the position of the initial slope development. Sediments supply and sea-level change effect the slope adjustment and depositional architectures of the slope wedge. Research results from this study can be used to elucidate further the development and evolution of northern continental margins of South China Sea.

Keywords: Slope structures; Control factors; South China Sea; Qiongdongnan Basin

Geologic Evolution of the Socotra Basin in the South Sea, Korea

CHANG SEONG KOH[1] AND SEOK HOON YOON[1]

[1] Department of Earth and Marine Sciences, Jeju National University, Korea (koh1460@jejunu.ac.kr)

In order to understand the geologic evolution of the Socotra Basin in the south Sea of Korea, we interpreted the seismic stratigraphy, tectonic evolution, and depositional environments. In process of the analysis, the multi-channel seismic reflection data was used with the supplementary data of three drilling wells from the previous hydrocarbon explorations. The results of analysis reveal that the Socotra Basin is identified as the local basement lows which surrounded by large-scale basement highs, and the basin-filling sedimentary sequences are divided into 4 mega-sequences (MS1-MS4) which have angular-unconformitic boundaries except MS3/MS4 (paraconformity). Through the biostratigraphic data from the Korea and Chinese researches, the age of the mega-sequences is defined as the Eocene (MS1), Oligocene (MS2), Miocene (MS3), and Plio-Pleistocene (MS4). The tectonic evolution and their correlated depositional environment changes of the basin are divided into six stages based on the correlation with geologic structures, biozones in drilling wells, and partly on seismic facies analysis. (1) In the Late Cretaceous, initial rift began to build a series of grabens and half-grabens, and syn-rift deposits (MS1) filled the basement lows in alluvial and lacustrine settings. (2) In Late Eocene-Early Oligocene regional uplift and folding which terminated the initial rifting and folded the MS1 occurred. (3) After this event, the rifting and subsidence started again, the environment gradually changed from coastal to marine, the top of folded MS1 is overlain by a marine transgression surface. Subsequently, MS2 filled in grabens and half-grabens. (4) The rifting and subsidence are interrupted again and the subaerial environment resulted from uplift, MS2 is folded during this period. (5) After that, the regional subsidence continued and the coastal setting occurred in Miocene. The top of folded MS2 has been eroded and MS3 covered the entire area to flat. In addition, the volcanism giving rise to various volcanic complexes (edifices, sills, and dikes) was active in local area including Socotra Basin and adjacent basement highs in Early-Middle Miocene. (6) In Plio-Pleistocene, regional subsidence continued and MS4 developed in the entire area through the marine environment.

Keywords: South Sea, Socotra Basin, seismic stratigraphy, rifting, uplift, environment

Geophysical investigations of crustal structure of Cenozoic rifting basin in passive continental margin: the Pearl River Mouth Basin, South China Sea

NING QIU[1], ZHEN SUN[1], XIONG PANG[2] AND JINYUN ZHENG[2]

[1] CAS Key Lab of Marginal Sea Geology, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou 510301, China (ningqiu@scsio.ac.cn)

[2] Shenzhen Branch of CNOOC Limited, Guangzhou 510420, China

The Pearl River Mouth Basin (PRMB) initiated in the Cenozoic with rifting, and became a part of the South China Sea (SCS) rifted passive continental margin. Decades of industrial exploration in this proliferous region have produced lots of geological and geophysical data.

In order to get the first order crustal scale structure, we integrate well data, multi channel seismic reflection, and the observed gravity field for a joint inversion. The Cenozoic sediment of PRMB comprises of several stratigraphic sequences, including the terrestrial facies, the marine facies and the transitional facies. The sedimentary model takes into account of two main parts that refer to the Paleogene to Neogene unit and the Neogene to Quaternary unit, which were respectively formed during the intercontinental rifting stage and the passive continental margin post-rifting stage.

By integrating long cable seismic profiles, interval velocity and performing gravity modelling, we have modelled the sub-sedimentary basement. There are some high-density bodies in the lower part of crust (ρ> 2.8 g/cm^3), most of which were probably made up by emplacement from the upper mantle into the lower crust. The crystalline continental crust spans from unstretched domains (as thick as about 25 km) near the continental shelf to extremely thinned domains (of less than 6 km thickness) in the sag center. The presented crust-scale structural model shows that the crystalline crust of the Liwan Sag (LWS) and Baiyun sag (BYS) are thinner than other parts of PRMB, especially, the crystalline crust thickness in BYS is even less than 6 km. we could preliminary infer that the crystalline crust may be more easily stretched and be thinned by the existence of hot and soft substances at the lower crust.

Keywords: seismic; gravity; oceanic-continental transition zone; passive continental margin; Pearl River Mouth Basin; South China Sea; tectonic

The hydrocarbon significance of post-rift fault activity in Baiyun sag, northern South China Sea

XIE ZHIYUAN AND SUN ZHEN[1]

[1] South China Sea Institute of Oceanology, Chinese Academy of Sciences, China (zhensun@scsio.ac.cn)

Baiyun sag, one of largest sags in Pearl River Mouth Basin, is located in the passive continental margin of northern South China Sea. Massive fault activities and magmatism could be found in the post-rift stage which indicates that reactivation rather than quiescence mainly dominated the post-rift stage. Tectonic reactivation would profoundly influence hydrocarbon migration and accumulation and should be regarded as priority for petroleum exploration. We managed to evaluate the strength of tectonic activity based on fault growth index and weighted length. The results show that the post-rifting thermal subsidence period could be divided into three stages , namely 32Ma-16.5Ma, 16.5Ma-10Ma and 10Ma-0.The first stage is characterized by strong tectonic activity with localized volcanism. By contrast, the second stage shows extraordinary weak tectonic activity. The third stage, whereas, is featured by intense fault activity and angular unconformity indicating a remarkable tectonic movement occurred. To better understand the significance of fault activities on hydrocarbon, a basin modelling study was conducted. The results shows that Baiyun sag steps into main oil-generating period around 18.5Ma,while the main gas-generating period starts from 10Ma.In this case, it is inferred that faults active in 18.5Ma-16.5Ma and 10.5Ma-0 couple well with hydrocarbon migration, thus play a key role in the migration of hydrocarbon. The mechanism for post-rift fault activity is unclear so far , though several hypotheses have been proposed to explain it. It is conjectured that second order mantle convection and high discrepant sedimentation rate might contribute to the anomalous post-rift subsidence which are in accord with the strong tectonic activity from 23.8Ma to 16.5Ma.The Dongsha movement has been proposed to explain the tectonic reactivation after 10Ma.More works are needed to explain the origin and internal mechanism of post-rift tectonic activity in the deep-water area of the Pearl River Mouth Basin.

Keywords: post-rift, fault activity, hydrocarbon

The volcanic-sedimentary evolution of Qushenla Group in the southern margin of Qiangtang Basin

GANG TAO[1,2],LIDONG ZHU[1,*],WENGUANG YANG[1,2],ZHIWU LI[1,2],CHAO LI[1,2],BI HE[1,2],DUWEN LI[1,2]

[1] Institute of Sedimentary Geology, Chengdu University of Technology, Chengdu 610059, China (zhuld_cdut@163.com)
[2] State Key Laboratory of Oil and Gas Reservoir Geology and Exploration, Chengdu 610059, China
[3] Geoscience Institute,Chengdu University of Technology,610059, China

Qushenla Group (K_1q), which distributes in the southern margin of Qiangtang Basin, has a special vertical sequence and rock composition that reflect characteristics of the inland volcanic - sedimentary basin. The sequence significantly shows two first class volcanic-sedimentary cycles, in which volcanic eruption phase, volcanic rock overflow phase and sedimentary-volcanic developes. During the conversion period from vocanism process to deposition process,the volcanic and sedimentary rocks interactively appear. In the evolution process: K_1q^1 is divided into 22 eruption rhythms and 3 volcanic eruption cycles; K_1q^2 has seismites that indicating that the basin is in tectonically active state, argillaceous limestone layer reflects the weakening of basin subsidence and short development of lake basin; K_1q^3 is divided into 7 volcanic eruption rhythms and 3 eruption cycles; K_1q^4 reflects braided river sedimentary environment.

Keywords: Qushenla Group,Qiangtang Basin, volcanic-sedimentary cycles, volcanic eruption, seismites

2-D crustal structure of the Taiwan shoal area in the northeastern South China Sea

KUIYUAN WAN[1, 2], SHAOHONG XIA[1], JINLONG SUN[1], JINGHE CAO[1], HUILONG XU[1]

[1] CAS Key Laboratory of Marginal Sea Geology, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou 510301, China (shxia@scsio.ac.cn)

[2] University of Chinese Academy of Sciences, Beijing 100049, China

We present a new 2-D forward P-velocity model of the crustal structure along the profile OBS2012 that delineate the Moho morphology and magmatic features of the margin in the northeastern-most South China Sea. These data reveal a normal continental crust ~27-29km thick in the Pearl River Mouth Basin (PRMB) and the thickness decreased moderately seaward. However, the crust thickened rapidly under the Dongsha rise accompanying the increasing of Moho depth and the thinning of sediment layer. In the Tainan Basin, which was highly stretched, the crust sharply thinned from 15 km to 8 km and the Moho depth shallows dramatically forming a convex in the distal model. A high velocity layer (HVL) (~7.0-7.6 km/s), with ~5-7 km thick in the low crust, was imaged under Dongsha uplift. What's significant about the spatial position of the high velocity body is that the northeast of SCS high magnetic belt coincides with it, which perhaps is associated with a Mesozoic volcanic arc caused by the subduction of paleo-Pacific plate. Moreover, another HVL, with ~3-5 km thick, was found in the Tainan basin. We take this to be magmatic underplating, which caused by the lithosphere extension during postrift seafloor spreading.

Keywords: northeastern South China Sea, Dongsha rise, high velocity layer (HVL), the Moho depth, subduction of paleo-Pacific plate

Seismic constraints on Late Mesozoic magmatic plumbing system in the onshore-offshore area of Hong Kong

SHAOHONG XIA[1,*], DAPENG ZHAO[2], XUELIN QIU[1], HUILONG XU[1], JINLONG SUN[1]

[1] CAS Key Laboratory of Marginal Sea Geology, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou, 510301, China (shxia@scsio.ac.cn)

[2] Department of Geophysics, Tohoku University, Sendai 980-8578, Japan

We used active source wide-angle seismic data to determine a high-resolution P-wave crustal tomography beneath the onshore-offshore area of Hong Kong at the southern end of a broad belt dominated by Late Mesozoic intrusive and extrusive rocks in the coastal region of Southeast China. Our results reveal a localized high-velocity anomaly in the lower crust offshore between Hong Kong and Dangan Island, which may reflect basaltic underplating that is closely associated with formation of voluminous silicic eruptions and granitoid plutons in the onshore-offshore area of Hong Kong. Tilted high-velocity zones connecting with the localized high-velocity anomaly in the lower crust are clearly visible in the entire crust beneath Dangan Island and the calderas of Hong Kong. Taking into account previous results of geochemical, petrologic and numerical modeling studies, we think that the tilted high-velocity zones may be the results of mingling of mafic and felsic end members and extreme degree of crustal partial melt extraction necessary to generate a large amount of extrusive rocks in the calderas, reflecting the cooled magma conduits as a manifestation of solidified Late Mesozoic magmatic plumbing system in the crust. Considering the petrologic and geochemical characteristics of Late Mesozoic granites and basalt in Southeast China, we suggest that the subduction and dehydration of paleo-Pacific plate might trigger the basaltic magma underplating and result in extensive crust-mantle interaction, which not only provided necessary heat energy to cause the crustal partial melting, but also added minor mafic materials to the newly generated granitic melts. This model explains our tomographic results as well as the intimate mingling of coeval mafic and silicic magmas in Hong Kong. Intersecting faults could play an important role in forming magma conduits and loci of fissure-like volcanic centers.

Keywords: Basaltic underplating; Magmatic plumbing; Southeast China; Calderas; Active-source seismic tomography

Seismic Record of Tectonic and Depositional Evolution in the Okinawa Trough

QI LI[1], XIU KONG[1], SUWEI SHAO[1]

[1] School of Ocean Sciences,China University of Geosciences, Beijing,China. (liqi@cugb.edu.cn)

The Ryukyu island arc system is located at a convergent plate margin where the Philippine Sea Plate is subducting under the Eurasia Plate, and is characterized by the existence of an active continental backarc basin, the Okinawa Trough.

Analysis of regional multi-channel seismic data from the Okinawa Trough and adjacent shelf provides some important constraints on the structural development of the area. We describe systematically a complete cross-section from the East China Sea continental shelf to the Ryukyu trench from the viewpoint of seismic stratigraphy. The sedimentary strata in the East China Sea shelf basin, separated from the Okinawa Trough by the Taiwan-Sinzi belt, are affected by the Miocene compressional tectonism and truncated by the Late Miocene unconformity.

Seven major seismic units and three stages in the tectonic evolution of the system are identified:

(1) During stage A from Late Miocene to earliest Pleistocene, pre-rift deposits accumulated over a wide region from the East China Sea continental shelf to the fore-arc region;

(2) Stage B is defined by a series of tectonic processes involving crustal doming, erosion, subsidence, and sedimentation, in association with initial rifting of the southern Okinawa Trough during most of Early Pleistocene time;

(3) During stage C since the Late Pleistocene the backarc rifting is still in progress and Syn-rift sedimentation has been under way.

Lithosphere structure of the Southwest Subbasin, South China Sea: Integrated heat flow, gravity, and topography data

HU LITIAN[1] ,HAO TIANYAO[1], XU YA[1]

[1] Key Laboratory of Petroleum Resources Research, Institute of Geology and Geophysics, Chinese Academy of Sciences ,Beijing 100029, China (hulitian@mail.iggcas.ac.cn)

The lithospheric structure is important to study the tectonic evolution and mantle dynamics. Here, a present-day lithospheric structure across the Southwest Subbasin of the South China Sea is presented. The results from Ocean Bottom Seismometer (OBS) experiments in the Xisha Trough and the Southwest Subbasin are used to constrain the crustal structure and density variations, and the topography data is used to determine the lithospheric mantle thickness. We integrate the heat flow, gravity and tomography data to calculate the 2-D lithospheric transect that runs from the South China continent to the Nansha Block, crossing the Qiongyue Uplift, Zhujiangkou Depression, Zhongsha Uplift and the Southwest Subbasin. The transect result is under three assumptions: the density of the lithospheric mantle dependent on the temperature, the thermal steady-state and the local isostasy. The lithospheric depth varies from 90km beneath the South China continent, to 50km beneath the Southwest Subbasin and to the 75km beneath the Nansha Block. Our lithospheric thickness result is different from that predicted by oceanic lithosphere cooling model. The reasons may be that the long-time mantle upwelling prevents the lithosphere from cooling and the thickness of the crust and the sediment in the Southwest Subbasin is different from the oceanic lithosphere cooling model which predicts the crustal thickness is roughly constant 7km and disregards the sediment loading.

Keywords: lithospheric structure, gravity, heat flow, topography, Southwest Subbasin, South China Sea

Structural characteristics of the Diaoyudao Uplift Belt and its tectonic coupling with the Okinawa Trough in late Cenozoic

LUNING SHANG[1], XUNHUA ZAHNG[2], YONGGANG JIA[1]

[1] Ocean University of China, China (shang1924@163.com)
[2] Qingdao Institute of Marine Geology

The Diaoyudao Uplift Belt, which is also called the Taiwan-Sinzi Belt, was suggested to extend from Taiwan to Japan along the East China Sea Shelf margin by some authors and separates the shelf basin to the west and the Okinawa Trough to the east. Detailed analysis of seismic reflection, gravity and magnetic data provide some new constraints on the structure of the Diaoyudao Uplift and its relation with the Okinawa Trough during the late Cenozoic tectonic evolution. Bounded to the south by the transition zone between Yushan-Kume and Miyako faults, the middle-northern segments of the uplift are characterized by wide and flat pre-Miocene basement with a series of half grabens developed on the eastern edge which subsiding eastward down to the Okinawa Trough, showing a passive continental margin affiliated structure. Whereas no large basement high can be found beneath the southwestern shelf edge, only magmatic intrusions which deformed the thick overlying sediments developed there. Pliocene and older strata extended from Keelung Depression into the western part of the southern Okinawa Trough but was intensely deformed by volcanism and faulting. However, almost only Quaternary strata developed in the axial and eastern parts, distinct from the middle-northern Okinawa Trough which are filled with thick Miocene-Pliocene sediments. We postulate that prior to the formation of Okinawa Trough and Taiwan Orogenic Belt, a paleo-uplift belt composed of today's Diaoyudao Uplift Belt, Okinawa Trough basement and Ryukyu Arc exist to the east of the shelf basin. The middle-northern Okinawa Trough initially rifted near the axis of the paleo-uplift in early or middle Miocene, whereas the southern Okinawa Trough was mainly formed along the western part of the paleo-uplift in Quaternary. This space-time variation of tectonic evolution was primarily influenced by the arc-continent collision in Taiwan and accommodated by the NW-SE trending Yushan-Kume and Miyako faults.

Keywords: Diaoyudao Uplift Belt, Okinawa Trough, structures, tectonic evolution

Distribution and hydrocarbon potential of Mesozoic strata in the South China Sea

WEIJIAN HU[1], TIANYAO HAO[1], WEIWEI JIANG[1], YA XU[1], DIDI JIANG[1]

[1] Key Laboratory of Petroleum Resources Research, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China. (huweijian@mail.iggcas.ac.cn)

A series of drilling, dredge and seismic investigations indicate that Mesozoic sediments exist in the South China Sea (SCS) which shows a bright prospect for oil and gas exploration. In order to study the distribution of Mesozoic strata and their residual thicknesses in the SCS, we carried out an integrated geophysical study based mainly on gravity data, gravity basement depth and distribution of residual Mesozoic thickness in the SCS were obtained using gravity inversion constrained with high-precision drilling and seismic data. In addition, the fine deep crustal structures and distribution characteristics of Mesozoic thicknesses of three typical profiles were obtained by gravity fitting inversion. Mesozoic strata in the SCS are mainly distributed in the south and north continental margins, and have been reformed by the later tectonic activities. They extend in NE-trending stripes are macro-controlled by the deep and large NE-trending faults, and cut by the NW-trending faults which were active in later times. The offset in NW direction of Mesozoic strata in Nansha area of the southern margin are more obvious as compared to the north margin. In the Pearl River Mouth Basin and Southwest Taiwan Basin of the north continental margin the Mesozoic sediments are continuously distributed with a relatively large thickness. In the Nansha area of the south margin the Mesozoic strata are discontinuous and their thicknesses vary considerably. According to the characteristics of Mesozoic thickness distribution and hydrocarbon potential analyses from drilling and other data, Dongsha Uplift-Chaoshan Depression, Southwest Taiwan Basin-Peikang Uplift and Liyue Bank have large thickness of the Mesozoic residual strata, have good hydrocarbon genesis capability and complete source-reservoir-cap combinations, show a bright prospect of Mesozoic oil/gas resources.

Keywords: South China Sea, Mesozoic residual thickness, gravity, hydrocarbon potential

A 2.5D gravity inversion method for multi-interfaces underground

XING JIAN[1,2] AND HAO TIANYAO[1]

[1] Key Laboratory of Petroleum Resources Research, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China (xingjian@mail.iggcas.ac.cn)
[2] University of Chinese Academy of Sciences, Beijing 100049, China

It has been of great interest for geophysicists to delineate the crustal structure, especially in areas of complex underground situations, in order to have a better understanding of the distribution of petroleum, gas and minerals as well as to help demystify the geological evolution of the research area. In places where seismic profiles are absent due to expensiveness for implementation, gravity inversion methods turn out to be a good alternative owing to their lower surveying cost and better horizontal resolution. Here we propose a multi-interface inversion method that has a wide applicability. Our method deals with the 2.5D profile inversion. We define the strata as an aggregate of rectangular prisms whose bottoms depict the interfaces ready to be inverted. It makes possible the modeling of the terrain, which means this method does not require terrain correction. To overcome the ill-posed problem in the gravity inversion due to the non-uniqueness and non-stability of solutions, we adopt the standard Tikhonov regularization method to guarantee a stable solution by introducing the borehole data-misfit information, the total variation function and the iterative residual function as parts of the regularizing function. Such weighted information imposes certain characteristics of the geologic setting in the research area, which would constrain the inversion to let the estimated stable solution be close to the true one. Synthetic models are introduced to manifest the way of parameter selection as well as to show the feasibility of the method. Real data applications are also presented to test the inversion method.

Keywords: gravity, inversion, interface, multiple

ACTIVITY AND FUTURE PLAN OF K-IODP

GIL YOUNG KIM[1], SE WON CHANG[1], SANG MIN HYUN[2], YOUNG JOO LEE[1]

[1] KOREA INSTITUTE OF GEOSCIENCE AND MINERAL RESOURCES (KIGAM), DAEJEON, KOREA (gykim@kigam.re.kr)

[2] KOREA INSTITUTE OF OCEAN SCIENCE AND TECHNOLOGY, ANSAN, Korea

K-IODP was begun from 1998 as funding by Korean government. From 1998 to 2015, about 35 Korean scientists were participated in ODP/IODP drilling expeditions in world ocean area. They successfully carried out international collaboration and learned advanced technology from IODP sailing. The workshop of K-IODP working groups covering a variety of themes of New IODP is held every year. This workshop is designed to support the scientists in developing new and innovative scientific proposals for submission to IODP. The first IODP Forum meeting was held from 26 to 28 May 2014 in Busan (Novotel Ambassador), Korea. About 40 people from IODP member countries were participated. K-IODP Summer School is opened for graduate students in marine science every year. Generally about 20 graduate students from 10 universities participate in K-IODP Summer School. We are also introduced in real time to the participants the JOIDES Resolution activity during IODP Expedition using SKYPE. In addition, field excursion is also carried out for practical training. Every year, we send 3-4 graduate students to J-DESC core school for the advanced education. K-IODP has also translated IODP books as Korean version for the promotion of the public.

From 29th July to 28th September 2013, IODP Exp. 346 was conducted in the East Sea/Sea of Japan. After Expedition 346 scientific drilling, JOIDES Resolution entered to Busan harbor for port call outreach activities (29-30 September 2013). Guided tours on the ship were organized for the public by K-IODP in collaboration with Ocean Leadership. During the port call, 402 people (middle and high school students, university students, graduate students, and researcher/professor) had the opportunity to get acquainted with IODP by visiting the JOIDES Resolution. K-IODP expects collaboration with other countries through IODP communities.

Borehole breakout analysis at Sites 1378 and 1379 of IODP Exp. 334

GIL YOUNG KIM[1], BUYANBAT NARANTSETSEG[2]

[1] Korea Institute of Geoscience and Mineral Resources (KIGAM), Daejeon, Korea (gykim@kigam.re.kr)
[2] Mongolian University of Science and Technology, Mongolia

The breakouts on the LWD image data collected during IODP Exp. 334 were investigated from Holes U1378A and U1379A. Also, the diameter and width of borehole for two holes were calculated using GMI Imager software.

In Hole U1378A, borehole breakouts are detected in intervals between 110 mbsf to 438 mbsf. The breakout azimuth is slightly changed between 176 mbsf and 369 mbsf. Also, the average width of breakout varies from 52.46º to 70.55°. The maximum horizontal stress in Hole U1378A is oriented northwest–southeast direction. In Hole U1379A, borehole breakouts show different pattern compared to those of Hole U1378A. The borehole breakouts in interval between 300 mbsf to 890 mbsf are detected. The average width of breakout does not show significant variation (from 51º to 56º). Below 640 mbsf, the direction of borehole breakouts is slightly changed appearing a lot of breakouts. From borehole breakout analysis, we suggest that the maximum horizontal stress may be oriented northeast–southwest direction. This direction is probably related with complicated plate movement in this area.

Physical properties for core samples were measured using weight-volume method and MSCL. Grain size analyses for subsamples were also performed using Microtrac 3500 equipment. In Holes U1378B and U1379C, the water content and porosity generally decrease with burial depth. Accordingly bulk density shows increasing pattern well. The shear strength also increases with depth. These results reflect well the result of dewatering caused by consolidation and/or compaction with sediment depth. The physical properties at two sites show slightly different properties. This may be due to differences of sediment texture, mineralogy, the degree of compaction, and tectonic event in upper plate.

Drilling to assess Ulleung Basin gas hydrates and submarine landslides

JANG-JUN BAHK[1], ROGER URGELES[2], SANG-HOON LEE[3], SENAY HOROZAL[1], SUENG-WON JEONG[1], NABIL SULTAN[4], KYUNG-EUN LEE[5], GREG MOORE[6], GIL-YOUNG KIM[1], KATIE TALADAY[6], SEONG-PIL KIM[1], BRANDON DUGAN[7], MICHAEL STRASSER[9], DAVID MOSHER[8], MARTA TORRES[10]

[1] Petroleum and Marine Research Division, Korea Institute of Geosciences and Mineral Resources (KIGAM), Daejeon, Korea
[2] Institut de Ciències del Mar (CSIC), Barcelona, Spain
[3] Marine Geology and Geophysics Laboratory, Korea Insitute of Ocean Science and Technology (KIOST), Ansan, Korea
[4] Département Géosciences Marines, Ifremer, Plouzané, France
[5] Division of Marine Environment and Bioscience, Korea Maritime and Ocean University, Busan, Korea
[6] Department of Geology and Geophysics, University of Hawaii, Honolulu, USA
[7] Department of Earth Science, Rice University, Houston, Texas, USA
[8] Geological Survey of Canada-Atlantic, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada
[9] ETH Zurich, Geoglogical Institute, Zurich, Switzerland
[10] College of Earth, Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, OR 7331, USA

Submarine slope failure and derived sediment gravity flows are recognized as a major sedimentary process in basins worldwide. Their large failure volumes and long-runout distances pose significant tsunami hazard for offshore and coastal facilities, and thus it is important to understand the mechanisms and processes involved in the initiation of slope failure. One hypothesis currently being debated is that sea level fluctuations and ocean bottom temperature changes can cause gas hydrate dissociation and/or dissolution and/or gas exsolution and expansion leading to submarine slope failure. However, evidence that propagation in seafloor sediments of pressure and thermal perturbations associated with climate change induce slope instability is lacking, and more importantly there has not been a dedicated study to investigate these feedbacks. To move forward in our understanding of the roles of climate, sedimentation patterns, geomechanical properties of gas-hydrate bearing sediments and slope stability, we propose to acquire an expanded Quaternary record of mass-wasting activity, gas emissions, climatic/paeloceanographic proxies and physical properties to better constrain the gas hydrate-slope failure system. The Ulleung Basin, situated between the Korean peninsula and the Japanese archipelago, is an optimal study region because: (1) the high abundance of gas hydrates, particularly at the southern end of the basin (2) more than 50% of the >1000 m thick Plio-Quaternary succession is comprised of Mass Transport Deposits (MTDs), (3) high susceptibility of background sedimentary cycles to climate changes, and (4) extensive Site Survey Data has already been collected in this region which ensures proper site selection. The fundamental science objective of the IODP proposal ULYSSES (ULleung basin gas hYdrates and Submarine landSlides: climatE-driven hazardS?) will not only improve our understanding of the hydrate-slope failure link in relation to climate induced perturbations, but will enhance our understanding of dynamic behavior of the MTDs and further help to address societally relevant problems related to assessing geohazards to adjacent land-masses.

Shipboard results on record of Himalayan orogeny and climate across the Middle Bengal Fan (IODP Expedition 354)

JANG-JUN BAHK[1], CHRISTIAN FRANCE-LANORD[2], VOLKHARD SPIESS[3], TILMANN SCHWENK[3], ADAM KLAUS[4], AND IODP EXPEDITION 354 SCIENTISTS

[1] Petroleum and Marine Research Division, Korea Institute of Geosciences and Mineral Resources (KIGAM), Daejeon 305-350, Korea

[2] Centre de Recherches Pétrographiques et Géochimiques, Centre National de la Recherche Scientifique (CNRS), BP20 54501 Vandoeuvre-les-Nancy, France

[3] Department of Geosciences, University of Bremen, Bremen 28359, Germany

[4] United States Implementing Organization, International Ocean Discovery Program, Texas A&M University, Colleage Station TX 77845, USA

IODP Expedition 354 was planned to core the sedimentary record of erosion of the Himalayan mountain range in order to determine accumulation rates across the submarine turbidite fan complex in the Bay of Bengal and ultimately constrain fluxes of erosion associated with climate and tectonic changes. To meet these objectives, a transect approach perpendicular to the axis of the fan at 8°N was adopted. Expedition 354 succeeded in establishing (1) a seven-site transect (Sites U1449-U1455) recording Pleistocene deposition and fan architecture, (2) a three-site transect (Sites U1450, U1451, U1455) recording complete Miocene and Pliocene accumulation, and (3) a deep hole at Site U1451 which penetrated to 1180 mbsf to record Paleogene fan deposition. The shipboard analysis results revealed generally good agreement between characteristics of seismic reflectors and recovered core lithology. Low amplitude wedge-shaped reflectors mostly represent overspill mud turbidite successions of levee deposits. High amplitude parallel reflectors normally correspond to thick-to very-thick bedded massive sand/silt turbidites topped by thin mud turbidite units indicating terminal or avulsion lobes in interlevee deposits. Distinct regionally correlative seismic horizons with low reflectivity are mostly characterized by hemipelagic layers with varying thickness, indicating significant pause of turbidite sedimentation. The late Quaternary sedimentary records prove that there has been a significant pause in turbidite sedimentation over the entire segment of the fan to the east of the modern active channel (Sites U1453, U1452, U1450, U1449, and U1451) at least since the MIS 5e and turbidite sedimentation from the modern active channel has been limited to the Site U1455 eastward. The late Quaternary pause in turbidite sedimentation over the eastern segment of the fan is thought to be analogous to the repeated Pleistocene pauses in turbidite sedimentation represented by the regionally correlative hemipelagic layers and suggesting diversion of active channels to the western segment. Bed-by-bed lithological logging of selected Quaternary levee sequences reveals significant variations in thickness and silt to clay ratio of overspill mud turbidites, which are well-imaged by Parasound subbottom profiles. Such logging of a late Quaternary avulsion lobe sequence at Site U1449 also shows an upward thickening trend of sand beds indicative of lobe progradation. Detailed comparison of sedimentary features with physical properties in the late Quaternary and mid-Pleistocene thick hemipelagic-dominated intervals reveals that considerable parts of the intervals are characterized by hemipelagic sedimentation influenced by turbidite sedimentation.

Characteristics of ferromanganese nodule in deep subseafoor sediments in South Pacific Gyre (SPG): IODP expedition 329

KIHO YANG[1], STEVEN D'HONDT[2], HIONSUCK BAIK[3], JINWOOK KIM[1*]

[1] Department of Earth System Sciences, Yonsei University, Korea (jinwook@yonsei.ac.kr)
[2] Graduate school of Oceanography, University of Rhode Island, USA
[3] Korea Institute of Basic Science (KBSI), Seoul center, Korea

The ferromanganese (Fe-Mn) nodule from the South Pacific Gyre (SPG) deep subseafloor sediments were investigated using a multiline of techniques in order to describe their genesis. The nodule was recovered by the International Ocean Discovery Program (IODP) Expedition 329 (2010.10.10-2010.12.13) from deep subseafloor sediments (118.22 mbsf), hole U1371F, SW direction to Mid Ocean Ridge (MOR). A positive value of redox potential from porewater was measured at the same depth of buried Fe-Mn nodule (118.22 mbsf) which has been exposed to oxic conditions as a sequence of basaltic aquifer diffusion from basal basalt into the sediments. The Fe-Mn nodule consist of mainly two well-defined regions with distinct textural and mineral compositions. The upper black-brown coloured concentric layers are relatively enriched in manganese oxide minerals, such as todorokite, vernadite, and ramsdellite compared to the underlying region of yellow coloured substrate, which is relatively enriched in anorthite, carbonate fluorapatite (CFA), phillipsite, and clay minerals such as smectite, kaolinite, and illite. Textural and mineral compositions of concentric layers suggest growth conditions under hydrogenic process. On the other hand, underlying substrate suggest act as seed of nodule growth and impregnated with secondary minerals of CFA. Result of XRD on clay mineral compositions both inside of substrate from Fe-Mn nodule and surrounding pelagic sediments revealed same clay mineral assemblages. Our results show that Fe-Mn nodule had been grown lying above the seafloor pelagic sediments, and then buried later with fast settled sediments. We're going to determine the age of Fe-Mn nodule as well as surrounding pelagic clays by adapting the isotope age-date.

Keywords: South Pacific Gyre (SPG), ferromanganese nodule, IODP expedition 329

Preliminary interpretation of Organic Geochemistry of IODP Exp. 344 : Costa Rica Seismogenesis Project II (CRISP II)

JIYOUNG CHOI[1*], JI-HOON KIM[1], MARTA E. TORRES[2], MIRIAM KASTNER[3]

KIL YOUNG KIM[1] AND EXPEDITION 344 SCIENTISTS

[1] KIGAM, Petroleum & Marine Research Division, KOREA (jychoi@kigam.re.kr)
[2] OCEOAS, Oregon State University, USA
[3] Scripps Institution of Oceanography, University of California at San Diego, USA

The Costa Rica Seismogenesis Project II (CRISP-II) is designed to recognize processes controlling earthquakes in erosional subduction zone. The CRISP study area is located offshore the Osa Peninsula where the incoming Cocos Ridge has lifted the seismogenic zone to within reach of scientific drilling (Expedition 344 Scientists, 2013). In this study, we aim to investigate the geochemical characteristics of organic matter (OM) and hydrocarbon gas (HG) in core sediments for a fluid system.

The carbon and nitrogen stable isotope of OM ($\delta^{13}C_{org}$ and $\delta^{15}N_{org}$) were in the range of -27.85 ~ -22.97‰ and 4.23 ~ 7.00‰ in site U1380;, -26.06 ~ -22.61‰ and 2.50 ~ 6.86‰ in site U1412;, and -26.88 ~ -22.77‰ and 3.49 ~ 8.41‰ in site U1413. These results indicate. The nitrogen stable isotope were in the range of 4.23 ~ 7.00‰ in site U1380, 2.50 ~ 6.86‰ in site U1412, and 3.49 ~ 8.41‰ in site U1413. According to stable isotope results that the OM might be mainly originated from land plant.

Hydrocarbon gas results show that methane (CH_4) is the major component and ethane (C_2H_6) is a minor component. For HS and VG, Tthe relationship between $\delta^{13}CCH_4$ and C_1/C_{2+} and the C-D diagram of headspace (HS) and void gases (VG) show illustrate that all values for HS and VGanalyzed data are located in the field of biogenic methane generated by CO_2 reduction. Therefore, we believe that the gas from the study sites is originated by biogenic via CO_2 reduction rather than by thermogenic.

Finally,We calculate conversion ratio was calculated for estimating how much OM should be converted to HG in-situ using Rayleigh ratio (modified from Pohlman et al., 2009). The estimated conversion ratio was were a range ofvaried 21.8 ~ 30.7% in site U1412 and 15.4 ~ 30.2% in site U1413, respectively, and it was . In site U1412 and U1413, conversion ration slightly decrease with depth. It means that methane in the study area might be migrated from deeper parts and mixed with in-situ methane.

Keywords: IODP, CRISP-II, Organic matter, Hydrocarbon gas

Preliminary palynological analysis for the Miocene marine environments in the Ulleung Basin, East Sea: IODP Expedition 346 Site U1430

YONGMI KIM[1*] SANGHEON YI[1], GIL YOUNG KIM[1]

[1] Korea Institute of Geoscience and Mineral Resources (KIGAM) (kym1221@kigam.re.kr)

The well-constructed palynostratigraphy may provide valuable information of the paleoclimate and paleoceanography. The acid-resistant organic microfossils of pollen and dinoflagellates which are well-preserved in any oceanographic conditions can be used as a tool of bio-eco-stratigraphy. Therefore, the organic microfossils recorded in the hemipelagic sediments can play an important role to reconstruct the paleoclimate and paleoceanography during the time of deposition. In order to reconstruct the paleoenvironment of the East Sea, the samples were taken from the Integrated Ocean Drilling Program (IODP) Expedition 346 Site U1430 drilled in the Ulleung Basin, East Sea. Up to now, the palynological analysis was carried out from the Miocene interval which was the lowest section of the Site U1430. This study mainly focuses on the Miocene paleoceanography and climate changes based on palynological records from the studied section. We, herein, worked firstly on the taxonomic classification such as pollen and dinoflagellate and their assemblages were used to reconstruct preliminary paleoceanography and climate changes. The preliminary results will come out till the conference date of ICAMG-8. In future, an age-controlled palynostratigraphy should be established to correlate the others biostratigraphy, such as diatom, radiolarian and foraminifera, and magnetostratigraphy in East Sea, and to be used for other research subjects.

Keywords: Paleoclimate, Palynostratigraphy, Pollen, Dinoflagellate, IODP Expedition 346 Site U1430

Ocean and continent transition in passive continental margins and analysis on lithospheric extension and breakup process：implication for research of the deep water basins in the continental margins of South China Sea

REN JIANYE[1], PANG XIONG[2], ZHANG JUNXIA[3], LEI CHAO[1], YANG LINLONG[1]

[1] Key laboratory of Tectonics and petroleum resources of the Education Ministry, China University of Geosciences, Wuhan, Hubei, 430074 (jyren@cug.edu.cn)

[2] CNOOC deepwater Development Co. Ltd., Shenzhen, Guangdong, 518067

[3] China University of Geosciences, Wuhan, 430074

As an important transition domain between the last identifiable extended continent crust and the first true oceanic crust, the ocean-continent transition (OCT) zone preserved a wealth of information on the processes of lithospheric extension and breakup. Considering OCT as a key to understand the mechanism of the lithospheric extension and breakup , we try to show the geological nature of the OCT, and its geological and geophysical identification based on an integrated analysis of a rich subsurface data, including borehole data and newly released geological and geophysical data collected by marine geological survey and hydrocarbon exploration and development. We are also to elucidate the continental lithosphere configuration and its tectono-stratigraphic framework of overlying sedimentary basins in the different tectonic units on the continental margin. We will compare the structures, major tectonic boundaries and tectonic sequences in the sediment fillings of the basins, which will explore the information during the processes of the continental margin extension, exhumation, breakup and oceanic spreading. In addition, we will study the large-scale detachment faults and their controls on the lithospheric thinning and continental mantle exhumation. We will investigate where the lithosphere of continent margin concentrate, and how the deformation migrated and superimposed, further construct the model of lithospheric extension and breakup.

The deep-ultra deep water margins in the South China Sea (SCS) show striking similarities in crustal structures and basin styles with that of highly extended continental margins similar to Iberia-Newfoundland conjugate margins, including possible serpentinited mantle bodies exhumed onto sea floor at the OCT, detachment faults and supra-detachment basins, which have been imaged by state-of-the-art reflection seismic data. Based on the geological interpretation of high-resolution 3-D seismic data covering some main deep-ultra deep water basins, e.g. Baiyun depression, Heshan depression, Liwan depression and Jinghai depression, we try to identify the OCT along boundary of oceanic basin in the SCS, define the tectonic units in the continental margin and the extensional structural style of different tectonic units, and recover the subsidence and filling progress of supra-detachment basins. Finally, the relationship between the extension thinning and break up of lithosphere in the SCS and the structure and tectonic evolution of the basin is discussed. OCT is strong lithospheric deformation and final breakup area. Therefore, our research will better improve our understanding on the birth of the oceanic crust and conjugate structures in the South China Sea, and has a great significance for economic exploration (hydrocarbon) in the deep-ultra deep water area of South China Sea.

Keywords: South China Sea; ocean-continent transition; detachment fault; exhumation; supra-detachment basin

P-wave Velocity of Marine Sediments in the Northern South China Sea Continental Margin

KANG-HAO YU[1] , CHAR-SHINE LIU[1]

[1] Institute of Oceanography, National Taiwan University, Republic of China (R.O.C) (a5902259@hotmail.com)

P-wave velocity is an important physical property of marine sediments, it also plays an important role in seismic data processing. Traditionally, we obtain physical properties of marine sediments by direct measurements of cored samples, but most of such samples come from very shallow sediments beneath seafloor, except where samples from deep sea drilling investigation are available. In order to obtain P-wave velocity information of sedimentary strata at depth, seismic velocity analysis techniques are often used. This study presents a summary of P-wave velocities of the sediments in the Northern South China Sea (NSCS) continental margin. Data from 2-D multichannel seismic reflection surveys are analyzed, using velocity spectrum analysis (VSPEC) technique to derive interval velocities in marine sediments. Through careful VSPEC, we can build a velocity model along the seismic profile which reveals velocity variations in the study area. We establish the characters of P-wave velocities for 3 geological provinces in NSCS: continental slope, continental rise, and ocean basin. The characters of P-wave velocity are usually presented in the form of equations relating interval velocity V with one way travel time t. The following relations are established for each of the 3 geological provinces: in the continental rise of NSCS-: $V=1511+2718.2t-896.14\ t^2$; in the Northwest Subbasin of NSCS: $V=1511+2104.6t-127.13\ t^2$; in the continental slop area of NSCS: $V=xxxx+xxxt+xxx\ t^2$. In addition, we compared our velocity analysis results with those derives from logging data of the ODP site 1148 located in the Northwest Subbasin of NSCS. At site 1148, four seismic horizons from Pleistocene to Oligocene can be recognized, and so are our results from VSPEC. The velocity information from core data are in consistent with the velocity information derived from seismic data in this study.

Keywords: Northern South China Sea, marine sediments, velocity spectrum analysis, velocity function

A study of integrated seafloor visualization and geological characteristics for habitat mapping around the nearshore area of Dokdo in the East Sea

MYOUNG-HOON, LEE[1], CHANG-HWAN, KIM[1], CHAN-HONG, PARK[1] AND HYEON-YEONG, PARK[1]

[1]Dokdo Research Center, Korea Institute of Ocean Sciencs & Technology, Uljin, 767-813, Korea (leemh@kiost.ac.kr)

We obtained precise seabed geomorphology and analysed submarine conditions for understanding habitat seafloor characteristics around the nearshore area of Dokdo in the East Sea. The field survey was carried out in the southern nearshore area of Dongdo(East Islet) and Seodo(West Islet) of Dokdo. We have been acquired the precise topography map using multibeam echosounder system(EM 3001, Kongsberg). Side scan sonar(EdgeTech 4125) survey for producing seafloor backscattering images was carried out. High-resolution underwater video images were obtained by scuba dive survey. As a result of bathymetry survey, the southern nearshore area of Dokdo has shallow water depth range(Dongdo : ~ 30m, Seodo : ~ 50m). And extended bedrocks from land of Dongdo and Seodo are laid on the nearshore islets. From the near islets to 15~20m, there are irregular underwater rocks with a little steep slope. Below 20m, the slope became gradual and surface sediments consist of gravelly sand and sandy gravel. We fulfilled an integrated visualization technique with topography map, seafloor backscattering images and underwater video images of the survey area. The integrated visualization results present more information than separate geological products for seabed environmental mapping study. They are useful to understand the relation between seafloor characteristics and topographic environments for habitat mapping of Dokdo.

Keywords: multibeam, side scan sonar, mapping, seafloor, visualization

An experimental study of element release from the sediments of the Changjiang (Yangtze River) Estuary

YANWEI GUO[1] AND SHOUYE YANG[1]

[1] State Key Laboratory of Marine Geology, Tongji University, Shanghai 200092, China (ywguo@tongji.edu.cn)

The Changjiang (Yangtze River) is the largest river in China, which plays a critical role in terrestrial material cycle and ecosystem health of the East China Sea. In recent years, the continuous input of industrial sewage and sanitary waste is resulting in the deterioration of marine environment, e.g. the occurrence of a large hypoxia off the Changjiang Estuary. Elements especially the heavy metals of sediments can be released into ambient water again because of the change of aquatic environment conditions, causing serious negative effects to human beings and marine environment, and further influencing the material cycle and biogeochemical process in the East China Sea and West Pacific.

In this contribution, an experimental study was carried out to examine the release rates of elements (Ca, Mg, Cu, Fe, Mn and Cr) from the surface sediments of the Changjiang Estuary, combining with the BCR sequential extraction method to explore the element release behaviour and mechanism under different concentrations of dissolved oxygen (DO) (DO=0~1 mg/L, and DO=6~9 mg/L). Mn and Ca have the highest proportions of exchangeable and reducible phases, indicating that these two elements are the most mobile among the elements studied. DO concentration is an important factor influencing element releasing from the sediment, the higher DO inducing the larger release flux of elements. Release rates of the elements calculated also increase with the increasing DO concentration, and furthermore, Ca has higher release rates than the other elements. The chemical phase of the elements plays an important role in the stability of these elements in the sediments. Over all, although the release rates of the elements are relatively slow, the DO changes could cause significant release of elements from the naturally-weathered terrigenous sediments into the ambient marine environment, which has to be considered carefully in the future studies on global environmental change.

Keywords: Changjiang Estuary, sediments, element release, dissolved oxygen

Analysis of clay minerals and clay fabric and their effects on the physical properties of the Heuksan mud belt, Southeastern Yellow Sea, Korea

BUYANBAT NARANTSETSEG[1*], GIL YOUNG KIM[2], JIN-WOOK KIM[3], JAMBA TSEVEENJAV[1]

[1] Department of Petroleum Drilling, Mongolian Science and Technology University, Mongolia (bnaraa2005@yahoo.com)
[2] Petroleum and Marine Research Division, Korea Institute of Geoscience & Mineral Resources (KIGAM), Daejeon 305-350, South Korea
[3] Department of Earth System Sciences, Yonsei University, South Korea

Twenty seven piston core samples were collected from the Heuksan Mud belt on the Southeastern Inner Shelf of Korea. The purpose of the this study are to evaluate the distribution of physical and acoustic properties, and the relationship between physical property and clay fabric/mineralogy of Heuksan Mud belt, southeastern Yellow Sea, Korea. Clay mineral composition was identified similar at the north, middle and southern parts of the study area. The major clay minerals were identified as illite, chlorite, chlorite+kaolinite and kaolinite. The distribution of clay content increases from north to middle and south in the study area.

The distributions of porosity and water content are higher (< 72%, < 48% and < 72%, < 49%) in the middle and south-eastern parts than the northern part of the study area caused by increase in clay content. Towards south-westward, porosity and water content decrease (< 57% and < 38%) indicating compaction caused by increase in silt and sand contents. On the contrary, wet bulk density content decreases in the middle and south-eastern parts including compaction. Interestingly, shear strength value increases toward to the southwest caused by compaction and consolidation which may be results of overburden pressure. The distribution of velocity value higher (< 1557 m/s) in the northern part than south-western and middle parts, which may be results by increases of sand content. The velocity was decreased toward from the northern to south-eastern part, caused by increase clay and silt contents. The station 13HMB-P01 is likely to be more compacted and consolidated than stations 14HMB-P01 and 12HMB-P15. The clay fabric analysis using scanning electron microscopy (SEM) was performed on splitter at core samples 12HMB-P15 (10 cm, 60 cm in core depth), 13HMB-P01 (101 cm, 322 cm in core depth) and 14HMB-P01 (5 cm, 327 cm in core depth). The variation of clay fabric was related to porosity, water content, shear strength, grain size, consolidation and mineralogy.

Keywords: physical property, clay minerals, clay fabric, Heuksan mud belt

Digital datasheet interfaces of marine sediment core sample analysis data

SHIN YU[1], DAE CHOUL KIM[2], SEONG PIL KIM[3], GEE SOO KONG[1]

[1] Petroleum & Marine Research Division, Korea Institute of Geoscience and Mineral Resources, Korea (yushin@pknu.ac.kr)
[2] Department of Energy Resources Engineering, Pukyong National University, Korea
[3] KIGAM Pohang Branch, Korea Institute of Geoscience and Mineral Resources, Korea

To construct effective database and useful information offering system of the marine core sample analysis data, a digital format datasheet was designed. The core curation includes whole works related to acquisition, analysis, and even maintenance and restoration to prevent drying and deformation of the marine sediment core. This study focused on the effective data preservation that recorded during the process. The datasheet mainly consist of shipboard and shorebased data. The shipboard data are subdivided into the records of basic information, sampling location, equipment, and marine observation data. The basic information includes core collecting time, organization name, and core ID. In the section of sampling location, latitude-longitude data and the map of surroundings are included that automatically reflects current position. The marine observation data provides useful information from several oceanographic organizations through web-linked database in the form of metadata. Cross section report and results of each experiment comprise the shorebased data as an upper item. The cross section information is subdivided into the JPEG files of cross-sectional image, core description, and soft X-ray photograph. Results of experiments are also loaded in the format of data files that include the values of shear strength, p-wave velocity with the attenuation, sediment density, and particle size analysis. The digital datasheet have many benefits for the field work and core database management. Further supplementation is also planned through the active and positive feedback between the developer and scientist.

Keywords: sediment core, datasheet, core curation, field note

Evolution of late Quaternary deposits in the South Sea continental shelf, Korea

SUNG HO BAE[1], DAE CHOUL KIM[2], GEE SOO KONG[1], GWANG SOO LEE[1]

[1] Petroleum & Marine Resources Division, Korea Institute of Geoscience Mineral Resources (KIGAM) Daejeon, Korea (shbae@kigam.re.kr)

[2] Energy Resources Engineering, Pukyong National University, Busan, Korea

High-resolution seismic profiling (Chirp and Sparker system) and core sediment sampling have been conducted to investigate the sequence stratigraphy and depositional environment of late Quaternary deposits in the South Sea continental shelf, Korea. Approximately 9,200 line-km data of chirp profiles provided by KHOA (Korea Hydrographic and Oceanographic Administration) and 600 line-km data of sparker profiles were acquired on board R.V. Tamyang of the Pukyong National University. Along with seismic profiles eight piston core samples were collected. We also used a deep drill core (SSDP-103) to interpret the sedimentary sequence. In this study, high-resolution seismic profiles and deep drill cores show the complex sedimentary structure.

The late Quaternary deposits succession in the study area can be divided into four sedimentary units (units S1, S2, S3, and S4 from the oldest to youngest) bounded by an erosional surface and internal seismic reflectors, the formation of which was largely influenced by the repeated falls and rises of sea level: (1) transgressive incised channel fill (unit S1), (2) transgressive sand sheet (unit S2), (3) transgressive sand ridges (unit S3), (4) Holocene mud deposits (unit S4). The paleo-river channel developed in the central South Sea during the 15-20 kyr BP. The sea-level rise began about 15 kyr BP to 16 kyr BP and the shoreline migrated landward across the shelf. The paleo-river in the exposed continental shelf were filled with fluvial or estuarine sediment, forming the unit S1. As a landward shifting of shoreline continued, the erosional surface was covered by unit S2 consisting of transgressive sand sheet. During sea-level rise between 10 kyr BP and 7 kyr BP identified stair-type elevation, with the sea-level position sP-wave Velocity of everal tens of meters lower than that of the global curves. At that time, paleo-river was discharges large volume of sand. The thick layer of sediments were deposited at 55-100 m water depth that correspond to unit S3. Sea-level reached the present position approximately 6 kyr BP and the inner shelf of study area began to receive a large amount of fine-grained sediment from the Seomjin River. The highstand systems tract (unit S4) overlying the maximum flooding surface (MFS) is the recent mud deposits. The Holocene mud deposits called Central South Sea Mud (CSSM) can be divided into two different provinces classified by the internal reflectors, Seomjin River derived deposit and western originated sediment. The groups are facing each other in the southeast of Geumo Island.

Keywords: South Sea, sequence stratigraphy, late Quaternary deposits

Evolution of pala eowater depth and the Northern Slope transition of the South China Sea in Baiyun Sag, Pearl River Mouth Basin——Evidence from paleontology of well LW3-1-2

YAJUN LI[1], ZHENGLONG JIANG[2], XINYUAN WANG[3]

[1] School of Energy Resources, China University of Geosciences, China (liyajun_daliu@sina.com)
[2] School of Marine Sciences, China University of Geosciences, China
[3] Sinopec International Petroleum Exploration & Production Corporation, China

The Baiyun Sag lies in the transitional zone from the continental shelf to continental slope of the South China Sea. The significant evolution in palaeowater depth of the Baiyun Sag explains the forming process of Northern Slope of the South China Sea (Pang et al., 2009；Liu et al., 2011). The changes of palaeowater depths at the site of well LW3-1-2 have been discussed in detail based on the abundance, diversity, Simpson index, variability of foraminiferal and calcareous nannofossil，percentages of planktonic foraminifer and the ratios of warm waters and cool waters calcareous nannofossil species. The palaeoenvironment inferred from the paleontological data of well LW3-1-2 indicates the period and process of the North Slope of the South China Sea developed from south to north.

During the last sedimentary period of the Late Oligocene Zhuhai Formation, the Baiyun Sag was in a fault-depressed diversionary period, and the palaeowater depth increased gradually. In the Late Oligocene, the Baiyun Sag was in the inner continental shelf plain, and the palaeowater depth is less than 50m. A substantial research shows palaeoenvironment of core IODP1148 was bathyal environment in the Late Oligocene (Shao et al., 2004；Zhao, 2005), and its palaeowater depth is deeper than 1000m. In the Late Oligocene, the Northern Slope of the South China Sea developed at the south of the Baiyun Sag. In the early period of Early Miocene，the palaeowater depth of the Baiyun Sag kept fluctuant rising, the palaeoenvironment converted into continental shelf margin slope in the early period of Early Miocene. In the late period of Early Miocene, the Palaeowater depth was deeper than 1000m, and the Baiyun Sag was in the palaeoenvironment of continental slope and bathyal milieu.

Keywords: Pearl River Mouth Basin, Baiyun Sag, paleontology, continental slope

Intrusion of the Taiwan Warm Current into the Changjiang River Mouth in winter: evidence from H-O isotopes

ERGANG LIAN[1*], SHOUYE YANG[1], CHENGFAN YANG[1], CHAO LI[1, 2], YULONG GUO[1]

[1] State Key Laboratory of Marine Geology, Tongji University, Shanghai, P. R. China (qzgang859@163.com)
[2] Key Laboratory of Yangtze River Water Environment, Ministry of Education, Shanghai, P. R. China

The Taiwan Warm Current flows along the coast of Fujian and Zhejiang Provinces all year around with relatively stable speeds and directions, and seasonally intrudes into the submerged valley off the Changjiang River mouth. As one of the major currents in the East China Sea shelf circulation system, it carries a considerable amount of heat, salt and nutrient to the East China Sea, which is tightly related to the coastal upwelling, hypoxia and dinoflagellate blooms on the shelf. There is no doubt that the Taiwan Warm Current stems from the Taiwan Strait warm water and shelf-intrusion Kuroshio branch current northeast of Taiwan in summer, but its source in winter is subjected to debate to date.

In this regard, two cruises observations were conducted in March 2013 and February 2014 in the Changjiang Estuary, Taiwan Strait and East China Sea shelf, respectively. The in situ temperature and salinity were measured by CTD during cruise, and the stable H/O isotopic composition of water samples were analysed using LGR's Isotopic Water Analyzer (IWA-45EP) at State Key Laboratory of Marine Geology, Tongji University, Shanghai. Combined with the satellite-derived SST (sea surface temperature) images, the hydrographic spatial distributions suggest that the Taiwan Warm Current indeed exists and intrudes into the Changjiang River mouth in winter. Of note that the plots of $\delta^{18}O$ vs. salinity and δD vs. temperature indicate that, in winter, the saline and warm intrusion water in the Changjiang River mouth originates from overshooting of the Kuroshio subsurface water across the continental shelf northeast of Taiwan but warm water through the Taiwan Strait. Combined with the previously published hydrological and current observations, modelling, satellite-tracked drifter, and historical isotope data, it is obvious that the Kuroshio subsurface water intrudes into ECS all year around while the Taiwan Strait warm current becomes as strong as Kuroshio intrusion in summer. The strong intrusion of Kuroshio Current into the East China Sea shelf and its potential influence on the biogeochemical and ecological processes deserve more research attention.

Keywords: Taiwan Strait, Taiwan Warm Current, Kuroshio, stable H-O isotopes, East China Sea, Changjiang River

Newly rock-magnetic and paleomagnetic insights on sediments from the South Yellow Sea and the chronological significances

LIU JIANXING[1], SHI XUEFA[1], LIU QINGSONG[2], ZHANG XUNHUA[3], GE SHULAN[1]

[1]First Institute of Oceanography, State Oceanic Administration, China (ljx880116@163.com)
[2]Institute of Geology and Geophysics, Chinese Academy of Sciences, China
[3]Qingdao Institute of Marine Geology, China

Sediments from the continental shelf are highly sensitive to sea level and climatic changes as well as tectonic movements. The Yellow Sea is a typical shelf sea and has always been a hot spot for geo-scientific studies. However, most of the previous studies were focused on short time scales, long sedimentary records are relatively sparse mainly due to the lack of long time-scale chronology.

Paleomagnetic dating is often the major method to obtain the chronology of million-year scale for marine sediments. Moreover, to determine the extract phases of magnetic minerals is the prerequisite for the magnetostratigraphy with high fidelity, which denotes great importance and necessity of systematically rock-magnetic investigation.

Our recent studies on sediments of the South Yellow Sea (SYS) indicate that the magnetic minerals are complicated, including both primary iron oxides such as magnetite and hematite and secondary iron sulfides such as greigite and pyrite. A thick-layer greigite is widespead in the central SYS. It not only has great affect on the interpretation of paleomagnetic results but also bears importantly environmental implications. The existing magnetostratigraphic studies (core QC2, EY02-2, NHH01, CSDP-1) all demonstrate that the average depth of Brunhes-Matuyama (B/M) boundary in the central-west SYS is about 70 m. Two long cores (NHH01 and CSDP-1) imply that the thickness of sediments since 1 Ma B.P. is about 100 m. Preliminary studies on a 300-m long core (CSDP-1) in the SYS reveal that the bottom of the Quaternary is at the depth of ~230 m for the first time. All these expand the time-scale of sedimentary records and provide effective age constraints for Quaternary studies in the Yellow Sea.

Keywords: rock-magnetic, paleomagnetic, South Yellow Sea, chronology, greigite

Paleontologic and Petrographic Characteristics of the Calcarenites in Burgos, Ilocos Norte (Northern Philippines)

GRETCHEN P. CALLEJO*, ALLAN GIL S. FERNANDO AND LEOPOLDO P. DE SILVA, JR.

National Institute of Geological Sciences, University of the Philippines, Diliman, Quezon City, Philippines
(gpcallejo@nigs.upd.edu.ph)

The municipality of Burgos in Ilocos Norte (northern Philippines) is underlain by several lithologic units, most notably the calcarenites that comprise the Kapurpurawan Rock Formation, one of the top tourist destinations in the province and a candidate as one of the National Geological Monuments of the Philippines. The calcarenites have been previously included either in the Early Miocene Bojeador Formation (MGB, 2010) or Late Miocene Pasuquin Limestone (Queano et al., 2014). The difference in the formational assignment of the units is attributed to the lack of suitable materials for paleontologic analysis. The age dates of the units, therefore, were mostly based on their stratigraphic relationships and/or position with respect to other formational units. Recent fieldwork in the area revealed two different calcarenite units (i.e., white and red calcarenites) that are underlain by interbedded clastic and volcanic units, and overlain by an uplifted reef.

Preliminary paleontologic and petrographic analyses of the calcarenites revealed clues to their age and possible depositional environment. Planktonic foraminifera analysis shows that both calcarenite units are Early Pliocene (N18-N19 Zone) in age based on the foraminifera assemblage consisting of Sphaeroidinellopsis seminulina, Globoquadrina altispira altispira, Globigerinoides obliquus extremus and Globorotalia margaritae. Petrographic analysis of the white calcarenite show abundance of planktonic foraminifera set in a micritic matrix. The red calcarenites, on the other hand, mostly contain red-colored bioclasts dominated by reefal benthic foraminifera with some echinoid spines and planktonic foraminifera set in a reddish matrix. Based on the paleontologic assemblage, therefore, the calcarenites could have been deposited in the shallow marine-continental shelf transitional environment. Ongoing geochemical analysis will determine whether the difference in color of the two calcarenite units are either diagenetic or syn-sedimentary in origin.

Sedimental geochemical method application on the seabed polymetallic sulfide ore deposit prospecting

CHENHUA HAN[1], GUANGHAI WU[1], YING YE[2]

[1] Key Laboratory of Marine Ecosystem and Environment, Second Institute of Oceanography, State Oceanic Administration (SOA), Hangzhou 310012, China (hanchenhua0127@163.com)

[2] Ocean College, Zhejiang University, Hangzhou 310058, China

Seafloor polymetallic sulfide deposits formation is domintated by the submarine volcanic exhalation and its genesis relates to hydrothermal activities. There are two main types of hydrothermal sediments: one is general polymetallic sediment that is directly mixed with the diminutive hydrothermal plume paticles of sulfides or Fe/Mn oxides, and enriched in Fe, Mn, Cu, Pb, Zn, Au, Ag, etc; the other is oxidized and altered sediment or sediment chemically mixed with the altered sulfide micro-paticles. Based on Bostrom (1973)'s combined index of Al, Fe, Mn (simultanously satisfing Fe/(Fe+Al+Mn)>0.5, Al/(Fe+Al+Mn)<0.3, (Fe+Mn)/Al>2.5), we can identify? the fresh hydrothermal polymetallic sediments. However, it does not applicable to the alterred hydrothermal sediments due to the remigration of Fe and Mn. On basis of the geological characteristics statistical analysis of 30 sediment samples collected from the Southwest Indian Ocean Ridge (SWIR), a combined index of the single element component (TFe>0.75%, FeO>0.23%, MnO>0.86‰, Cu>23 ppm, Pb>20 ppm, V>12 ppm) was proposed to discriminate between the ordinary sediment and the hydrothermal-affected sediment. Considerring that hydrothermal activities would enrich Fe and Si and deplete Al, a TFe_2O_3/Al_2O_3 and Si/Al ratio combination index (TFe_2O_3/Al_2O_3>4.6 and Si/Al>16) was further introduced to supplement the discrimination. In view of the investigated oxidized sediment of which Fe, Si, Al ratio is near the background value, we inferred it may relate to the iron enrichment and migration during the oxidizing process. This sedimental geochemical method was also applied to some samples collected in the non-active hydrothermal fields at SWIR 63.9°E and 50.5°E, and suggested that the sediments were alterred. Besides, the fields at SWIR 47.96ºE, 55.6ºE and 58.36ºE showed no definitive clue to the hydrothermal influence due to the local sedimental geochemical abnormalities. Sedimental geochemical method may have some limitations to the use for discriminating hydrothermal-affected sediment, due to non-uniqueness solutions of this method and complex hydrothermal acitivities processes.

Keywords: sedimental geochemical method, seafloor ore sulfide, polymetallic sediment, hydrothermal activity, element index

Solid elemental sulphur in marine sediments and implication for SMTZ fluctuation

JIASHENG WANG[1, 2], QI LIN[2], QING WEI[3], JUNXIA YANG[2] AND RONGXIAO LIN[2]

[1] State key laboratory of Biogeology and Environmental Geology, P. R. China (js-wang@cug.edu.cn)
[2] School of Earth Sciences, China University of Geosciences, P. R. China
[3] Faculty of Material Science and Chemical Engineering, China University of Geosciences, P. R. China

Solid elemental sulfur (ES) is found in the cored sediments from South China Sea and from Andaman Sea. As one of the intermediates in inorganic sulfur cycle the ES plays a key role in the fractionation of stable sulfur isotopes in different marine environment. Based on the morphology and distribution of ES, Raman spectroscopy, pyrite concentrations and sulfur isotopes, we identified several solid ESs within the recovered sediments from two sites in northern South China Sea and from the site U1447 of IODP 353 in Andaman Sea. Most of solid ES coexist with the pyrite micro-crystals and clay minerals, and occurred on the surface of the mineral aggregates. The indentified ESs are distributed mainly within and near the sulphate methane transition zone (SMTZ) despite little morphological diversity, and their formations might be related to the oxidation of hydrogen sulfide and be linked with the fluctuations of SMTZ position in northern South China Sea. The additional anaerobic oxidation of methane (AOM) within the SMTZ, coupled with dissimilatory sulfate reduction, will enhance the efficiency of the inorganic sulfur cycle, the hydrogen sulphide precipitation and the favourable condition for ES formation. Therefore, the occurrence of solid ES in marine sediments suggests a potential relationship with SMTZ fluctuations, and might imply for the recognizing of methane events associated with the gas hydrate evolution (Zhang et al., 2015).

Keywords: solid element sulfur, marine sediment, SMTZ, fluctuation

Stratigraphic and geoacoustic models at the DH-1, 2 long-core sites in the Korean continental margin of the East Sea

WH RYANG[1], SP KIM[2], GS LEE[2], AND J HAHN[3]

[1] Chonbuk National University, Republic of Korea (ryang@jbnu.ac.kr)
[2] Korea Institute of Geoscience and Mining Resources, Republic of Korea
[3] Agency for Defense Development, Republic of Korea

In the Korean continental margin of the western East Sea, long cores of 23.6 m and 27.2 m were acquired at the DH-1, 2 sites, respectively. The core sites are located near the Donghae City and the water depths are 357.8 m and 316.6 m deep, respectively. The long-core sediments were recovered using the Portable Remotely Operated Drill (PROD), a fully contained drilling system, remotely operated at the seafloor. The recovered core sediments were analyzed for physical, sedimentological, and geoacoustic properties mostly at 10~30 cm intervals. Stratigraphic and bottom models were investigated on the basis of the long-core data and stratigraphic analysis with subbottom and air-gun profiles in the core sites. The detailed geoacoustic model at the DH-1 core site comprises vertical data of the 125 P-wave speeds and 121 P-wave attenuations of 23.6 m core sediments. The geoacoustic model of the DH-2 core site was based on vertical measurements of the 86 P-wave speeds and 76 attenuation values of 27.2 m core sediments. These stratigraphic and geoacoustic models probably contribute for understanding vertical and lateral variability of acoustic properties in the Korean continental margin of the western East Sea.

Keywords: long core, geoacoustic, East Sea, continental margin, P-wave speed

The heat flow in-situ measurement in Yap trench of the Western Pacific

SONG YONGDONG[1] , XU TAO[1] , YAN JUN[1] , LIU XIANSAN[1]

[1] Institute of Oceanology, Chinese Academy of Sciences, Qingdao, China

The heat flow measurement is an important geophysical research method of marine active tectonic, and the heat flow anomalies provide critical information of oceanic crust and thermal state of the upper mantle lithosphere. The Yap Trench lies on the southeastern boundary of the Philippine Sea Plate in the western Pacific, which comprises a series of basins and ridges. It is one section of convergent plate boundary, the active subduction tectonic cause advection of heat that produces anomalies in surface heat flow. In order to know the distribution of the heat flow on both sides of subduction zone of Yap trench, in March 2015 the researchers from IOCAS for the first time have in-situ measured the marine heat flow in this area by using the latest Lister-type probe during the research vessel Kexue cruise Haishan. The ten heat flow positions were measured totally along the subduction zone of Yap trench and then the eight effective data were successfully obtained finally. The results show that the geothermal gradient of this area ranges from 0.011 Km-1 to 0.137Km-1, with an average of 0.089 Km-1, the thermal conductivity ranges from 0.58 Wm-1K-1 to 1.32 Wm-1K-1, and value of heat flow range from 14.4 mWm-2 to 118.85mWm-2, with an average of 68.02 mWm-2. The values of heat flow indicate that heat flow in the area is really quite high, its distribution trend is that gradually decreases from the Yap trench to either side. Obviously, the thermal profile in Yap trench mostly similar to that in normal trenches with slightly higher values in the arc-backarc side close to the trench.

Keywords: the western Pacific; Yap trench; Heat flow value; in-situ measurement

Water depth as a dominant control on the TEX86 in the South China sea

YI YANG[1], XIAOYAN RUAN[2],WANXIAN JIA[2], RUI WU[2], HUAN YANG[1], SHUCHENG XIE[1],*XUEJIE LI[3],YONGJIAN YAO[3]

[1] State Key Laboratory of Biogeology and Environmental Geology, China University of Geosciences, Wuhan, China (xiecug@163.com)

[2] Key Laboratory of Tectonics and Petroleum Resources of Ministry of Education, China University of Geosciences, Wuhan, China

[3] Guangzhou Marine Geological Survey, Guangzhou, China

The isoprenoid glycerol dialkyl glycerol tetraethers (isoGDGTs) in marine sediments were thought to primarily originate from the Thaumarchaeota. The TEX86 paleothermometer based on the isoGDGTs has been widely used to reconstruct the past sea surface temperatures(SSTs) worldwide (Kim et al., 2015). However, in some regions such as the South China Sea (SCS), a tropical marginal sea with annual SST ranging from 25℃ to 29℃ (NOAA), there is no correlation between the TEX86 and the annual SST according to the data of 71 samples, 32 of which have reported by Jia(2012). The BIT, a proxy for estimating the relative contribution of soil organic matter to marine sediments (Hopmans et al., 2004), varies from 0.03 to 0.19 (n=39). Interestingly, the TEX86 index in nearshore (<160m water depth) samples strongly correlates with the water depth (R2 = 0.74, n=11; 4 samples reported by Ge (Ge et al., 2013)) rather than with SST. In contrast, the relationship is lacking in the offshore samples. In the SCS, an increased GDGT-2 and crenarchaeol regio-isomer and decreased GDGT-1 and GDGT-3 were observed with the increasing water depth. We then further investigate the relationship of TEX86 with factors including salinity at different water depths, the seasonal and annual sea surface temperature, BIT, and water depth in the SCS. The two axes (contains BIT, salt, water depth, winter and spring temperature) explain 72% of the variance of isoGDGT distribution. Axis 1 alone explains 64.6% of the variance and captures the gradients in depth to the right. In addition, summer SST and the BIT appear to show no obvious influence on the isoGDGT distribution. Of all the isoGDGT components, only the abundance of GDGT-3 and crenacheaol in the SCS are influenced by the water depth.

Keywords: isoGDGTs, South China Sea, water depth

Spatial and Temporal Dynamic Monitoring of Oxygen in Sediment and Water Interface, From One Dimension to two Dimension

ZI-KE JIANG [1] , XINSHENG YU[1,2]

[1]College of Marine Geosciences, Ocean University of China, P. R. China (jiangzike2011@126.com)
[2]Key Lab. Of Submarine Geoscience and Prospecting Techniquess, Ministry of Education, Shandong, China

Dissolved oxygen plays a central role for the cycling of matter in marine environment. Direct monitoring the heterogeneity/homogeneity of oxygen distribution in sediment and water interface provides key information on biological activities and biogeochemical cycling. It is important to understand the oxygen distribution in millimetre to centimetre scale because of the high variation of oxygen consumption in sediment-water interface. In this report, the characteristics of microelectrodes, micro-optodes and planar optodes are reviewed and the constrains of these technique are discussed. Finally, We demonstrated the planar optode developed in our Lab. for high resolution measurement of spatial and temporal scale of oxygen distribution caused by bioturbation in sediment and water interface and discussed the trends of this new technology for in situ application.

Keywords: high resolution distribution, dissolved oxygen, planar oxygen optodes, microsensor profile

Configuration of equipment to obtain 2-D high-resolution multi-channel seismic data: Application to the southern Yellow Sea

SEONGHOON MOON[1], HYEONG-TAE JOU, CHUNG-HO KIM, JIN-SOO KIM, HAN-JOON KIM, HYE-JIN MOON

[1]KIOST, 787, Haeanro, Ansan 426-744, Korea (shmoon@kiost.ac.kr)

2-D multi-channel seismic (2DMCS) data acquired using a conventional air-gun source in the southern Yellow Sea shows a clear unconformity which indicates the onset of marine transgression in the Miocene. These 2DMCS data do not reveal the details of structure of the analysing marine sedimentary layers. A single-channel shallow seismic survey using a source such as the Sparker system is suited for the high-definition investigation of Quaternary sedimentary layers because of its high-frequency content and convenience. But this system does not give the penetration depth required for the investigation of the entire marine layers with the total thickness up to 1 km in the Yellow Sea. It is not an easy work in seismic surveys to achieve both penetration depth and resolution at the same time because they have repelling relations.

It is important in seismic acquisition to set up proper configuration of equipment depending on regional characteristics. We have acquired seismic data in the southern Yellow Sea for several years. The purpose of this study is to obtain the optimum configuration of the seismic system for the investigation of the marine layers in the southern Yellow Sea. For this purpose, resolution needs to be higher than a conventional 2DMCS system can provide and source needs to be more powerful than the Sparker system. In this study, we have acquired high-resolution 2DMCS data using a small air-gun source array with 4 s shot interval and a 24 channel streamer with 6.25 m group interval (maximum offset – 193.75 m), which will much enhance the signal quality through 2DMCS data processing. The 2DMCS data were processed to produce final stack sections. The processing procedure includes geometry correction, filtering, CDP gathering, velocity analysis, NMO stacking, and predictive deconvolution. The stack sections enable us to define the detailed features of sedimentary layers with the total thickness up to 1 km deposited since the beginning of marine transgression in the Miocene.

Keywords: 2-D high-resolution multi-channel seismic data, Miocene marine transgression, The southern Yellow Sea

Development of geoacoustic properties measurement system based on LabVIEW and PXI for marine sediment

KI-JU PARK[1], DAE-CHOUL KIM[2], GWANG-SOO LEE[1], SUNG HO BAE[1] , GIL YOUNG KIM[1]

[1]Korea Institute of Geoscience and Mineral Resources, Korea
[2]Department of Energy Resources Engineering, Pukyong National University, Korea

A previous velocity measurement system for unconsolidated sediment had several problems such as the errors occurred when picking first arrival time and the inconvenient measurement procedure. We developed a new acoustic properties measurement system to resolve these problems by using PXI (PCI eXtensions for Instrumentation) module based on LabVIEW. The result of the measurement using the new system in a parallel with the previous system under the same experimental environment showed 1~2% margin of error for the velocity. According to previous studies, values of attenuation coefficient are the greatest in very fine sand, and mixtures of sand, coarse silt, and clay in the grain-size range of 3.5ø to 4.5ø, and gradually decline with decreasing grain size (increasing ø) into fine silts and clays. Estimates of attenuation from both systems generally increase with increasing grain size from about 5ø to about 8ø, which coincides with the trend of previous studies on attenuation. We concluded that the new system can efficiently measure the acoustic properties of marine sediment. It also has an advantage to construct the database of acoustic data and raw signal.

Keywords: LabVIEW, PXI, acoustic properties measurement system, sediment, velocity, attenuation

Development of Seabed Observing System for Deep Ocean

XINSHENG YU[1], GUANGTAO ZHAO[1], YUGUO LI[1]

[1]College of Marine Geosciences, Ocean University of China, China (xsyu@ouc.edu.cn)

Various technologies have been developed to observe geological and biological system of deep ocean in order to improve our understanding of the complex interaction og natural phenmena. The long term in-situ observation has proven to be most efficient technology to obtain the real time data. In this report, we will describe the most advances in the development of the low cost, modular, seabed platform by the Ocean University of China, one is Benvir lander and the other is seabed logging platform for telectromagnetic surveying. The Lander named as Benvir is capable to carry instruments to collect chemical and physical data in the benthic environment and it has beed deployed at at depths of about 3889 m in an research voyage to south sea of China in April 2012. The newly designed seabed logging platform of telectromagnetic surveying has been dropped to the deep sea floor at depths of 4022m. Equipped with magneti as well as electric sensors, the seabed logging platform can be applied to collect time varying magnetic field and induced electric field data. Technical aspects on the construction and design these seabed observatories are discribed. The initial experiment results proven that the seabed observatories is the praticlly and economically way to obtain high quality data from sea floor with low cost.

Keywords: seabed observaing system, lander, seabed logging platform, in situ, deep ocean

Discussion on automatically image masaicing for high definition digital pictures of deep sea based on ROV

LIU XIANSAN[1] XUTAO[1] AND SONG YONGDONG[1]

[1] Key Laboratory of Marine Geology and Environment, Institute of Oceanology, Chinese Academy of Sciences, China (xutao@qdio.ac.cn)

High definition digital pictures for deep sea have their own characteristics, such as high difficult to obtain data, small covering area, not enough feature points or objects and big data quantity. For these reasons, traditional image mosaic technology for unmanned aerial vehicle over land can't be directly used for these pictures .In this paper, a method is proposed to mosaic high definition video data for deep sea collecting by Remotely Operated Vehicle based on POS data. High definition pictures are firstly extracted from video and then transformed to into UTM coordinate system. All pictures are mosaicked into a large image based on their position and orientation and automatic dodging method is also employed to remove the inconsistency of colour. According to the image, marine researchers can understand the bottom topography and geomorphology more directly , analyze sediment conditions of seabed and learn about the ecological environment of benthos. In addition, it can be overlaid with terrain data and provide data supporting for building a 3-dimensional scene of the seafloor. Some preliminary results were made in this paper. The experiment in this paper proved that automatic mosaic of deep sea pictures is possible based on POS data and image registration but the effect was badly impacted by the quality of high definition digital pictures and the veracity of auxiliary POS data.

Keywords: ROV, POS, image mosaic, colour uniform

Littoral Gap Filler : Cost effective kayak based swath bathymetric mapping system

YOSUP PARK[1], SHIN HU[2], DONG HYUN KIM[3], KWANG SEOK KWON[3]

[1]Maritime Security Research Center, K OREA Institute of Ocean Science and Technology, 787, Haeanro, Ansan, 426-744, KOREA (yosup@kiost.ac)

Multi Beam Echo Sounder & Side Scan Sonar system are major tools for Marin e geo-habitat mapping. In general, Swath mapping system generates very wide coverage at mid and deep depth area, but it is need many survey lines to cover 100% bottom coverage at littoral area where is very intensive anthropogenic development and vulnerable marine ecosystems. and modern chart-product oriented swath mapping system is very expensive itself, and needs fully auxiliary sensors. Cost problem is a high barrier to development country to adopt swath bathymetric mapping system to delineate seabed marine ecosystem.

Our bathymetric mapping kayak system equips low cost Imagenex Delta-T 200kHz multibeam echo sounder, DGPS, Hummingbird Side Imaging Sounder, down-look camera based on Gopro and Solar power battery management systems on portable & very low draft twin hull kayak with electric propulsion. Open Source software packages((MB-Systems, Q-GIS/Grass, Cloud Compare, Python, etc.) are used for post-processing and for making a thematic maps. Building cost for bathymetric kayak is 10% less of chart-product oriented system. Developed mapping kayak system: Littoral Gap Filler will be the cost effective solution to extend opportunity of geo-habitat mapping of development country.

Keywords: multibeam, side scan sonar, habitat mapping

Numerical simulation of fluid implementing heat transfer in naturally fractured geothermal reservoir with DFN method

T.H. LEE[1], K.H. KIM[1], K.B. LEE[1], W.S. LEE[1]

[1] KIGAM, Korea (thlee@kigam.re.kr)

Natural fractures have an effect on the fluid flow and heat transfer in the naturally fractured geothermal reservoir. However, most of the previous works in this area assumed that reservoir systems are continuum model whether it is single continuum or dual continuum. Moreover, some people have studied without continuum model but, it was just pipeline model. In this paper, we developed a generalized discrete fracture network (DFN) geothermal reservoir simulator. In the model, 2D flow is possible within a rectangular fracture, which is important in thick naturally fractured reservoirs. The DFN model developed in this study was validated for two synthetic fracture systems using a commercial thermal model, TETRAD. Comparison results showed an excellent matching between both models. However, this model is only fracture model and it can't calculate simulation of fluid flow and heat transfer in matrix. Therefore, matrix flow model will be added to this model.

Keywords: Naturally fractured reservoir, Discrete fracture network (DFN), Geothermal reservoir, Heat extraction

Particle Dynamic Monitoring Using an Underwater Digital Holographic System

YANYAN WANG[1], WEI ZHANG[1], XINSHENG YU[1,2]

[1]College of Marine Geosciences, Ocean University of China, P. R. China (yanyanwang7@outlook.com)
[2]Key Lab. Of Submarine Geoscience and Prospecting Techniques, Ministry of Education, Qingdao, China

Sediment transport and deposition is a primary and growing environmental issue around the world. Study of the concentration and the distribution of underwater suspended particles is vital for understanding the mechanism of suspended sediment transport in oceanographic phenomenon. The holography technique provides a high-resolution, three-dimensional and non-intrusive measurement method to monitor the dynamics of marine particulate matter in situ. In this paper, a digital in-line holography video system is developed to capture images of particles in water column. The system consists of a pulsed laser illumination, in-line optical structure and high resolution CMOS camera. With a 6.0μm pixel and of a field of view of 24.5×18.4 mm, the system generates high resolution images of particles. Image recordings are reconstructed and size of the particles measurement is evaluated. Two grades of quartz sand are used to assess the system performance and it is showed that the digital holographic system has the advantages over conventional image systems in analysing location, shape, size distribution and trajectory of the particles. A modification to the system into a field instrument and the potential for plankton monitoring application are discussed.

Keywords: digital holography, suspended particle, hologram reconstruction, image processing

Preventing Wellbore Instability In Drilling Shale Formation By Using KCl Polymer Mud

RACHMI KARTINI[1] AND WONSUK LEE

[1] rachmi.kartini@ust.ac.kr

Many problems in oil well drilling are related to wellbore instability on shale formation. Wellbore stability in shale is highly affected by the type of drilling fluid. There are many available types of mud for maintaining wellbore stability in shale formation. The full length of this paper discusses the usage of KCL Polymer Mud which commonly used in drilling shale formation.

This became a prime concern given the increasing activities of shale gas exploration as an effort in the search for alternative energy sources. The purpose of the research is to find formulations of water - based drilling fluid that are compatible with shale and able to performed at high temperature reservoir (up to 325 oF).

Shale samples were obtained from shale formation in North Sumatera, Indonesia, from Baong and Bampo Formation. Analysis of shale samples mineralogy have been conducted, by using XRD (X-Ray Diffraction). Samples from Baong formation contain Smectite, Illite, Kaolinite and Chlorite and samples from Bampo formation contain only Illite and Chlorite. SEM (Scanning Electron Microscope) was conducted on samples before and after in contact with KCl polymer mud to visualize the changing of samples micro structure.

Mud properties testing were based on API 13 B1 (for Water Base Mud). The Sensitivity of shale samples to the formulated KCl Polymer mud was measured by using LSM (Linear Swell Meter). When tested with water, LSM result of nine samples shows swelling percentage ranging from 3.3 to 10.6 %. While with KCl polymer the swelling percentage drop to 0.1-6.2 %. Potassium in the KCl polymer mud works as shale inhibitor as indicate by the reduction of swelling percentage. Therefore would increase wellbore stability.

Shipborne mobile LiDAR (Light Detection And Ranging) system for monitoring beach erosion

CHANGHWAN KIM[1], GILMO KANG[1], CHANHONG PARK1, HYUNWOOK KIM[1], WONHYUCK KIM[1] AND HYENYEONG PARK[1]

[1]Korea Institute Of Ocean Science & Technology, Korea (kimch@kiost.ac)

Coastal areas are increasingly used as human utilization areas like leisure space, medical care, ports and power plants, etc. However, coastal areas are regions that are continuously changing and interconnected with oceans and land and the sea level has risen by about 8cm (1.9mm / yr) due to global warming from 1964 year to 2006 year in Korea. Coastal erosion due to sea-level rise has caused the problem of marine ecosystems and loss of tourism resources, etc. Regular monitoring of coastal erosion is essential at key locations with such volatility. But the survey method of land mobile LiDAR (light detection and ranging) system has much time consuming and many restrictions. For effective monitoring beach erosion, KIOST (Korea Institute of Ocean Science & Technology) has constructed a shipborne mobile LiDAR system. The shipborne mobile LiDAR system comprised a land mobile LiDAR (RIEGL LMS-420i), an INS (inertial navigation system, MAGUS Inertial+), a RTKGPS (LEICA GS15 GS25), and a fixed platfrom. The shipborne mobile LiDAR system is much more effective than a land mobile LiDAR system in the measuring of fore shore areas without shadow zone. Because the vessel with the shipborne mobile LiDAR system is continuously moved along the shoreline, it is possible to efficiently survey a large area in a relatively short time. U.S. Army, Finnish Geodetic Institute, Quality Positioning Services Co., and etc. have actively being used to build the system. Effective monitoring and understanding of the changes using the constructed shipborne mobile LiDAR system for seriously eroded coastal areas will be able to contribute to coastal erosion management and response.

Keywords: coastal erosion, shipborne, LiDAR, INS, RTKGPS

Submarine topography and seafloor image survey of Jukbyeon port in Uljin, South Korea using multi-beam echo sounder and side scan sonar

WONHYUCK KIM[1], CHANGHWAN KIM[1], MYUNGHOON LEE[1], CHANHONG PARK[1] AND HYEONHEONG PARK[1]

[1]Dokdo Research Center, East Sea Research Institute, Korea Institute of Ocean Science & Technology, South Korea (hyuckis@kiost.ac.kr)

We conducted submarine topography and seafloor image survey from 4, Mar. 2013 using R/V Jangmok2(35 ton), multi-beam echo sounder EM3001(Kongsberg corporation) and side scan sonar 4125(Edge Tech corporation). We used EM3001 multi-beam echo sounder and 4125 shallow water sides can sonar for survey. Multi-beam echo sounder is a device for observing and recording the submarine topography using sound. We mounted the EM3001 on right side of the vessel. Multi-beam echo sounder transducer commonly to mounted at right angles to the surface of water. However, we tilted 20-degrees of transducer for long range with 85-degrees measurement on the right side of the vessel. We were equipped with a motion sensor, DGPS(Differential Global Positioning System), and SV(Sound velocity) sensor for the vessel's motion compensation, vessel's position measure, measure the velocity of sound of seawater. Side scan sonar launch ultrasonic wave from both sides of the transducer. And it restores the image by receiving signals. Seafloor image survey is commonly used to tow the sensor in the rear side of vessel. However, we fixed the tow-fish on right side of the vessel in the seawater with long frame. The mounted side scan sonar survey was useful in shallow water like the port having many obstacles. This exploration can see the sediment and waste materials accumulated in port. The maximum depth was 12m and We saw a lot of forsaken tire in the port. Such multi-beam echo sounder survey and side scan sonar survey will facilitate the management and the improvement of environment of port.

Keywords: multi-beam echo sounder, side scan sonar, port, Jukbyeon

Tracer calibration in stable oxygen isotope analysis

JIANG XIAOYING[1*], CHEN XINRONG[1]

[1]State Key Laboratory of Mar. Geol., Tongji University, Shanghai 200092, China (jiangxy@tongji.edu.cn)

Earth scientists are very interested in the $\delta^{18}O$ composition of ocean water affected by changes in water temperature and the global ice volume. These changes in past $\delta^{18}O$ values are recorded in the foraminiferal shells. The real and natural $\delta^{18}O$ value is very important. A simple method, tracer calibration, could be used in isotope analysis to improve precision. Although there are some unknown interference factors influencing analyzed results, they may be excluded by tracer calibration.

The foraminiferal samples were analyzed with several international standard (NBS19) samples together every day. The factors interfering foraminiferal samples also interfere NBS19 samples. Actually, the $\delta^{18}O$ values of NBS19 is relatively constant(zheng and chen 2000). The NBS19 deference between analyzed value and real value could be chosen as the adjustment factor to calibrate analyzed foraminiferal samples. The similar technique has been already applied in other isotopes analysis (Johansson, Harms et al. 2004, Koskinas, Pires et al. 2008, McLean, Condon et al. 2015).

In fact, it's quite necessary to trace the analysis procedure. According to everyday measured results of several NBS19, there is some accidental system error occurred every single test. However, it's difficult to identify the causes. Tracer calibration can effectively eliminate all the synthesized interference as much as possible.

Keywords: tracer calibration, $\delta^{18}O$, NBS19, foraminiferal samples

References

Johansson, L. C., A. V. Harms, J. D. Keightley, A. K. Pearce, D. H. Woods and M. J. Woods (2004). "Primary standardisation of 204Tl using the efficiency tracing method." Applied Radiation and Isotopes 60(2–4): 347-351.

Koskinas, M. F., C. A. Pires, I. M. Yamazaki, E. A. Silva and M. S. Dias (2008). "Standardization of 55Fe by tracing method." Applied Radiation and Isotopes 66(6–7): 733-736.

McLean, N. M., D. J. Condon, B. Schoene and S. A. Bowring (2015). "Evaluating Uncertainties in the Calibration of Isotopic Reference Materials and Multi-Element Isotopic Tracers (EARTHTIME Tracer Calibration Part II)." Geochimica et Cosmochimica Acta(0).

zheng, Y.-F. and J.-f. chen (2000). Stable isotope geochemistry. Beijing, Peng bin.

Impact of Sand Mining Activities at Ramunia Shoal in Offshore Johore, Malaysia

ABDULLAH SULAIMAN[1,2], NORAN ALWAKHIR SHAARANI[1], AMIN NOORASID ABDUL JALIL[1], MOHD RAIS RAMLI[1] AND VIJAYANV.R[1]

[1]Minerals and Geoscience Department Malaysia, Technical Services Division, Jalan Sultan Azlan Shah 31400 Ipoh, Perak (abdullah@jmg.gov.my)

[2]Institute of Oceanography and Environment (INOS), Universiti Malaysia Terengganu

The first study on impact of the sand mining activities in Malaysia was carried out by Minerals and Geoscience Department Malaysia at Ramunia Shoal since it was actively dredged from 1996 to 2010. A multi-disciplinary scope was undertaken in this study such as bathymetry, sediment sampling, coastal mapping and hydraulic modelling. The multibeam data analysis indicated the shoal was cut through at two parts due to the sand mining activity. The sediment sampling data has further confirmed that the sediment at the two parts of the shoal has changed from sandy to muddy sediments. Coastal mapping data showed severe coastal erosion at south of Tg. Punggai and several significant erosion signs observed in other study sites. The hydraulic modelling results showed that there is an insignificant current speed change at the coastal locations which is less than 0.02 m/s. As conclusion, sand resources still can be mined at Ramunia Shoal but at a sustainable manner where very close monitoring is required in order not to over mine the area and maintain the level of the sea floor with the surrounding to minimise the impact of changes in the current pattern and floor.

Keywords : Sand mining, offshore sand resources, hydraulic modelling, bathymetry, environmental impact

Physical and geoacoustic properties in the southwestern surficial sediments of the Ulleung Basin, the East Sea

GWANG-SOO LEE[1], SO RA KIM[2], DAE-CHOUL KIM[2], SEONG-PIL KIM[3]

[1]Petroleum and Marine Research Division, Korea Institute of Geoscience and Mineral Resources, Daejeon 305-350, Korea
[2]Department of Energy Resource Engineering, Pukyong National University, Busan 608-737, Korea
[3]KIGAM Pohang Branch, Korea Institute of Geoscience and Mineral Resources, Pohang 791-948, Korea

To identify the physical and geoacoutic properties in the southwestern surficial sediments of the Ulleung Basin, the East Sea, 157 piston and box core samples were collected and analyzed in the study area. As a result, the inner shelf and basin slope in the study area are dominated by fine grained sediment and show high porosity and water content, with low bulk density and velocity. Low porosity and water content with high bulk density and velocity mainly appear in the trough of Korea Strait and outer shelf where are composed of coarse grained sediment. Based on in situ velocity, which was calculated from laboratory measured velocity data, and sediment properties, the study area is divided into five provinces: (1) Province IA (in situ velocity: 1427 m/s, mean grain size: 8.4 Φ, bulk density: 1.24 g/cm3, and porosity: 84%) is interpreted as hemi-pelagic mud partially mixed with intermittent sandy sediment which are derived from the outer shelf due to slide/slump or mass flow, (2) Province IB (1442 m/s, 7.9 Φ, 1.35 g/cm3, 78%) is covered with muddy sediment that are deposited during Holocene, (3) Province II (1477 m/s, 6.1 Φ, 1.53 g/cm3, 68%) is marked by mixed recent and relict sediment, (4) Province III (1560 m/s, 3.8 Φ, 1.77 g/cm3, 54%) is dominated by coarse-grained relict sediment formed during Pleistocene, (5) Province IV (1668 m/s, 3.0 Φ, 1.91 g/cm3, 46%) is consisted of more coarser sediment than Province III. Compressional wave velocity, mean grain size, and bulk density increase from Province IA to Province IV, whereas porosity and water content decrease from Province IA to Province IV.

A review of marine environmental changes and management for better achievement of Integrated Coastal Zone Management of Jiaozhou Bay, Qingdao, China

WEN WU[1], SHENGKANG LIANG[2]. STUART PERSON[3], DEHAI SONG[4], YINGJIE MA[5], LULU QIAO[6]

[1] College of Physical and Environmental Oceanography, Ocean University of China, China (wenwu1985@ouc.edu.cn)
[2] Key Laboratory of Marine Chemistry Theory and Technology, Ministry of Education, China
[3] School of Physical, Environmental and Mathematical Sciences, University of New South Wales Canberra, Australia
[4] Key Laboratory of Physical Oceanography, Ministry of Education, China
[5] School of Law and Politics, Ocean University of China, China
[6] College of Marine Geosciences, Ocean University of China, China

Marine environmental problems happened during the socio-economic development of Qingdao City and the exploitation and utilization of Jiaozhou Bay. Its environmental condition has been dominated by intensive anthropogenic activities, e.g. the increased wastewater discharge and rapid coastline evolution, which have reduced the ecosystem's ability to sustain itself. Efforts have been taken in scientific research and Integrated Coastal Zone Management since 1990s. However a lack of holistic views of Jiaozhou Bay system generates knowledge gaps in different research disciplines as well as the linkage between science and management. Therefore past investigations into the use market-based solutions and further integration using management models are included in this study. Recommendations for future improvements include wider knowledge sharing through community-benefit research projects, and the development of indicators and models to inform business, management and policy that include pollutant, legal measures and valuation research. Integrated research with interdisciplinary problem-solving mechanism in the next few years will develop these ideas into actionable knowledge on one of the world's most rapidly developing coastlines.

Keywords: Jiaozhou Bay, anthropogenic factors, land reclamation, water quality control, marine environmental management, future recommendation

A study on distribution and origin of Quaternary Mass Transport Deposit in the Ulleung Basin, East Sea

YOUNG-MI YI[1], DONG-GEUN YOO[1]. NYEON-KEON KANG[1], BO-YEON YI[1]

[1] Petroleum and Marine Research Division, Korea Institute of Geoscience and Mineral Resources, Korea (ym8921@naver.com)

Analysis of multi-channel seismic reflection profiles collected from the Ulleung Basin reveals that the Quaternary sequence consists of four stratigraphic units separated by erosional unconformities. Individual stratigraphic unit includes eighteen mass transport deposits which are variable in geometric characteristics and spatial distribution. Each mass transport deposit on the seismic profile is acoustically characterized by chaotic or transparent seismic facies, and shows wedge or lens-shaped external geometry. The mass transport deposits, which comprise a succession of stacked wedges, mainly occur on the southern slope, and their thickness gradually decreases toward the basin floor. The time structure map of erosional unconformities shows that geomorphologic features including tectonic-induced structural high and troughs toward the northwest and northeast are developed at the central part of the basin. According to the isochron map of each stratigraphic unit, the mass transport deposits originated from southern part of the study area were transported to the basin floor. They were divided into two directions by the structural high. Based on the results, mass transport deposits mostly were originated from southern margin of the Ulleung Basin as well as western and southeastern margin of the Ulleung Basin. Consequently, the mass transport deposits within the Quaternary sequence in the Ulleung Basin are largely controlled by geomorphology, the large amounts of sediment supply, and dissociation of gas hydrate during the lowstands.

Keywords: Ulleung Basin, Quaternary, mass transport deposits, lowstands, Dissociation of gas hydrate

Analysis of geometric characteristics for naming of undersea features in the East Sea

PARK HYUN TAK[1] LEE JEONG MIN[1] SHIM MOON BO[2] HAN KWANG NAM[2]

[1] KOSBI, Daejeon, Rep. Of Korea (htpark@kosbi.co.kr)
[2] KHOA, Busan, Rep. Of Korea

Undersea feature names are essential to nautical charts production for safe ship navigation, proper communication with marine policy decisions and variety of research activities. Therefore, worldwide nations show aggressive activities for naming of undersea features such as discovery, registration and promotion. In order to register undersea feature names, it is necessary to define a suitable feature geometry. However, most geometries have been defined as point type or subjective interpretation has been involved in the delimitation process of undersea features. GIS makes it possible to describe undersea features objectively and extract accurate coordinates of geometry. In addition, seismic data provides various information such as sedimentary structure, environment and formation mechanism to define the generic term. In this study, we suggest scientific integrated analysis method of bathymetric data and seismic data using GIS tools. Also, we analyzed the geometric characteristics of a moat and a canyon found in the East Sea using suggested method. Moat founded in the western lower slope of Hupo Bank has a depressed channel form and is characterized by <40 m depth, 1-5 km width and length of several tens kilometres. Canyon occurs with scars in the western slope of Ulleung Basin and shows about 18 km length (E-W) and 2-5.5 km width.

Keywords: undersea feature name, bathymetry, GIS, seismic

Analysis of wave power potential in the East Sea, South Korea

MIHYANG JANG[1] AND YOSOON CHOI[1]

[1] Department Of Energy Resources Engineering, Pukyong National University, Busan 608-737, Korea (Energy@Pknu.Ac.Kr)

In this study, we analyzed the wave power potential in the East Sea, South Korea. Annual electricity production and economic effects of 28 wave energy converters with 750 kW capacity were analyzed using significant wave height and peak wave period data (created from the NOAA's NWW3 model) and InVEST software (developed by Stanford University and University of Minnesota). Annual electricity production was estimated to be up to 1,207 MWh/year and at least 163 MWh/year. The spatial pattern of annual electricity production showed that sea far from land has higher wave power potential than sea near coast. The net present value (NPV) of 28 wave energy converters was calculated by considering an operation period of 25 years. When assuming that the electricity produced from wave energy converters is transferred to onshore power plants through underwater cables, the NPV was estimated to be up to 5,883 USD (6,600,000 KRW) and at least - 63,494 USD (- 71,000,000 KRW). In contrast, the NPV increased up to 28,095 USD (31,600,000 KRW) when assuming that the electricity is utilized in the Ulleungdo and Dokdo. In addition, it was found that the break-even line of NPV in the East Sea becomes closer towards the land according to the increment of electricity price. The NPV of wave energy converters near the Ulleungdo and Dokdo will be 88,158 USD(99,000,000 KRW) if the increment of electricity price is 100 KRW.

Keywords: ocean energy, wave power, economic potential, energy analysis

Chirp (2-7 kHz) echo characteristics of the sea-floor around the Jeju Island, Korea

HYUK-SOO HAN[1]

[1] Korea MarineAid Co.

A detailed study of high-resolution Chirp (2-7 kHz) seismic profiles reveals the presence of 13 different types of echo character around Jeju Island.

They are either 1) Type I (distinct echoes; Echo types I-1, 2, 3, 4, 5, 6, and 7), 2) Type II (mound echo; Echo types II-1, 2, and 3), 3) Type III (hyperbolic echoes; Echo types III-1 and 2), or 4) Type IV (combined echoes; Echo types IV-1).

Type I echoes are characterized by a sharp continuous smooth bottom echo. Seven kinds of distinct echoes are recognized on the basis of presence or absence of subbottom reflectors and their nature. Type II is represented by mounded seafloor with smooth or eroded surface. Type III shows irregular hyperbolae and regular overlapping hyperbolae with no subbottom reflectors. Type IV is characterized by eroded seafloor with a great topographic relief, no subbottom reflectors.

Detection of sea bottom using STA/LTA ratio and low-pass filter in high-resolution shallow marine seismic data

MOON-SOO LIM[1] AND YOUNG-KYO SEO[1]

[1] Gematek, Co., Ltd., Busan Korea (lms478@naver.com)

First-break picking is the task of determining, given a set of seismic traces, the onsets of the first signal arrivals as accurately as possible in seismic survey. First-break detection in the seismic signals has been used with a variety of ways of energy ratio, neural network, STA/LTA ratio method, multi-window method and so on. It is difficult to determine sea bottom of high-resolution shallow seismic data affected by waves, swell, suspended particles, and electrical noise in the traditional way. We detect sea bottom by mixed methods of energy ratio, STA/LTA ratio, and low-pass filter in low quality seismic data. If the S/N ratio is lower, it will be difficult to define sea bottom using energy ratio method. If LTA window length is too short in shallow water, it will be also difficult to estimate sea bottom in STA/LTA algorithm. We have applied low-pass filter in order to compensate these drawbacks; it has improved the accuracy of bottom detection by predicting sea bottom for the next trace. The improved method for detection of sea bottom will enhance the seismic data processing such as water depth extraction, static correction, swell filter and so on.

Keywords: high-resolution shallow seismic, sea bottom, energy ratio, STA/LTA ratio, low-pass filter

Development of Amphibious Unmanned Mapping System for Continuous Topographic Survey in Coast and Inshore

KWANG-SEOK KWON[1], DONG-HYUN KIM[1] AND CHEON-WOO HU[1]

[1] UST21 Inc., Korea (kskwon02@ust21.co.kr)

According to the secondary coastal integrated management plan(Ministry of Land, Infrastructure and Transport, Maritime Affairs, 2011), it was expected that the population of coastal cities is 13.391 million people (2010) , increasing to 14.828 million people (2020) and marine leisure boats is 3,833 vessels (2010), increasing to 10,461 vessels (in 2020) by growth of coastal cities and national income increases. Changes in the coastal environment will bring about various demands of coastal information. updated Topographic and bathymetric data are need to be basically acquired and periodically updated for planning and management of coastal areas. However, traditional topographic and bathymetric surveying cannot perfectly cover coastal areas with high tidal range such as Yellow Sea and South Sea in Korea.

In coastal areas with high tidal range, observable time by traditional survey techniques is limited and interpolated data with topographic and bathymetric data merging cannot be ensured in uncovered areas. Because of Low water depth, fisheries, fishing nets and various underwater obstacles, ship based observations are difficult and dangerous. In high turbid and breaking wave area, LiDAR cannot acquire data and operate anytime.

Recent unmanned systems are developing and utilizing in hydrography. But USV(Unmanned Surface Vehicle) is used in limited conditions and exposed to risks of under-water obstacles. UAV(Unmanned Aerial Vehicle) can observe coastal areas at low tide time with limitation of operation conditions. It is still difficult to obtain the continuous topographic data in coast and inshore.

In this paper, the amphibious unmanned mapping system was proposed to acquire continuous topographic data by dragging a sensor platform with a blimp in coast and inshore. The sensor platform was designed with low centre of mass, additional batteries for dragging blimp and two wheels for land. It is consisted of single beam echo sounder, L1/L2 GNSS(Global Navigation Satellite Systems) receiver, fibre optic gyro to acquire topographic and bathymetric data seamlessly. Field test was performed to approve operability of the amphibious unmanned system for continuous topographic data in Kkotji beach, Yellow Sea, Korea.

Keywords: Amphibious, Unmanned, Mapping System, Topography, Bathymetry; Blimp

References

Ministry of Land, Transport and Maritime Affairs, 2011, The Second Integrated Coastal Management Plan (2011-2021), 40p

Development of marine forecast indices for supporting people's marine leisure activities

SUNG-TAE JANG[1], RYONG HUR [2] , JI MIN KO [2]

[1] GeoSystem Research Corporation (stjang@geosr.com)
[2] Korea Hydrographic and Oceanographic Administration

Korea Hydrographic and Oceanographic Administration(KHOA) is to develop a set of marine forecast index for national marine life derived using empirical analysis which is aggregated data of ocean and meteorology. Each inex is as follows: sea-bathing, sea fisihing, tidal flat experience, crossing the sea experience, scuba and seasickenss indices. Used observation data is real-time ocean data observed in the oceanographic observation network by KHOA and meteorological data by Korea Meteorogical Administraton(KMA). The data set is reliable with spatial and temporal coverage. Forecast data is the result of numerical weather prediction model, ocean circualtion forecast model and wave prediction model by KHOA. The forecast data set is possible for three days.

Determined index should be easy to be understood, responsive to changes and nomalized with max-min method. Especially, they are evaluated to be scientifically and statistically valid which is capable of providing quantitative information. The weight of indices was determined by Analytic Hierachy Process(AHP) and Principal Component Analysis(PCA) methods.

Marine forecast indices is provided the information of forecasts by internet broadcasting and web site. Each forecast will support people's marine leisure activities.

Geoacoustic and physical properties of marine sediment on the inner-continental shelf off the Kuem River Estuary, the Yellow Sea, Korea

HWA-RANG KIM[1], DAE CHOUL KIM[1], YOUNG KYO SEO[2], GWANG SOO LEE[3]

[1] Department of Energy Resource Engineering, Pukyong National University, Korea (khrang@hanmail.net)
[2] Gematek Corporation, Korea
[3] Petroleum and Marine Research Division, Korea Institute of Geoscience and Mineral Resources (KIGMA), Korea

Geoacoustic and physical properties of sediment on the inner-continental shelf off the Kuem River Estuary of Korea have been studied based on eight piston core samples. The sediments are largely composed of homogeneous sandy mud or muddy sand in Kuem River estuary and north part of this study area and appear sand or silty sand in the mid part of study area and outer shelf. Geoacoustic and physical properties and mean grain size of sediment are mostly uniform with sediment depth. Mean grain size and physical properties are the most important variable to determine the geoacoustic properties. Correlations between geoacoustic and physical properties show slightly distinction from those of the compared data, caused by the difference of mineral composition, and the sedimentary processes and measurement system. Comparison of other previous data and this study data show also big difference. In particular, the velocity are lower (approximately 30-40m/s) than those of previous data measured in the surrounding area. Because other previous data are modeling data calculated using sediment texture instead of direct measurement, this discrepancy can be explained. We propose new model of physical and geoacoustic characteristics of shelf sediment in the study area.

Keywords: geoacoustic and physical properties, Kuem River Estuary, geoacoustic model

Optimal data processing sequence for chirp raw data and its field application

KEYU YOUNG-JUN KIM[1], NAM-HYUNG KOO[1,2], JEONG-KI KIM[1], KAB-SUK SEO[1], SNONS CHEONG[1], SU-MIN KIM[1,2], WON-SIK KIM[1] ,AND CHAN-SU KIM[3]

[1] Petroleum & Marine Research Division, Korea Institute of Geoscience & Mineral Resources, KOREA (kimyj@kigam.re.kr)
[2] Department of Petroleum Resources Tecnology, University of Science & Technolgy, KOREA
[3] esearch Institute, Geoview Co., KOREA

Chirp system provides a high-resolution seismic image with a decimeter-scaled vertical resolution and 50 - 70 m penetration depth because of using the source sweep signal with a frequency modulation of 1 - 10 kHz band (Quinn et al., 1998). Chirp survey has been applied in a variety of marine geological and geophysical fields such as environmental assessments, geohazard assessments, archaeological research, site survey, and so on (Bull et al., 2005). The conventional chirp section acquired using a conventional chirp envelope data acquisition system is easily available without the special processing procedure but it doesn't have the polarity and phase information (Henkart, 2006). In this study, we acquired the chirp raw data set using the newly constructed chirp recording system and conventional chirp raw data acquisition system. To produce high-resolution chirp sections from raw signal, we constructed an optimal processing sequence composed of a sweep signature estimation, correlation, deconvolution, swell effect correction, and migration. Unlike the conventional envelope section, the raw section preserving polarity and phase information clearly showed the shallow gas related acoustic anomaly at the seafloor and underlying sediments. We successfully applied an optimal processing sequence to the archaeological survey conducted in Ma-do, Taean peninsula, Korea.

Keywords: chirp, high-resolution, sweep signal, raw signal, archaeological survey

Origin and distribution of cut and fill structures in the southwestern margin of Ulleung Basin, East Sea

YONG-JOON PARK[1], NYEON-KEON KANG[2], BO-YEON YI[2] AND DONG-GEUN YOO[2]

[1] Department of Petroleum Resources Technology, Korea University of Science and Technology, Korea (dgyoo@kigam.re.kr)
[2] Petroleum and Marine Research Division, Korea Institute of Geoscience and Mineral Resources, Korea

Analysis of multi-channel seismic reflection profiles acquired from the southwestern margin of Ulleung Basin reveals that the cut and fill structures, which show U-shaped or V-shaped morphology, occur on variable size. The cut and fill structure mostly consists of fine-grained sediments on the well data and is characterized by transparent or semi-transparent seismic facies on the seismic section. Such cut and fill structures dominantly occur in the syn-compressional megasequence (MSQ3), which was deposited during basin deformation of late Miocene, among the four megasequences of the study area. These cut and fill structures can be divided into three groups based on their size and formation time. The cut and fill structures of Group Ⅰ were formed when Dolgorae structure was active, and occurred on a small scale. The cut and fill structures of group Ⅱ were formed when both Dolgorae structure and Gorae V structure were active, and the number and size of those increased compared with group Ⅰ. The cut and fill structures of group Ⅲ were formed when Dolgorae structure was weaken gradually but Gorae V structure kept active, and the number and size of those decreased in comparison with group Ⅱ. Consequently the cut and fill structures in the southwestern margin of Ulleung basin are interpreted as submarine canyon based on spatial distribution, size and fill sediment. They were controlled by the tectonic movement in response to basin closure and tectonic-induced sediment supply variation.

Keywords: Ulleung Basin, syn-compressional megasequence, cut and fill structure, tectonic movement, sediment supply

Physical and acoustical properties of offshore sediments at the three area (Ulsan, Pohang and Uljin), the East sea of Korea

J.H. JUNG[1], Y.K. SEO[1], M.S. LIM[1], K.O. KIM[2] AND D.C. KIM[3]

[1] Gematek Co., Ltd., Korea (jh1206@gematek.com)
[2] Korea institute of geoscience and mineral resources, Korea
[3] Department of Energy Resources Engineering, Pukyoung national university, Korea

Total 37 piston core samples were collected at the three offshore area(Ulsan, Pohang and Uljin) by KIGAM and were analyzed to investigate the physical and acoustical properties by GEMATEK.

The first area, Ulsan, was divided into two different sediment type zones. The one is muddy sediment of southeastern mud belt of korea (water depth is below 70~80m). The other is sandy sediment of continental slope (water depth is more than 100m). Properties of muddy sediments are as follows. Mean grain size (Mz) was 6.9~9.5Ø, Sorting (Sd) was 1.3~2.3Ø. Porosity (Po) was 68~80%. Water content (Wc) was 53~75%. P-wave velocity (Vp) and attenuation (Ap) were 771~1516m/s and 0.1~2.1dB/m/kHz. Hundreds m/s of Vp values are considered by gassy sediments or degassying crack. Properties of sandy sediments are as follows. Mz was 2.3~7.9Ø. Sd was 1.07~3.16Ø. Po was 36.25~78.36%. Wc was 18.60~61.02%. Vp and Ap were 1464~1762m/s and 0.08~1.3dB/m/kHz.

The second area, Pohang, was also divided into two different sediment type zones. The one is muddy sediment of southeastern mud belt of korea (water depth is more than 100m). The other is sandy sediment of coastal area (water depth is less than 80m). Properties of muddy sediments are as follows. Mz was 3.05~9.61Ø. Sd was 1.29~3.11Ø. Po was 38.10~81.81%. Wc was 21.88~63.99%. Vp and Ap were 1461~1758m/s and 0.2~2.1dB/m/kHz. Properties of sandy sediments are as follows. Mz was -1.73~6.53Ø. Sd was 1.01~4.64Ø. Po was 20.37~70.84%. Wc was 8.64~50.72%. Vp were 1533~1749m/s.

The third area, Uljin, was predominantly distributed by muddy sediments. Silt, silty sand and sandy clay appeared in some samples. Properties of sediments are as follows. Mz was 0.0~9.5Ø. Sd was 0.63~4.38Ø. Po was 18.46~82.50%. Wc was 8.64~67.93%. Vp were 1411~1691m/s.

Keywords: physical properties, acoustical properties, offshore, sediments, East sea

Study about developing application procedure funded by IHO Capacity Building Fund

HOYUN KANG [1] ,JOONSEOK OH [1] ,YONG BAEK [2]

[1] Korea Hydrography and Research Association, KOREA, (hykang@khra.kr)
[2] Korea Hydrographic and Oceanographic Administration, KOREA

The Republic of Korea discussed MOU to supports training and education of IHO Capacity Building Sub-Committee (CBSC) in IHO meeting, April 2005. In 1st May 2006, MOU was singed and Rep. of Korea support budget of $100,000 every year. CBSC was established in September 2003 under the IHO for the purpose of bathymetry for developing country, ocean survey, building the capacity of ENC production and perform like training, technical visits.

Each Regional Hydrographic Committee request capacity building fund(CB Fund) to IHO for training and technical workshop that is hard to process in regional hydrographic Committee and evaluate and then support. There are 8 steps like application, financial report and report submission. However, for now, this procedure has limits to manage systemically with using email not on-line system. Therefore, this study enables systematic management about application flows through establishing effective on-line system to overcome this limits and this study also enable effective CB Fund support throughout well-established database.

Keywords: IHO(International Hydrographic Organization), CBSC(Capacity Building Sub-Committee), CB(Capacity Building) Procedures, TRDC(Training Research Development Center)

Temperature correction on physical and geoacoustic properties in surficial sediments of the Hupo Basin, the East Sea of Korea

So Ra Kim[1], Dae Choul Kim[1], Seong Pil Kim[2], Gwang Soo Lee[2], Hwa Rang Kim[1]

[1] Department of Energy Resource Engineering, Pukyong National University, Korea (soraani@pknu.ac.kr)
[2] Petroleum and Marine Research Division, Korea Institute of Geoscience and Mineral Resources (KIGAM), Korea

Sediment core samples were acquired in order to investigate the physical and geoacoustic properties of surficial sediments in the Hupo Basin, the East Sea of Korea. Total sixty-four piston and box core samples were analysed for sediment texture (grain size, sand, silt, and clay contents), physical properties (porosity, water content, bulk density, and grain density) and acoustic properties (compressional wave velocity and attenuation). To present the accurate distribution of the velocity, the velocity was corrected using Kim et al. (2015)'s temperature correction equation (temperature rises to 1℃, velocity increases to nearly 2.63 m/s/℃ and 2.80 m/s/℃ in mud and sand sediments, respectively). The result of velocity correction depending on temperature indicates that in situ velocity decreases up to 75 m/s, compared to the laboratory velocity. Based on physical and geoacoustic properties, the study area is divided into 4 provinces; Province I is composed of hemi-pelagic mud transported by slide/slump other mass flow. Province II is covered with muddy sediments deposited during the Holocene. Province III is covered by the coarse-sediments transported from the Hyeongsan River. Province IV is dominated by very coarse relict sediments. The velocity, mean grain size, and bulk density increase from Province I (1430 m/s, 8.4 Φ, 1.21 g/cm3, respectively) through Province II (1445 m/s, 8.0 Φ, 1.38 g/cm3) to Province III (1583 m/s, 4.2 Φ, 1.71 g/cm3) and Province IV (1660 m/s, 3.5 Φ, 1.88 g/cm3), whereas the porosity decreases from Province I (85%) to Province IV (47%).

Keywords: physical and geoacoustic properties, temperature correction, surficial sediment, Hupo Basin, East Sea

The Enhanced Classification of Earth Globes

EUNMI CHANG[1] AND KYEONG PARK[2]

[1] Department of Geomatics, 21centry Hall, Siripdaero 163,,Dongdaemungu, Seoul, Korea, 120-734 (emchang21@gmail.com)
[2] Department of Geography, Sungshin Women's Univeristy, Bomunro 34da Gil, Seongbukgu, Seoul, Korea, 136-742

It is natural to have round globes in bookstores or giftshops in the world and to find it is worthwhile to have enough information on earth at leat for the surface. But most globes have a limit information on the bathymetry and names of undersea featue names, as the humanbeings belongs to lands. As GEBCO has archived several levels of bathymetric data over the world and Google and ESRI have enhanced the assessibility to the data and visulization of the massive data. As there are many classification schemes of maps such as topographic maps and thematic maps, paper maps and digital maps, interactive maps or dynamic map. But for the globes, it is rare to classfity the globes. We suggest the classification schems to globes, including the reviews of map classification and the cutting-edged technologies in 2015. Such a trial will give some vision to expand awereness of both bathymetric data and undersea feaures where marine lives lives on to be discovered in the future.

We also discussed the effective ways to provide the digital maps to in the clasrooms in underdeveloped countries as well as highley developed countries that do not have any curricullums on bathymetric data. Even GEBCO data's intellectural right may be compromised to make the potential commercialization, we discussed those issues to deliever various classes of globes with SWOT analysis.

Keywords: classification of globes, GEBCO, outreach activities, intellectual right for bathymetric data

References

Florian Hruby, Irmgard Plank, Andreas Riedl, 2006, Cartographic heritage as shared experience in virtual space: A digital representation of the earth globe of Gerard Mercardor (1541) E-Perimetron 1(2): 88-98

Jarke, van Wijk, 2008, Unfolding the Earth: Myriahedra Projections, The Cartographic Journal 45(1): 32-42

Riemer, 1983,.Method of manufacture of raised relief illuminated globe, US Patent No. 4,414,731

A Study on the Development and Application of S-100 Test bed system

GYEONGMIN JO[1], SEWOONG OH[2]

[1] The Prost, Republic of Korea (gmjo@theprost.net)
[2] Korea Research Institute of Ships and Ocean Engineering, Republic of Korea

IHO has established the S-100 standard to meet the recent requirements for the hydrographic communities and supersede the existing S-57 standard. Accordingly, KHOA decided to develop an S-100 test bed system to cope with the new standard and secure a relevant technologies as a national hydrographic office. The S-100 test bed system was drafted based on the latest standard of S-100 and has been used to verify product specifications such as S-101(ENC), S-102(Bathy surface grid), S-111(Surface current), S-124(Maritime Safety Information). This paper describes the background and process of developing the S-100 test bed system and contains application examples for S-10X product specifications. Since the S-100 standard will be an important enabler for applying hydrographic data to IMO e-Navigation, Korean hydrographic community is required to note the progress of S-100 and test bed system.

Keywords: S-100, ENC, ECDIS, IHO, e-Navigation

Development and Application of Customized MIOs

HYUNSOO TROY CHOI[1] AND SEWOONG OH[1] AND SUNPHILL HWANG[1] AND SUNYOUNG KIM[1]

[1]Korea Research Institute of Ships and Ocean Engineering (troychoi@kriso.re.kr)

In this study, a system of overlay priority for customized MIO(Marine Information Overlay) was developed as a customized marine geospatial information. MIO universally operates with ENCs by overlay priority system for high observable technology. A data modeling method was used to analyze and improve the utilization of information about marine information such as fishery operation and management area, military practice area for shooting training and marine environmental sanctuary. An editing program of ENC, CARIS Composer and a viewing program of ENC, ENC system for administrative work of KHOA was applied to operate the customized MIO.

Keywords: MIO(Marine Information Overlay), ENC, Overlay priority

References (if necessary)

Choi HyunSoo (2014), Analysis of ENC Viewer, The Hydrographic Society of Korea, Vol. 3

Choi HyunSoo (2015), A Study on Development of Application Technologies for Customized MIO on Prohibited Fishery Zone Information, The Hydrographic Society of Korea, Vol. 4,

Lee Alexander (2007), Relationship of Marine Information Overlays (MIOs) to Current/Future IHO Standards, International Hydrographic Review, Vol. 8, No. 2, November 2007, p. 80-82.

Lee Alexander (2003), Marine Information Objects (MIOs) and ECDIS: Concept and Practice, U.S. Hydrographic Conference, 24-27 March 2003, Biloxi, MS.

Oh SeWoong (2014), A Study on service process and application case of Customized Marine Geospatial Information, The Hydrographic Society of Korea, June, SessionⅡ.

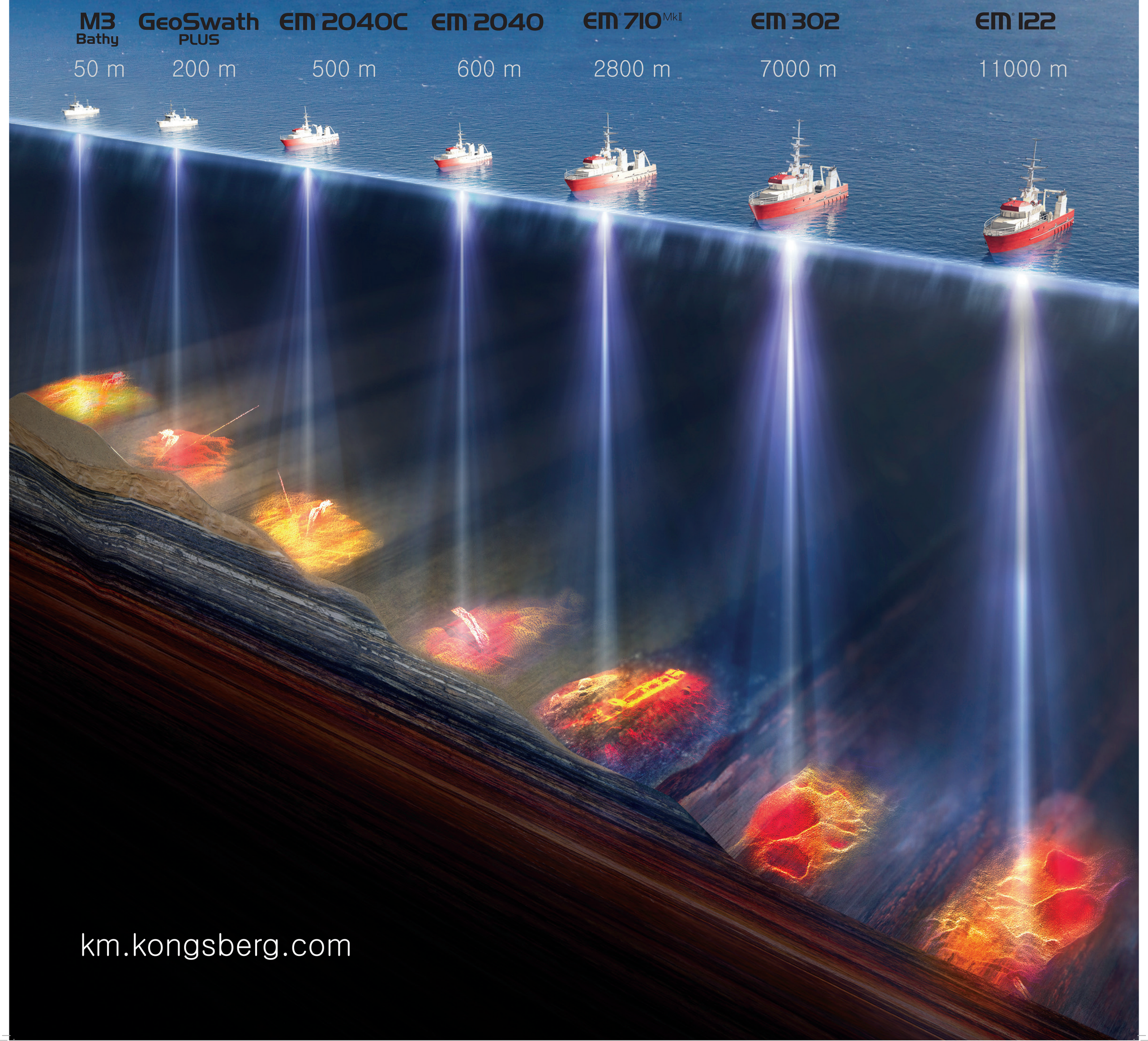
Oh SeWoong (2014), Development of Test Bed System for Customized Marine Information Services based on ENCs, The Hydrographic Society of Korea, Vol. 3, No. 2, p. 49-59.

KONGSBERG

LUCKY SUSAN
Ocean Science & Technology

MULTIBEAM ECHO SOUNDERS

THE COMPLETE MULTIBEAM ECHO SOUNDER RANGE



km.kongsberg.com

KONGSBERG

LUCKY SUSAN
Ocean Science & Technology

SUB-BOTTOM PROFILERS

EA® 400
40 ms

TOPAS PS 120
70 ms

GeoPulse Plus
106 ms

TOPAS PS 40
120 ms

TOPAS PS 18
300 ms

SBP 300
300 ms

SBP 120
300 ms

PENETRATION PERFORMANCE*

km.kongsberg.com

*performance depending on sub-surface characteristics

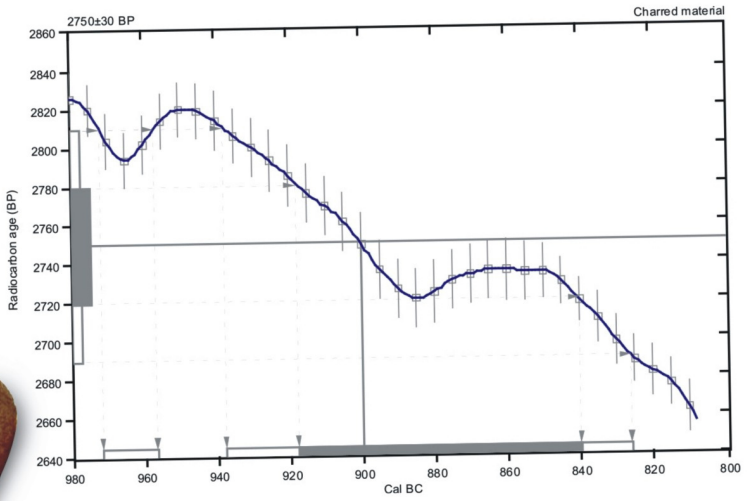
발굴 현장 즉석에서 연대측정 결과 보기

Radiocarbon Age Calibration

Laboratory number: Beta-317090

Conventional radiocarbon age: 2750±30 BP

2 Sigma calibrated results: (95% probability) Cal BC 970 to 960 (Cal BP 2920 to 2910) and Cal BC 940 to 830 (Cal BP 2890 to 2780)



- 최대 **2-3**일 만에 결과 보고
- 온라인상으로 결과보기 가능

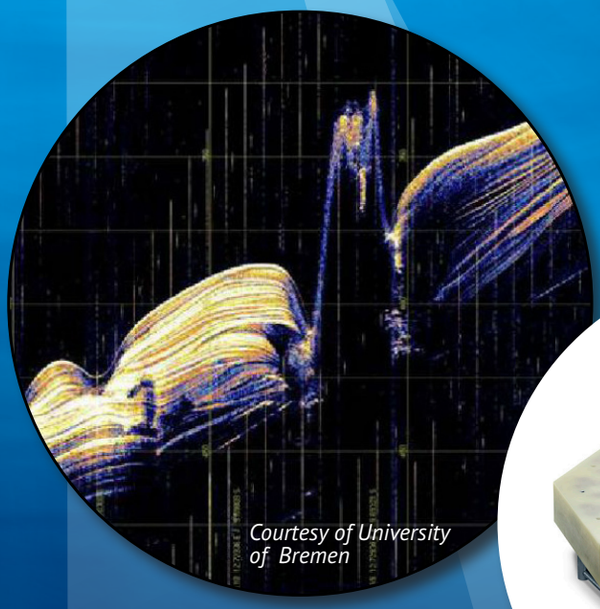
Beta Analytic Inc. 한국지사
서울시 서초구 서초동 1321-1 강남빌딩 16층
(전화) 02-2190-3725 (팩스) 02-2190-3710
(핸드폰) 010-7580-3900

BETA

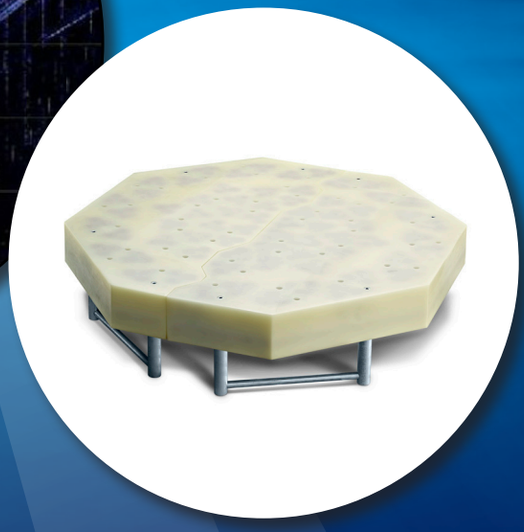
Beta Analytic
Radiocarbon Dating
www.radiocarbon.com

TELEDYNE PARASOUND VERSATILE DEEP SEA SUB-BOTTOM PROFILER

...ON BOARD OF KIOST'S NEW R/V ISABU



Courtesy of University of Bremen



TELEDYNE PARASOUND

- Efficient exploration of natural resources with recording of the entire **water column** at the same time to sediment profiling
- Max. sediment penetration >200 m with up to **70 kW transmission**
- Unique resolution, also at higher ship's speed, due to **Equidistant Multi-Ping** with up to 16 pings and optimal beam footprint coverage on the seafloor

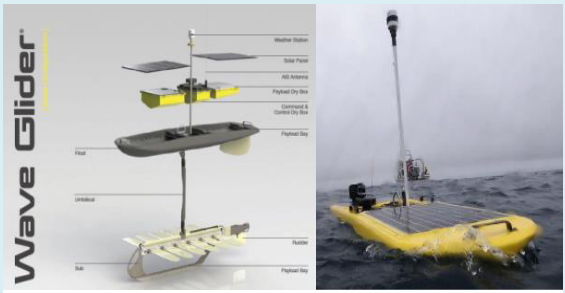
TELEDYNE
ATLAS HYDROGRAPHIC
Everywhere**you**look™
A Teledyne RESON GmbH Product Line

GeoTech System Corp.
Tel: +82 2 2068 3070
Fax: +82 2 2068 9067
E-mail: info@geotechsystem.com
Web: www.geotechsystem.com

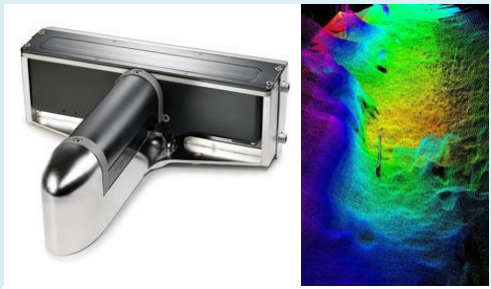
GEO TECH SYSTEM

Marine Geology System

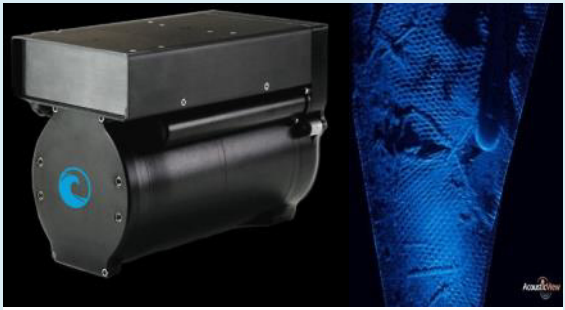
- Wave Glider
- Dual frequency Identification Sonar (DIDSON)
- Multi and Single Seismic system
- Multibeam Echo-sounder system
- Sub-Bottom Profiler
- Magnetometer



Liquid Robotics – Wave Glider



Reson – SeaBat 7125 SV2



Sound Metrics – DIDSON

Innomar – SES-2000 quattro

SIG – SIG Pulse M2 w/ Electrode

Marine Magnetics – SeaQuest

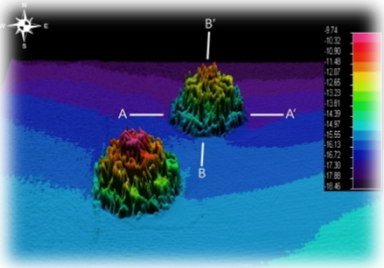
Ilshin Bldg, 214, Haengjusansung-ro, Deogyang-gu, Goyang-si, Gyeonggi-do, Korea Zip. 10440
Tel. 82 31 995 9000| Fax.82 31 995 9099
E mail : sales@oceantech.co.kr | Home : www.oceantech.co.kr

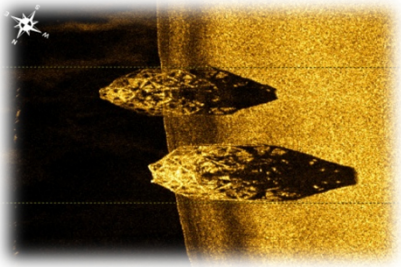
The Best Ocean Leader
Marine Survey Company

Gematek Co. Ltd.

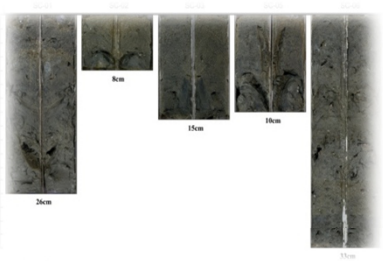
Geophysical Survey

- Multi Beam Echo Sounder
- Side Scan Sonar
- Seismic Survey





Marine Environmental Research



Geological Survey

- Sediment Sampling & Analysis
- Underwater Photography Survey(ROV)

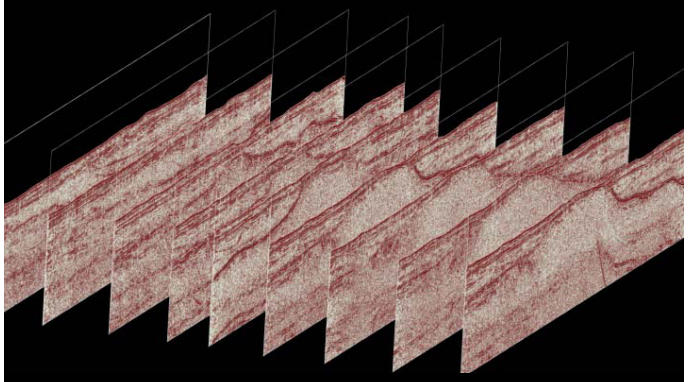
Marine Remote Sensing

- Observation Buoy / Unmanned Boat Production

WWW.GEMATEK.COM
GEO-MARINE TECHNOLOGY

(612-865) 3th F, KT Building, 1420 Jwa-dong, Haeundae-gu, Busan, Korea
Tel) +82-51-623-6229 / Tel) +82-51-623-6205
E-mail : gematek@gematek.com / Homepage: www.gematek.com

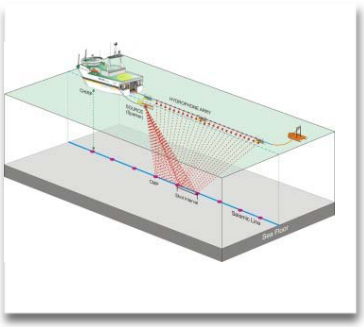
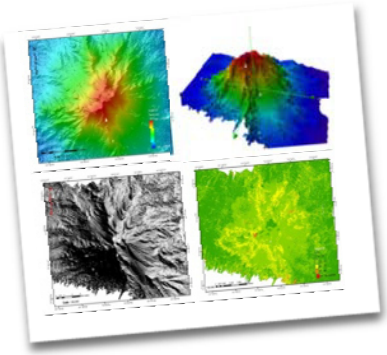
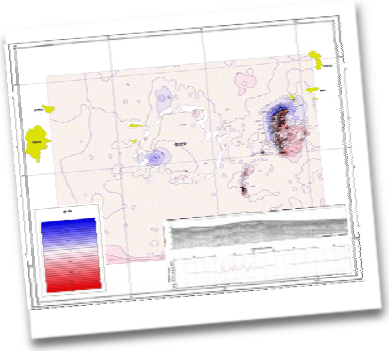
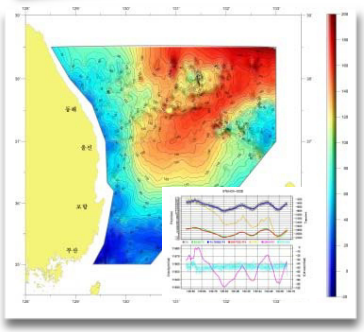
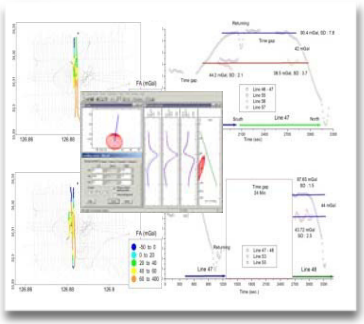
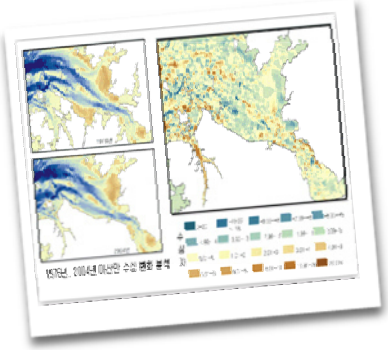
PRECISION
DYNAMIC
CREATIVE

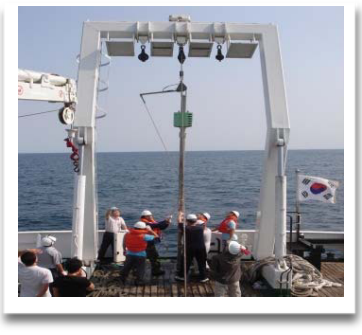


By the research

By the youth

KOREA MARINEAID Co. Ltd.



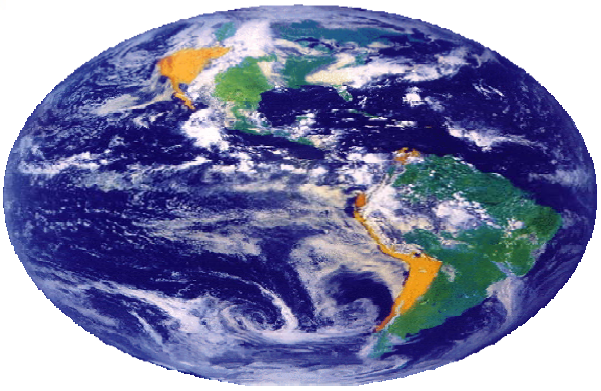
- ✓ Geophysical Survey
  - Single & Multi Channel Seismic Survey
  - Geomagnetic Survey
  - MBES Survey
- ✓ Geophysical data Processing & Interpretation
  - Gravity, Magnetic , topography , Seismic data etc.
- ✓ Marine GIS & Remote Sensing
  - Topographic change Monitoring
  - Measurement system using robot in tidal zone
- ✓ Geological Survey
  - Sediment Sampling & Analysis

www.marineaid.co.kr

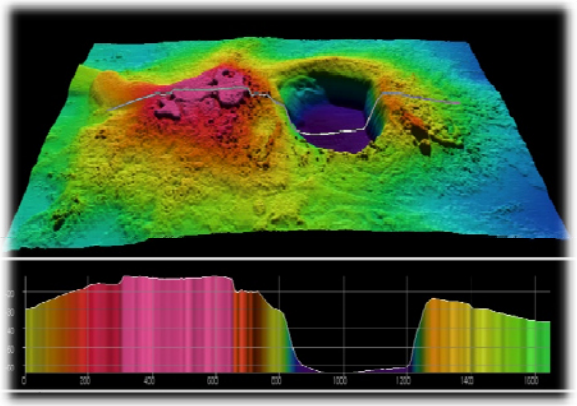
(300-812) 201, 866, Daejeon-ro, dong-gu, Daejeon, Korea

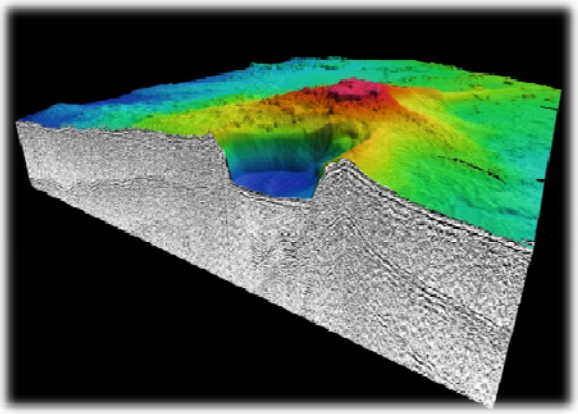
Tel) +82-42-716-7471 / Fax) +82-42-716-7470

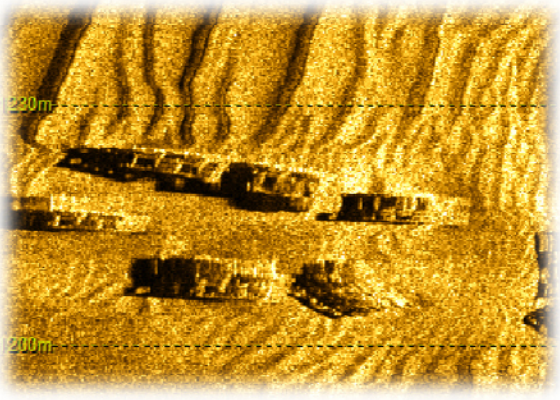
What We do

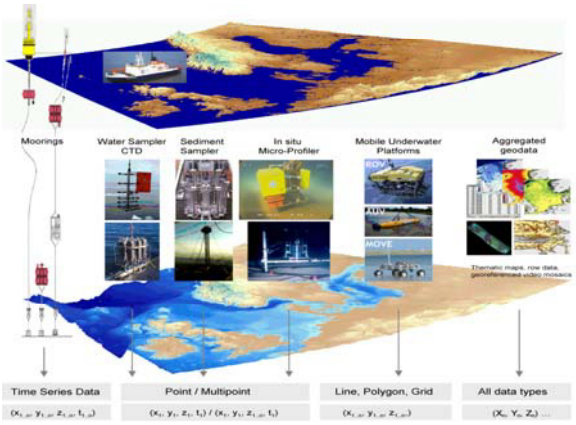


- *Marine Geophysical Survey Data Processing & Interpretation*
- *Analysis of Bathymetry & Seabed Characteristics*
- *Construction of DB & Development of DB Management sys.*









Korea Sea Bed Information KOSBI

㈜ 한국해저정보

Korea Seabed Information Inc.
Tel: +82-42-825-7535
Fax: +82-42-825-7534
Web: www.kosbi.co.kr

Innovative, Creative and Advanced Solution for Ocean Research & Development

MD System Marine Geology

HYPACK, Inc.

Hydrographic Survey Software

Coda Octopus
Sound Underwater Intelligence

Seismic Post processing Software

R2SONIC

Multibeam Echosounder

KNUDSEN

Singlebeam Echosounder

ngk ocean

Sediment Trap

OSIL

Corer Grabs

EdgeTech
An Affiliate of ORE Offshore

Sub Bottom Profiler

WÄRTSILÄ
ELAC Nautik

Deep Sea MBES

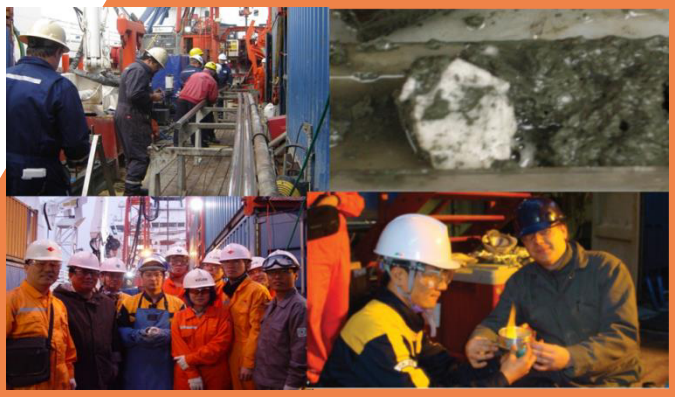
MD System Co., Ltd.
3F, 338, Banghwa-daero, Gangseo-gu, Seoul, Korea (Rep of.)
Email: sales@mdsys.co.kr / Tel: +82-2663-8567

가스하이드레이트 개발사업단
Gas Hydrate R&D Organization

MOTIE Ministry of Trade, Industry & Energy
KIGAM Korea Institute of Geoscience & Mineral Resources
KOGAS Korea Gas Corporation
KNOC Korea National Oil Corporation

Role of GHDO Coordinating and facilitating national GH Program including R&D project management, international cooperation, strategy and action plan development

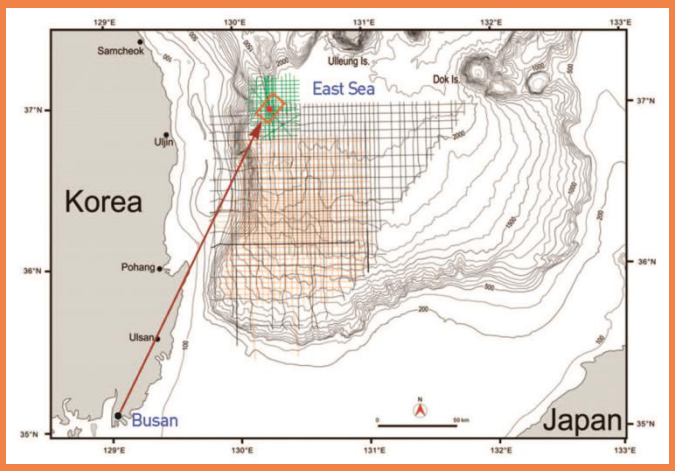
Confirmation of Gashydrate Existence in Ulleung Basin(2007)



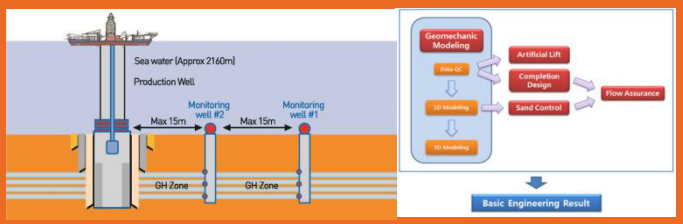
1st Ulleung Basin Gashydrate Expedition for con firmation of GH Existence (2007)

2nd Ulleung Basin Gashydrate Expedition for Resource Assess ment & selection of proposed sites for Production Test (2010)

- Result of Resource Assessment : 6.2 *10^8 ton



Site selection for GH Production Test (2013)



Preparation of GH Production Test (2014)

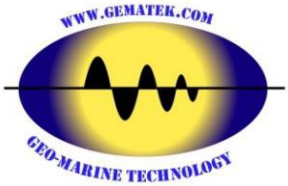
124, Gwahak-ro, Yuseong-gu, Daejeon, Korea 305-350
Tel. 82 42 868 3363 Fax . 82 42 868 3423
E-mail : arkim@gashydrate.or.kr

OECD Ministerial Meeting Daejeon 2015
World Science & Technology Forum

KIMST
한국해양과학기술진흥원

KOREA
TOURISM
ORGANIZATION

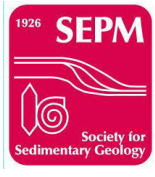
KB 마린



한국지질자원연구원
Korea Institute of Geoscience and Mineral Resources

Ministry of Science, ICT and
Future Planning

MINISTRY OF
OCEANS AND FISHERIES



Beta Analytic Inc.

KONGSBERG