The 18th International Symposium on Polar Sciences

-Milestones in Polar Research Collaboration-

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Editors

Dr. Seung-Il NAM & Dr. Jong Kuk HONG

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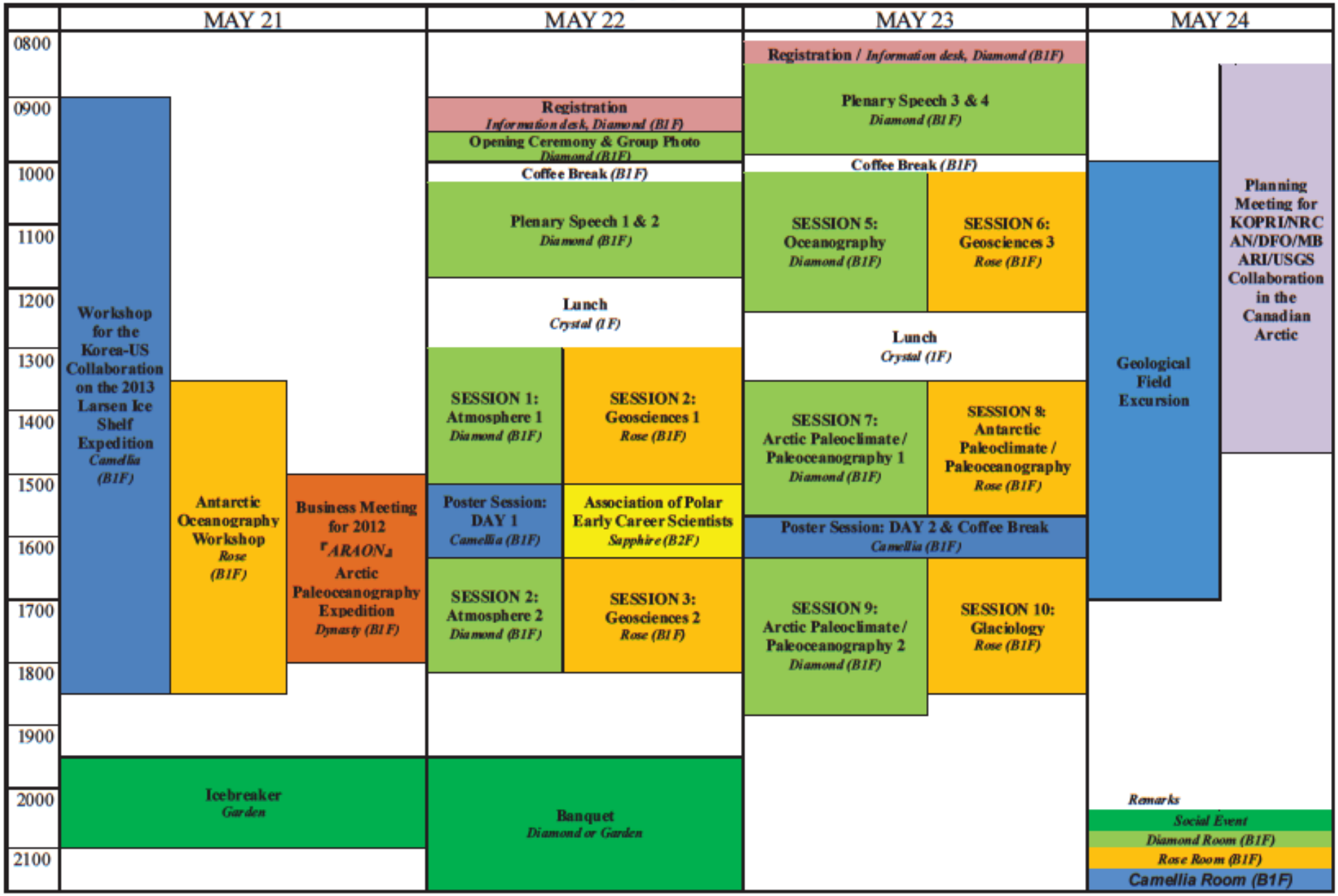
The 18th International Symposium on Polar Sciences



SYMPOSIUM PROGRAM

MAY 21 (MONDAY)

TIME	SCHEDULE
09:00-18:30	**Workshop for the Korea-US Collaboration on the 2013 Larsen Ice Shelf Expedition** *Camellia room*
13:30-18:30	**Antarctic Oceanography Workshop** *Rose room*
16:00-18:00	**Business Meeting for 2012 「ARAON」 Arctic Paleoceanography Expedition** *Dynasty room*
19:30-21:00	**Icebreaker** *Garden*

MAY 22 (TUESDAY)

TIME	SCHEDULE	
09:00-09:30	**Registration** *Information desk, Diamond room*	
09:30-09:50	**Opening Ceremony** *Diamond room*	
09:50-10:00	**Group Photo** *Diamond room*	
10:00-10:20	**Coffee Break**	
10:20-11:00	**Plenary Speech 1: Arctic Climate Change: A New Normal?** *James Overland* *NOAA, USA*	
11:00-11:40	**Plenary Speech 2: Highlights of Korean Earth Sciences Program in the Polar Regions** *Yeadong Kim* *Korea Polar Research Institute*	
11:40-13:00	**Lunch** *Crystal room*	
13:00-15:10	**ATMOSHERE 1** *Diamond room* ***Session Chair**:* *Seong-Joong Kim, Hans W. Linderholm*	**GEOSCIENCES 1** *Rose room* ***Session Chair**:* *Laura De Santis, Moon Young Choe*
13:00-13:30	Antarctic Climate Change for the Past 50 Years *Seong-Joong Kim* *Korea Polar Research Institute*	Geology of the Transantarctic Mountains: Working Models and New Opportunities *John Goodge* *University of Minnesota-Duluth, USA*
13:30-13:50	West Antarctic Sea Ice, Patagonian Tree-rings and the Antarctic Oscillation *Hans W. Linderholm* *University of Gothenburg, Sweden*	Stratigraphic Records of the Cambrian Ross Orogeny in the Northern Victoria Land: a Plan for Geological Survey in 2012-2013 Seasons *Jusun Woo* *Korea Polar Research Institute*

13:50-14:10	Is the Antarctic Oscillation Trend during the Last 50 Years Unusual? *ZiYin Zhang* *Beijing Meteorological Bureau,China*	The Italian Antarctic Program Geophysical Surveys in the Ross Sea: Past Achievements and Current Projects *Laura De Santis* *OGS, Italy*
14:10-14:30	Influence of Convective Gravity Waves in the Southern Hemisphere Polar Winter Stratosphere *Hyun-Joo Choi* *Yonsei University, Korea*	High Resolution, Localized Study in Potential Field Modeling for Antarctic Lithosphere *HyungRae Kim* *Kongju National University, Korea*
14:30-14:50	Timing of Atmospheric CO2 and Climate Change at the Onset of the Last Glacial Termination *Jinhwa Shin* *Seoul National University, Korea*	The Aeromagnetic and Aerial Photographic Surveys by an Autonomous Unmanned Aerial Vehicle, Ant-Plane 6-3 around Livingston Island, Antarctica *Minoru Funaki* *NIPR, Japan*
14:50-15:10	Southern Annular Mode (SAM) for the Last Glacial Maximum derived from PMIP2 Coupled Model Simulations *Junmei Lu* *Chinese Academy of Meteorological Sciences, China*	Magnetic Anomaly around the King Sejong Station, King George Island, Antarctica *Shinya Sakanaka* *Akita University, Japan*
15:10-16:20	**Poster Session** *Camellia room*	**Association of Polar Early Career Scientists** *Sapphire room*
16:20-18:30	**ATMOSHERE 2** *Diamond room* ***Session Chair**:* *Baek-Min Kim, Miaoni Gao*	**GEOSCIENCES 2** *Rose room* ***Session Chair**:* *Gerhard Kuhn, Ki-weon Seo*
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16:50-17:10	A Possible Explanation on the Link between Arctic Sea-Ice Loss and Stratospheric Polar Vortex *Baek-Min Kim* *Korea Polar Research Institute*	Development of New IODP Proposals for Drilling Cenozoic History Sites in the Pacific Southern Ocean *Gerhard Khun* *AWI, Germany*
17:10-17:30	Effect of Arctic Warming on the Extratropical Cold Winter *Jong-Seong Kug* *Korea Ocean Research and Development Institute*	Grace Measurements of Ice Mass Change and Ocean Tides in Polar Regions *Shin-Chan Han* *NASA, USA*
17:30-17:50	Inter-decadal Change of the Relationship between Spring Arctic Oscillation and East Asian Summer Monsoon *Miaoni Gao* *Beijing Normal University, China*	Favorable Environment for Blue Ice Area Development and its Relationship to Surface Mass Balance *Jaehyung Yu* *Chungam National University, Korea*
17:50-18:10	Altered Atmospheric Responses to Warm Pool and Cold Tongue El Ninos over the North Atlantic Region due to Stratospheric Interference *Mi-Kyung Sung* *Yonsei University, Korea*	Ice Velocity Mapping by Matching Surface Undulations Measured by ICES at Laser Altimetry *Chun-Ki Lee* *Korea Polar Research Institute*
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MAY 23 (WEDNESDAY)

TIME	SCHEDULE	
08:10-08:30	**Registration** *Information desk, Diamond room*	
08:30-09:10	**Plenary Speech 3: The Structure and Evolution of the Ross Sea** *Fred Davey* *GNS Science, New Zealand*	
09:10-09:50	**Plenary Speech 4: Paleoceanographic Research Perspectives for the Pacific Sector of the Arctic** *Leonid Polyak* *Ohio State University, USA*	
09:50-10:10	**Coffee Break**	
10:10-12:20	**OCEANOGRAPHY** *Diamond room* ***Session Chair**:* *Doshik Hahm*	**GEOSCIENCES 3** *Rose room* ***Session Chair**:* *Scott Dallimore, Young Keun Jin*
10:10-10:40	Ocean Circulation in the Canada Basin *Koji Shimada* *Tokyo University, Japan*	Canada's Arctic Geoscience Priorities *Daniel Lebel* *Geological Survey of Canada*
10:40-11:00	Korean Research Activities in King George Island and International Cooperation *In-Young Ahn* *Korea Polar Research Institute*	KOPRI Research Activities on Gas Hydrates in the Cold Seas: Antarctic, Okhotsk and Arctic Sea *Young Keun Jin* *Korea Polar Research Instutute*
11:00-11:20	Ocean Acidification in the Western Pacific Sector of the Southern Ocean *Masao Ishii* *Meteorological Research Institute, Japan*	Evidence of Methane Venting from Decomposing Permafrost and Gas Hydrate on the Shelf and Slope of the Canadian Beaufort Sea *Charles Paull* *MBARI, USA*
11:20-11:40	Coexistence of Mesopredators in an Intact Polar Ocean Ecosystem: the Basis for Defining a Ross Sea Marine Protected Area *Grant Ballard* *PROBO Conservation Science, USA*	A Framework for Korea-Canada-USA Arctic Research using the 『*ARAON*』 Research Vessel *Scott Dallimore* *Geological Survey of Canada-Pacific*
11:40-12:00	Acoustic Characterization of *Euphausia Crystallorophias* Distribution in Amundsen Sea Polynya, West Antarctica Austral Summer 2011 and 2012 *Hyoungsul La* *Korea Polar Research Institute*	The Ross Sea: Examples of Paleoclimate and Sedimentary Dynamic Studies. The Holoclip and the Rosslope Projects. *Ester Colizza* *University of Trieste, Italy*
12:00-12:20	Oceanographic Moorings as Observatories for Study Variability and Change in the Arctic Ocean *Humfrey Melling* *Institute of Ocean Science, Canada*	Observation of Submarine Tectonic Activities using Long Term Passive Ocean Bottom Seismometers in the Ross Sea, Antarctica *Won Sang Lee* *Korea Polar Research Institute*
12:20-13:30	**Lunch** *Crystal room*	

13:30-15:40	**ARCTIC PALEOCLIMATE / PALEOCEANOGRAPHY 1** *Diamond room* ***Session Chair**:* *Frank Nissen, Kyeong Ja Kim*	**ANTARCTIC PALEOCLIMATE / PALEOCEANOGRAPHY 2** *Rose room* ***Session Chair**:* *Ester Colizza, Kyu-Cheul Yoo*
13:30-14:00	An Undiscovered Ocean in a Changing World Key Areas and Scientific Approaches of the Alfred Wegener Institute to Reconstruct the Preglacial and Glacial History of the Arctic Ocean *Frank Nissen* *AWI, Germany*	Holocene Deglaciation History of King George Island as one Example for Future Changes of the West Antarctic Ice Sheet, Antarctica *Gerhard Kuhn* *AWI, Germany*
14:00-14:20	Origin of Authigenic Calcite and Aragonite in Pelagic Sediments of the Mendeleev Ridge (Arctic Ocean) and Their Implications *Kyung Sik Woo* *Kangwon National University, Korea*	Seafloor Geomorphology and Sediment Facies Distribution in the Larsen A Embayment, Northwestern Weddell Sea: Preliminary Results from 2012 LARISSA Cruise *Julia Wellner* *University of Houston, USA*
14:20-14:40	Investigation on Glacial History and Paleoceanographic Changes of the Western Arctic Ocean (Mendeleev Ridge) using Beryllium Isotopes *Kyeong Ja Kim* *Korea Institute of Geoscience and Mineral Resources*	Perseverance Drift, Joinville-D'Urville Trough, Northeastern Antarctic Peninsula *Amy Leventer* *Colgate University, USA*
14:40-15:00	Authigenic Neodymium Isotopes Recording Change In Arctic Deep Water Sources *Kwangchul Jang* *Seoul National University, Korea*	Terrestrial Exposure-age Record of Ice Sheet and Ice Shelf Change, Northeast Antarctic Peninsula *Greg Balco* *Berkeley Geochronology Center, USA*
15:00-15:20	Modern and Late Holocene Environments in the Lena river Delta Area, the Southern Laptev Sea *Alexander Matul* *P.P. Shirshov Institute of Oceanology, Russia*	Reconstruction of Paleo-seawater Temperature using Biomarker Diols in Scotia Sea, Antarctic Peninsula *Sooa Jeon* *Hanyang University, Korea*
15:20-15:40	Palynological Studies from Ny-Alesund, Svalbard: Interpreting the Late Quaternary Climate of the Arctic Region *Ratan Kar* *Birbal Sahni Institute of Palaeobotany, India*	Late Quaternary Variations in Sediment Supply in the Southern Drake Passage *Jae Il Lee* *Korea Polar Research Institute*
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16:20-18:30	**ARCTIC PALEOCLIMATE / PALEOCEANOGRAPHY 2** *Diamond room* **Session Chair:** *Rujian Wang, Boo-Keun Khim*	**GLACIOLOGY** *Rose room* ***Session Chair**:* *Shugui Hou, Sang-Bum Hong*
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16:50-17:10	Chinese Sedimentologic and Paleoceanographic Researches in the Western Arctic Ocean *Rujian Wang* *Tongji University, China*	Accumulation and its Moisture Origin over Dome Argus, Antarctica *Shugui Hou* *Nanjing University, China*

17:10-17:30	Development of Auto-imageanalysis Technique for Ice-rafted Debris on Transparent X-ray Imagery by using TATSCAN-X1 *Tats Sakamoto* *JAMSTEC, Japan*	Changes in Elemental and Pb Isotopic Compositions in EPICA Dome C Ice Core: Climatic Implication during the Past 800,000 years *Sungmin Hong* *Inha University,Korea*
17:30-17:50	Biomarkers as a Tool of Paleoenvironmental Reconstruction in the Western Arctic Ocean *Masanobu Yamamoto* *Hokkaido University, Japan*	Total Mercury Content in Inland Snow and their Implication for Mercury Dynamics in Antarctica *Yeongcheol Han* *Seoul National Univeristy, Korea*
17:50-18:10	Long-chain Alkenone and Long-chain Diols Composition in the Sediment of Western Arctic: A tool for Tracing Past Sea Surface Temperature? *Adegoke Badejo* *Hanyang University, Korea*	Isotopic Evolution of a Seasonal Snow cover and its Melt by Isotopic Exchange between Liquid Water and Ice *Jeonghoon Lee* *Korea Polar Research Institute*
18:10-18:30	Holocene Paleoceanographic Change in the Chukchi Shelf, Western Arctic Ocean *Boo-Keun Khim* *Pusan National University, Korea*	Introduction of Ice drilling technology and Development of Intermediate Ice Drill between Korea and France *Alemany Olivier* *Universite Joseph Fourier, France*
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POSTER SESSION

MAY 22 (DAY 1) *Camellia room*	
ATMOSPHERE	
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PS-A02	Tidal Deflection Characteristics of Campbell Glacier, East Antarctica, observed by Cosmo-Skymed Double-Differential Interferograms *Hyangsun Han* *Kangwon National University, Korea*
PS-A03	CO2 Flux from Tundra Lichen, Moss, and Tussock, Council, Alaska: Assessment of Spatial Representativeness *Yongwon Kim* *International Arctic Research Center, USA*
PS-A04	Effects of Cloud Amounts and Snow Cover on Surface UV Irradiance at King Sejong Station, Antarctica *Yun Gon Lee* *Seoul National University, Korea*
PS-A05	Decadal Changes in Surface Air Temperature Variability and Cold Surge Characteristics over Northeast Asia and their Relation with Arctic Oscillation for the Past Three Decades (1979-2011) *Sung-Ho Woo* *Korea Ocean Research & Development Institute*
PS-A06	Impact of Sea Surface Temperature at Sea Ice Changed Region on Winter Arctic Climate in the AGCM Experiment *Sang-Yoon Jun* *Seoul National University, Korea*
OCEANOGRAPHY	
PS-O01	Sea Surface Height, Ocean Dynamic Topography, and Ocean Tides in the Chukchi Borderland Using Sea Ice-Based High-Precision GPS Observations *Pedro Elosegui* *Institute for Space Science and Marine Technology Unit, Spain*
PS-O02	Real-Time Photoprotective Response of Xanthophyll Pigments and Mycosporine-Like Amino Acids of Porosira Glacialis (Bacillariophyceae) *Sun-Yong Ha* *Hanyang University, Korea*
PS-O03	Spatial Variability of Do2/Ar in the Amundsen Sea, Antarctica *Doshik Ham* *Korea Polar Research Institute*
PS-O04	Circulation and Water Mass Distribution on the Larsen A Continental Shelf: Preliminary Results from Larissa Cruise NBP1203 *Bruce Huber* *The LARISSA science team*
PS-O05	Geographical Distribution of Krill in Amundsen Sea, Antarctic Ocean, 2011 and 2012 *Hyungbeen Lee* *Korea Ocean Research & Development Institute*

PS-O06	Structure and Distribution of Phytoplankton Communities during Summer Season in Arctic Sea, 2011 *Hyoung Min Joo* *Korea Polar Research Institute*
PS-O07	Macromolecular Production of Phytoplankton in the Northern Bering Sea in 2007 *Huitae Joo* *Pusan National University, Korea*
PS-O08	A Study of Phytoplankton from the Chukchi Sea to the Canada Basin in the Arctic Ocean, 2010 *Bokyung Kim* *Pusan National University, Korea*
PS-O09	Phytoplankton Study in Melt Ponds and Open Sea of the Arctic Ocean, 2011 *Bokyung Kim* *Pusan National University, Korea*
PS-O10	Variability in Pacific-Origin Summer Water in the Chukchi Borderland, Arctic Ocean *Tae Wan Kim* *Korea Polar Research Institute*
PS-O11	Bio-Optical Properties in Amundsen Sea, Antarctica *Hyun-Cheol Kim* *Korea Polar Research Institute*
PS-O12	A Hindcast Simulation of Arctic Sea Ice Variability during the Period from 1990 to 2009 *Mi Ok Kwon* *Korea Maritime University*
PS-O13	Measurement of Suspended Particulate Matter under the Sea Ice, Arctic Ocean: *Hyunjung Lee* *Korea Polar Research Institute*
PS-O14	Climate Warming Creates New Ice Algal Habitat in the Arctic Ocean *Sang Lee* *Pusan National University, Korea*
PS-O15	Melt Pond Production in the Arctic Ocean *Sang Lee* *Pusan National University, Korea*
PS-O16	Carbon Monoxide Emissions from the Southern Ocean estimated by Underway Measurements *Keyhong Rhee* *Korea Polar Research Institute*
PS-O17	Unique Procaryotic Communities of Polynya in the Amundsen Sea, Antarctic revealed by 454 Pyrosequencing *Sung Keun Rhee* *Chungbuk National University, Korea*
PS-O18	Distribution of Nutrients and Chl A in Prydz Bay during the Austral Summer of 2011 *Wei-Ping Sun* *State Oceanic Administration, China*
PS-O19	Isotopic Shift in the Antarctic Limpet Nacella Concinna from Rocky Coastal habitats, Marian Cove, King George Island *Eun Jung Choy* *Korea Polar Research Institute*
PS-O20	Long-Lived Greenhouse Gases (Co2, Ch4, And N2O) In the Amundsen Sea at Austral Summer Season of 2011 and 2012 *Tae Siek Rhee* *Korea Polar Research Institute*

PS-O21	Onboard Experiments of Photochemical Production and Microbial Consumption of Carbon Monoxide and Molecular Hydrogen during the Amundsen Sea Expedition *Young-Shin Kwon* *Korea Polar Research Institute*
PS-O22	Inorganic Carbon System and Controls in the Chukchi Sea of the Arctic Ocean Observed for Two Years *Hyunduck Jeon* *Korea Polar Research Institute*
PS-O23	Synthesis of Natural Iron Fertilization in the southern Scotia Sea and thoughts on future studies *Meng Zhou* *University of Massachusetts Boston*
BIOLOGY	
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PS-B02	Mesozooplankton Assemblages in Summer 2010 in the Western Arctic Ocean *HANS-U. Dahms* *Sangmyung University, Korea*

MAY 23 (DAY 2) *Camellia room*	
GEOSCIENCES	
PS-GS01	Estimates of Ice Loss in Greenland from Gravity Satellite Data *Jooyoung Eom* *Korea Polar Research Institute*
PS-GS02	Bathymetry of the Amundsen Sea in West Antarctica Derived from the Multibeam Data on IBRV 『*ARAON*』 *Hyoung-Jun Kim* *Korea Polar Research Institute*
PS-GS03	Study of Reduction/Advancement of Amery and Ross Ice Shelves from 1988 to 2003 *Yong Hwi Kim* *Chungam National University, Korea*
PS-GS04	Ground Penetrating Radar Investigation of Sea Ice *Joohan Lee* *Korea Polar Research Institute*
PS-GS05	P-Wave Velocity Structure beneath the Northern Antarctic Peninsula: Implications to a Steeply Subducting Slab and a Deep-Rooted Low-Velocity Anomaly *Yongcheol Park* *Korea Polar Research Institute*
PS-GS06	Integrated Monitoring System for David Glacier and Study on the Glacier Evolution *Ki-Weon Seo* *Korea Polar Research Institute*
PS-GS07	Design and Implementation of Seismic Statioins for Remote Autonomous Antarctic Observations *Dongseob Shin* *Korea Polar Research Institute*
GLACIOLOGY	
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PS-G02	Single Particle Mineralogy of Aeolian Dust in the East Rongbuk Ice Core from Mt. Qomolangma (Everest) *Heejin Hwang* *Korea Polar Research Institute*
PS-G03	Persistent Organic Pollutants in Dome A, Antarctica *Jung-Ho Kang* *Korea Polar Research Institute*
PS-G04	Rare Earth Element Cycling in the Pore Waters of the Bering Sea Slope (IODP Exp. 323) *Tseren-Ochir Soyol-Erdene* *Seoul National University, Korea*
PS-G05	Investigation into CO_2 Diffusion in Polar Ice from Siple Dome Core, Antarctica *Jiwoong Yang* *Seoul National University, Korea*

ARCTIC / ANTARCTIC PALEOCLIMATE / PALEOCEANOGRAPHY

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PS-AP02	Provenance Discrimination in Arctic Ocean Surface Sediments constrained by Quantitative Mineralogical Analyses *Evgenia Bazhenova* *AWI, Germany*
PS-AP03	Seasonal Variability of Central Arctic Ocean Sea-Ice Cover: New Biomarker (Ip25 and Pip25) Data from Sediment Traps deployed on Southern Lomonosov Ridge *Kirsten Fahl* *AWI, Germany*
PS-AP04	The Sedimentary Record of Organic-Walled Dinoflagellate Cysts as Indicators of Paleoceanographic Changes across the Chukchi Borderland and Southern Mendeleev Ridge in the Western Arctic Ocean *So-Young Kim* *Korea Polar Research Institute*
PS-AP05	Changes of Sea Ice and Surface Water Temperature in the Bering Sea during Deglacial to Holocene Times: Evidence from IP25 and Alkenone Data *Marie Meheust* *AWI, Germany*
PS-AP06	Reconstruction of Paleoenvironmental Changes based on GDGT-Proxies from the Chukchi-Alaska Margin during the Holocene *Yu-Hyeon Park* *Hokkaido University, Japan*
PS-AP07	The Next Phase of Scientific Drilling in the Arctic Ocean: Key Objectives, Areas, and Strategies *Ruediger Stein* *AWI, Germany*
PS-AP08	Modern Spatial Variability of Sea Ice Cover and Terrigenous Input in the Kara and Laptev Seas: Reconstruction from New Biomarker Data Determined in Surface Sediments *Xiaotong Xiao* *AWI, Germany*
PS-AP09	Stable Oxygen and Carbon Isotopes from the Planktonic Foraminifera *Neogloboquadrina pachyderma* in Western Arctic Surface Sediments *Wenshen Xiao* *Tongji University, China*

PS-AP10	Manganese Content Cycles in Arctic Ocean and Bering Sea Sediments *Xin Xie* *Tongji University, China*
PS-AP11	New Sedimentological and Mineralogical Records from Mendeleev Ridge: Implications for Reconstruction of Late Quaternary History of Circum-Arctic Ice Sheets and Arctic Ocean Paleoceanographic Circulation *Hao Zou* *AWI, Germany*
PS-AP12	Biogenic Silica Recycling in Surface Sediments of Prydz Bay, Antarctica *Chuanyu Hu* *State Oceanic Administration, China*
PS-AP13	Weathering in South Patagonian Rivers : A Combined Approach of Major Ions, U-Series and 10Be Isotopes Methods *Borom Lee* *Seoul National University, Korea*
PS-AP14	Holocene Oceanographic Record from Outer Barilari Bay, Western Antarctic Peninsula: Insights From Diatoms *Amy Leventer* *Colgate University, USA*
PS-AP15	Preliminary Results of Sedimentological Analyses of Gravity Cores and High-resolution Sub-bottom Profiles from the Chukchi Sea, the Western Arctic Ocean *S.H. Yoon* *Jeju National University, Korea*
PS-AP16	High Resolution Study for Geochemical Proxies in North Atlantic Ocean: Implications for Paleoceanographic Evolution *Sangmin Hyun* *Korea Ocean Reaearch & Development Institute*
BIOLOGY	
PS-B03	Effect of Temperature Gradient on the Microbial Extremophiles Morphology and Biofilm Formation in a Microfluidic Channel *Aeri Park* *Chungnam National University, Korea*
PS-B04	Conservation Status of Moss Species in the Admiralty Bay Area, King George Island, Antarctica *Filipe Victoria* *National Institute of Science and Techonology Antarctic for Enviromental Research, Brazil*

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DAY 2: MAY 23rd

PLENARY SPEECH

ARCTIC CLIMATE CHANGE: A NEW NORMAL?

James E. Overland

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ABSTRACT

The Arctic is showing large visible changes over the last decade, which are indicators of shifts in regional and global feedback processes. Of principal importance is "Arctic Amplification" where surface temperatures in the Arctic are increasing more than twice as fast as elsewhere in the world. Arctic changes are also occurring faster than suggested by coupled air-sea-ice climate models. While at the time it was unclear whether the record sea ice minimum in 2007 was an extreme outlier or not, every year since then (2008-2011) has a lower September extent than years before 2007. The amount of old, thick multi-year sea ice in the Arctic has decreased by 42% from 2004 through 2008. Sea ice has become more mobile. The Arctic is likely moving toward a new state where it is dominated by first year sea ice processes, and has lost some of the multi-year memory associated with old, thick sea ice. Evidence continues to accumulate that systematic changes are occurring in the Arctic including early spring snow melt, increased shrubbiness in tundra regions, changes in permafrost, increased forest fires, increased ocean temperatures, and changes in ecosystems. These changes can no longer be associated solely with the dominant climate variability patterns such as the Arctic Oscillation or Pacific North American pattern. Enhanced heat storage in the sea-ice free regions of the Arctic Ocean, return of this heat to the atmosphere in the following autumn, and modified wind patterns form positive feedbacks. Added heat to the lower atmosphere generates storms in newly sea ice free areas and has possible increased linkages with southern locations. Scientific progress requires sustained decadal observations.

HIGHLIGHTS OF KOREAN EARTH SCIENCES PROGRAM IN THE POLAR REGIONS

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ABSTRACT

Korea is the 33rd signatory of the Antarctic Treaty and its Consultative Party. Also Korea is a member of Scientific Committee on Antarctic Research (SCAR) and the International Arctic Science Committee (IASC). Polar research is conducted through Korean Arctic and Antarctic Research Program (KAARP) that is a nationally supported science program to enhance and expand knowledge of the both Polar Regions. Korea Polar Research Institute (KOPRI) is the operating agency of KAARP under the guidance of Korean National Committee on Polar Research (KONPOR) and has full responsibility for the national polar program.

Korean polar program is dated back to 1988 when King Sejong Station was built in King George Island, Antarctica. Since then King Sejong has been manned all the time to make observation and provide logistic support to field scientists. Research has been conducted in various fields mainly in the northern Antarctic Peninsula and earth science is one of the most studied discipline. Research cruise has been carried out during the Austral summer season in Drake Passage, Bransfield Strait and the northwestern part of the Weddell Sea. The on-going program in the Antarctic Peninsula includes researches on meteorology and geology of the Antarctic Ocean and northern Antarctic Peninsula. These multidisciplinary studies are intended to enhance understanding of environmental changes of the Antarctic Peninsula, the most sensitive area to climate change in Antarctica.

Arctic station, Dasan, was installed at Ny-Ålesund, Svalbard in 2002. The station mainly supports scientists working in atmospheric and life sciences. Only 1,200 km from the North Pole Ny-Ålesund is the world's northernmost permanent settlement and a modern research centre with facilities and infrastructure of a high standard.

Global environmental study including climate change is one of the main focuses of Korean research activities in the Polar Regions. It is well known that global change is highlighted and its history is best kept in the high latitude. Paleoceanography is studied with cores from the offshore Antarctic Peninsula, Svalbard fjord and even Barents Sea in the Arctic. Ice cores from poles as well as high altitude mountains are also analyzed to see the variation of atmospheric contents through geologic times.

International collaboration is one of the vital parts of Korean polar program. KOPRI actively involves in various international organizations and research programs and bilateral cooperation is also quite encouraged as well. As preparing to expand its role in international polar community, KOPRI launched a new icebreaker, ‘Araon’ in 2009 and plans to build the second station, ‘ Jang Bogo’ in the Antarctic by 2014. The

Jang Bogo Station will be located in Terra Nova Bay that is at the boundary between East and West Antarctica. This position will allow comparative studies on climate change of both regions, filling the knowledge gap on the West Antarctic region caused by its limited accessibility. In close collaboration with the King Sejong Station the Jang Bogo Station will form West Antarctic Observatory Network using the icebreaker Araon. During the last three Austral seasons meteorite search and preliminary shallow ice coring were conducted and seismic network including OBS mooring was installed in the Terra Nova Bay area. Detailed seafloor mapping around the Franklin Island that locates on the extensional axis of the Victoria Land Basin was done to delineate the extension related seafloor morphology. Meteorology, GPS and seismic observing stations were installed on the Drygalski Ice Tongue and David Glacier to observe the movement and changes of Antarctic glacier in the light of global changes.

KOPRI will expand its earth science program especially in the fields of geophysics, paleooceanography and meteorology focused in Terra Nova Bay and the western Ross Sea. Once it is established Jang Bogo Station will serve as a hub to move into the interior of the Antarctic and to conduct oceanographic research in the Ross Sea and the Pacific part of the Southern Ocean.

SESSION Ⅰ

ATMOSHPERE 1

ANTARCTIC CLIMATE CHANGE FOR THE PAST 50 YEARS

Seong-Joong Kim[1], Heysun Choi, Baek-Min Ki[1]

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ABSTRACT

The Antarctic climate change for the past 50 years has been analyzed using station based data. Since the year 1957, the Antarctic surface temperature has shown a substantial warming in the Antarctic Peninsula (AP), especially in austral fall and winter seasons when the warming trends exceeds 0.8°C/decade. On the other hand, there is little temperature change in east Antarctica (EA) and even a slight cooling trend is observed in austral fall season. The surface cooling is especially large in the Weddell Sea sector in all seasons. The marked warming in the AP and slight cooling in the EA is more pronounced after 1979 and is overall consistent with the increase (decrease) in sea surface temperature (sea ice extent) around west Antarctica and decrease (increase) in sea surface temperature (sea ice extent) around east Antarctica. In austral summer and fall, the marked warming in the AP and slight cooling in EA since 1979 has been attributed primarily to the increase in the Southern Annular Mode (SAM) polarity and secondarily to the increase El Nino-Southern Oscillation (ENSO) mode. The marked warming in the AP also occurs in austral winter and spring in consistent with the surface ocean warming associated with sea ice reduction. However, in these seasons, the change in the SAM and/or ENSO appears to contribute to the surface cooling in the AP rather than warming found in the observation. In austral winter and spring after 1979, factors influencing the surface ocean properties such as the ocean circulation change and local air-sea interactions are more important than the large-scale atmosphere circulation in warming the AP.

WEST ANTARCTIC SEA ICE, PATAGONIAN TREE-RINGS AND THE ANTARCTIC OSCILLATION

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ABSTRACT

The Antarctic Oscillation (AAO) is the dominant pattern of atmospheric circulation variability south of 20°S, distinguished by pressure anomalies of opposite signs over the Antarctic and at around 40-50°S. The AAO plays an important role in large-scale and regional climate changes across the Southern Hemisphere. Recent research has shown that its northern counterpart, the Arctic oscillation (AO), is linked to changes in the extent of Arctic sea-ice. Here we present some preliminary results of an investigation of the possible link between sea-ice variability in West Antarctica, and how it is related to the AAO. Moreover, we explore the possibility to use tree-ring data from Patagonia, the land area outside Antarctica closest to this region, to assess this association back beyond the short observational records. The suitability of using tree-rings to reconstruct the atmospheric circulation, e.g. the AAO, has previously been demonstrated. Our results indicate that 1) strong associations between the AAO and temperature and precipitation are found over the Antarctic peninsula and Patagonia, both in the Austral summer (when the trees grow) and winter. The associations change over the year, yielding a dipole pattern in summer. 2) Focusing on Austral summer, there is a strong link between the AAO and sea-ice concentrations off the Antarctic peninsula, notably in the Weddell Sea. Furthermore, Patagonian summer climate (temperature and precipitation) is linked to Antarctic sea-ice concentrations, especially in the Weddell Sea. Our preliminary results do indeed suggest that tree-ring data from Patagonia can provide means to assess the association between Arctic sea-ice variability and the AAO in the past.

IS THE ANTARCTIC OSCILLATION TREND DURING THE LAST 50 YEARS UNUSUAL?

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ABSTRACT

The Antarctic Oscillation (AAO) has been characterized by an intense strengthening trend in austral summer (December-January-February, DJF) during the last fifty years. Thus, the question has arisen of whether the persistent positive trend of the DJF AAO is unprecedented. To understand this issue, the trends of DJF AAO in the historical period were investigated using five reconstructed AAO series based on sea level pressure records or multiple proxies and covering the past 150 and 500 years respectively. The results show that similar or stronger strengthening trends of DJF AAO have occurred many times in history, indicating that the intense positive trend of the DJF AAO during the last five decades is not abnormal from a long-term perspective. Furthermore, an attribution analysis for the positive trend of DJF AAO during the 1970–1998 period was conducted using three multiple model ensembles derived from the 20C3M and PICTL simulations projected in IPCC AR4. The results suggest that the ozone depletion over Antarctica and global warming may play the most important roles in the strengthening trend and that natural variability also exerts a considerable influence on this positive trend. Within the context of global warming, a stronger positive trend of AAO activity may appear in the future if it is enhanced by intense natural variability, or it could even exhibit an unprecedented strengthening trend.

INFLUENCE OF CONVECTIVE GRAVITY WAVES IN THE SOUTHERN HEMISPHERE POLAR WINTER STRATOSPHERE

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ABSTRACT

Cold pole and strong polar vortex in the southern hemisphere (SH) winter stratosphere are the long-lasting problem in most general circulation models (GCMs). Recent studies show that this problem is related to the underestimated model wave drag in the SH winter extratropical stratosphere, especially by underestimated or missing gravity wave drag (GWD) parameterization in the SH. Convective GWD is one of the major missing GWDs in most current GCMs that could significantly influence on the temperature and polar vortex in the SH winter stratosphere. Cumulus convection is strong in the storm track regions of the winter extratropics as well as in the tropics, and thus convectively induced gravity waves provide substantial GWD in the SH winter stratosphere. The non-orographic GWD parameterizations that do not consider specific sources may not realistically represent the GWD in those specific regions. In this study, we use the Whole Atmosphere Community Climate Model (WACCM) and show that the temperature and wind biases in the SH winter stratosphere of the model in the July climatology are significantly alleviated by including two convective gravity wave drag (GWDC) parameterizations (a columnar scheme and a ray-based scheme). The reduction in the wind biases is due to directly the addition of GWDC in the SH midlatitudes and indirectly the enhanced resolved wave drag in response to GWDC. The cold temperature biases are alleviated by increased downwelling in the SH winter polar regions, which stems from an increased poleward motion due to the enhanced wave drag.

TIMING OF ATMOSPHERIC CO_2 AND CLIMATE CHANGE AT THE ONSET OF THE LAST GLACIAL TERMINATION

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ABSTRACT

Deciphering exact nature of atmospheric CO_2 and climate is very important for better understanding future climate. Ice cores provide unique archives for ancient air and reveal that atmospheric CO_2 is strongly correlated with Antarctic temperature. However, the exact link and control mechanisms are not well understood. Especially, CO_2 variations during the glacial-interglacial cycle cycles remains poorly understood. One of the most important target ages for the glacial-interglacial climate studies is the onset of the last glacial termination because that time interval is crucial for understanding glacial-interglacial climate cycles. Previous ice core studies showed slight or no time lag of CO_2 rise after Antarctic temperature rise. However, those results are not robust because of improper selection of ice cores, and insufficient resolution, precision and/or chronology of CO_2 records. Here we present preliminary CO_2 records from Siple Dome core, Antarctica. We take advantage from state-of-art analytical facilities at both Oregon State University and Seoul National University. The ice samples were shared in both universities and we found that the CO_2 results of the both institutions agree well within analytical uncertainty. Our results show CO_2, CH_4 and Antarctic temperature started to rise simultaneously at the onset of the last termination. The results may provide a better constraint for carbon cycle-climate modeling.

SOUTHERN ANNULAR MODE (SAM) FOR THE LAST GLACIAL MAXIMUM DERIVED FROM PMIP2 COUPLED MODEL SIMULATIONS

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ABSTRACT

The increasing trend of the Southern Annular Mode (SAM) or Antarctic Oscillation in recent decades has influenced the climate change in the southern and northern 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 HadCM3M2, IPSL, FGOALS, CCSM, 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, whereas in MIROC the SAM variability appears to be slightly larger in the LGM. 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.

Upward-propagating stationary Rossby waves are found to be stronger during the LGM than in the preindustrial simulation. This increase in planetary wave activity might be responsible for the simulated weakening of the SAM during the LGM.

SESSION II

GEOSCIENCES 1

GEOLOGY OF THE TRANSANTARCTIC MOUNTAINS: WORKING MODELS AND NEW OPPORTUNITIES

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ABSTRACT

The Transantarctic Mountains (TAM), one of Earth's great mountain belts, are a fundamental physiographic feature of Antarctica. They are continental-scale, cross many latitudes, have high relief, expose much of the continent's geology, and form a major transition in many natural and geologic features, including lithosphere structure and evolution between Precambrian and Mesozoic time; secular change in Paleozoic-Mesozoic climate and biota; uplift and erosion history; influence on ice-sheet development; surface processes and environments; climate and weather systems from Neogene to present-day; glacial history and dynamics of East and West Antarctic ice sheets; and gradients in modern biodiversity and biogeochemical processes. The TAM provide a cryptic record of supercontinent history during the late Neoproterozoic and early Paleozoic transformation from Rodinia to Gondwana. They also provide a unique record of Gondwana-wide sedimentation, large igneous province magmatism, Mesozoic and Cenozoic uplift histories, and Neogene volcanism, rifting and landscape evolution. Thus, the TAM have both continental and global importance through time.

Important questions to be addressed by future research include: (1)What is the ancient history of crystalline basement along the TAM margin, what can we learn about ice-covered areas, and how does it correlate with former conjugate cratons? (2)What did the Neoproterozoic rift margin look like, what was its conjugate, and how did its geometry control later tectonic events? (3)How did early Paleozoic magmatism vary in time and space along the Ross Orogen? Does it reflect an interplay between intra-arc extension and compression? When did magmatism start and by what petrogenetic process? (4) What can Neoproterozoic, lower Paleozoic and Mesozoic sediment provenance tell us about age, transport pathways, and sources of deposition? (5)What paleoenvironmental clues are found in Beacon Supergroup sediments, and what does sediment deposition and chemical composition say about late Paleozoic and Mesozoic paleoclimate? (6) How far-traveled are Ferrar magmas, and what do their differentiation trends tell us about crystallization process? (7)How does the Cenozoic denudation history relate to tectonic and glacial process? (8)What do Neogene sediment deposition and landscape evolution tell us about growth and stability of the East Antarctic ice sheet? A critical need in TAM geology is a broader database of precise geochronology in order to make progress in crustal evolution of the basement terrains, sources of sediment,

STRATIGRAPHIC RECORDS OF THE CAMBRIAN ROSS OROGENY IN THE NORTHERN VICTORIA LAND: A PLAN FOR GEOLOGICAL SURVEY IN 2012-2013 SEASON

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ABSTRACT

Cambrian Ross Orogeny is one of the major tectonic events shaping Antarctic geology. It started in the Middle Cambrian and ended in the Ordovician. It was related to the subduction of paleo-Pacific plate beneath the Antarctic margin of the Gondwana land. Modes and timing of tectonic deformation, related changes in sediment supply, and geological features are variable along the Transantarctic Mountains. In the northern Victoria Land, in the course of the orogeny, three different terranes were accreted. Wilson Terrane is characterized by metasedimentary complexes with varying metamorphic degree. Thick succession of sediment was deposited in the Bowers and Robertson Bay terranes and recorded the history of the accretion. In the austral summer of 2012-2013, the bowers terrane in the Lanterman range will be a target area of the KOPRI geology team. The trilobites from the Spurs Formation will provide a framework for the stratigraphy of the area. Dating of the volcanic in the lower part (Sledgers Group) will be attacked for the chronostratigraphic guidelines. Detrital zircons from the systematic samples of the sandstones will be used to display stratigraphic changes in the sediment province. Samples for stable isotope from carbonate interbeds will be collected to use as environmental proxy and for chemostratigraphic marker. All the mentioned data will give a new framework to revise spatio-temporal relationship among lithologic units in the Northern Victoria Land formed in the Ross Orogeny.

THE ITALIAN ANTARCTIC PROGRAM GEOPHYSICAL SURVEYS IN THE ROSS SEA: PAST ACHIEVEMENTS AND CURRENT PROJECTS

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ABSTRACT

Italy collected about 12.000 km of geophysical data from the Ross Sea since 1988 in the frame of the National Program for Antarctic Research (PNRA).
The data are mainly multichannel reflection seismic, gravity and magnetic data over the continental shelf and slope, and were collected with the aim to provide insights for reconstructing the tectonic evolution of the Ross Sea and of the Antarctic Ice Sheet dynamics in this sector.

The Italian PNRA geophysical data were integrated with those from other countries to publish a set of contour depth and isopach maps of main unconformities and seismic sequences (Brancolini et al.,1995), in the frame of the ANTOSTRAT/SCAR program.
Age and environmental constraint of the seismic sequences was provided by DSDP leg 28 (Hayes and Frakes, 1975) and by CIROS-1 drill sites (Barrett et al., 1989). Cape Roberts (2001) and ANDRILL (Naish et al.,2009) drill sites allowed later to refine and revise the interpretation of the seismic sequences in the western Ross Sea, along the Victoria Land coast.

The ANTOSTRAT maps represented a step forward in the knowledge of the West Antarctic Ice Sheet evolution and of the Ross Sea Cenozoic structural dynamics. The distribution of the glacial facies and the change in geometry of the basins and highs through time documented that ice caps nucleating from subaerially-elevated basement horst blocks in central Ross Sea and advanced across shallow-marine platforms rimming the broad basement-uplifts, in the late Oligocene. Ice cap advance and retreat continued during the early and middle Miocene, delivering sediment to the intervening deep-water basins. Following a significant ice cap retreat in the Middle Miocene Climatic Optimum, Antarctic glaciation re-intensified during the later part of the middle Miocene and late Miocene as local ice caps coalesced and grounded ice eventually advanced across a continental shelf in the Ross Sea. As a consequence of widespread and progressive glacial erosion, the shelf overdeepened in the latest Miocene/earliest Pliocene (De Santis et al., 1995; De Santis et al., 1999).

Geophysical crustal studies that integrated multichannel seismic and gravity

data, provided indication about the deep structure of the Ross Sea down to the Moho (Coren et al., 1994), and through kinematic modelling unravel the role of pre-existing geological structure in the evolution of the Cenozoic rift (Busetti et al., 1999).
An integrated study of onshore and offshore geology of the Ross Sea region reveal that Cenozoic dextral intraplate shearing has affected the Ross Sea along NW–SE dextral fault systems, across the continental lithosphere of Victoria Land (Salvini et al. 1997; Rossetti et al. 2003, 2006). This tectonic regime overprinted an older Mesozoic extensional event, responsible for formation of N-S basins in the Ross Sea. The Cenozoic tectonic phase is interpreted as responsible for the post 32 Ma transition from orthogonal to oblique rifting in the western Ross Sea (Salvini et al. 1997), and for magma production and emplacement of the Cenozoic McMurdo Magmatic Province along the western Ross Sea shoulder (Salvini et al. 1997; Rocchi et al. 2002).
Cenozoic volcanoes develop at the intersections of the NW-SE and the major N-S faults. The NW-SE faults cut almost continually from the Ross Sea to East Antarctica through lithospheric sectors with different rheology and thickness. At least two of the NW-SE faults correspond to older Paleozoic terrane boundaries in northern Victoria Land. The NW-SE faults link in the Southern Ocean with major transform faults related to the plate motions of Australia, New Zealand, and Antarctica. Tectonic lineaments possibly connected to the Victoria Land intraplate system and with the Southern Ocean transform faults are observed in the George V Land continental shelf (De Santis et al., 2010).

Close-spaced grids of high resolution single and multichannel reflection seismic data combined with multibeam surveys were recently collected by PNRA along the Victoria Land cost and near the eastern Ross Sea shelf margin, to address shallow targets: in the case of the Victoria Land coast, the project aimed to investigate neo-tectonic lineaments, along which cold seeps and mud volcanoes formed, likely related to fluid and gas escape at the sea bed as well as occurrence of gas hydrate (Geletti and Busetti, 2011).

In the case of the eastern Ross Sea shelf margin, tomography was applied to Plio-Quaternary seismic sequences to reconstruct an accurate velocity model in depth. This study allowed to detect and map overcompacted strata versus normally-consolidated interglacial marine sediments and to infer different WAIS pattern and dynamics during Plio-Quaternary glacial advances (Böhm et al., 2009).

Current research in the frame of international projects, opened to further partnership, includes the IODP 751-full Proposal “Direct chronologic and environmental-change constraints on the WAIS late Neogene grounding events at the Eastern Basin, Ross Sea, outer continental shelf”. The IODP proposal’s primary objective is to test hypotheses concerning WAIS advance and retreat from full-glacial configurations and investigate the role of upwelling currents and the export mode of cold bottom current trough time, by drilling the Eastern Basin outer continental shelf and continental rise stratigraphy. This area receives drainage from the Pacific sector of the WAIS and the seismic-stratigraphic framework is the best documented than any other Antarctic sector.

International effort is currently focused on collecting further seismic, multibeam and sediment core data from the Ross Sea continental margin to: i) implement the IODP 751-full proposal’s site survey in the slope and rise; ii) to extract early glacial stratigraphic records by drilling the Coulman High, below the Ross Sea Ice Shelf (ANDRILL project) and by drilling the southernmost sector of the eastern Ross Sea continental shelf, where Mesozoic and early Cenozoic sequences are supposed to outcrop at the sea floor (SHALDRILL project).

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HIGH RESOLUTION, LOCALIZED STUDY IN POTENTIAL FIELD MODELING FOR ANTARCTIC LITHOSPHERE

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ABSTRACT

Antarctic Digital Magnetic Anomaly Project (ADMAP) was initiated in 1995 for the purpose of producing a comprehensive magnetic map of Antarctic lithosphere that is a powerful tool for determining the structure, processes, and tectonic evolution of the continent, together with providing valuable information in the reconstruction of the Gondwanaland and Rodinia supercontinents. This multinational project has made a progress with a great number of extensive studies and meetings to review and exchange the discussions and interpretations.

In view of intergrating the all available data collected from airborne, shipborne, ground and satellite surveys, a localized modeling technique is implemented that has been effectively used to model satellite geopotential data over a small limited region. These so-called Slepian functions are basically a linear combination of global spherical harmonic functions concentrated on the region of interest. The main advantage of these spatiospectral functions is to use a considerably fewer number of these Slepian coefficients necessary enough to represent the magnetic anomaly features over the area where the data are uniformly distributed and of sensitivity. In this study, a high-resolution lithospherical magnetic anomaly field is modeled with spherical Slepian coefficients that can be transformed to a full set of global spherical harmonic coefficients. This approach will be of interest in implementing the ADMAP database into a set of fewer coefficients that can be evaluated for the integral and differential properties of the Antactic crustal anomalies anywhere at the Earth's surface up to satellite altitudes.

THE AEROMAGNETIC AND AERIAL PHOTOGRAPHIC SURVEYS BY AN AUTONOMOUS UNMANNED AERIAL VEHICLE, ANT-PLANE 6-3 AROUND LIVINGSTON ISLAND, ANTARCTICA

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ABSTRACT

It is expected that an autonomous unmanned aerial vehicle (UAV) contributes to a safe and economical airborne survey in the risky area, such as the polar region or active volcanos. We developed UAV, so called Ant-Plane, to be used at the coastal regions of Antarctica in the summer season. Ant-Plane 6-3 is a pusher type UAV having 2.89 m in span with 86 cc gasoline engine. The weight is 30 kg (20 kg for dry) including 10 liters of gasoline and 2 kg of payload. The plane flies along waypoints, consisting of latitude, longitude, altitude and speed, controlled by an onboard computer. An onboard magnetometer system (525g in weight, 0.5 W) consisting of 3-axes fluxgate magnetometer, data logger and GPS, and a digital video camera are stored in the nose of airframe. The sensor of magnetometer was attached at the tip of aluminum pipe of 1 m length that was extended forward from the nose to avoid the magnetic noise of airplane. Deception Island is located in Bransfield Strait between Antarctic Peninsula and South Shetland Island and was formed by volcanism resulting from opening structure of Bransfield Strait. The aeromagnetic survey in this study was carried out above Deception Island due to lack of the precise magnetic data in the island.

December 18, 2011, Ant-Plane 6-3 took off from the glacier behind St.Kliment Ohridski Base (Bulgarian Antarctic Station, Livingston Island, South Shetland Island) which is 35 km from Deception Island. The flight was 302 km in distance, 3 hours 38 minutes in time and 800 m in altitude. Twelve survey lines of 18 km in length of the parallel to latitude were set to the N-S direction within 10 km in distance, where the first 2 lines and the last 2 lines were same courses but they were anti parallel directions each other. Namely, the interval of survey lines was 11.1 km.

As the heading of airplane was unknown, a total magnetic field was used for analyses of the magnetic anomaly. The variation of magnetic field was more than 2000 nT at 800 m in altitude. The positive anomaly appeared at the east side of island where is concordant to the highest topography. The negative one appeared at the ocean of the N-W area of the survey area. According to the results of the seaborne magnetic

surveys by Spanish team, our results compensated for the blank area of the magnetic anomaly map observed by the seaborne survey. The aerial photographs revealed the volcanic and glacial topography of the northern half of Deception Island.

The survey in the southern half of Deception Island was not conducted due to bad weather for UAV flight. We stayed for 2 weeks in St. Kliment Ohridski Base and 1 month in King Sejong Station (Korean Antarctic station in King George Island) in 2011-12 summer season, but only 1 day was available for UAV flight. South Shetland Island is not suitable place for UAV operation due to the location of the southern end of storm zone. Nevertheless, this success of aeromagnetic survey demonstrated that the small autonomous UAV benefits us for the economy and the safe airborne survey in Antarctica.

This survey was carried out under the joint research with National Institute of Polar Research (Japan), Korea Polar Research Institute, Chile Antarctic Institute, Bulgarian Antarctic research and Spanish Antarctic team.

MAGNETIC ANOMALY AROUND THE KING SEJONG STATION, KING GEORGE ISLAND, ANTARCTICA

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ABSTRACT

Magnetic surveys were conducted around Korean King Sejong Station, King Georg Island, Antarctica. These surveys were carried out in the part of the flight project of the autonomous unmanned aerial vehicles (UAV). The project was incorporated with National Institute of Polar Research (Japan), Korea Polar Research Institute, Chile Antarctic Institute, Bulgarian Antarctic research and Spanish Antarctic team.

We carried out the first magnetic survey during February in 2011 around Marian cove on the front of the King Sejong Station including Weaver Peninsula and Barton Peninsula. Second magnetic survey was carried out during January in 2012. Both surveys were smoothly proceeded under the help of Korean station staff members.

At the first survey overhauser proton magnetometer (GSM-19 made by GEM Systems) was mainly used for gathering the magnetic total intensity data and a small fuluxgate magnetometer with three components (FLFG27 made by Tierra Tecnica) was partly used. The second survey was supplementary and additional to the first survey. On land area we walked around sustaining the sensor of the magnetometers at the height of around 2.5 m with the aid of GPS loggers for the location. The sampling rate of the Overhauser magnetomer was 3 sec with 1 sec sampling of GPS posotioning. The fluxgate magnetometer is able to aquire the magnetic and GPS data with 10 Hz sampling. A zodiac (a rubber rafting boat with motor engine with the length of around 5 m and the width of around 2 m) belonging to Korean Antarctic basement of King Sejong station was used on Marian cove. The sensor of Overhauser proton magnetometer was made efort of fixing on the swinging boat at the height of around 2 m on the sea surface. The fluxgate magnetometer was on the hand-made small boat towed by the zodiac with a 20 m rope. On the route of the zodiac we also recorded the depth of the sea water by acoustic exploration. Such precise bathymetric data will be able to be used for further analysis of the magnetic structure.

The resuted magnetic anomalies of the total intensity at the height of the Overhauser magnetometer sensor are merged and we make a map of magnetic anomaly. In order to remove the diurnal geomagnetic chnages, we use the fixed reference data

monitoring (1 Hz) at King Sejong Station. The geological map around the King Sejong Station was published by Lee et al. (2002) and we can compare with the magnetic anomalies.

We found that the range of the magnetic anomalies in this area is up to 3000 nT. We can see intense positive magnetic anomalies on the southern shore of Marian cove (at the side of Barton peninsula). The source of these intense positive anomalies is inferred due to the intrusive granodiorite in the era of Paleocene to Eocene. On the outcrop of the granodiorite we comfirmed the color of the rocks was whitish. However, the hypothesis that granodiorite could be the source of strong magnetic field is under the question at present. On the northern side of Marian cove called Weaver peninsula, east-west oriented mafic dykes are there but we cannot see the intense magnetic anomalies just around the mafic dykes. On the other hand a set of positive and negative magnetic anomalies are recognized around the gabrro outcrop just north of Marian cove on Weaver peninsula.

In the view of the topography of King Georg Island we can see several east-west elongated coves in lines. Probably these coves were formed by glacier or ice erosion along a kind of pull-aprt or normal faults. In this study we conducted magnetic survey at Marian cove which is one of these coves. If we do similar surveys at other coves in arranging the same line, we might be able to discover the features of structure such as characteristic of intrusion or fault filling at this kind of coves in King Gerge Island.

SESSION Ⅲ

ATMOSHPERE 2

DIFFERENTIAL SEA ICE MELT IN THE CHUKCHI BORDERLAND

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ABSTRACT

Differential bottom sea ice melt were observed between the two sea ice mass balance buoys, deployed in the Chukchi Borderland on early August in 2011. One buoy recorded the melt rate more than 5 cm per day, whist the melt rate of other buoy remained around or below 2 cm per day. Comparison between parameterized (McPhee 1992) and observed melt rates confirmed that such melt rates were indeed realistic. The effects of solar heating on the differential melt was evaluated by comparing solar heat inputs estimated using a parameterization by Perovich et al. (2008) with the required heat inputs for the observed melt. The results showed that local solar heat inputs varied considerably both spatially and temporally near the ice edge and could supply sufficient amount of heat inputs to cause the observed differential melt. Our study shows that the combined effects of local solar heating and differential ice motion can cause very contrasting sea ice melt even within relatively short distance (about 90 km) near the retreating sea ice edge.

A POSSIBLE EXPLANATION ON THE LINK BETWEEN ARCTIC SEA-ICE LOSS AND STRATOSPHERIC POLAR VORTEX

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ABSTRACT

Extremely cold winters have occurred in recent years over central North America, northwestern Europe, and East Asia exerting a severe social and economic impact. The negative phase of the Arctic Oscillation (AO) has been suggested as a cause for these anomalously cold midlatitude winters. Although previous studies have suggested that a negative AO-like response can occur in response to the Arctic sea-ice melting, the mechanism linking the AO with sea-ice melting is not fully understood. We propose here that the recent negative trend in winter AO can be, in part, caused by Arctic sea-ice melting in autumn. Using idealized linear model experiments, we suggest that this lagged connection between sea-ice and AO can be due to the stratosphere-troposphere dynamic coupling. Our results suggest that Arctic sea-ice loss is not just a passive response to Arctic warming but plays an active role in the Arctic amplification by affecting atmospheric circulation much more than previously thought.

EFFECT OF ARCTIC WARMING ON THE EXTRATROPICAL COLD WINTER

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ABSTRACT

In recent three years, the extremely cold winters continuously took place over Eurasian continent, while there was distinctive Arctic warming. In this study, we examined a role of the Arctic warming/cooling on the extratropical climate variation. It is demonstrated that the Arctic surface temperature variation is negatively correlated to the extratropical surface temperature over Eurasian continent, implying that Arctic warming is related to the cooling over Eurasian continent. We found that most climate models tend to simulate the observational relation, supporting the robustness of our finding. It is hypothesized that the weakened westerlies due to the weakened meridional temperature gradient provides a favorable condition for intrusion of the coldest polar air to extratropical regions. It is also demonstrated that the Arctic temperature variation is independent of the Arctic Oscillation, so that the two phenomena originated from the polar region can be used for understanding and predicting extratropical climate variation.

INTER-DECADAL CHANGE OF THE RELATIONSHIP BETWEEN SPRING ARCTIC OSCILLATION AND EAST ASIAN SUMMER MONSOON

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ABSTRACT

Spring Arctic Oscillation (SAO) and East Asian summer monsoon (EASM) have been found connected through circulation changes over the western North Pacific. This study further found two remarkable interdecadal transitions of their correlations, respectively in the late 1970s and the late 1990s. The correlation coefficient between positive SAO phase and positive EASM index is 0.16 before the late 1970s, and becomes 0.70 during the period from the late 1970s to the late 1990s, but turns into -0.56 after the late 1990s. The changes of the associated circulations and sea surface temperature (SST) contribute to the interdecadal transition of SAO-EASM relationship, and the possible reasons are discussed.

ALTERED ATMOSPHERIC RESPONSES TO WARM POOL AND COLD TONGUE EL NIÑOS OVER THE NORTH ATLANTIC REGION DUE TO STRATOSPHERIC INTERFERENCE

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ABSTRACT

Two types of El Niño, namely the cold tongue (CT) and warm pool (WP) El Niños, exert different climatic impacts around the North Atlantic region during late winter. The difference in the remote impact of the two types of El Niño is related to the atmospheric pattern over the North Atlantic region, which during the late CT El Niño winter closely resembles the negative North Atlantic Oscillation (NAO) pattern. This study investigates the characteristics of the teleconnection of the two El Niño types with a focus on stratosphere-troposphere coupling. During the CT El Niño, polar stratospheric warming and polar vortex weakening frequently occur with a prominent tendency for downward propagation. In this case, the lower stratospheric warming projects onto the negative NAO in the troposphere. For WP El Niño events, on the other hand, stratospheric warming events that propagate downward are hardly accompanied. The difference in stratospheric circulation between the CT and WP El Niños arises due to the difference in tropospheric wave response to the two El Niños. To find the origin of the difference between the teleconnections of the two El Niños, we examined the relationship between the different SST distributions and wave responses during the CT and WP El Niños. The results suggest that the difference in wave response associated with the distinctive longitudinal position of the warm SST anomaly is an important factor in determining stratosphere-troposphere coupling.

SESSION Ⅳ

GEOSCIENCES 2

THE LINKS BETWEEN LARGE IGNEOUS PROVINCES AND GONDWANA BREAK-UP: EVIDENCE REVIEWED FROM ANTARCTICA

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ABSTRACT

Earth history is punctuated by events during which large volumes of predominantly mafic magmas were generated and emplaced by processes that are generally accepted as being, unrelated to "normal" sea-floor spreading and subduction processes. These events form large igneous provinces (LIPs) which are best preserved in the Mesozoic and Cenozoic where they occur as continental and ocean basin flood basalts, giant radiating dyke swarms, volcanic rifted margins, oceanic plateaus, submarine ridges, and seamount chains. The Mesozoic history of Antarctica is no exception in that a number of different igneous provinces were emplaced during the initial break-up and continued disintegration of Gondwana, leading to the isolation of Antarctica in a polar position. The link between the emplacement of the igneous rocks and continental break-up processes remains controversial. This presentation will explore the links between the emplacement of large igneous provinces in Antarctica focusing on the Ferrar Large igneous province in the Transantarctic Mountains, and the isolation of Antarctica from other Gondwana continents.

DEVELOPMENT OF NEW IODP PROPOSALS FOR DRILLING CENOZOIC HISTORY SITES IN THE PACIFIC SOUTHERN OCEAN

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ABSTRACT

Paleoceanographic and -climatic research during the last decades has documented that processes occurring in the Southern Ocean and within large Antarctic ice sheets play crucial roles in shaping the Earth's climate. However, our picture of Southern Ocean climate development is still incomplete, because little information is available from the Pacific sector, even though it represents the largest portion of the Southern Ocean and the major West Antarctic Ice Sheet (WAIS) drainage area. To substantially augment our knowledge from this sector, we propose deep-sea drilling to recover latitudinal and depth transects allowing the study of the Cenozoic paleoceanographic and -climatic history of the Pacific Southern Ocean at orbital to high and ultra-high time resolution to understand and quantify (1) its response to the development of circum-Antarctic water mass circulation and pathways related to plate tectonic opening and closure of deep and shallow gateways (Tasmanian Seaway, Drake Passage, Ross-Weddell Sea Passage) and development of South Pacific basin and ridge systems, (2) its implications for Antarctic continental ice sheet and ice shelf development, (3) its role in shaping global circulation and distribution of heat, vapour and nutrients, (4) its impact on global biogeochemical cycles through changes in productivity, nutrient cycling, burial of organic matter and ocean/atmosphere CO_2 exchange, (5) its response to orbital and solar forcing and (6) its impact and response on/to internal climatically relevant processes by comparing the phase relationship of South Pacific environmental change with records from other Southern Ocean sectors as well as the low and northern-high latitudes including Antarctic and Greenland ice core records. Such studies will fill a critical gap in the understanding of the role of the Pacific sector of the Southern Ocean in long- and short-term climate development, its tectonic history and development of ocean gateways and the southern cryosphere evolution. The drilling should also generate new data for documenting and dating the Late Pliocene impact of the Eltanin asteroid into the eastern Pacific Southern Ocean, the yet only known example of an oceanic impact.

A first attempt to promote such drilling was accomplished with IODP-proposal 625-Full “Cenozoic Southern Ocean Pacific, CESOP” (Gersonde et al. 2008), which suggested drilling at 14 sites primarily located on a latitudinal transect in the eastern South Pacific (Amundsen Sea to East Pacific Rise), a transect in the western South Pacific (Ross Sea to SW-Pacific Basin) and additional sites in the impact area of the Eltanin asteroid. Although launched successfully, this proposal was hampered by the

broad lack of seismic data at the proposed sites, which present a mandatory part of the pre-site survey requested by IODP. It was only in 2009/10 that appropriate seismic and bathymetric data could be gathered at six sites from the eastern South Pacific during RV *Polarstern* cruises (ANT-XXVI/2, –XXVI/3) and RV *Sonne* cruise SO213 together with sediment cores. After study of the collected data and materials a new IODP proposal ("South-East Pacific Paleoceanography, SEPAP"; Gersonde, Lamy, Gohl, Tiedemann, Kuhn et al.) is now in progress. The extensive sediment coring and PARASOUND survey accomplished during ANT-XXVI/2 (Gersonde 2011, http://10013/epic.37910) resulted in the definition of a suite of new potential drill sites for the western South Pacific, which will be proposed for drilling in a second IODP proposal ("South-West Pacific Paleoceanography, SOWEPAP"; Lamy, Gersonde et al.). However, seismic surveys from these sites are still lacking. For the development of a successful proposal, which bridges drilling in the Ross Sea and New Zealand, we invite collaboration partners both for the generation of seismic data, but also to enhance the paleoceanographic expertise (e.g. in sedimentology).

GRACE MEASUREMENTS OF ICE MASS CHANGE AND OCEAN TIDES IN POLAR REGIONS

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ABSTRACT

As a new remote sensing technique to measure changes in surface mass distribution, the Gravity Recovery And Climate Experiement (GRACE) satellite mission is being exploited to quantify mass flux and transport as well as adjustment within the Earth system. The comprehensive nature of the gravimetric (mass change) measurements have yielded multidisciplinary applications to terrestrial and atmospheric water mass, ice mass change in polar region, ocean tides underneath ice shelves, non-tidal ocean currents, present rebound after the glacier melt, and episodic and gradual deformation associated with large earthquakes. In this presentation, I will discuss the fundamental concept of the Gravity Recovery And Climate Experiement (GRACE) satellite mission: what it measures and how the observations can be used to infer changes in gravity, mostly due to surface mass re-distribution. I will report our on-going effort to recover and quantify the ice mass change and ocean tide signals from the last decade of GRACE observations. Particularly, I will show the up-to-date trend of ice mass change over the Greenland, Gulf of Alaska, and Antacrtica. I will discuss the importance of quality of ocean tide correction to gravimetric and altimetric measurement of ice height change, regarding to diurnal solar tide that mimics inter-seasonal climate change signal through tidal aliasing.

FAVORABLE ENVIRONMENT FOR BLUE ICE AREA DEVELOPMENT AND ITS RELATIONSHIP TO SURFACE MASS BALANCE

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ABSTRACT

Blue ice areas are commonly found on the Antarctic continent. Blue ice areas are considered as zero accumulation and negative net surface mass balance areas due to sublimation. Due to their significance in surface mass balance of Antarctic ice sheet, their development and climatological implication have been one of the interests of the glaciological society. This paper investigates favorable topographic environment of blue ice areas using topographic profile analysis. Blue ice areas are mapped based on spectral characteristics extracted from Landsat ETM+ data. Mapped blue ice areas are topographically analyzed on the basis of several topographic parameters such as local relief, local slope, elevation and extent of 85 patches of blue ice areas employing AESTER global digital elevation model. In general, the positive correlation between extent of blue ice areas and local relief is observed for the blue ice areas located below 1,200m while blue ice area located at higher elevations doesn't show recognizable correlations due to decrease of sublimation effect. However, as we compare changes in blue ice extent and surface mass balance, we observed considerable correlation for blue ice areas located at higher elevations where local sublimation effect is minimal.

ICE VELOCITY MAPPING BY MATCHING SURFACE UNDULATIONS MEASURED BY ICESAT LASER ALTIMETRY

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ABSTRACT

We present a novel method for estimating the surface velocity on ice shelves using laser altimetry data from the Ice Cloud and land Elevation Satellite (ICESat; 2003-2009). The method matches undulations measured at crossover points between successive campaigns. Elevation measurements are first relocated into a time-varying (moving) coordinate system using an initial estimated velocity (e.g., from an earlier mapping), and then crossover height differences are minimized with an adjustment vector. Errors in geolocation of the ICESat tracks result in some error in the adjustment vectors, but these are small relative to the velocity adjustment for fast-moving ice shelves. We use the algorithm to estimate changes in the ice velocity of Ross Ice Shelf between an earlier mapping (from VELMAP) and the ICESat period. The new velocity field is compared with velocities from *in situ* measurements and satellite radar interferometry. The residual errors (~ 0.09 m) may result from ice thickness changes or surface deformations. The method can be expanded to the simultaneous mapping of ice horizontal velocity, ice thickness change, and surface deformation for Antarctic ice shelves as well as a more accurate mapping using future ICESat-2 measurements.

POSTER SESSION – DAY1

ATMOSPHERE

ESTABLISHMENT OF ENVIRONMENTAL CHANGE OBSERVATION NETWORK IN THE CIRCUM-ARCTIC PERMERFROST: SEWARD PENINSULA, ALASKA

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ABSTRACT

Response of the Arctic to global warming is seen as a high-sensitivity indicator of climate change. Considering that 25% of Earth's terrestrial surface is underlain by permafrost, warming permafrost may play important roles in carbon cycle of the Arctic. However, due to the lack of measurements at representative locations, and the high degree of spatial and temporal variability in the Arctic, it is difficult to evaluate environmental change. Therefore, it is necessary to establish Circum-Arctic observation network consisting of monitoring sites. We made an on-site survey of candidate sites for environmental change observation in the Seward Peninsula, Alaska under collaboration with international Arctic research center, University of Alaska Fairbanks (UAF). The site (64°50.63´ N, 163°42.64´ W) was selected in Council which is comprised of vascular plants (e.g. *Erophorum scheuchzeri* and *Betula nana*), moss (e.g. *Sphagnum lenese pohle* and *Sphagnum russowii Warnst*) and lichen (*Cladonia stellaris*). Annual air temperature ranged from -30 to 20℃, predominent wind direction was North and Northwest, wind speed ranged from 2 to 6 ms^{-1} and maximum snow depth was 70cm based on meteorological tower of UAF. An automatic CO_2 chamber system was installed to monitor CO_2 exchange between soil surface and atmosphere. Chamber system consists of 15 chambers, soil temperature, water content sensors and solar and wind power generators. In addition, profile of soil temperature, water content and thaw depth were measured near the system. Soil samples were collected in order to characterize permafrost soil properties, microbial communities and their correlation. Main objective is to understand interaction between of atmosphere, vegetation, soil system in carbon cycle of permafrost region. In next season, CO_2 flux, sensible heat flux and latent heat flux will be measured using eddy covariance system and phenology will be monitor to estimate greeness. This study was supported by the National Research Foundation of Korea Grant funded by the Korean Government (MEST) (NRF-C1ABA001 - 2011-0021063).

TIDAL DEFLECTION CHARACTERISTICS OF CAMPBELL GLACIER, EAST ANTARCTICA, OBSERVED BY COSMO-SKYMED DOUBLE-DIFFERENTIAL INTERFEROGRAMS

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ABSTRACT

Double-Differential Interferometric SAR (DDInSAR) technique is a powerful tool to extract tidal motion of floating glacier by differencing two differential interferograms and thus removing horizontal glacial motion under the assumption of constant flow rate of the glacier. During June 2010 to November 2011, we have obtained 16 COSMO-SkyMed one-day interferometric SAR image pairs over Campbell Glacier in East Antarctica and generated one-day interferometric images (Table 1). To remove the phase differences due to topography in the interferograms, we used 2-pass Differential InSAR (DInSAR) technique using ASTER Global DEM (GDEM). In the differential interferograms, Campbell Glacier showed both horizontal displacement by creep flow and vertical displacement by change in tide height during a day. If the flow rate of the glacier is almost same with time, the tidal displacement can be extracted by differencing two interferograms.

The tidal deflection of glacier Z, is a function of the distance from a grounding line of the glacier (x) and time (t), can have a solution from an elastic beam model as follows [Holdsworth, 1977].

$$Z(x,t) = Z_0(t)\left[1 - e^{-\beta x}(\cos\beta x + \sin\beta x)\right] \quad (1)$$

where Z_0 is the tidal deflection beyond the hinge zone ($x \to \infty$). β is the elastic damping factor for a glacier which is given by

$$\beta^4 = 3\rho_s g \frac{1-\nu^2}{Eh^3} \quad (2)$$

where ρ_s (=1030 kgm^{-3}) is the density of sea water, g (=9.81 ms^{-2}) is the acceleration of gravity, ν (=0.3) is the Poisson's ration for the glacier, E (=0.88±0.35 GPa) is the Young's modulus for the glacier and h is glacier thickness [Vaughan, 1995]. β is more sensitive to the glacier thickness than to ν and E. The Z depends on tide height (T) and the rigidity property of glacier. We consider a deflection constant α at $x \to \infty$ of the glacier having the value range of [0, 1]. The product of α and T is to be Z_0. The derivation of Z measured by the one-day

differential interferograms, $\dot{Z}$, can be estimated by using the change of tide height during a day ($\dot{T}$). In the double differential interferograms, the difference of $\dot{Z}$ measured from one-day differential interferograms is given by

$$\Delta\dot{Z}(x,t) = \alpha\Delta\dot{T}(t)\left[1-e^{-\beta x}(\cos\beta x+\sin\beta x)\right] \quad (3)$$

where $\Delta\dot{T}$ is the difference of $\dot{T}$. The α and β are the representative parameters that explain the elastic deflection characteristics of glacier by tidal effect.

To find most representative value of α, we performed linear regression between $\Delta\dot{Z}_0$ extracted from 120 double differential interferograms ans $\Delta\dot{T}$ predicted by IBE (inverse barometric effect) -corrected TPXO7.1, FES2004, CATS2008a and Ross_Inv tide models. The linear regression between $\Delta\dot{Z}_0$ and $\Delta\dot{T}$ from Ross_Inv showed the best relationship ($R^2 = 0.926$) with α of 0.964. Based on the high R^2 and the fact that the intercept of the regressions is close to 0, we confirmed the assumption of steady ice creep is correct and the deflection constant is independent of tidal height. We also calculated β from 120 double differential interferograms. The average of β is 0.827 km^{-1} with a standard deviation of 0.099 km^{-1}. Using equation (2), the ice thickness was estimated as 406 m. Thickness estimated from hydrostatic equilibrium by measuring the elevation at grounding line was 456 m, leaving the difference of 50 m with our estimation. As the uncertainty of ice thickness estimation from hydrostatic equilibrium is said to be ±100 m, the height value estimated in this paper is considered reasonable.

Table 1. COSMO-SkyMed one-day interferometric tandem pairs used in this study

Dates (master, slave)	Perpendicular baseline (m)	Dates (master, slave)	Perpendicular baseline (m)
2010/06/16, 2010/06/17	31.6	2011/06/03, 2011/06/04	-36.5
2010/07/02, 2010/07/03	-46.3	2011/06/19, 2011/06/20	-47.5
2011/01/26, 2011/01/27	18.9	2011/08/22, 2011/08/23	181.7
2011/02/27, 2011/02/28	5.7	2011/09/07, 2011/09/08	37.3
2011/03/15, 2011/03/16	-44.4	2011/10/09, 2011/10/10	-44.4
2011/03/31, 2011/04/01	-39.2	2011/10/25, 2011/10/26	-110.9
2011/05/02, 2011/05/03	-89.6	2011/11/10, 2011/11/11	-91.7
2011/05/18, 2011/05/19	75.9	2011/11/26, 2011/11/27	-23.4

CO_2 FLUX FROM TUNDRA LICHEN, MOSS, AND TUSSOCK, COUNCIL, ALASKA: ASSESSMENT OF SPATIAL REPRESENTATIVENESS

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ABSTRACT

CO_2 flux-measurement in dominant tundra vegetation on the Seward Peninsula of Alaska was examined for spatial representativeness, using a manual chamber system. In order to assess the representativeness of CO_2 flux, a 40 m × 40 m (5-m interval; 81 total points) plot was used in June, August, and September of 2011. Average CO_2 fluxes in lichen, moss, and tussock tundra were 3.4 ± 2.7, 4.5 ± 2.9, and 7.2 ± 5.7 $mgCO_2/m^2/m$ during growing season, respectively, suggesting that tussock tundra is a significant CO_2 source, especially considering the wide distribution of tussock tundra in the circumpolar region. Further, soil temperature, rather than soil moisture, held the key role in regulating CO_2 flux at the study site: CO_2 flux from tussock increased linearly as soil temperature increased, while the flux from lichen and moss followed soil temperature nearly exponentially, reflecting differences in surface area covered by the chamber system. Regarding sample size, the 81 total sampling points over June, August, and September satisfy an experimental average that falls within ±10% of full sample average, with a 95% confidence level. However, the number of sampling points for each variety of vegetation during each month must provide at least ±20%, with an 80% confidence level. In order to overcome the logistical constraints, we were required to identify the site's characteristics with a manual chamber system over a 40 m × 40 m plot and to subsequently employ an automated chamber for spatiotemporal representativeness.

EFFECTS OF CLOUD AMOUNTS AND SNOW COVER ON SURFACE UV IRRADIANCE AT KING SEJONG STATION, ANTARCTICA

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ABSTRACT

The Erythemal UV (EUV) and Total UV (TUV) irradiances were, respectively, observed from UV-Biometer (Model 501) and Eppley UV photometer at the King Sejong Station, the Antarctic Peninsula for the period of 1998 – 2003. In this study, the effects of cloud amount and snow on the variations of surface UV irradiances were investigated on the basis of surface measurements.

We analyzed the effects of total ozone on EUV using Radiative Amplification Factor (RAF) calculated for the function of solar zenith angle (SZA) and cloud amount (the total sky divided into 8 parts; octas). The RAFs increase from 0.30 (overcast sky conditions; $7 \leq n \leq 8$) to 1.94 (partly cloudy conditions; $3 \leq n < 4$) as SZA increases. This result suggested that the effects of total ozone on the variations of EUV are more significant at higher SZA, corresponding to the increase of slant path. The cloud transmissions of EUV for the mean cloud layer decrease gradually from 0.72 to 0.44 as cloud amounts increase from 3/8 to 8/8. In particular, the cloud transmissions of EUV under partly cloudy conditions ($4 \leq n < 5$) and SZAs of 50°-60° are relatively higher. This enhancement of cloud transmission under partly cloudy conditions could be related to the multiple-scattering by broken clouds. On the other hand, the cloud transmissions of TUV for mean cloud layer decrease from 0.84 to 0.44 as cloud amount increases from 3/8 to 8/8, similar to the trend of EUV. Compared with the cloud transmission of EUV under all-sky conditions and SZAs of 50°-70°, the cloud transmissions of TUV are higher by 7~20% than those of EUV. It can be inferred that TUV with a wide wavelength ranges from 295 nm to 385 nm effectively penetrates cloud layers and atmosphere.

The variations of EUV and TUV caused by the high albedo of snow cover were analyzed. The EUV at snow surface under overcast sky conditions ($7 \leq n \leq 8$) increase by 15-30% and TUV increase by 6-50% as SZA increases, compared with those at snow-free surface. It is found that the snow effects on TUV at high SZAs of 65°-75° are more considerable than those on EUV, similar to the results of cloud transmission.

DECADAL CHANGES IN SURFACE AIR TEMPERATURE VARIABILITY AND COLD SURGE CHARACTERISTICS OVER NORTHEAST ASIA AND THEIR RELATION WITH ARCTIC OSCILLATION (AO) FOR THE PAST THREE DECADES (1979-2011)

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ABSTRACT

Decadal changes in surface air temperature (SAT) variability and cold surge characteristics over Northeast Asia during late winter (January-March) are analyzed for recent three decades. Power spectrum of SAT reveals that the low-frequency variabilities with a period longer than 10 days are significantly enhanced, while the high-frequency variabilities with a period shorter than 10 days are weakened in the 1980s and in the 2000s. Moreover, cold surges were stronger and lasted longer during the 1980s and 2000s than those occurred in 1990s. Here, we propose that large-scale atmospheric conditions manifested by a different phases of Arctic Oscillation (AO) provide a preconditioning for cold surge event, which showed a prominent decadal fluctuation. The more (less) frequent strong and longer-lasting cold surge occurrences in 1980s and 2000s (1990s) are preceded by the more dominant negative (positive) phase of the AO. Lag-composite analyses for cold surge events categorized by AO phases indicate that stronger and longer-lasting cold air advection dominates at the lower-level when upper-level wave train and coastal trough are developed over the East Asia under the strong negative AO phase. These results suggest that the decadal changes in SAT variability and cold surge characteristics are strongly associated with the decadal changes in the phase distribution of AO.

IMPACT OF SEA SURFACE TEMPERATURE AT SEA ICE CHANGED REGION ON WINTER ARCTIC CLIMATE IN THE AGCM EXPERIMENT

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ABSTRACT

As Arctic Ocean becomes warmer in recent decades, the regions fractionally covered by Arctic sea-ice are increasing. Over the area partly covered by Arctic sea-ice, sea surface temperature (SST) is related with the fractional sea-ice cover itself. In this study, we investigate the atmospheric response to the reduced sea-ice cover due to Arctic warming and show that the response sensitively depends on the SST distribution over the fractional sea-ice covered region especially during the winter season. We perform three atmospheric model runs of different SST prescription over the region and one baseline run for the comparison. The averaged sea-ice fraction for 2006-2010 is prescribed as a boundary condition for the three runs. The only differences among the runs are the different SST prescribed in the region where the sea-ice fraction is between 0.1 and 0.9: 1) constant SST obtained by averaging over entire Arctic Ocean 2) climatological SST (1982-2000) prescribed over the region and 3) 2nd order polynomial fitting between sea-ice and SST over the Arctic Ocean. Baseline experiment is prepared by using the climatological (1982-2000) SST and sea-ice over the entire model Ocean grids. As a result, we find that the atmospheric warming sensitively depends on the SST condition even under the condition of the same sea-ice fractional cover. Dependency of the surface heat fluxes on SST is key for this sensitivity; longwave radiation during early winter, sensible heat flux during mid-winter, and latent heat flux during whole cold season. Among those fluxes, latent and sensible heat fluxes are more responsible for different responses compared to longwave radiation. Sensible heat flux warms air at near surface below 850 hPa by diffusion, and latent heat flux decreases the vertical stability by moistening the near-surface air and contributes to vertical expansion of warming. Increase in latent heatflux also warms air at mid troposphere above 800 hPa by condensation process. This result suggests that SST values at sea ice changed region could be another important surface boundary condition related to sea ice in the AGCM simulation.

POSTER SESSION – DAY1

OCEANOGRAPHY

SEA SURFACE HEIGHT, OCEAN DYNAMIC TOPOGRAPHY, AND OCEAN TIDES IN THE CHUKCHI BORDERLAND USING SEA ICE-BASED HIGH-PRECISION GPS OBSERVATIONS

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and the SATICE Project – 2011 ARAON Participants[*]

ABSTRACT

The application to the Arctic Ocean of the latest technological developments in Space Geodesy gives us the opportunity to address scientific issues of physical relevance in both the sea ice and the ocean components of the Arctic Ocean system. We have developed a geodetic-quality, high-precision GPS autonomous platform suited to the challenging Arctic Ocean environment. The system enables determination of sea ice motions with few-cm level precision in three-dimensions, including the vertical component, every 10 s, or even faster. When several systems are deployed as a network, they also provide high-spatial density. The platform includes a sea ice freeboard sensor and two-way communications, thus also enabling near-real time monitoring and remote data retrieval. We deployed two such GPS systems in the Chukchi Sea as part of the 2011 scientific cruise of Araon to the Arctic Ocean, in August 2011. Estimates of the vertical component of site position of these systems detect unambiguously the variations of the sea surface height (geoid) along the buoy ocean tracks as well as dynamic topography. We will present results from the 2011 Araon deployment pertaining to sea ice dynamics, Arctic Ocean tides, ocean dynamic topography, ocean currents, Arctic Ocean freshwater storage, and sea ice freeboard, thickness, and mass balance, from the analysis of the GPS and freeboard data collected by those systems.

[*]*SATICE-ARAON Project Participants includes: M. Olsson (CSIC), S. Rodwell (SAMS), A. James (SAMS), P. Hwang (SAMS), K. H. Chung (KORDI), S. H. Kim (KORDI), G-G Choi (KORDI), B. C. Jeon (KORDI), S. Y. Jeong (KORDI), J. Wilkinson (SAMS), R. Gerdes (AWI), J. Johannessen (NERSC), R. Forsberg (DTU-Space), M. Doble (LOV), P. Wadhams (Cambridge Univ.), M. Nettles (LDEO), and L. Padman (E&SR)*

REAL-TIME PHOTOPROTECTIVE RESPONSE OF XANTHOPHYLL PIGMENTS AND MYCOSPORINE-LIKE AMINO ACIDS OF *POROSIRA GLACIALIS* (BACILLARIOPHYCEAE)

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ABSTRACT

This study is investigation of the newly synthesis of photoprotective compounds by *Porosira glacialis* in real time using a ^{13}C tracer. Our results showed the relationship between the production rates of mycosporine-like amino acids (MAAs) and photoprotective pigment, such as diadinoxanthin (DD). We were experimented during May 2011 for use in the current experiment on indoor exposure to artificial UV radiation. Our results show that UV tolerance of *P. glacialis* was evidenced by the growth rate and chlorophyll *a* (Chl *a*) concentration under the UV conditions. The carbon uptake rate indicated that was continuously exposed to photosynthetically active radiation (PAR) for 24 hours, which was higher than that of one exposed to ultraviolet (UV) radiation (UVR). However, it indicated when the exposure time was 72 hours, which was higher than the initial value of *P. glacialis* exposed to UV radiation and also was higher than that of *P. glacialis* exposed to PAR. The time difference between the productions of these two compounds clearly reveals the defense strategy used by *P. glacialis* to synthesize photoprotective compounds (MAAs and DD). The results of this study appear to reflect the synthetic pathways of photoprotective compounds and the carbon cycle within the cell in contrasting patterns over time that are defined by the production of photoprotective pigments (DD) and MAAs.

SPATIAL VARIABILITY OF ΔO_2/AR IN THE AMUNDSEN SEA, ANTARCTICA

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ABSTRACT

We surveyed O_2/Ar in the surface waters of the Amundsen Sea during the austral summer to investigate the variability of net community production (NCP), a measure of the net carbon removed from the atmosphere via biological productivity. The biological O_2 saturation (ΔO_2/Ar) dropped as low as -10% in the sea-ice area, implying net consumption of O_2 over the winter as a result of respiration and limited production. In contrast, ΔO_2/Ar increased to 30% in the polynya, where ΔO_2/Ar, together with pCO_2 and chlorophyll-a, showed a strong correlation with sea surface temperature. This finding suggests that when the sea ice melts, causing radiative heating, the upper water column is stabilized, and this stabilization results in the high biological productivity and consequent O_2 supersaturation in the polynya. The NCP in the polynya was 90 - 170 mmol O_2 m^{-2} d^{-1}, making the Amundsen polynya one of the most effective carbon sinks in the world's oceans.

CIRCULATION AND WATER MASS DISTRIBUTION ON THE LARSEN A CONTINENTAL SHELF: PRELIMINARY RESULTS FROM LARISSA CRUISE NBP1203

The LARISSA science team

ABSTRACT

During the recent LARISSA cruise on RVIB Nathaniel B Palmer, CTD with lowered acoustic Doppler current profiler (CTD/LADCP) casts were carried out in the Larsen A embayment at sites ranging from mid-shelf to within several km of the Drygalski glacier front at the western extreme of the embayment. Preliminary analysis of the data indicate that modified Weddell Deep Water (mWDW) at two distinct density horizons is present on the continental shelf from the easternmost sites extending westward, but is not found at the western edge of the embayment nor in the vicinity of the remnant of Larsen A ice shelf to the south.

Stations occupied in the Prince Gustav Channel, which connects the Larsen A embayment to the Erebus and Terror Gulf to the north, reveal distinct separations in water mass characteristics, and flow regimes which are predominantly tidal in character. A topographic sill at approximately 250 m depth prevents the exchange of water types below the sill depth

A two-year time series of temperature was recovered from a bottom-moored recorder in Antarctic Sound, at a depth of 1050 m. Bottom temperature there is highly seasonal, ranging from near-freezing in austral winter, to summer maxima of -1.2°C to -1.0°C with strong fortnightly tidal variance evident in the non-winter periods.

GEOGRAPHICAL DISTRIBUTION OF KRILL IN AMUNDSEN SEA, ANTARCTIC OCEAN, 2011 AND 2012

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ABSTRACT

The objective of the hydroacoustic survey is to know geographical (spatial/vertical) distribution of krill around Amundsen Sea, in January 2011 and February 2012. Hydroacoustic data were collected using a multi-frequency echo sounder (EK60, Simrad), configured with down-looking 38, 120 and 200 kHz split-beam transducers mounted in the hull of *RVIB* Araon. Acoustic surveys were divided into four transects in the Amundsen Sea: (1) near ice shelf, (2) center of coastal polynya, (3) pack ice zone near the polynya, (4) open sea. Simultaneously, net samplings were done to compare the acoustic data and zooplankton data. High concentrations of krill are mainly found at center of coastal polynya and pack ice zone near the polynya. The krill patches in the two zone formed thick layer and its depth was between surface and 200 m. Contrary to polynya, there wasn't any krill patch in the open sea. Abundance and distribution of krill was highly variable near ice shelf. From net survey, *Euphausia crystallorophias* is dominant krill species in Amundsen Sea, while *Euphausia superba* is distributed in some area. From the studies, it shows that spatial distributions of krill in Amundsen Sea apparently differ with geographic area.

Key words: Amundsen Sea, krill, hydroacoustic survey.

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STRUCTURE AND DISTRIBUTION OF PHYTOPLANKTON COMMUNITIES DURING SUMMER SEASON IN ARCTIC SEA, 2011

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ABSTRACT

Recent studies have shown that photosynthetic eukaryotes are an active and often dominant component of Arctic phytoplankton assemblages. In order to investigate the structure of phytoplankton communities, this study was carried out at 18 stations from July 29 to August 20, 2011 in the Chukchi Sea and Canadian Basin. Concentrations of total microphytoplankton, and nano-picophytoplankton chlorophyll *a* were higher at southwest area than northern area in the study area due to Bering shelf Anadyr Water current from Bering Strait. On the Melting ponds in Canadian Basin, phytoplankton communities were composed of 31 taxa representing Bacillariophyceae, Chrysophyceae, Dictyochophyceae, Prasinophyceae and unidentified phytoplankton(< 20㎛). The most abundant species were *Pyramimonas* sp. and *Thalassiosira* sp. except nano-pico sized phytoplankton in Melting pond.

MACROMOLECULAR PRODUCTION OF PHYTOPLANKTON IN THE NORTHERN BERING SEA IN 2007

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ABSTRACT

Macromolecualr production of phytoplankton in the Northern Bering Sea in 2007 was investigated, and the relationships between the production and environmental factors (Nutrients, salinity, light, temperature, Chlorophyll-a) were examined. Productivity experiments were conducted at the three light depths (100%, 30%, and 1%) for photosynthetic carbon allocations at nine different stations, using ^{13}C isotope tracer technique. The photosynthetic carbon allocations into different macromolecular classes (proteins, lipids, polycarbonates, and low-molecular-weight metabolithes(LMWM)) of primary producers were determined based on the productivity experiments. The average allocations of LMWM and lipids were 37.86±18.79%, and 26.60±17.44%, respectively, and those of polycarbonates and proteins were 9.09±7.84%, and 26.46±20.65%, respectively, LMWM and polycarbonates had similar vertical patterns whereas lipids and proteins had reverse vertical patterns at all the stations. In our study, low incorporation into proteins and relatively high incorporation into lipids at 100% light depth would suggest that the phytoplankton had nitrogen limitation in the Northern Bering Sea. Incontrast, high incorporation into proteins and relatively low incorporation into lipids 1% light depth would suggest that the phytoplankton had no nitrogen limitation during our study period, 2007.

A STUDY OF PHYTOPLANKTON FROM THE CHUKCHI SEA TO THE CANADA BASIN IN THE ARCTIC OCEAN, 2010

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ABSTRACT

The Arctic Ocean is easily vulnerable from global climate changes such as increasing temperature which affects marine ecosystem and environmental conditions including sea ice melting. To monitor fast changing Arctic ecosystem, we studied the phytoplankton from the Chukchi Sea to the Canada Basin in the Arctic Ocean using R/V Araon in 2010. Average of integrated total phytoplankton biomass (chl-a), carbon uptake rates, and nitrogen uptake rates were 8.13 ± 5.12 $mg \cdot m^{-2}$, 1.27 ± 1.13 $mgC \cdot m^{-2}h^{-1}$, and 4.20 ± 4.58 $mgN \cdot m^{-2}h^{-1}$, respectively. The average values of each content were integrated from 100% to 1% light depth in water columns. During the cruise, the northern Chukchi Sea and a middle of eddy in the Canada Basin showed that integrated total chl-a concentration, carbon and nitrogen uptake rates were relatively higher than those of other areas. Size fractionated chl-a compositions of phytoplankton community significantly differed between these regions. The northern Chukchi Sea was dominated by large phytoplankton (>20μm), accounting for 56% of total chl-a concentration. In the Canada Basin, small phytoplankton (0.7-5μm) were predominant (65%) for the phytoplankton community.

PHYTOPLANKTON STUDY IN MELT PONDS AND OPEN SEA OF THE ARCTIC OCEAN, 2011

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ABSTRACT

The Arctic Ocean is one of the regions with the fastest climate change in the world. Due to global warming, reduction of sea ice thickness and a rapid melting progress influence both formation of melt ponds (mp) in sea ice and ambient water ecosystem in the Arctic Ocean. For thinner sea ice, melt ponds are connected to the underneath water surface and lead to new ice algal habitats. To better understand changing arctic ecosystem, we investigated the chlorophyll-a (Chl-a) concentration, phytoplankton size-fractionated composition, and major nutrient concentrations in various melt ponds and open sea stations from July to August, 2011. As a result, the average Chl-a values integrated from 100% to 1% was 29.3 ± 29 $mg \cdot m^{-2}$ in water columns of the open sea stations. The phytoplankton community was dominated by small phytoplankton (0.7-5um) accounting for 65±11% of the total Chl-a concentration, followed by middle (5-20um) and large phytoplankton (>20um). In comparison, the phytoplankton compositions in mp 1 of ice station 1 were 58%, 36%, and 6% for small, middle, and large phytoplankton, respectively. In mp 3, the compositions were 47%, 45%, and 8% for small, middle, and large phytoplankton, respectively.

VARIABILITY IN PACIFIC-ORIGIN SUMMER WATER IN THE CHUKCHI BORDERLAND, ARCTIC OCEAN

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ABSTRACT

The warm water intrusion from the Northern Pacific is considered as an important driving force to melt down the sea ice and change the horizontal and vertical flux of heat, salt and momentum. After passing through a gateway, the Bering Strait, the Pacific-origin water can be highly transformed and redistributed in the vicinity of the Chukchi Borderland/Mendeleev Ridge by the rapid melting of sea ice and freshwater runoff. To investigate the variability in spatial and temporal distribution of water masses and understand its transformation along the pathways and its relationship with variation in sea ice concentration, during the 21-day expedition was conducted by the IBRV *Araon* in the Chukchi Borderland/Mendeleev Ridge. The distribution of Pacific-origin water is not spatially uniform in the vicinity of Chukchi Borderland/Mendeleev Ridge. The salinity of PSW in 2011 is lower than that in 2008. A major pathway of PSW in this year is assumed to be located along the eastern flank of Chukchi Plateau. This change in the major pathway arises from the location of freshwater anomaly in the Canada Basin.

BIO-OPTICAL PROPERTIES IN AMUNDSEN SEA, SOUTHERN OCEAN

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ABSTRACT

In Amundsen Sea, polynya varied from year to year in area. Ocean color data (represented as chlorophyll-a) varied as well. From these variations, we expected that sea-ice melting seems to be related with marine ecosystem variation. However, accuracy of ocean color data should be studied to assess the variation because the ocean color algorithms have not much calibrated and validated in high latitude due to the inaccessibility. Bio-optical data were sampled to improve the accuracy and to understand the relationship by using Korean icebreaker, ARAON. We had two expeditions that from Dec. 2010 through Jan. 2011 and from Jan to Feb 2012. Inherent optical properties (IOPs) and apparent optical properties (AOPs) were measured. For the IOPs, we sampled 3 depths water at each station. For the AOPs, we deployed free-fall typed hyper-spectroradiometer (HPRO II/Satlantic inc.) until euphotic depth having 1% light intensity from sea surface and above water reflectance by using the above water spectroradiometer (HSAS/Satlantic inc.) every 15 minutes over the expedition as well. Mostly, satellite retrieved chlorophyll-a data were higher than in-situ chlorophyll-a data. But spatial distributions of chlorophyll-a data showed relatively similar between the both data. Absorptions by phytoplankton (a_{ph}) in polynya were higher than in open sea especially around 600nm. Water leaving radiances retrieved from MODIS/AQUA data were underestimated comparing with field-measured data. Sampled data can be used to develop current ocean color data in high latitude region.

A HINDCAST SIMULATION OF ARCTIC SEA ICE VARIABILITY DURING THE PERIOD FROM 1990 TO 2009

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ABSTRACT

We simulated the interannual variation of sea-ice in the Arctic Sea using an ice-coupled Ocean General Circulation Model (OGCM). The OGCM used in this study is the Regional Ocean Model System (ROMS) version 3.4, which is a three dimensional, s-coordinate, primitive equation ocean model with a free surface. The model covers the Arctic Sea north of 65°N with an orthogonal curvilinear grid system. The horizontal grid size ranges from 41 to 63 km with an average of 50 km. A total of 50 s-coordinate levels are adopted along the vertical direction with enhanced resolution near the surface.

A set of 12-hourly atmospheric fields obtained from ERA (European center of medium range weather forecasting Re-Analysis)-Interim during the period from 1990 to 2009 is used to calculate turbulent air/sea and air/ice fluxes. We used the 6-year (2004-2009) monthly mean HYCOM/NCODA (Hybrid Coordinate Ocean Model/Navy Coupled Ocean Data Assimilation) Global 1/12° analysis data to specify input values of temperature, salinity, sea surface elevation and velocity components for boundary conditions.

MEASUREMENT OF SUSPENDED PARTICULATE MATTER UNDER THE SEA ICE, ARCTIC OCEAN: LISST-HOLO APPLICATION

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ABSTRACT

Arctic regions are well known to be an indicator and a potential driver of Earth's climate changes, as manifested by recent intensification of global warming and dramatic shrinking of sea-ice coverage. Due to the high melt rate, a large amount of particulate matters existed in the Arctic sea ice are released into the underlying water column. Using recently released submersible digital holographic camera (Sequoia, LISST-HOLO), an *in-situ* experiment was conducted on the drifting sea ice to estimate spatial and temporal variation in suspended particulate matters (SPM) distribution under the sea ice, for the first time. Owing to cutting-edge technology of holography, the three-dimensional aspect of SPM within the sampling volume was reconstructed with in-focus, high-resolution images. LISST-HOLO experiment was performed in the northern part of Chukchi Plateau, Arctic Ocean during about 23 hours with acoustic Doppler current profiler (ADCP). The sediment captured in the sea ice might release into the underlying water by melt out through the melt pond. The peak in size range of sediment measured by LISST-HOLO was 40~50 μm, this range corresponded with the dominant size of phytoplankton under the sea ice. SPM larger than 100 μm was observed, because the sea ice probably encompassed black carbon and sediments originated from atmospheric forcing.

In the context of acoustic/optical responses to SPM, during the presentation, the characteristics of sea-ice-origin SPM and effect of sea-ice-melting on suspended mass flux will be presented. Furthermore, the future applications of LISST-HOLO system will be proposed to monitor the characteristic features of SPM in Polar Oceans.

CLIMATE WARMING CREATES NEW ICE ALGAL HABITAT IN THE ARCTIC OCEAN

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ABSTRACT

The retreat and thinning of Arctic sea ice associated with climate warming is resulting in ever-changing ecological processes and patterns. An example is our discovery of a myriad of new 'marine aquaria' formed by melt holes in the perennial sea ice. We found large masses of ice algae incorporated in the newly freezing sea ice on the surface of melt ponds in the Chukchi Sea and Central Arctic Ocean. Due to warming arctic conditions ice surface ponds can now melt through the ice cover to become holes in the sea ice that refreeze in late summer creating a new habitat for ice algae. In a cold arctic with thicker sea ice summer surface melting forms only shallow freshwater ponds sitting on top of the sea ice without connection to seawater below the ice. What was a cold freshwater environment has been transformed by climate change to a new marine environment.

MELT POND PRODUCTION IN THE ARCTIC OCEAN

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ABSTRACT

Carbon and nitrogen uptake rates of phytoplankton were measured at 26 different melt ponds in 2005 and 2008, using a ^{13}C-^{15}N dual stable isotope tracer technique. Chl-a concentrations in melt ponds ranged from 0.1 to 2.9 mg Chl-a m^{-3} with an mean of 0.6 mg Chl-a m^{-3} (S.D. = ± 0.8 mg Chl-a m^{-3}) in the Canada Basin in 2005, whereas the range of the Chl-a concentrations was from 0.1 to 0.3 mg Chl-a m^{-3} with a mean of 0.2 mg Chl-a m^{-3} (S.D. = ± 0.1 mg Chl-a m^{-3}) in the central Arctic Ocean in 2008. The average annual carbon production in sea ice melt ponds was 0.67 g C m^{-3} (S.D. = ± 1.03 g C m^{-3}) in the Arctic Ocean. Based on this study, recent annual carbon production of all melt ponds was roughly estimated to be approximately 2.6 Tg C, which is less than 1 % of the total production in the Arctic Ocean.

CARBON MONOXIDE EMISSIONS FROM THE SOUTHERN OCEAN ESTIMATED BY UNDERWAY MEASUREMENTS

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ABSTRACT

Atmospheric carbon monoxide (CO) plays an important role in ozone-related chemistry in the troposphere, especially under low-NOx conditions like the open ocean. While the ocean has been known as a source of atmospheric CO, previous studies reveal large discrepancies among their source strength estimates. Thus, clarifying the contribution of the ocean to atmospheric CO budget is essential to understand atmospheric chemistry. During austral summer seasons of 2009 through 2012, we performed continuous shipboard measurement of atmospheric and dissolved CO in the Southern Ocean and along the trans-pacific passage from Incheon, Korea to Christchurch, New Zealand. Based on our observation, we will present source strength of carbon monoxide in the Southern Ocean. Furthermore, global source strength of CO from the ocean will be optimized using inversion analysis of our measurements and the result of 3-D global chemical transport model.

UNIQUE PROCARYOTIC COMMUNITIES OF POLYNYA IN THE AMUNDSEN SEA, ANTARCTIC REVEALED BY 454 PYROSEQUENCING

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ABSTRACT

Microbial communities responding to high variation of temperature and irradiation in Antarctic Ocean are largely understudied. Polynyas are ecological hot spots for energy and matter exchange between atmosphere and ocean in Antarctic Ocean. Here, we performed an investigation of a polynya in the Amundsen Sea using the 454 pyrosequencing technology to get an extended description of the procaryotic assemblages. Oceanographic data shows distinct profiles of environmental variables in polynya from temperate oceans although diversities of procaryotes were comparable with those of temperate oceans. Cluster analysis indicates three distinct microbial assemblates: 1) surface water of polynya, 2) deep water of polynya, and 3) surface water of seaice stations. Two clades of bacteria were dominant which might be involved in carbon remineralization in polynya: 1) *Polaribacter* clade was dominant in surface waters (20-64%), which might associated with degradation polymers of particles; 2) *Pelagibacter* clade was pre-dominant in all samples (17-42%) and may contribute to mineralization of dissolved organic carbons. Archaea of MGI was predominant over other marine archaeal groups in all layers of polynya. Affiliation of most of MGI sequences to *Ca.* Nitrosopumilus maritimus and scarcity of ammonia-oxidizing bacterial sequence indicates the involvement of archaea in nitrification in polynya. Our results unveiled for the first time the unique prokaryotic communities associated with phytoplankton bloom in polynya.

DISTRIBUTION OF NUTRIENTS AND CHL A IN PRYDZ BAY DURING THE AUSTRAL SUMMER OF 2011

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ABSTRACT

Water samples in Prydz Bay were collected during the Antarctic summer of 2011 and the contents of Chl a and nutrients were analyzed. The results showed that the distribution of Chl a in the surface water of Prydz Bay was: margin of ice shelf> continental shelf>continental slope and open sea, melting of ice and stability of water body were the main factors that had influence on the Chl a distribution in the surface water. The vertical distribution of Chl a was related to the irradiation condition, mostly upper water had high content and decreased with the depth。Horizontal and vertical distribution of phosphate, silicate and nitrate was contrary to that of Chl a. Distribution of ammonium in the surface water was contrary to that of main nutrients. The vertical distribution of ammonium at the margin of ice shelf and in the continental shelf was different with that in the continental slope and open sea. The degradation of organic matters mainly control the ammonium content in the water column at the margin of ice shelf and in the continental shelf, however the balance between uptake by phytoplankton and degradation of organic matters controlled that in the continental slope and open sea. According to the contents and distribution of Chl a and nutrients, the cause of DCM and the inhibition of ammonium on nitrate uptake in the surface water south of 67.5°S were discussed.

ISOTOPIC SHIFT IN THE ANTARCTIC LIMPET *NACELLA CONCINNA* FROM ROCKY COASTAL HABITATS, MARIAN COVE, KING GEORGE ISLAND

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ABSTRACT

$\delta^{13}C$ and $\delta^{15}N$ of the Antarctic limpet *Nacella concinna* tissues and their potential food sources were measured to determine their dietary origins and their movements between diverse habitats of intertidal and subtidal rocky shores and tide pools of Marian Cove, King George Island, Antarctica in the austral summer. $\delta^{13}C$ and $\delta^{15}N$ of the organic matter sources of epilithic microalgae, macroalgae, and suspended particulate organic matter (SPOM) were readily distinguishable to discern their relative contribution to the limpet diets, with the most depleted values being found in SPOM and the most enriched in macroalgae. The limpets exhibited a spatial trend in distribution due to their seasonal migration, with smaller individuals in the subtidal zone as compared with larger ones on the intertidal sites. The limpet isotopes had relatively broad ranges of $\delta^{13}C$ and $\delta^{15}N$ (−26.6 to −12.8‰ and 2.6 to 7.1‰, respectively), suggesting a dietary shift between habitats as well as size classes. The stable isotope ratios for each habitat seem likely to reflect the differing availabilities of the three potential food sources. Isotope mixing model results indicate a spatial shift in dietary mixture between habitats as well as limpet size classes. Epilithic microalgae and phytoplankton made great contributions to the diet of the subtidal limpets. Together with epilithic microalgae, macroalgae were significant contributors to the intertidal limpets where macroalgae were abundant. A higher contribution of macroalgae to the limpet diets was found in the tide pools. In contrast, while phytoplankton was an important food source for the limpet spats, a great dietary dependence on epilithic microalgae was found in the small-size limpets from the lower intertidal zone. Our results suggest that limpet grazing can determine microalgal and/or macroalgal abundance and coverage on the Antarctic rocky-shore ecosystem, and trophic structure of benthic food web can change along environmental gradients even at spatial scales of dozens or hundreds of meters in the Antarctic.

Key words: food availability, Antarctic limpet *Nacella concinna*, phytobenthos, tidal pools, rocky shores, King George Island

LONG-LIVED GREENHOUSE GASES (CO_2, CH_4, and N_2O) IN THE AMUNDSEN SEA AT AUSTRAL SUMMER SEASON OF 2011 AND 2012

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ABSTRACT

The ocean plays a considerable role in the budget of long-lived greenhouse gases in the atmosphere: as a sink for CO_2 and a source for CH_4 and N_2O. The high latitude of the Southern Ocean is particularly important as the change in the sea ice extent and melting glaciers will influence the ecological and physical settings that govern the content and flux of dissolved gases in seawater. In order to investigate the impact of the change in the cryospheric environment to the fluxes of these trace gases, we visited the Amundsen Sea during the austral summer in 2011 and 2012. In the open ocean, CO_2 was mostly undersaturated while N_2O and CH_4 were supersaturated in seawater. These typical features were reversed in the sea-ice region except for N_2O. In the Amundsen Sea polynya, CO_2 and CH_4 were depleted in seawater while dissolved N_2O was supersaturated with respect to the atmosphere in the marine boundary layer.

ONBOARD EXPERIMENTS OF PHOTOCHEMICAL PRODUCTION AND MICROBIAL CONSUMPTION OF CARBON MONOXIDE AND MOLECULAR HYDROGEN DURING THE AMUNDSEN SEA EXPEDITION

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ABSTRACT

Carbon monoxide (CO) and molecular hydrogen (H_2) are important trace gases that have potential for affecting the global climate. The ocean is a minor source for these gases although it covers ~70% of the earth. In the surface of the ocean, CO is produced by photochemical degradation of chromophoric dissolved organic matter (CDOM). CO emitted to the atmosphere is oxidized by active reaction with the OH radical, which is the indicator of oxidation capacity of the atmosphere. On the surface of the ocean, H_2 is supersaturated with respect to the atmosphere and has maximum at surface decreasing with depth in the euphotic zone. So the ocean is one of the natural sources for H_2. However, the production and removal mechanism of H_2 in the ocean is not clear yet. Unlike CO which is produced wherever light and dissolved organic matter exist, H_2 may not be the case.

Focusing on these properties of the two gases, we carried out a series of experiments related to their production and removal in seawater during the expedition in the Amundsen Sea from February to March in 2012, which is the period of transition from summer to fall in the Antarctic. At 15 stations covering from 71°S to 75°S and from 100°W to 140°W, we have collected seawaters. Samples were divided into four experimental groups and each group was given different conditions. The first group, collected from surface water, were put in the light source with non-Hg(that is, there were biological activities) and the second in the light source with ca. 0.2mL Hg(that is, there was non-biological activity.).The third and forth groups collected from deep water were at the same conditions with the first and the second, respectively. Triplicate seawater samples were collected for each group and exposed to the light source for given time periods. CO and H_2 in the headspace of each bottle were analyzed with a gas chromatograph. From these experiments, we learn the differences of the production and removal mechanisms of CO and H_2 between oceanic surface and deep waters.

INORGANIC CARBON SYSTEM AND CONTROLS IN THE CHUKCHI SEA OF THE ARCTIC OCEAN OBSERVED FOR TWO YEARS.

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ABSTRACT

The Arctic Ocean has potential to take up atmospheric CO_2 owing to high biological productivity driven by melting sea-ice. The sea-ice coverage in Arctic summer has been dwindled since 1970s. Biological production and CO_2 fluxes in the Arctic Ocean are highly dependent on sea-ice coverage and the formation and melt of sea ice as well. In order to study the inorganic carbon system in Arctic surface water in response to sea ice melt, shipborne measurements were conducted along Northwind Ridge and western boundary of Canada Basin in July 2010 and Chukchi Borderland and Mendeleev Ridge in August 2011. Dissolved inorganic carbon (DIC), total alkalinity (TA), and dissolved CO_2 (pCO_2) were measured in the study area. Seawater samples for DIC and TA were collected onboard of the Korean ice-breaking research vessel, Araon, and were analyzed in the laboratory. pCO_2 on the surface water was measured underway using an automated flowing pCO_2 measuring system. Together with fundamental hydrographic parameters such as temperature, salinity, nutrients, and dissolved oxygen, we will discuss the spatial variation of inorganic carbon system and controls in the Chukchi Sea in the presentation.

SYNTHESIS OF NATURAL IRON FERTILIZATION IN THE SOUTHERN SCOTIA SEA AND THOUGHTS ON FUTURE STUDIES

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ABSTRACT

Natural iron fertilization in the Southern Ocean plays an important role in enhancing the primary production within the high nutrient low chlorophyll (HNLC) regions. To study the physical, biogeochemical and biological processes associated with natural iron fertilization, several expeditions were conducted in the Southern Ocean around the Crozet and Kerguelen Islands and in the southern Scotia Sea in the southern Drake Passage. The shelf slope region north of Elephant Island is one of the major natural iron sources in the Southern Ocean where shelf waters are enriched with an iron flux from sediments through vertical mixing, and transported off the shelf fertilizing the Antarctic Circumpolar Current (ACC) region downstream. Two cruises in the southern Scotia Sea were conducted in austral summer 2004 and winter 2006 to study the coupled physical and biogeochemical processes. The dominant physical process driving iron-enriched shelf waters off shelves is the blockage of the Shackleton Transverse Ridge (STR) in the southern Drake Passage, which forces the ACC to detour southeastward forming a Taylor Column, a topographically-induced stationary eddy over the STR, and a jet through a narrow gap between the STR and the shelf-break north of the Elephant Island. The interaction between the south-detoured ACC and shelf waters around Elephant Island produced significant offshelf transport of shelf waters approximately 0.36 Sv with the iron concentration of 1.5 nM within the upper 200 m in austral summer 2004, and 1.5 Sv with the iron concentration of 3.0 nM in austral winter 2006. Radium isotopes also elucidate a fast horizontal mixing process between shelf and offshelf waters. The iron addition led to enhanced primary production in the downstream area approximately 1000 km long and 400 km wide. These studies suggest that the shelves are one of the major iron sources to the Southern Ocean. However, significant questions remain such as how far can the shelf water plume advect into the ACC, what processes are responsible for transforming this lithogenic source into a bioavailable form, what are the roles of the microbial loop and

zooplankton grazing in iron-biogeochemical processes, and how do these processes vary with extreme changes in solar radiation, mixing and biological activities between different seasons?

POSTER SESSION – DAY1

BIOLOGY 1

BACTERIAL RESPONSE TO TEMPERATURE IN MICROFLUIDIC DEVICE

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ABSTRACT

Sensing changes in the environment is a fundamental property of living organisms. It allows them to respond and adapt to their new surroundings. Bacteria sense and respond to change in their environment. Chemotaxis is now well understood, but thermotaxis is still unclear. Thermotaxis, the temperature-sensing ability, drives the bacteria towards their natural temperature and causes the initial accumulation.
In this work we study the response of strains isolated from Antarctica to temperature gradient. Scientist have found that bacteria which survive in polar environment. This environment is extremely cold and nutrient-poor region.
Recently the modern microfabrication tools allow us to create complex environments at the micrometer-scale and study of small micro-environment. In the last decade microfabrication and microfluidics have been found to be very useful in the study of the observance of microorganisms.
In this work, microstructured environments were manufactured to use PDMS mold which a biocompatible and transparent polymer to observe the motility of bacteria moving into microchannels. Thus, we demonstrate that thermotaxis, motility of bacteria in microchannels have temperature gradient.

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MESOZOOPLANKTON ASSEMBLAGES IN SUMMER 2010 IN THE WESTERN ARCTIC OCEAN

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ABSTRACT

The Arctic Ocean is characterized by its permanent and seasonal ice cover, and its limited connection to other oceans. Zooplankton species distribution and diversity here are important measures of environmental changes in the polar region of the Northern Hemisphere and serve as bioindicators of environmental health in this part of the world. During August 2010 zooplankton samples were collected from board of the Korean icebreaker RV Araon during a cruise to the central Arctic Ocean and Chukchi Sea. Holoplanktonic zooplankton has been studied from various areas in the Arctic Ocean with the largest diversity, abundance and biomass among the copepods. We analyzed copepod distribution and abundance at 11 stations along a transect line in the Western Arctic. We identified a total of 27 copepod species consisting of 19 genera belonging to the Calanoida, Cyclopoida, Harpacticoida, and Poecilostomatoida. Integrating all samples, the numerically most dominant genus was *Calanus* with the 2 species *Calanus hyperboreus* and *C. glacialis*. At the same time was *C. hyperboreus* the most frequently occurring species with an occurrence rate of 92.3%, being retrieved from all stations except the southernmost stations. We are discussing the indicator species concept for its application to discriminate hydrographic regions in the Arctic Ocean using our findings and comparative information from the literature. Future changes in temperature and ice cover in the Arctic are expected to impact Arctic maritime ecosystems. Zooplankton communities are expected to show effects as well in their occurrence, dispersal, biogeographic boundaries, and for the productivity of subsequent trophic levels.

PLENARY SPEECH

THE STRUCTURE AND EVOLUTION OF THE ROSS SEA

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ABSTRACT

Our knowledge of the geological structure and evolution of the Ross Sea and its past environment is based on limited direct geological information supplemented by a broad coverage of geophysical data. Land geological information is confined to the margins (Transantarctic Mountains (TAM) and Western Marie Byrd Land) where only igneous rocks are recorded with ages between the Jurassic and Pliocene. Offshore direct geological data are sparse apart from near surface sediments, sampled by piston coring. Several drilling projects have recovered sediments as old as Late Eocene, with two drill holes sampling basement. However, these drill holes are mainly concentrated in the McMurdo Sound region with only four sites in the most of the Ross Sea. These data can be extrapolated into the remainder of the Ross Sea by seismic and other geophysical studies but there is a lack of good age control for large parts of the sedimentary sequences. The drill hole data have defined icesheet proximal past environmental conditions in detail, including cyclical events. The combined data sets have defined the major structures in the Ross Sea – the four major basins (Victoria Land (VLB), Northern, and Eastern Basins and the Central Trough) and major faulting through the Ross Sea, although there is some uncertainty over the style and presence of the faulting. The continuation of these structures south under the Ross Ice Shelf has been inferred but not well constrained. The presence of volcanic edifices and ridges has been documented within the Ross Sea but their age is often uncertain. At the seafloor and in the upper sediments, BSRs, pock marks and mud volcanoes have been documented, along with sub-glacial features such as grounding zone wedges. Detailed morphological data have recorded sub-ice sheet processes, including moraines, lineations, and iceberg furrows, that document the past movements of the ice sheet across the Ross Sea. Oceanic magnetic anomaly data provide plate tectonic constraints on the evolution of the region, requiring some plate boundary deformation through the region during the Tertiary. Several geodynamic models have been developed to explain the TAM – Ross Sea evolution, but most are 2D models across the VLB region which only covers part of the TAM margin and suggests that the two features (TAM, VLB) are not coupled. Several outstanding issues need addressing including the age of the oldest sediments in the Ross Sea basins, the continuity of the oceanic Adare basin into the Northern basin, the cause of the Polar-3 anomaly (transfer fault?), the age of the NW trending strike slip faults, the restricted extent of the VLB and a consistent seismic stratigraphy for the Ross Sea.

PALEOCEANOGRAPHIC RESEARCH PERSPECTIVES FOR THE PACIFIC SECTOR OF THE ARCTIC

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ABSTRACT

Present retreat of Arctic sea ice driven by climate warming is especially pronounced in the Pacific sector of the Arctic. This situation opens broader access to this part of the Arctic Ocean and prompts more investigation of modern and past climatic processes to aid prediction of future changes. Based on our existing knowledge of this region, the major objectives of paleoceanographic research include: (1) Pacific water inflow and its influence on sedimentary, hydrographic, biological, and ice conditions, (2) variability of sea ice in relation to climate changes, (3) history of the Beringian land bridge that connected Asia and North America during low sea levels, (4) Pleistocene glaciations of the Chukchi margin, and (5) development of sub-sea permafrost and gas hydrates. These research goals are primarily associated with the Late Cenozoic period of the Earth history. On longer time scales, the Chukchi Borderland and adjacent geological structures are the key targets for understanding the origin and tectonic evolution of the Amerasian basin.

In pursuit of these and related research objectives, multiple expeditions with geological-geophysical components have been performed recently in the Chukchi Sea and adjacent waters, and more cruises are being planned for the coming years. A characteristic feature of these research activities is a widening range of participating countries in addition to those that have traditionally worked in the Arctic in the 20th century. This reality creates incentives for broadening international cooperation, which can greatly increase the overall efficiency of the scientific output. An excellent opportunity for international cooperation can be provided by bringing the Integrated Ocean Drilling Program into the Arctic. This development is becoming possible due to the unprecedented retreat of the summer ice margin. Four IODP projects with primarily paleoceanographic agendas are already being developed for the Chukchi-Beaufort region (in a full- or pre-proposal stage), and another one may be developed in the near future with a focus on tectonic issues. Paloceanographic questions are expected to be tested by drilling sediment accumulations including Cenozoic sedimentary basins on both sides of the Bering Strait and mouth fans of canyons that cross the Chukchi shelf. A comparison with IODP results from the Bering Sea (Expedition 323) will further contribute to the comprehensive understanding of the history of climatic and oceanic systems in the Pacific sector of the Arctic.

SESSION Ⅴ

OCEANOGRAPHY

OCEAN CIRCULATION IN THE CANADA BASIN

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ABSTRACT

Freshwater input for the upper ocean supplied by sea ice melt was a remarkable feature in eastern Canada Basin during IPY2007-2008. From 2006 to 2008, observed increase in freshwater content relative to S=34.8 was about 5m. Since the thickness of sea ice in this region is much less than 5m, the increase in freshwater content was assumed to be formed by accumulation of melt water. The accumulated freshwater began to form a sub-circulation inside of large scale Beaufort Gyre. In 2008, the center of the freshwater pool was located in the eastern Canada Basin near the Canada-US borderline (figure 1: upper left). In the western part of the freshwater pool, northward flows were settled by the sub-circulation (figure 1: upper right). As the results, main pathway of the Pacific Summer Water showed widely extended pattern between Northwind Ridge and Canada-US borderline. In 2011, the freshwater pool was advected in the region of the Northwind Ridge by the large-scale background Beaufort Gyre (figure 1: lower left). The spreading pathway of the PSW was significantly altered by the distribution of the freshwater pool. Now the target area of IBRV Araon is the center of Arctic Ocean change in near future. In the presentation, we also plan to argue the recent drastic changes in momentum penetration from atmosphere into the ocean via sea ice, resultant changes in large scale ocean circulation, and vertical mixing in the upper ocean.

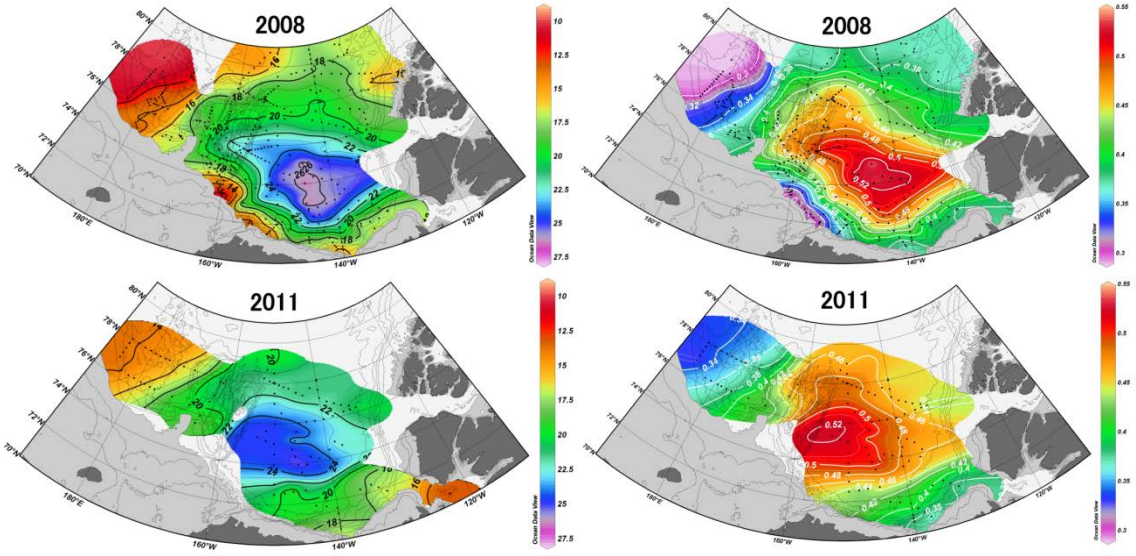

Figure 1: freshwater content in 0-1000m (left), Dynamic height at 50dbar referred to 800dbar (right)

KOREAN RESEARCH ACTIVITIES IN KING GEORGE ISLAND AND INTERNATIONAL COOPERATION

In-Young Ahn

Vice President, KOPRI

ABSTRACT

Korean Antarctic Program initiated with the establishment of the King Sejong Station in King George Island in 1988. Up until the recent years, before the launching of the icebreaker, *Araon*, most of our work had been carried out in KGI and in the vicinity around the South Shetland Islands. Despite the logistic limitation, we have come up with meaningful scientific achievements from our activities in KGI, in marine biology, oceanography, geology and atmospheric sciences etc. The KGI is the most crowded place in the Antarctic, where eight countries have been operating their stations all year round, and a high number of visitors come and go every summer time. In addition, KGI belongs to Antarctic Peninsular Region where climate change is proceeding faster than anywhere else in the Antarctic. For that reason, there are now scientific as well as economic and environmental protection imperatives for National Programs to work closer together in partnership in KGI. In this presentation, our past and ongoing activities in KGI will be introduced with some scientific outcomes. Some suggestions will also be proposed for future collaboration in KGI.

OCEAN ACIDIFICATION IN THE WESTERN PACIFIC SECTOR OF THE SOUTHERN OCEAN

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ABSTRACT

The oceans are thought to be absorbing about a quarter of anthropogenic CO_2 that is released to the atmosphere each year as a result of fossil fuel burning and land-use changes. The trend of acidification thus caused by the addition of CO_2, *i.e.* carbonic acid, into global oceans is considered to lead to serious consequences for marine biodiversity and ecosystems.

On the basis of the records of measurements for oceanic CO_2 partial pressure and related surface properties in several summer seasons during 1969 – 2003, we determined the long-term trends of ocean acidification in surface waters of the western Pacific sector of the Southern Ocean. The computed values of pH exhibited substantial decrease in the extensive region from the subtropical to polar zones. The mean rates of pH change over the 35-year period ranged from -0.0011 to -0.0013 yr^{-1} in the zones north of the Polar Front and were negatively larger in the polar zone (-0.0020 yr^{-1}). The higher rate of acidification in surface water of the polar zone was attributed to the enhanced CO_2 supply from subsurface by intensified wind stress as well as the accumulation of anthropogenic CO_2. A preliminary result of evaluation for future changes in seawater carbonate system projected that the polar zones out of the Polar Front is to be undersaturated with respect to the biogenic carbonate mineral aragonite in summer late this century.

More rigorous assessments of ocean acidification need longer time records of seawater CO_2 measurements in various regions of the oceans. They requires sustained international collaborations that include plannings of measurements and data sharing through the databases such as SOCAT for surface water CO_2 and CARINA and PACIFICA for the ocean interior.

COEXISTENCE OF MESOPREDATORS IN AN INTACT POLAR OCEAN ECOSYSTEM: THE BASIS FOR DEFINING A ROSS SEA MARINE PROTECTED AREA

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ABSTRACT

Designation of an effective marine protected area (MPA) requires substantial knowledge of the spatial use of the region by key species, particularly those of high mobility. Within the Ross Sea, Antarctica, the least altered marine ecosystem on Earth, unusually large and closely interacting populations of several marine bird and mammal species co-exist. Understanding how that is possible is important to maintaining the ecological integrity of the system, the major goal in designating the Ross Sea as an MPA. We report analyses of niche occupation, two-dimensional habitat use, and overlap for the majority (9) of mesopredator species in the Ross Sea considering three components: 1) diet, 2) vertical distribution and 3) horizontal distribution. For (1) and (2) we used information in the literature; for (3) we used maximum entropy modeling to project species' distributions from occurrence data from several ocean cruises and satellite telemetry, correlated with six environmental variables. Results identified and ranked areas of importance in a conservation prioritization framework. While diet overlapped intensively, some spatial partitioning existed in the vertical dimension (diving depth). Horizontal partitioning, however, was the key structuring factor, defined by three general patterns of environmental suitability: 1) continental shelf break, 2) shelf and slope, and 3) marginal ice zone of the pack ice surrounding the Ross Sea post-polynya. In aggregate, the 9 mesopredators used the entire continental shelf and slope, allowing the large populations of these species to co-exist. Conservation prioritization analyses identified the outer shelf and slope and the deeper troughs in the Ross Sea shelf to be most important. Our results substantially improve understanding of these species' niche occupation and imply that a piecemeal approach to MPA designation in this system is not likely to be successful.

ACOUSTIC CHARACTERIZATION OF EUPHAUSIA CRYSTALLOROPHIAS DISTRIBUTION IN AMUNDSEN SEA POLYNYA, WEST ANTARCTICA AUSTRAL SUMMER 2011 AND 2012

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ABSTRACT

A basin-scale acoustic survey was undertaken in the Amundsen Sea polynya during austral summer (January 2011and Feburary 2012) to describe the distribution of ice krill (*Euphausia crystallorophias*). Acoustic data (120 kHz, EK60) and environmental data were collected to examine its broad relationship with the bio-physical environment. Simultaneously, target trawls using bongo net were taken to obtain length-frequency distributions of *E. crystallorophias*. The acoustic data attributed to *E. crystallorophias* were compressed to convert MVBS (Mean Volume Backscattering Strength) using virtual echogram technique. The density of *E. crystallorophias* was compared with environmental variables (sea ice concentration, bathymetry, temperature, salinity, density, fluorescence and dissolved oxygen). Higher *E. crystallorophias* concentrations were observed both at the boundary zone between pack ice and coastal polynya and near Getz ice shelf, while only low concentrations were detected near Dotson ice shelf. The distribution patterns of *E. crystallorophias* seem to be significantly correlated with temperature variations (r^2=0.55) among the several enviomental factors. *E. crystallorophias* density was tended to be greater with increasing mean sea temperature in both seasons.

Key words: Amundsen Sea, coastal polynya, *Euphausia crystallorophias*, MVBS

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OCEANOGRAPHIC MOORINGS AS OBSERVATORIES FOR STUDY VARIABILITY AND CHANGE IN THE ARCTIC OCEAN

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ABSTRACT

The Canadian Institute of Ocean Sciences began year-round sustained observations in the Beaufort Sea using sonar in the early 1990s. We are using this record to study variability and change over the last two decades. Our thickness record for first-year sea ice reveals high variability at annual-to-decadal periods but little consistency in trends. Such characteristics are also seen in 50-year records of fast ice. Because the apparent insensitivity to increasing air temperature is enigmatic at our present level of understanding, we examine other factors in play. Ice dynamics (import/export, divergence, compression) for example is linked to other parameters of climate, namely mean atmospheric circulation and storminess. These in turn leave an imprint on the underlying ocean. We propose plausible mechanisms to link winds to the production and export of new ice, to the rapid thickening of pack ice via ridge-building, to the expansion of first-year pack ice north of Alaska and to changes in the dates of break-up and freeze-up. A stronger scientific focus on first-year ice, perhaps long overdue, is needed to substantiate these hypotheses.

SESSION VI

GEOSCIENCES 3

CANADA'S ARCTIC GEOSCIENCE PRIORITIES

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ABSTRACT

Globalization, the probable opening of an Arctic shipping route, changing climatic conditions, national sovereignty and security issues, and resource prices/issues have resulted in increased focus on Arctic natural resources. The Arctic constitutes a significant, strategic and largely unknown and untapped reserve of natural resources. Future Arctic prosperity will largely depend on each individual Arctic nation's abilities to develop responsible and sustainable Arctic policies and measures (P&Ms).

The circum-Arctic community is an international community of nations, sectors, people, and distinctive physical environments. Each country is unique in terms of the quantity, quality, characteristics, and descriptions of its natural resources. Understanding and respecting differing national and regional circumstances provides insights into how a nation utilizes the natural resources over which it holds stewardship and is a prerequisite to: science-informed discussions; the development of sound domestic natural resource priorities and P&Ms; and, helping ensure circum-Arctic sustainability. Appropriate Arctic priorities and P&Ms must be determined by each sovereign country according to its own national circumstances, and supported by science.

The Government of Canada's northern agenda and its supporting geoscience S&T programs (e.g., onshore and offshore mineral and energy resource mapping; public safety, and permafrost monitoring) are focused on understanding Canada's national circumstances. Canada is building a strong Arctic S&T infrastructure that will help Canada and its international S&T partners responsibly develop Canada's north.

KOPRI RESEARCH ACTIVITIES ON GAS HYDRATES IN THE COLD SEAS: ANTARCTIC, OKHOTSK AND ARCTIC SEA

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ABSTRACT

Because gas hydrates are formed in low temperature and high pressure environments, cold seas including Polar and Okhotsk Seas are very favorable areas for gas hydrate formation on earth.

KOPRI collected single-/multi-channel seismic reflection data on the South Shetland continental margin, Antarctic Peninsula since 1993 using RV *Onnuri and Yuzhmogeologya*. Seismic data show that Bottom Simulating Reflectors (BSRs) are widely distributed on the South Shetland margin. We estimated the total volume of gas hydrate in the area. Assuming that gas hydrates exist only where BSRs are observed, the total volume of gas hydrates along the seismic profiles in the area is about 4.8×10^{10} m^3 (7.7×10^{12} m^3 volume of methane at standard temperature and pressure).

Multidisciplinary surveys have been conducted to investigate gas seepage and gas hydrate accumulation on the Sakhalin continental slope (SS), Sea of Okhotsk, during joint Korea-Russia-Japan expeditions conducted from 2003 to 2011 (CHAOS and SSGH projects). Active gas seeps in a gas hydrate province on the SS were evident from features in the water column, on the seafloor, and in the subsurface: well-defined hydroacoustic anomalies (gas flares), side-scan sonar structures with high backscatter intensity (seepage structures), bathymetric structures (pockmarks and mounds), gas- and gas-hydrate-related seismic features (bottom-simulating reflectors, gas chimneys, high-amplitude reflectors, and acoustic blanking), high methane concentrations in seawater, and gas hydrates in sediment near the seafloor. These expressions were generally spatially related; a gas flare would be associated with a seepage structure (mound), below which a gas chimney was present.

As the ice-breaker RV *Araon* in 2009 was launched, KOPRI will expand gas hydrate research activities in the polar sea. KOPRI has developed a Korea-Canada-US international research project to focus on geological, geophysical and oceanographic investigations of the Beaufort Sea shelf to study the stability of decomposing permafrost and gas hydrate and the mechanisms for gas migration and release at the sea floor. Our research will allow assessment of the importance of Arctic shelves as past and present sources of methane for the atmosphere and will quantify a range of geohazard/environmental processes associated with gas migration and release that have not been documented to date. In addition, KOPRI will conduct surveys to investigate gas hydrate and its related phenomena in Chukchi Sea (Arctic) and Ross Sea (Antarctica).

EVIDENCE OF METHANE VENTING FROM DECOMPOSING PERMAFROST AND GAS HYDRATE ON THE SHELF AND SLOPE OF THE CANADIAN BEAUFORT SEA

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ABSTRACT

The sub-seafloor under the Arctic Shelf is arguably the part of the Earth that is undergoing the most dramatic warming. In the southern Beaufort Sea, the shelf area was terrestrially exposed during much of the Quaternary period when sea level was ~120m lower than present. As a consequence, many areas are underlain by >600m of ice-bonded permafrost that conditions the geothermal regime such that the base of the methane hydrate stability can be >1000m deep. Marine transgression has imposed a change in mean annual surface temperature from -15°C or lower during periods of terrestrial exposure, to mean annual sea bottom temperatures near 0°C. The thermal disturbance caused by transgression is still influencing the upper km of subsurface sediments. Decomposition of gas hydrate is inferred to be occurring at the base and the top of the gas hydrate stability zone. As gas hydrate and permafrost intervals degrade, a range of processes occur that are somewhat unique to this setting. Decomposition of gas hydrate at depth can cause sediment weakening, generate excess pore water pressure, and form free gas. Similarly, thawing permafrost can cause thaw consolidation, liberate trapped gas bubbles in ice bonded permafrost. Understanding the connection between deep subsurface processes generated by transgression, surficial sediment processes near the seafloor, and gas flux into the ocean and atmosphere is important to assessing geohazard and environmental conditions in this setting. In contrast, conditions for marine gas hydrate formation occur on the adjacent continental slope below ~270m water depths. In this paper, we present field observations of gas venting from three geologically distinct environments in the Canadian Beaufort Sea, two on the shelf and one on the slope. A complimentary paper by Dallimore et al reviews the geothermal changes conditioning this environment. Vigorous methane venting is occurring over Pingo-Like-Features (PLF) on the mid-shelf. Diffuse venting of methane is occurring over a large area along the shelf edge. The methane gas emanating from both shelf features have stable isotopic compositions that indicate they are microbial in origin and are radiocarbon dead and thus sourced from geologic deposits. The PLF vents are believed to be sourced from the top of the gas hydrate stability field, while the gas emanating along the shelf edge can be from either permafrost or gas hydrate decomposition. Gas venting from both these shelf edge environments is consistent with

heating associated with the last transgression. On the continental slope 3 circular topographic features up to 1 km in diameter occur in 290-790 m water depth. Data will be presented that show these are coincident with gas chimneys connected to geologic structures at depth. Water column flares, vigorous methane release and pore water freshening in cores suggest these are active vent sites and contain near seafloor marine gas hydrate. In this one area where both permafrost and marine gas hydrate occur in close proximity there is a remarkable coalescence of geologic features that are potentially related to climatically induced gas hydrate or permafrost decomposition.

A FRAMEWORK FOR KOREA-CANADA-USA ARCTIC RESEA RCH USING THE ARAON RESEARCH VESSEL

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ABSTRACT

In December 2011 a new international collaboration was initiated to undertake geoscience and oceanographic studies in the Canadian Arctic. During the first phase of the research (2011 to 2015), we hope to conduct new geological, geophysical and oceanographic investigations of the Beaufort Sea shelf to study the stability of decomposing permafrost and gas hydrate and the mechanisms for gas migration and release at the sea floor. Our hypothesis is that shelf areas of the Arctic less than 100m water depth, which make up ~32% of the area of the Arctic Ocean, are underlain by permafrost and gas hydrate stability conditions that formed during past glacial periods and are only now being altered by the thermal effects of marine transgression which may promote their degradation. Our research will allow assessment of the importance of Arctic shelves as past and present sources of methane for the atmosphere and will quantify a range of geohazard/environmental processes associated with gas migration and release that have not been documented to date.

The Beaufort Shelf is an ideal study area because: (1) significant amounts of thermally disturbed permafrost gas hydrate are known to exist in the subsurface, (2) gas venting has been documented in association with unique physical features on the sea floor (i.e. active submarine pingo like features, pockmarks, sub-marine slope failures and permafrost taliks), suggesting there are unique point sources and transitional pathways for fluid and gas movements from decomposing gas hydrates, and (3) the surface sediments in this area are predominantly fine-grained, permitting collection of good sediment cores to enable stratigraphic, biostratigraphic and geochemical studies. We believe that research in the Beaufort Sea will contribute to our understanding of other larger Arctic shelves (e.g. the Siberian shelf) and will be greatly valued by the international research community. Both the Integrated Ocean Drilling Program (IODP) and the Integrated Continental Scientific Drilling Program (ICDP) are also considering research in the Beaufort Sea and our research would provide site survey data in support of active drilling proposals.

THE ROSS SEA: EXAMPLES OF PALEOCLIMATE AND SEDI MENTARY DYNAMIC STUDIES. THE HOLOCLIP AND THE ROSSLOPE PROJECTS

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ABSTRACT

The first Italian Antarctic sedimentological expedition funded by PNRA (National Program for Antarctic Research) started in the summer of 1987. Continental (beach, lacustrine, moraine sediment) and surface marine sediment were collected and a textural map of the Terra Nova Bay was produced (Brambati et al., 1997) as well as other geochemical and sedimentological data on sea floor sediments in Joides and Drygalsky Basins (Brambati, 1989; Brambati et al., 1997; 1999; Heike Merlin et al, 1991; Lenardon, 1989).

The further oceanographic cruises (from 1989 to 2002) were performed to investigate the areas along the Victoria Land (Cape Adare, Joides Basin, Drygalski Basins, Terra Nova area) toward the Central Ross Sea: great many grabs, box cores and sediment cores were collected in order to reconstruct post glacial sequences and to facilitate an understanding of the fluctuations of the grounding line during the last glacial maximum (Brambati, 2000; Brambati et al., 2001; Colizza et al., 3003; Finocchiaro et al, 2007; Melis et al, 2002; Pistolato et al, 2005; Quaia et al, 1998; Salvi et al, 2006; Salvi et al, 2004).

In 2003 the BAY project started ("Palaeoenvironmental evidences of Holocene climate fluctuation in bay sediments of the western Ross Sea"). During the cruise cores and box cores were collected in 5 coastal areas (Cape Adare, Cape Hallett, Wood Bay, Terra Nova Bay, Cape Bird). The goal of the project was the reconstruction of palaeoenvironmental fluctuations related to rapid and variable changes of global climate during the Holocene recorded in marine sediments with high sedimentation rate (Finocchiaro et al, 2003; 2005; Colizza et al, 2010).

The seismic data and the cores collected within the framework of BAY Project was a very important contribution to an-other project started in 2010: the HOLOCLIP project (2010-2012). The HOLOCLIP project (Holocene climate variability at high-southern latitude: an integrated perspective) is a European Science Foundation /European Polar Board PolarCLIMATE initiative whicht involves seven European countries (Italy, France, Spain, Germany, Netherlands, Belgium, United Kingdom) coordinated by Dr. Barbara Stenni (University of Trieste, Italy). The Italian partner is funded by PNRA. The project aims to bring together the ice core, the sediment core and the modeling scientific communities in order to understand the processes linking different components of the climate system and linking climatic response to external forcing over the Holocene. The areas in which the European research efforts have been

concentrated over the past decades are suited for integrating existing ice and marine records in terms of amount and quality of collected materials. Key areas of the Antarctic Ice Sheet and their marine surroundings have been selected: Western Ross Sea, Oates-George V-Adelie Lands including Dome C ice drainage basin, Prydz Bay, Dronning Maud Land and Antarctic Peninsula-Scotia Sea.

The ROSSLOPE project ("Past and present sedimentary dynamic in the ROSS Sea: a multidisciplinary approach to study the continental Slope") started at the end of 2011 and the multidisciplinary research will be developed in two years. This project is entirely funded by PNRA. The aim of the project is to investigate the relationship between present and past water mass circulation from modern and late-Cenozoic sedimentary sequences of the Ross Sea outer shelf and continental slope of the 2 areas 1) Adare and Central Basins and 2) the area to the East of Pennell-Iselin Banks. The study will be performed through the comparison and integration of oceanographic data concerning the circulation of the present dense, cold water masses produced in the Ross Sea (High Salinity Shelf Water and the Ice Shelf Water), with the chemical-physical-biotic features of superficial and recent sediments and the geomorphological characteristics of these areas. In these areas few and scattered geological, geophysical, oceanographic and morpho-bathymetric data exist.

The working area East of the Iselin Bank is very important because it is the site for the location of IODP Proposal proposed by P. Bart (Louisiana University, USA) in collaboration with other proponents. The objectives of the IODP proposal were very well evaluated but it is necessary for the acquisition of new seismic and geomorphological survey to better characterize the drilling sites.

A memorandum of understanding has been signed between Dr. Jongkuk Hong (Korea Polar Research Institute, Kordi, Korea) and Dr. Ester Colizza (Rosslope Project coordinator; University of Trieste, Italy). The purpose of the project is to integrate the existing PNRA data with new data to be collected from the Ross Sea continental shelf, slope and rise with the Korean ship ARAON, in order to provide direct observations on modern and past bottom water processes. The Antarctic Araon cruise is planned for the austral summer of 2012/2013.

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OBSERVATION OF SUBMARINE TECTONIC ACTIVITIES USING LONG TERM PASSIVE OCEAN BOTTOM SEISMOMETERS IN THE ROSS SEA, ANTARCTICA

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ABSTRACT

A prominent continental rift is underlying the western part of the Antarctic continent. The current stretching is accompanied by active volcanism at the rim of the Ross Sea as well as underneath the thick ice sheet. Airborne radar measurements have detected active volcanoes south of the Ross Sea. Korea Polar Research Institute (KOPRI) and Alfred Wegener Insitute have deployed 4 long-term broadband Ocean Bottom Seismometers (OBSs) in the Ross Sea near the Jang Bogo Antarctic station during 2011-2012 KOPRI's Antarctic expedition. It is a pilot research project aiming to better understanding the current seismicity of the West Antarctic Rift System. To accomplish it, we are going to investigate local seismicity and ambient noise around Frankin Island to estimate possible magmatic activity around a seamount. Acoustic noise from glaciers nearby and *T*-phase propagation study would be conducted in parallel. In addition, we will observe teleseismic events to deteremine the lithospheric structure, and examine shear wave splitting using the OBS data.

SESSION Ⅶ

ARCTIC PALEOCLIMATE / PALEOCEANOGRAPHY 1

AN UNDISCOVERED OCEAN IN A CHANGING WORLD KEY AREAS AND SCIENTIFIC APPROACHES OF THE ALFRED WEGENER INSTITUTE TO RECONSTRUCT THE PREGLACIAL AND GLACIAL HISTORY OF THE ARCTIC OCEAN

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ABSTRACT

In spite of the critical role of the Arctic Ocean in climate evolution, our understanding of the short- and long-term paleoceanographic and paleoclimatic history since late Mesozoic-Cenozoic times remains behind that from the other world's oceans. This is mainly caused by the major technological/logistic problems in reaching this ice-covered region and in retrieving long and undisturbed sediment cores.

With the first long record from the central Arctic Ocean ACEX (or IODP Expedition 302) provided evidence for ice rafting and ice–dependent diatioms during the middle Eocene and for a ventilation of intermediate and deep waters attributed to the deepening and widening of the Fram Strait during late Eocene to Miocene. Despite the success of ACEX, fundamental questions related to the long- and short-term climate history of the Arctic Ocean remain unanswered and further drilling activities are needed and being proposed (see abstract R. Stein, this Symposium). As was the case for ACEX, site selection, evaluation of proposed drill sites for safety and environmental protection depends on comprehensive site survey data.

Multi-channel seismic investigations in the Arctic Ocean carried out using the AWI research icebreaker "Polarstern" provide a major data base for past (ACEX) and future drilling projects. One area of specific interest is the continental margin of the Chukchi and East Siberian seas. Based on a series of prograding sequences in the upper 4 km of sediments and the method of seismic sequence stratigraphy, the first relative sea-level curve for the Chukchi region is introduced, beginning in the Late Eocene (40 Ma). This sea-level curve does not correlate with global events for the period Eocene/Oligocene - Early Miocene. It is suggested that the Arctic Ocean was an isolated basin during Eocene/Oligocene until Early Miocene.

The same seismic data set provides evidence for a major unconformity near the top where prograding sequences are truncated. High resolution (sediment-echosounding)

seismic data exhibit that the erosional events are associated with the deposition of sediments interpreted as subglacial till and proglacial wedges and/or debris flows. In the area of the Mendeleev Ridge and as deep as 1300 m present water depth, former grounding of ice is also indicated by mega-scale glacial lineations covered by pelagic muds. These data are indicative of a change in the sedimentary environment from a none-glacial to a glacial continental margin along the Chukchi – East Siberian seas. For this area, a correlation of acoustic data with a preliminary age model derived from sediment cores suggests major glaciations occurred repeatedly with an onset during MIS 16 and a final termination during MIS 4 or 5. The data provide new evidence for the existence of extensive circum-Arctic ice sheets during the Quaternary and raise the question whether these ice sheets developed synchronously or asynchronously in North America, East Siberia, and Eurasia.

Studies of bulk mineralogy of surface sediments and cores focus on the determination of potential source areas for the terrigenous material derived from Eurasia and North America to reconstruct the sedimentary environments in the Amerasian Basin of the Arctic Ocean (abstract by Bazhenova et al. this Symposium). For example, MIS 16, 12, 10, and 8 are characterized by increased dolomite contents and high amount of sand (>63µm) indicating ice-rafted debris (IRD) input from the Laurentide Ice Sheet. MIS 6, on the other hand, is characterized by low dolomite and high quartz contents, suggesting a different source region for the IRD input. New XRD and grain-size data from the coarse-grained intervals of sediment cores from the Mendeleev Ridge are related to major glaciations in the different regions (abstract by Zou et al. this Symposium).

In terms of reconstructing the history of the Arctic sea ice on geological time scales the AWI uses a biomarker approach which is based on the determination of sea-ice diatom-specific highly-branched isoprenoids ("IP25") and a combined phytoplankton-IP25 biomarker ("PIP25"). These data are further combined with TOC, hydrogen indices; long-chain n-alkanes, sterols, alkenones; Uk37 and TEX86-Index; BIT-Index; and HBIs (see abstract by Méheust et al. and Xiao et al. this Symposium). Specific areas of interest for biomarker analysis include the central Arctic Ocean, Chukchi Plateau – East Siberian Sea, Kara and Laptev seas, the Canadian Arctic Archipelago, the Bering Sea and the area off East Greenland up to the Fram Strait. Published, ongoing and planned studies of biomarkers in sediment cores focus on time windows from MIS 6 to MIS 1 (see abstract by Méheust et al. and Xiao et al. this Symposium). Another strong focus include analyses of biomarker distribution in surface sediments as a reflection of sea-ice coverage and the biomarker distribution in sediment traps as a reflection of seasonal variation in ice cover and preservation in the water column (see abstract by Fahl and Stein this Syposium).

ORIGIN OF AUTHIGENIC CALCITE AND ARAGONITE IN PELAGIC SEDIMENTS OF THE MENDELEEV RIDGE (ARCTIC OCEAN) AND THEIR IMPLICATIONS

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ABSTRACT

Carbonate minerals were discovered from the giant box core (PS72/410-1) of the pelagic sediments recovered from the Canadian Arctic across the central Mendeleev Ridge (Station location= Lat. 80°30.37"N, Long. 175°44.38"W) during the Arctic cruise by Polarstern in 2008. The core was 39 cm in depth and was collected from the water depth of 1802 meters. The sediments show various colors from grey to brown as previously reported in other Arctic pelagic sediments. The sediments include planktonic foraminifers together with carbonate minerals. The contents of planktonic foraminifers and carbonate minerals vary with core depth, however these carbonate minerals are present through the whole sequence except for a few centimeters. After wet sieving, coarse fractions were texturally examined with binocular microscope and SEM, and stable isotope compositions were obtained. Mineralogy of carbonate minerals were determined using crystal shapes and qualitative Sr contents by EDAX. The carbonates are composed of calcite, aragonite or a combination of both.

Aragonite crystals show (1) radiating fibrous texture, (2) randomly oriented fibrous texture, (3) spherulitic fibrous texture, and (4) bladed texture, and calcite crystals show (1) foliated texture, (2) randomly bladed texture, (3) spherulitic fibrous texture, and (4) equant texture. Various crystal shapes of aragonite and calcite together with clear growth shapes of the crystals suggest that they are inorganic in origin. Highly enriched carbon isotope compositions ($\delta^{13}C$ = 0 ~ +5‰ vs. PDB) strongly indicate that they formed in methanogenic zone below sediment/water interface by the reaction between anoxic pore fluids and host sediments induced by methanogenic bacteria. However, a wide range of oxygen isotope values ($\delta^{18}O$ = -5 ~ +5‰ vs. PDB) still need more scrutiny. Four types of stable isotope compositions are recognized and they imply complicated evolution of early diagenetic pore waters. Because the host sediments including these carbonates are not organic-rich, the presence of the authigenic carbonates may be related to paleoceanograhic conditions of the Arctic Ocean which resulted in anoxic pore water conditions just a few centimeters below the sediment/water interface.

INVESTIGATION ON GLACIAL HISTORY AND PALEOCEANOGRAPHIC CHANGES OF THE WESTERN ARCTIC OCEAN (MENDELEEV RIDGE) USING BERYLLIUM ISOTOPES

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ABSTRACT

A recent investigation on paleoclimate and environmental changes using beryllium isotopes for the Mendeleev Ridge of the western Arctic Ocean was accomplished using a 39 cm-long box core sediment (PS72/396-3). The age of this core seems to be back to MIS 5.d based on the stratigraphy of Be 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 two major cold periods during the MIS 5.d and reveals a much longer warm period after the second cold period. The ^{10}Be stratigraphy reveals both production rate of ^{10}Be and climatic influence. At depth from 22 to 25 cm of this core, the lowest ^{10}Be signal is observed which could be due to the highest paleomagnetic intensity indicated as an age of 75 kyr elsewhere. Interestingly, ^{9}Be data show that constant input of ^{9}Be to the Mendeleev Ridge. 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 used as a good climatic tracer. This study could provide a useful tool to understand Arctic climate change for the Mendeleev Ridge as well as global paleoclimate changes during the late Quaternary glacial-interglacial cycles.

AUTHIGENIC NEODYMIUM ISOTOPES RECORDING CHANGE IN ARCTIC DEEP WATER SOURCES

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ABSTRACT

We analyzed neodymium isotope ratios of Fe-Mn oxide coatings in sediments from the Mendeleev Ridge collected during RV Polarstern Expedition ARK-XXIII/3. According to our age model constructed using AMS ^{14}C ages (n=4) and by correlating $\delta^{18}O$ and $\delta^{13}C$ with neighbouring cores 94B16 and 0503-8JPC, the record extends to MIS 5a. The top-core value was -11.14 ± 0.29 (2σ) which is quite similar to the present-day water column values of the Canada basins. While the average ε_{Nd} value (n = 39) was -10.19 ± 1.74 (2σ), three significant deviations from the average ε_{Nd} were observed. Middle MIS 3 and ca. 24-21 ka displayed unradiogenic ε_{Nd} accompanied by decreases in $\delta^{18}O$ and $\delta^{13}C$ of planktonic foraminifera (*N. pachyderma* sin.) and an increase in $\%CaCO_3$. The unradiogenic dissolved Nd of the Mackenzie River and carbonate-rich lithology of the Canadian Archipelago suggest that the melting of the Laurentide Ice Sheet (LIS) was mainly responsible. Additionally, the pinkish carbonate layer observed at this depth interval is reported to be derived from Banks and Victoria islands of the Canadian Archipelago. The radiogenic ε_{Nd} peak during Late MIS 4–Early MIS 3 period coincided with decreases in $\delta^{18}O$ and $\delta^{13}C$ values and low $\%CaCO_3$. The radiogenic dissolved Nd of the Ob and Yenisei rivers and the carbonate-poor lithology of western Siberia suggest that outburst of ice-dammed lakes from this region could have affected the western Arctic Ocean. Consequently, the contrasting deep water ε_{Nd} values incorporated with surface water signals suggest that huge surface water subduction to the deeper depth (at least 1800 m), possibly brine formation, had occurred.

MODERN AND LATE HOLOCENE ENVIRONMENTS IN THE LENA RIVER DELTA AREA, THE SOUTHERN LAPTEV SEA

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ABSTRACT

The micropaleontological studies, performed in the Laboratory of paleoecology and biostratigraphy of P.P. Shirshov Institute of Oceanology, have documented the modern state and the Late Holocene changes of the environments in the area of the interaction of the fresh Lena river waters and basin waters from the open Laptev Sea (Fig. 1). Detailed micropaleontological data were presented by Matul et al. [2007].

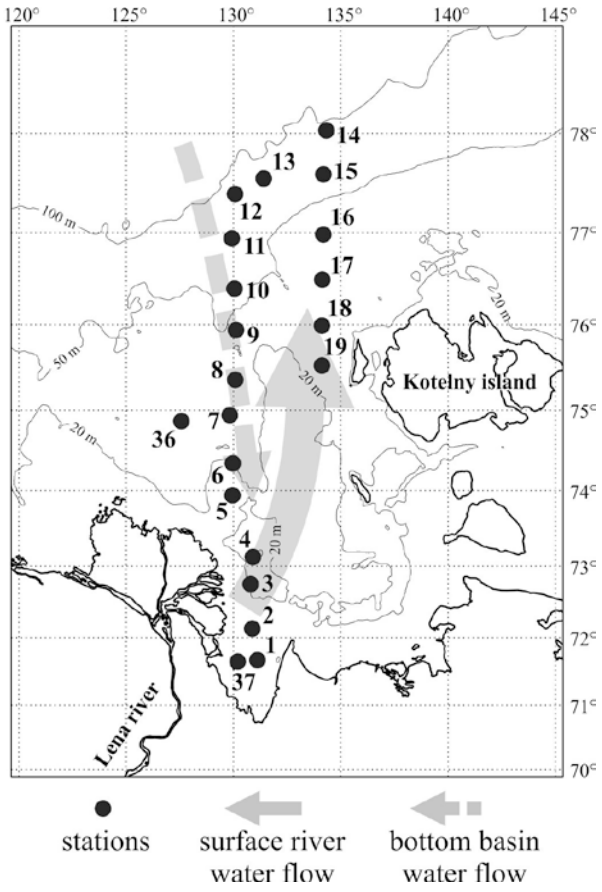

Fig. 1. Area of study: the Lena river delta in the southern Laptev Sea.

Modern conditions.

Microfossils (diatoms and benthic foraminifers) distinctly reflect influence of the fresh-water Lena river runoff on the southern Laptev Sea within a zone to ~100 km from the delta edge (Fig. 2). Here, the diatom microflora is diverse and abundant, reflecting an active interaction of the river and sea water masses. The benthic foraminiferal microfauna in the Lena delta is suppressed because of strong fresh-water influence, and very high terrigenous discharge including the poorly decaying terrestrial organic matter which is not accessible for the foraminifers. Changes toward the richer foraminiferal assemblages and "normal" sea-water diatom associations occur just beyond the outer part of the Lena delta.

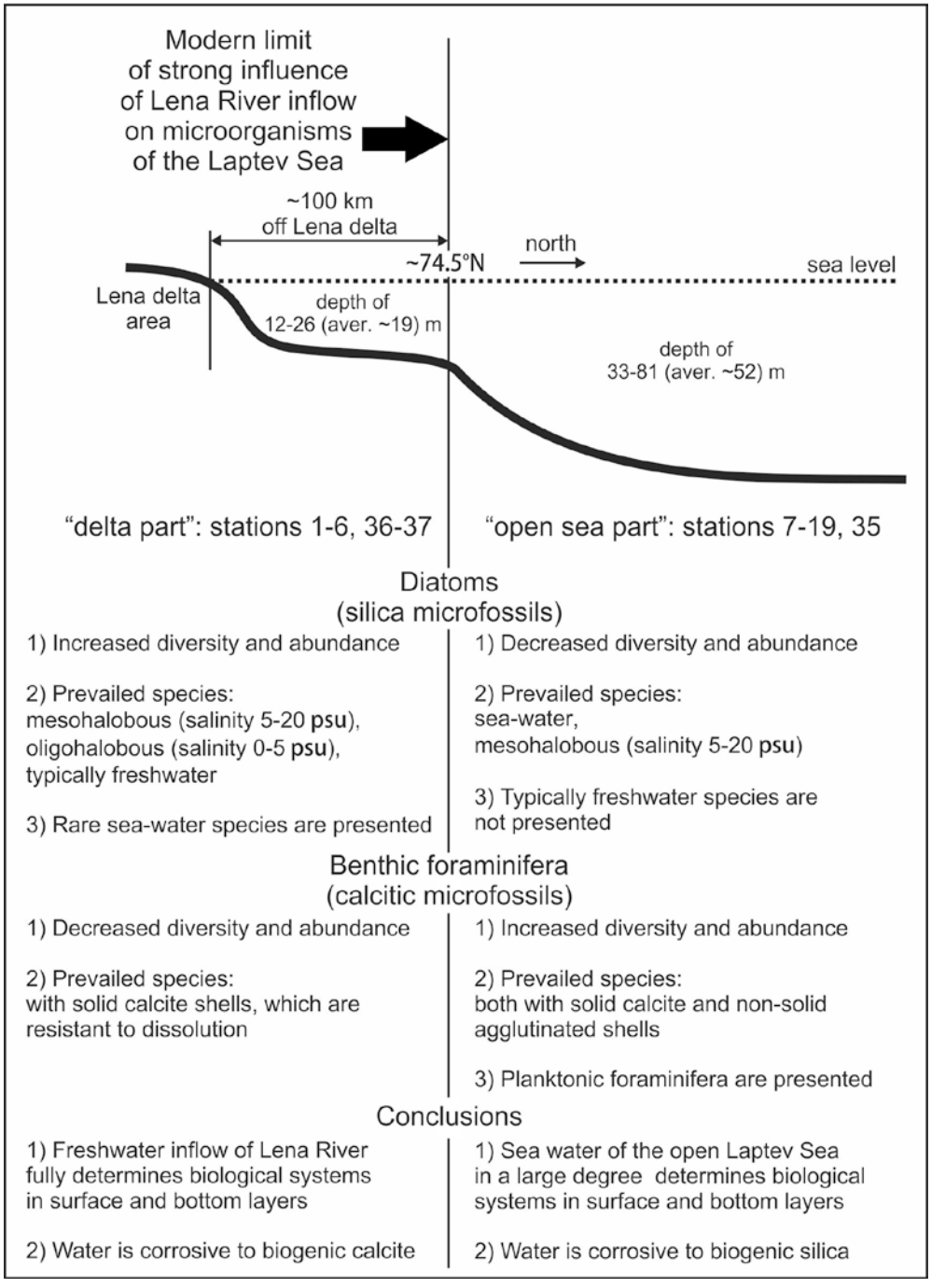

Fig. 2. Modern microfossil assemblages as a reflection of the Lena delta environments.

The Late Holocene – the last ~2000 years.

The micropaleontological study (diatoms, benthic foraminifers, planktonic foraminifers, pollen and spores) has documented the Late Holocene paleoenvironments in the southern Laptev Sea at the Lena River fan (Fig. 3). Presumable age estimates are made on average sedimentation rates according data of Kuptsov and Lisitsin [1996]. In the cores 4 and 7 (see map on Fig. 1), we have defined a number of the sediment core units correlated with paleoclimatic events within the last several millennia [Lamb, 1995; Hu et al., 2001]: a) multiple but not large coolings at the beginning of the Medieval Ages ~1100-1600 years B.P., c) Medieval Warm Period ~600-1100 years B.P. with optimum ~800-1000 years B.P., d) Little Ice Age ~100-600 years B.P., e) "industrial" warming during the last ~100 years. Together an increase in the diversity and abundance of the benthic foraminifers, an appearance of the moderate-warm-water diatoms, and the greater abundance of the forest-tundra (instead of the tundra) floral elements may say that the Medieval warming exceeded the "industrial" one in the area of study. Finding of the diverse warm-water planktonic foraminifers in the core 18 may point on the active advection of the North Atlantic water in the southern Laptev Sea during the Holocene optimum ~5100-6200 years B.P.

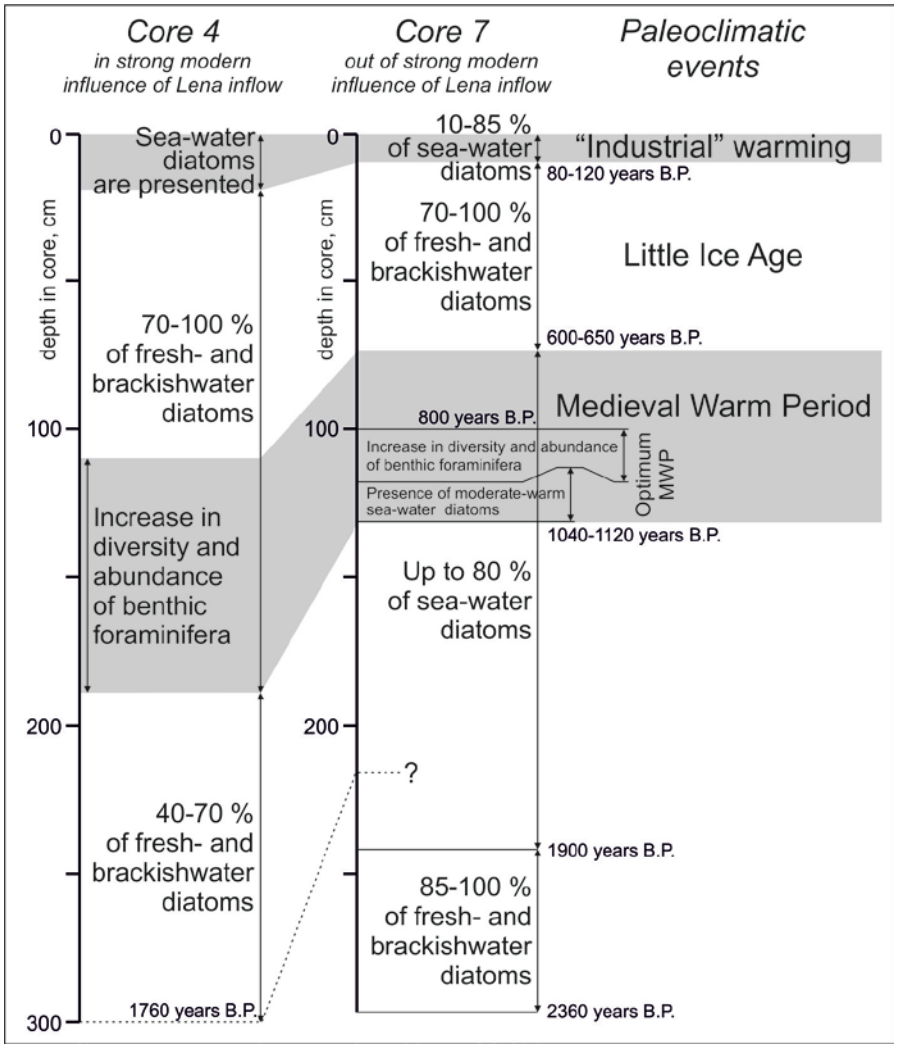

Fig 3. Late Holocene environments in the Lena delta.

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PALYNOLOGICAL STUDIES FROM NY-ALESUND, SVALBARD: INTERPRETING THE LATE QUATERNARY CLIMATE OF THE ARCTIC REGION

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ABSTRACT

Ny-Alesund in Svalbard (79^0 N), represents a typical high Arctic ecosystem. This area bears the characteristic imprints of Quaternary climatic oscillations, which are manifested by fiord environments, raised beaches and marine terraces and a variety of glacial and fluvio-glacial geomorphologic features. Studies have been initiated to decipher the Quaternary climatic history of the Arctic Region based on multi-proxy data, with special reference to palynology, supported by C^{14}/AMS and OSL dates. Samples have been collected from different geomorphic regimes by digging trial trenches around Ny-Alesund, Svalbard and are generating a wealth of information through palynological studies. Pollen of local herbaceous taxa, along with other organic matter is encountered in varying frequencies in the sediment profiles reflecting changes in the climatic conditions. Besides, pollen of extra-local tree taxa, transported by wind and deposited to the site of study, from the Boreal forests on the main land, are also present. Based on the frequency variations of local (*Dryas, Arabis, Plantago, Rubus,* Polygonaceae, Saxifragaceae, Ranunculaceae, Caryophyllaceae, Asteraceae, Poaceae etc.) and extra-local (*Pinus, Ulmus, Alnus, Betula, Juglans, Corylus* etc.) palynological entities, Late Quaternary climatic changes have so far been inferred since 27000 years BP, whereby different cold and warm phases have been deduced.

For a better interpretation of past climatic changes in the region, modern palynological analogues are also being developed. In this context, a number of surface samples have been collected from around the Ny-Alesund region, besides sea-floor sediments were also collected from the Kongsfjorden. In continuation to this, airborne pollen and spores were also monitored (Aeropalynology). Studies reveal a diverse spectrum of pollen, algal and fungal entities including extra-local pollen, which have been carried by air-currents from the mainland, and include pollen of Oleaceae, Polygonaceae, Chenopodiaceae, Asteraceae, Saxifragaceae, Ranunculaceae, Caryophyllaceae, Poaceae, Cyperaceae, *Eugenia* and *Pinus*. This data will be very useful to understand the pattern of deposition of the palynomorphs in the Quaternary sediments. Besides, polleniferous material from around thirty-five flowers from the Ny-Alesund region were collected for preparing type slides towards developing the pollen flora of Svalbard.

SESSION Ⅷ

ANTARCTIC PALEOCLIMATE / PALEOCEANOGRAPHY

HOLOCENE DEGLACIATION HISTORY OF KING GEORGE ISLAND AS ONE EXAMPLE FOR FUTURE CHANGES OF THE WEST ANTARCTIC ICE SHEET, ANTARCTICA

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ABSTRACT

Marine sediments in Maxwell Bay, a 500 m deep bay between Nelson and King George Island (KGI), record high-resolution Holocene environmental changes. Sediment, mineralogical, geochemical and biological compositions and the grain size of the terrigenous particles have been investigated for reconstructions of biological palaeoproductivity, sea-ice coverage, melt water inflow and the deglaciation history of the surrounding land areas. Reliable age determinations of sediments are rare but increased in number during the last years. First correlations of the local results to regional or global climate signals are possible and demonstrate the exceptional value of this region for past, recent and prognostic environmental studies. The concentration of multidisciplinary research from many nations in this small area provides a solid base for comprehensive data assimilation. We would try to establish a multi-, inter- and transdisciplinary (MIT) research project to integrate and complete the results from marine sediments with those from lakes, from glaciological studies, glacial exhumation, age determinations and from geomorphological studies and raised Holocene beaches in the King George Island area.

We will start with a compilation of available data in the area of the South Shetland Islands and finish the studies of sediment characterization in Potter Cove. To detect, discriminate and interpret regional and local environmental processes and effects from global trends we need comparisons from other bays and therefore one goal is to map Marian Cove, Collins Harbor and Ezcurra Inlet at Admiralty Bay with identical hydroacoustic methods we have used in Potter Cove and compare this with ground truth surface sediment sampling for a combined geo- and biological characterization.

Results on meltwater discharge, characterized by granulometric and sedimentological analysis, variations in geochemical processes and, changes in organic and inorganic accumulation rates that co-vary with global climate periods like the Medieval Climate Optimum and the Little Ice Age were described recently from sediment cores we collected in Maxwell Bay. There are discrepancies discovered between recent changes of glacial retreats and former ones during warmer Holocene periods, that might be related to a different sea level and changes from tide water glaciers to land based glaciers. Only a detailed palaeoglaciological and bedrock reconstruction of the KGI ice cap in combination with reconstructed regional past sea levels will answer questions related also to the West Antarctic Ice Sheet stability in the past and under future warmer climate conditions.

SEAFLOOR GEOMORPHOLOGY AND SEDIMENT FACIES DISTRIBUTION IN THE LARSEN A EMBAYMENT, NORTHWESTERN WEDDELL SEA: PRELIMINARY RESULTS FROM THE 2012 LARISSA CRUISE

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ABSTRACT

During March and April, 2012, the LARISSA team aboard the RV/IB *N.B. Palmer* surveyed the area of the Larsen A embayment in the northwestern Weddell Sea. This study area was chosen due to severe sea ice conditions in the Larsen B embayment that limited survey capabilities south of Robertson Island. The Larsen A embayment had a more extensive ice shelf until recent decades and thus is analogous to how the Larsen B is developing today. While the Larsen A area had already been surveyed with both multibeam and 3.5 kHz profilers during past cruises, which produced detailed images of past ice flow patterns across the continental shelf, areas close to shore were imaged for the first time during the 2012 cruise including Drygalski Trough, "Bombardier Bay," and the north side of the Seal Nunataks.

Drygalski Trough, in front of Drygalski Glacier in the central part of Larsen A embayment, is a hanging valley, meeting Greenpeace Trough at what is interpreted to be a fault running northeast-southwest, approximately parallel to the peninsula and trending towards Hectoria Basin, in the Larsen B area. Unlike many of the glacially-carved troughs in the region, Drygalski does not deepen all the way to the current shoreline; the deepest part of the trough is a few miles from the ice edge. Two small areas of sediment were identified from the 3.5 kHz records, one in the deepest part of the trough and one in a perched basin on the lateral margin, but both areas were remarkably limited in both depth and extent of sediment. "Bombardier Bay," in front of Bombardier Glacier to the north, on the other hand, continued to deepen as far in as the survey was able to proceed, to within about a mile of the glacial edge. The 3.5 kHz data from "Bombardier Bay" indicated almost no sediment deposited in the bay except for very thin deposits oriented parallel to dip, in between glacially-carved ridges. The limited extent of sediment in each of these bays is interpreted to reflect the relatively recent retreat of the ice shelf in the area as well as low overall flux of sediment from the peninsula.

A geophysical survey was also conducted along the north side of the Seal Nunataks, the

string of islands separating the Larsen A and B inlets. Pre-existing multibeam data documented the shallow nature of the sea floor adjacent to the islands, however bathymetric data for the northwestern corner of the embayment was limited. The goal of the survey was to evaluate whether a deep water connection existed between the Larsen A and B embayments here, a possibility suggested by the location of a fault along the eastern side of the Antarctic Peninsula, the boundary between the crystalline rocks of the Peninsula to the west, and the sedimentary rocks to the east. Our multibeam data revealed a 630-meter deep basin trending southwest to northeast, but that shallowed toward the Seal Nunataks. Remarkably little sediment was seen on the 3.5 kHz data. No definitive answer is clear about whether or not the Larsen A and B embayments are connected under the ice shelf here, but the most likely answer appears to be that, since the bathymetry shallows significantly towards the ice, there is at best a limited connection today between the two regions underneath the remnant ice shelf.

PERSEVERANCE DRIFT, JOINVILLE-D'URVILLE TROUGH, NORTHEASTERN ANTARCTIC PENINSULA

LARISSA Science Team

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ABSTRACT

During the 2012 LARISSA research cruise aboard the *RVIB NB Palmer*, marine geologic/biogeochemical and geophysical investigation of the Joinville-d'Urville Trough, in the northeastern Antarctic Peninsula, confirmed the presence of a sediment drift deposit at least 90 meters thick. This drift, informally known as the "Perseverance Drift" was discovered during cruise LMG0404. Work during NBP1203 was initiated with a geophysical survey of the region, entering from Antarctic Sound to the west, through the Larsen Channel and into the region between Joinville Island to the south and d'Urville Island to the north. Multibeam swath bathymetry revealed an extraordinarily complex bottom, with multiple small-scale deeps and shallows. The 3.5 kHz sub-bottom data confirmed the presence of a spectacular drift deposit, reaching at least 90 m in thickness in the eastern part of the study area where the bathymetry is more subdued. Limited shipboard ADCP data indicated minimal current velocities over the drift. Recovery of a 5 m jumbo kasten core revealed the sediments to be highly biosiliceous, organic rich, and reducing in nature. Sediment expansion and hydrogen sulfide emission occurred as soon as the core was brought into the lab. The kasten core was marked by the presence of 4 ikaite crystals from depths between 300 and 500 cm in the sediment, a signature of rapidly accumulating organic rich sediments found at several sites in the northeastern Antarctic Peninsula. The core is also rich in the preservation of carbonate shells, many articulated and clearly in situ, which will enable development of a robust core chronology. Close inspection of the sediments also revealed calcareous foraminifera in the lower part of the core providing hope of recovering a continuous foraminiferal record for faunal and stable isotopic analyses. Finally, an 80-foot jumbo piston core also recovered from the drift will extend the excellent kasten core record back farther in time, providing a high-resolution oceanographic record for this region.

TERRESTRIAL EXPOSURE-AGE RECORD OF ICE SHEET AND ICE SHELF CHANGE, NORTHEAST ANTARCTIC PENINSULA

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[3] The LARISSA ("Larsen Ice Shelf System, Antarctica") group includes: G. Balco, S. Brachfeld, M. de Batist, E. Domack, A. Gordon, T. Haran, J.-P. Henriet, B. Huber, S. Ishman, S. Jeong, M. King, C. Lavoie, C. van Dover, A. Leventer, M. McCormick, E. Pettit, T. Scambos, C. Smith, E. Mosley-Thompson, L. Thompson, M. Truffer, M. Vernet, K. Yu, and V. Zagorodnov.

ABSTRACT

We describe glacial-geologic observations and cosmogenic-nuclide exposure ages from ice- free areas adjacent to the Sjögren, Boydell, and Drygalski Glaciers of the northeast Antarctic Peninsula. These provide a record of Holocene glacier and ice shelf change in this region. During the Last Glacial Maximum (LGM), the ice surface elevation near the present coastline was at least 500 m above present sea level, but our observations do not constrain the maximum thickness of LGM ice or the time at which it was attained. LGM ice was frozen-based at elevations above 100-150 m, and wet-based below. The ice surface elevation decreased from ca. 500 m elevation to near present sea level between 9 ka and ca. 4 ka. Below 160 m elevation, erratics with mid-Holocene apparent exposure ages coexist with erratics with apparent exposure ages of 100-600 years. The most likely explanation for this is i) complete deglaciation of currently ice-free areas, which presumably required the absence of ice shelves, at 3.5-4.5 ka, followed by ii) subsequent ice shelf formation and grounding line advance during the late Holocene, most likely after 1.4 ka, and iii) complete re-exposure of the sites after recent ice shelf breakup and glacier surface lowering. These observations are consistent with marine sedimentary records indicating that ice shelves in the Prince Gustav Channel and Larsen A embayment were absent in the middle to late Holocene and were re-established within the last 2000 years.

RECONSTRUCTION OF PALEO-SEAWATER TEMPERATURE USING BIOMARKER DIOLS IN SCOTIA SEA, ANTARCTIC PENINSULA

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[1]Environmental Marine Sciences Hanyang Univ. 425-791, An-San
[2]Polar Sciences Laboratory, Korea Ocean Research and Development Institute, Ansan P.O. Box 29, Seoul 425-600, South KoreaSignificant UVR treatment–by-times interactions were found production rate of DD and PR, because trends between treatments varied over time.

ABSTRACT

1,14-diols is produced by Proboscia diatom and Apendinella Dyctiochophyceae in high nutrient region like upwelling area. It has been known for useful proxy of primary productivity. 1,13 and 1,15 – diols produced from mainly Eustigmatophyte are responded to changing sea temperature in Atlantic ocean. In this study, 1,13, 1,14, 1,15-diols (C28, C30, C32) are determined in long core GC03-C1, near Weddell sea.

Two diol indexes (Rampen Sebastiaan and Veronica Willmott) were used to interpret the temporal variation of relative abundance of proboscia diatoms as well as paleo-seawater temperature related with climate change. The two diol indexes showed similar variation with the sediment depth, indicating similar pattern to reconstructed paleo-temperature.

The reconstruction of paleo-temperature ranged from -2.97 to 2.82℃, showing the temperature rising up to 3℃. Interestingly, the high seawater temperature period (section of 250cmbf) occur simultaneously from early to mid Holocene in comparision to downcore variations of MS values and TN, C/N ration contents.

As a result, diol index should be useful tool to understand not only paleo-temperature but also primary productivity in the Antarctic region, providing essential clues to understand paleo-oceanographic environment

LATE QUATERNARY VARIATIONS IN SEDIMENT SUPPLY IN THE SOUTHERN DRAKE PASSAGE

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ABSTRACT

Trace element, rare earth element, and Nd and Sr isotopic composition of marine sediment from the southern Drake Passage were analyzed to reconstruct variations in sediment provenance and transport paths during the late Quaternary. The 5.95 m gravity core used in this study records paleoenvironmental changes during the last ~600 ka. Glacial-interglacial cycles are represented by cyclic variations in magnetic susceptibility, grain size distribution, and sediment facies. Down-core variations in geochemical characteristics reveal that sediment provenance varied according to glacial cycles. During glacial periods, detrital sediments in the southern Drake Passage were mostly derived from the nearby South Shetland Islands and shelf sediments. In contrast, interglacial sediments are composed of mixed sediments, derived from both West Antarctica and East Antarctica. The East Antarctic provenance of the interglacial sediments was inferred to be the Weddell Sea region. Sediment input from the Weddell Sea was reduced during glacial periods by extensive ice sheets and weakened current from the Weddell Sea. Sediment supply from the Weddell Sea increased during interglacial periods, especially those with higher warmth such as MIS 5, 9, and 11. This suggests that the influence of deep water from the Weddell Sea increases during interglacial periods and decreases during glacial periods, with the degree of influence increasing as interglacial intensity increases.

SESSION IX

ARCTIC PALEOCLIMATE / PALEOCEANOGRAPHY 2

PALEOCEANOGRAPHIC RESEARCH PROGRAM IN THE WESTERN ARCTIC OCEAN AND PRELIMINARY RESULTS

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ABSTRACT

The extent and thickness of Arctic sea ice have dramatically reduced due to the amplified response of the Arctic Ocean to recent global warming. The rapid melting of Arctic sea ice has led to increased research activities by the East Asian countries (Korea, China, Japan) of the Pacific-Arctic Group in the western Arctic to unravel the present and past climate/oceanographic changes. Reconstruction of paleoclimate/ paleoceanographic records preserved in the western Arctic sediments is of importance in terms of understanding the present oceanographic changes related to recent rapid sea-ice melting, and as the basis for a reliable prediction of future climate changes.

Within this context, KOPRI recently initiated new research program (K-Polar) for understanding of recent environmental changes and reconstructing glacial hisrory and paleoceanographic changes in the western Arctic using ice-breaker '*R.V. ARAON*'. The Pacific sector of the Arctic Ocean is particularly pronounced area with rapid and large extent reduction of the Arctic sea ice. This K-Polar program aims to: acquire shallow seismic data and retrieve long undisturbed sediment cores from the Chukchi Borderland and the Mendeleev Ridge using the '*R.V. ARAON'*, and establish a reliable stratigraphy of key sediment cores; then to reconstruct glacial history and high-resolution paleoceanographic changes in the western Arctic during the Quaternary glacial-interglacial cycles based on precise stratigraphic data and multiple proxies of climate change. In this symposium, I will introduce some preliminary results from sediment cores taken from the western Arctic Ocean during the 'Polarstern' Arctic expedition (ARK23/3) in 2008 together with the 2010/2011 'ARAON' Arctic expeditions.

CHINESE SEDIMENTOLOGIC AND PALEOCEANOGRAPHIC RESEARCHES IN THE WESTERN ARCTIC OCEAN

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ABSTRACT

Chinese Arctic and Antarctic Administration (CAA) organized the 1st to 4th Chinese National Arctic Expeditions in 1999, 2003, 2008 and 2010, respectively. Some samples of box-cores, multi-cores and gravity-cores were collected in the western Arctic Ocean during these cruises for sedimentologic and paleoceanographic researches. A total of more than 140 samples from the surface sediments have been investigated on distribution pattern in biogenic (CaCO3 and foraminiferal abundance, TOC, opal, planktonic oxygen and carbon isotopes and benthic assemblage, etc) and non-biogenic sediments (IRD and grain size, clay mineral, etc) and their relationship with recent environmental changes. These studies provide an important base for reconstruction of paleoceanography and paleoclimate in this area. Sediments of ten gravity cores collected in the western Arctic Ocean during these cruises have been studied on stratigraphy, sedimentology, micropaleontology, geochemistry, mineralogy and petrology, etc. Late Quaternary paleoceanographic changes in the western Arctic Ocean (Chukchi Abyssal Basin, Northwind and Alpha Ridges) are revealed by quantitative investigations on foraminiferal abundance, IRD and its mineralogical and petrological compositions, oxygen and carbon isotopes of *N. pachyderma* (sin.), biogenic and non-biogenic components.

DEVELOPMENT OF AUTO-IMAGE PROCESSING TECHNIQUE FOR DETECTING ICE-RAFTED DEBRIS ON TRANSPARENT X-RAY IMAGERY BY USING TATSCAN-X1 (NON-DESTRUCTIVE TRANSPARENT X-RAY 2-D CORE IMAGING SCANNER)

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ABSTRACT

In this presentation, I will present two subjects; (1) development of auto-image processing technique, (2) incoming research cruise of R/V Mirai, 2013 summer.

We are now developing new software for auto-detecting of particle or structure on transparent X-ray imagery. For arctic or high-latitude region, ice-rafted debris (IRD; sand, pebble cobble size) looks like isolated dense images on X-ray images. By using computer algorism of satellite imagery to detect, count, and measure crater, IRD can be detected automatically by new software, TATSCAN-X1-Quest. Transparent X-ray images are obtained by our original non-destructive transparent X-ray 2-D imaging scanner called as “TATSCAN-X1”. It originally measures a 2-D intensity of transparent X-ray through materials by using digital imaging intensifier X-ray camera. The “TATSCAN” is our code name of developing original instruments for non-destructive sediment scanning and imaging in range of millimeter and micrometer scale. It is possible to scan the materials up to 1500 mm-long and 150mm-wide. Spatial resolution of X-Y stage is set up within 0.1 μm. Conventional spatial resolution of digitized X-ray image will be <50μm.

BIOMARKERS AS A TOOL OF PALEOENVIRONMENTAL RECONSTRUCTION IN THE WESTERN ARCTIC OCEAN

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ABSTRACT

Micropaleontological approaches to paleoenvironment study are not fully efficient in the western Arctic Ocean, because the occurrence of microfossil is limited. We introduce examples of applications of organic compounds (biomarkers) to paleoenvironmental studies in the western Arctic Ocean using samples taken during ACEX, HOTRAX, ARAON cruises. Biomarkers found in western Arctic sediments are 1) higher plants-derived n-alkanes with stronger odd carbon number preference, fatty acids, alcohols, oleanene, and lignin, 2) fossil organic matter-derived n-alkanes with little odd carbon number preference, and hopanes, 3) bacteria-derived anteiso- and iso-fatty acids 3) soil bacteria-derived branched glycerol dialkyl glycerol tetraethers (GDGTs), and 4) marine Archaea-derived isoprenoid GDGTs, 5) marine algae-derived sterols, and $C_{25:1}$ highly branched isoprenoid alkene (IP_{25}). The relative abundance of biomarkers derived from different origins is useful to understand the provenance of sediments. In a Mendeleev ridge core (HLY05-03 8JPC), the concentrations of these biomarkers showed cyclic changes in the provenance of sediments, thus changes in oceanic circulation pattern, in response to a precessional cycle. Spike peaks of n-alkane concentrations corresponded to the layers of ice rafted debris, showing changes in the source region of icebergs. Lignin is a potential provenance marker because its composition reflects the vegetation in the source areas. GDGTs are recently applied to the study of Arctic sediments. The compositions of isoprenoid GDGTs (TEX_{86}) and branched GDGTs (MBT/CBT index) are potentially used for paleotemperature estimation. Biomarker approach will benefit the studies of paleoenvironments in the Arctic Ocean.

LONG-CHAIN ALKENONE AND LONG-CHAIN DIOLS COMPOSITION IN THE SEDIMENT OF WESTERN ARCTIC: A TOOL FOR TRACING PAST SEA SURFACE TEMPERATURE?

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ABSTRACT

In order to reconstruct past sea surface temperature (SST) in northern Chukchi Sea for the last 38 calkyr BP, this study investigated the alkenone temperature ($U^{K'}_{37}$ temperature) and diol temperature in bulk sediments core 03MUC-01 and 27MUC-01 recovered from the northern Chukchi Sea and slope of Northwindledge, respectively. Comparing gas chromatograms of long-chain, unsaturated ketons compositions measured in cultures of *E.huxleyi*, and *G.oceanica*, the haptophyte algae producing alkenone could be *E.huxleyi*. Strong variation in alkenone and diol concentrations could be related to their production by haptophte algea as well as diatom proboscia sp., suggesting high alkenone fluxes as a result of more stratified water column leading to high primary production, while an upwelling event could be a major importance for the high diol fluxes. There is a significant change in diol compound composition between the northern Chukchi Sea and slope of Northwindledge, probably reflecting difference in sea surface temperature. An offset (~1°C) was seen between the alkenone and diol temperature in the northern part could be as a result in different season or depth production due to different sea-ice distribution and seawater stratification related to changing climatic condition. The results thus indicate that alkenone temperature ($U^{K'}_{37}$ temperature) and diol temperature (LDI temperature) can be a useful tool for tracing past sea surface temperature in the western Arctic, but also seasonality of both paleo-tempratures should be considered in reconstructing past sea surface temperature.

HOLOCENE PALEOCEANOGRAPHIC CHANGE IN THE CHUKCHI SHELF, WESTERN ARCTIC OCEAN

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ABSTRACT

A 4.3 m long gravity core (GC12ex; 72°36'N, 166 °W, 53 m deep) and another 8.4 m long jumbo piston core (JPC35; 72°37.4'N, 168 °07.2'W, 62 m deep) were collected from the Chukchi Shelf during MR06-04 and HLY02-05 cruises, respectively. A variety of paleoceanographic proxies were obtained in order to verify the Holocene paleoceanographic change in the shallow marine environment. The 4 AMS ^{14}C dates of bulk sediments clearly define the linear sedimentation rate of 0.032 yr/cm of core GC12ex, in spite of large reservoir effect due to the incoportation of old carbon. Fortunately, an AMS ^{14}C date of shell fragment can limit the maximum age of 8436 yr at 300 cm of core depth. Thus, approximate sedimentation rate of 0.035 cm/yr was applied to the age model of the whole depth of core GC12ex. Previous age data of neighboring cores also guarantees the final age model of our cores. Downcore profiles of geochemical and isotopic properties are obviously similar between the two cores. Based on these properties, three distinct stages can be divided, corresponding to the lithologic units; Stage 1 (until ~ about 8.0 ka), Stage 2 (about 8.0 to 3.5 ka), and Stage 3 (3.5 ka to the present). Stage 1 is characterized by the transgressive condition to reflect the low productivity and dominant effect of terrestrial input. Stage 2 is characterized by mixture of terrestrial and marine input with increasing productivity, following the Holocene sea level rise. Stage 3 indicates the stable marine condition similar to the present-day feature. Two studied cores (GC12ex and JPC35) preserve the evident signatures of Holocene paleoceanographic change in the Chukchi Shelf. In addition, our results shed lights on the possible preservation of the sediment particles originated from the Bering Sea during the late Holocene. Further research should be required to uncover the northward transport of Bering Sea-derived sediments through the Bering Strait for the deposition in the Chukchi Shelf in the western Arctic Ocean.

PALEOENVIRONMENT IN THE CHUKCHI PLATEAU, WESTERN ARCTIC OCEAN SINCE LAST GLACIAL PERIOD

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ABSTRACT

A gravity core PC01 with a multiple core PL01 was collected from the Chukchi Plateau in the western Arctic Ocean on the R/V Mirai Cruise MR09-03 for the purpose of establishing the stratigraphy and unraveling the paleoceanographic history. Core PL01 was compensated for the top-loss of core PC01, based on the sediment color profiles, from which a complete composite core was obtained. Age of the composite core was estimated by AMS ^{14}C dates as well as the correlation of geochemical properties and IRD abundance with those of the well-dated cores nearby our core site. Microscope and SEM observation shows that the ice-rafted debris (IRD) constituents are composed primarily of carbonate minerals, supporting the high $CaCO_3$ content at the deglacial interval. These deglacial IRDs including carbonate minerals are possibly originated from the Canadian Arctic Archipelago. Glacial interval was characterized by low $CaCO_3$ and TOC contents, low C/N ratios, and high $\delta^{13}C$ values. Supply of terrestrial sediments was limited by weakened Beaufort Gyre because of permanent thick sea ice during the last glacial period. The distinct deglacial interval was notable in high $CaCO_3$ and TOC contents, high C/N ratios, and low $\delta^{13}C$ values. During the last deglaciation, enhanced current system was resumed due to thinning of sea ice, contributing the terrestrial sediments supply with/by coastal sea ice, calved icebergs, and meltwater from circum-Arctic margins into the Chukchi Plateau. The Holocene interval shows increasing TOC contents and decreasing $\delta^{13}C$ values, indicating the increase of productivity during the late Holocene.

SESSION X

GLACIOLOGY

A SYNTHESIS OF THE ANTARCTIC SURFACE MASS BALANCE DURING THE LAST EIGHT CENTURIES

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ABSTRACT

Global climate models suggest that Antarctic snowfall should increase in a warming climate and mitigate sea level rise, mainly due to the greater moisture-holding capacity of the warmer atmosphere. Several processes act on snow accumulation or surface mass balance (SMB), introducing large uncertainties in the past, present, and future ice sheet mass balance. To provide an extended past perspective of the SMB of Antarctica, we used 66 firn/ice core records to reconstruct the temporal variability over the past eight centuries and in greater detail over the last two centuries. Our SMB reconstructions show that the changes over most of Antarctica are statistically negligible and the current SMB is not exceptionally high compared with the last eight centuries. However, a clear increase in accumulation of more than 10% has occurred in high SMB coastal regions and over the highest part of the East Antarctic ice divide since 1960s. To explain the different behaviours between the coastal/ice divide sites and rest of Antarctica, we suggest that a higher frequency of blocking-anticyclones increases the precipitation at coastal sites, leading to the advection of moist air at the highest areas, whereas blowing snow and/or erosion have significant negative impacts on the SMB at windy sites. Eight centuries of SMB stacked records mirror the total solar irradiance, suggesting a link between the southern position of the Pacific Intertropical Convergence Zone and atmospheric circulation in Antarctica through the generation and propagation of a large-scale atmospheric wave train. Decadal records of the last eight centuries show that the observed increase in accumulation is not anomalous at the continental scale; indeed, high accumulation periods have also occurred in the past, during the 1370s and 1610s.

ACCUMULATION AND ITS MOISTURE ORIGIN OVER DOME A, ANTARCTICA

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ABSTRACT

A new snow pit records and stake measurements together with existing snow pit, ice core and automatic weather station (AWS) records and European Centre for Medium-Range Weather Forecasts (ECMWF) reanalysis were used to determine temporal and spatial variability in snow accumulation rate at Dome A. Snow accumulation rate shows large inter-annual variations, but stable patterns over the last seven centuries. Spatial variations in snow accumulation within the space of 50 km at Dome A are relatively small due to its smooth topography. A comparison of the accumulation observation with ECMWF analysis-based forecasts (ERA-40 and ERA-Interim) suggests ECMWF reanalysis underestimates the snow accumulation at Dome A but reproduces its seasonal variation. The moisture sources for precipitation over Dome A were examined by means of a Lagrangian moisture source diagnostic, based on the tracing of specific humidity changes along air parcel trajectories, for the period 2000–2004 using operational ECMWF analysis data. Dome A mainly receives moisture from the mid-latitude (46±4°S) South Indian Ocean, with a seasonal shift of about 6° at latitudes. Compared to deep ice core drilling sites in central East Antarctica such as Dome F, Dome C, Vostok, and EPICA Dronning Maud Land, Dome A has a more southerly moisture origin, probably due to topographic influences on the moisture transport paths. These results have important implications for the interpretation of future ice cores at Dome A.

CHANGES IN ELEMENTAL AND PB ISOTOPIC COMPOSITIONS IN EPICA DOME C ICE CORE: CLIMATIC IMPLICATION DURING THE PAST 800,000 YEARS

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ABSTRACT

Trace elements (V, Cr, Mn, Fe, Co, Cu, Zn, As, Rb, Sr, Mo, Cd, Sb, Ba, Tl, Pb, Bi, Th and U) and Pb isotopic compositions have been determined in various sections from the EPICA (European Project for Ice Coring in Antarctica) deep ice core, covering the period from ~573 kyr BP to ~800 kyr BP, by inductively coupled plasma sector field mass spectrometry (ICP-SFMS) and thermal ionization mass spectrometry (TIMS). Our study allows us to extend the previous Antarctic records of trace elements and Pb isotopes back to ~800 kyr BP (e.g., 1, 2). The records show well defined variations of trace element concentrations in relation to climate conditions with lower values during the interglacial periods and much higher values during the coldest periods of the last eight climatic cycles. Crustal enrichment factors indicate that the contribution from the main natural sources of atmospheric trace elements differ from one element to another and between each climatic period. The situation is also observed to be different during the interglacial periods before and after the Mid-Brunhes Event (MBE, ~430 kyr BP), suggesting that the main factors influencing the flux and sources of trace elements over the Antarctic plateau is closely linked with a progressive coupling of the climate of Antarctic and lower latitudes. The isotopic signature of Pb supports that changes in the provenance of dust from Potential Source Areas to Antarctica have occurred during the interglacial periods before and after the MBE.

TOTAL MERCURY CONTENT IN INLAND SNOW AND THEIR IMPLICATIONS FOR MERCURY DYNAMICS IN ANTARCTICA

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ABSTRACT

The total mercury concentration (Hg_T) determined from surface snow and snow pit samples collected at Dome Fuji in East Antarctica provided new information on mercury dynamics in inland Antarctica. The Hg_T ranged between 0.20 and 10.8 pg g^{-1} and mean mercury sequestration rates were 1 - 3 pg cm^{-2} yr^{-1}. Spatial and temporal profile of Hg_T and comparisons with other elements revealed that mercury behaves uniquely in the Antarctic interior. The seasonal variation in Hg sequestration was characterized by summertime maxima, even though the peaks were not always exactly in phase with sulfate or $\delta^{18}O$. The summer Hg_T peaks may be related to the active photochemical dynamics of mercury. However, its impact on Hg sequestration is limited to a few pg g^{-1}. We ascribe the interannual change in Hg sequestration to the variation in the atmospheric circulation over Antarctica, which regulates the meridional transport of aerosols containing oxidant precursors, continental dust, moisture and heat, each of which is thought to play a role in the mercury dynamics on the Antarctic Plateau.

ISOTOPIC EVOLUTION OF A SEASONAL SNOWCOVER AND ITS MELT BY ISOTOPIC EXCHANGE BETWEEN LIQUID WATER AND ICE

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ABSTRACT

Understanding an isotopic evolution of a snowpack is important for both climate and hydrological studies, because the snowmelt is a significant component of groundwater and surface runoff in temperate areas. In this work, we studied oxygen and hydrogen isotopic evolution from new snow to snow profile and to meltwater through two winter seasons (1998 and 2001) at the Central Sierra Snow Laboratory, California, USA. The slopes of the δD vs. $\delta^{18}O$ regression for the new snow are similar to that of the global meteoric water line (GMWL) of 8. However, this slope decreases in the snow profile and decreases further in the meltwater. We attribute this systematic slope changes to the isotopic exchange between ice and liquid water that is generated at the snow surface by melting and flows through the snowpack by percolation. A physically based one-dimensional model, including melting of snow at the surface and isotopic exchange between percolating water and ice, were used to simulate isotopic variation of snowmelt in 2001. A successful simulation was obtained for the δD-$\delta^{18}O$ slope of snowmelt (6.5), which is significantly lower than the slope of the meteoric water line (8.2) defined by the new snow. This result indicates that the liquid water evaporation should not be considered as the only process that yields slopes of the δD vs. $\delta^{18}O$ relationship in surface water and groundwater. The *d*-excess of the snowmelt is changed from the original snow because of the δD-$\delta^{18}O$ relationship controlled by ice-liquid exchange. With a δD-$\delta^{18}O$ slope less than 8, the *d*-excess would be anti-correlated with δD or $\delta^{18}O$. The model is also used to examine how isotopic heterogeneity of a snowpack affects the isotopic redistribution in the pore water, ice and meltwater of the snowpack. The results show that isotopic heterogeneity of the snowpack may significantly affect the temporal changes in the δD-$\delta^{18}O$ slopes, and a measured slope at a given time is a combined result of meteorological conditions, which affect both isotopic composition of the original snow and the process of snow metamorphism, and the melting history of the snowpack.

INTRODUCTION OF ICE DRILLING TECHNOLOGY AND DEVELOPMENT OF INTERMEDIATE ICE DRILL BETWEEN KOREA AND FRANCE

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ABSTRACT

Deep and Intermediate ice drilling operations are not so common; they need dedicated equipment and experimented team. During this presentation I will present the techniques, which are used in most European countries and especially in France (French National Ice Drilling Facility – C2FN). I will take advantage of this technical presentation to introduce the new intermediate drilling system that we are building together with KOPRI. This equipment is designed to drill up to 600 meters in a single field season.

POSTER SESSION – DAY 2

GEOSCIENCES

ESTIMATES OF ICE LOSS IN GREENLAND FROM SATELLITE GRAVITY DATA

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ABSTRACT

Greenland is the largest ice reservoir in the northern hemisphere and has about 2.5×10^6 km^3 of ice mass. If totally melted, it would raise the global mean sea level by about 7 m. Many studies show that Greenland ice has been melting mainly at coast area due probably to global warming and contemporarly it contributes to global sea level rise at 0.64 mm/yr. For the global climate projection, it is impotant to understand the quantity and mechanism of ice melting in Greenland, but it is not well known due to a lack of in-situ measurement. Remote-senging techniques such as satellite altimetry and InSAR have been used to infer the ice mass changes while they need additional information such as snow density and surface mass balance, which are highly uncertain. GRACE, launched in March 2002, can directly measure the change of ice mass through observing time-variable gravity field. The information from the monthy GRACE solution represents the redistribution of water in the surface of Earth. We use GRACE release 04 solutions for the period July 2003 to December 2010 to estimate ice mass change in Greenland. Commonly, a spatial averaging filter (Gaussian smoothing) and de-correlation method (P4M6) are applied for the GRACE solution to suppress the measurement noise and aliasing effect, but this post processing procedures also cause significant signal loss. In this study, we only apply high order de-correlation filter (P4M25) which is relatively able to conserve the signal. The de-correlated GRACE data is reduced by the Empirical Orthogonal Function (EOF) method to effectively reduce the GRACE error. Our post-procssing method sufficiently extracts signal relating ice mass change with less signal loss compared to the conventional approaches. The results show that there are significantly ice loss and annual cycle in coastal regions and some ice gain in central Greenland.

BATHYMETRY OF THE AMUNDSEN SEA IN WEST ANTARCTICA DERIVED FROM THE MULTIBEAM DATA ON *IBRV ARAON*

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ABSTRACT

High-resolution bathymetry under the Amundsen Sea in West Antarctica was obtained during the cruise on Korea's first *IBRV (Ice Beaker Research Vessel) ARAON*. The accurate bathymetry data is critical in safe cruise as well as for analysis of other scientific data gathered on the cruise. The global bathymetry has been processed by some institutions and the most of Earth's ocean has been covered by these data. However, it is difficult to find high resolution bathymetry in the Southern Ocean because the approach by any ship is very limited due to extreme weather conditions and ice distribution. Thus, the multibeam sonar instrument was installed on the bottom of *ARAON*, which can explore the innermost part of the Antarctic Ocean, and the bathymetry was measured during the cruise to the Amundsen Sea expedition.

The installed multibeam instrument is EM122, manufactured by Kongsberg. The swath angle is 70 degrees in each direction, 140 degrees in total. The cross-section of the scanned sea floor by this instrument is around 3 to 5 times the instantaneous depth at the location. The obtained data is calibrated by correcting the coordinates, sound velocity, tidal movements and false readings. Then, the bathymetry was constructed using these data.

The multibeam data obtained during this cruise will be combined with the previously archived data of the Amundsen Sea. The analysis will be coordinated with LDEO (Lamont-Doherty Earth Observatory) at Columbia university. The analyzed data will be the basic information for various researches which were simultaneously carried on the ship. Besides, the size and distribution of the sediments in the Antarctic Ocean will be used as the result of the sediment researches. As a result, the acquired bathymetry data is expected to be foundation of Korea's polar research and exploration in the future.

STUDY OF REDUCTION/ADVANCEMENT OF AMERY AND ROSS ICE SHELVES FROM 1988 TO 2003

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ABSTRACT

Research of Antarctica's coastline is vastly important, especially in recent years, since the melting of arctic ice can have severe impacts on global albedo percentages resulting in increased sea level rise as well as an increased global temperature. Landsat TM, EMT+, and MSS Satellite data acquired between 1988 and 2003 shows a significant change in Amery and Ross Ice Shelves. The ice shelves along Antarctica's coast are constantly altered annually. Using the data collected, the coastline was delineated within a 15 year timeframe to illustrate retreat and increase of ice fronts. The trends for the western and eastern section of Antarctica are represented through Ross and Amery Ice shelves. Once the coastlines of the shelves are delineated, the area, volume, ice shelf thickness, and yearly average change of the ice shelves can be calculated. These values can help infer yearly changes that give a glimpse of current and future of global climate trends.

GROUND PENETRATING RADER INVESTINGATION OF SEA ICE

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ABSTRACT

Drill-hole determined sea-ice thickness was compared with values derived from Ground Penetrating Radar (GPR) during expedition to Jang Bogo station in the Antarctica in January 2012. Sea ice characteristics can be inferred from the temporally conducted GPR survey. The southern 90-m NW-SE profile of drill-hole and the northern 180-m NW-SE profile are examined. We used a 500-MHz shielded GPR antenna with 32-fold vertical stack to increase S/N ratios. The average trace spacing was 0.43 m in the southern profile and 0.48 m in the northern profile. The boundary between sea-ice and water was poorly imaged due to brine inclusion. Electromagnetic properties of sea-ice can be inferred from the reflection strength of the radar returned from the inside of sea-ice. Air pockets and brine pockets cause heavy reflections and reduce reflections power of radar. The brine inclusion increases bulk permittivity of sea-ice which causes underestimating of sea-ice thickness.

P-WAVE VELOCITY STRUCTURE BENEATH THE NORTHERN ANTARCTIC PENINSULA: IMPLICATIONS TO A STEEPLY SUBDUCTING SLAB AND A DEEP-ROOTED LOW-VELOCITY ANOMALY

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ABSTRACT

Upper mantle structure 100 to 300 km depth below the northern Antarctic Peninsula is imaged by modeling P-wave traveltime residuals from teleseismic events recorded on the King Sejong Station (KSJ), the Argentinean/Italian stations (JUBA and ESPZ), an IRIS/GSN Station (PMSA), and the Seismic Experiment in Patagonia and Antarctica (SEPA) broadband stations. The resulting images reveal a subduction slab with a ~70° dip angle at 100 – 300 km depth and a strong low-velocity anomaly confined in the central Bransfield basin. The low velocity is attributed to a thermal anomaly in the mantle that could be as large as 350 – 560 K and which is associated with high heat flow and volcanism in the central Bransfield basin. The low-velocity zone does not extend under the northern Bransfield basin, suggesting that the rifting process might be different with a geodynamics in the northern Bransfield basin.

INTEGRATED MONITORING SYSTEM FOR DAVID GLACIER AND STUDY ON THE GLACIER EVOLUTION

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ABSTRACT

David Glacier is one of the largest glacier in Victoria land, which flows to the Ross sea as the Drygalski Ice Tongue. In the upstream of the glacier, two main flows converge in an icefall, the David Cauldron. The glacier velocity is higher than several hundred meters per year in most of the region. In addition to this dynamic glacier system, there is high geothermal heat flux beneath the glacier, which indicates a potential active interaction between the ice and the bed rock. To understand the status and the evolution of the glacier and the lithospheric feature, KOPRI has started a multi-disciplinary project funded from 2011 to 2013. In 2011/2012, KOPRI team visited the glacier and installed 9 seismic stations and 2 AMIGOS. For next seasons, 4 permanent GPS stations are planned to be deployed, and ice-radar expedition is scheduled. In this paper, objectives of the project and summary of the last field expedition are presented.

DESIGN AND IMPLEMENTATION OF SEISMIC STATIONS FOR REMOTE AUTONOMOUS ANTARCTIC OBSERVATIONS

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ABSTRACT

KOPRI have ever installed many seismometer at the Antarctica. To date, we have used IRIS/PASSCAL system for the Antarctic observations. In this case, if the system have some problem to operate, we can't do anything.

In 2012 project, we designed several parts and implemented to improve remote autonomous geophysical observations in the Antarctic environments. Our design provide power, communications, and environmental controls as necessary for our particular systems. Through testing in each facility's cold chambers and through field trials at test-beds located locally and in Antarctica, the KOPRI project investigated optimal battery designs(both rechargeable and non- rechargeable), power systems (solar), environmental conditioning.

Our objective is year round operation, to maintain data logging within operation specification, and to operate sensor for the good data. For year round operation, we installed two primary batteries, four secondary batteries in the excellent insulated box with vacuum insulation panel, and two 85w solar panels to get solar power. Also we used FRP double sensor dome.

KOPRI have installed seven seismic stations around David Glacier. KOPRI is getting well the data from the system with iridium communication system in the Antarctica. Our next plans is to test battery environment, develop new power controller, insulation box modification. For the next season, this seismic station will be upgraded with advanced power components after year-round operation.

POSTER SESSION – DAY 2

GLACIOLOGY

DECOMPOSITION OF ORGANIC CARBON AND INORGANIC CARBON BENEATH EUPHOTIC ZONE IN PRYDZ BAY, ANTARCTICA

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ABSTRACT

As the most important carbon pool in the ocean, particulate organic carbon (POC) plays an important role in marine carbon cycling. During the 25th Chinese National Antarctic Research Expedition (CHINARE-25), the decomposition ratio of organic carbon and inorganic carbon of Prydz Bay was calculated with a mathematical model. The results showed that the POC concentration of Prydz Bay ranged from 24.38 to 446.40μg•dm^{-3}, with an average of 118.16μg•dm^{-3}, decreasing offshore. Based on the observed data (dissolved inorganic carbon, dissolved O_2 and nutrients), during the burial processes of organic matter, the ratio of the decompositions of organic carbon and inorganic carbon was 1.27 (mole ratio), and the decomposition ratio of N/P elements was 19.29, at the P2 section on the continental shelf of Prydz Bay.

Key Words： Prydz Bay; POC; Inorganic carbon; Decomposition ratio;

SINGLE PARTICLE MINERALOGY OF AEOLIAN DUST IN THE EAST RONGBUK ICE CORE FROM MT. QOMOLANGMA (EVEREST)

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ABSTRACT

A recent work demonstrated the practical applicability of the combined use of two techniques, attenuated total reflectance FT–IR (ATR–FT–IR) imaging and a quantitative energy–dispersive electron probe X–ray microanalysis, low–Z particle EPMA, for the characterization of individual aerosol particles. These single particle analytical techniques provide complementary information on the physicochemical characteristics of the same individual particles, such as low–Z particle EPMA on morphology and elemental concentrations and the ATR–FT–IR imaging on molecular species, crystal structures, functional groups, and physical states. In this work, this analytical methodology was applied to characterize an insoluble mineral particle sample in the East Rongbuk ice core from Mt. Qomolangma (Everest). On the basis of morphological, X–ray spectral, and ATR–FT–IR spectral data, 140 individual particles were classified into different mineral types, such as SiO_2, montmorillonite, montmorillonite + K-feldspar, K-feldspar, Na-feldspar, carbonaceous, FeOx, muscovite, illite, vermiculite, and $AlSiO_3$. This work demonstrates that more detailed physiochemical properties of individual airborne particles can be obtained using this approach than when either the low–Z particle EPMA or ATR–FT–IR imaging technique is used alone.

PERSISTENT ORGANIC POLLUTANTS IN DOME A, ANTARCTICA

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ABSTRACT

Persistent organic pollutants (POPs) including hexachlorocyclohexanes and hexachlorobenzene were analyzed in 2.4 m-depth snowpack samples collected in Dome A (4093 meter above sea level), the highest ice feature in Antarctica during the 2004/2005 Chinese Antarctic Research Expedition (CHINARE). α-hexachlorocyclohexane (HCH), γ-HCH, and hexachlorobenzene (HCB) were frequently detected in the snow with concentrations ranging 37.7–59.5, 45.3–99.4, and ND–27.2 pg L^{-1}, respectively. The most abundant pesticide was γ-HCH, with a mean concentration of 66.4 pg L^{-1} followed by α-HCH with an average concentration of 46.2 pg L^{-1}. Our data suggest that some POPs were subjected to a long-range atmospheric transportation and deposited into the snow of inland Antarctica.

RARE EARTH ELEMENT CYCLING IN THE PORE WATERS OF THE BERING SEA SLOPE (IODP EXP. 323)

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ABSTRACT

We studied the diagenetic behavior of rare earth elements in a highly productive passive margin setting of the Bering Sea Slope. Pore water concentrations of fourteen REEs were determined to a depth of ~140 meters below seafloor (mbsf). Site U1345 was drilled during the Integrated Ocean Drilling program (IODP) Expedition 323 at a water depth of 1008 m presently in the center of an oxygen minimum zone. The concentrations of REEs were enriched in the pore water relative to deep seawater indicating that there is significant liberation from sediment during diagenesis. There was a peak at ~ 10 mbsf, which was more pronounced for the HREE, whose depth coincided with those of dissolved iron and manganese and below the sulfate-methane transition zone (~6.3 mbsf). In the upper 1 mbsf, there is a minor peak in HREE. Below ~40 mbsf, the concentration profiles were relatively constant. The positive Ce anomaly was relatively constant (average shale-normalized Ce/Ce*=1.1±0.2) throughout the depth profile indicating that Ce depletion in seawater is completely regenerated and maintained. HREE-enrichment is observed for the entire 140 mbsf except for the upper ~1 mbsf where there is MREE-bulge. REE release in the shallow depths (upper ~1 m) is attributed to preferential release of LREEs and MREEs during organoclastic reduction of Fe, Mn hydroxides in anoxic sediments. The high HREE concentrations observed at ~10 mbsf seems to be produced by reduction of Fe and Mn minerals this time tied to anaerobic oxidation of methane. $REECO_3^+$ is the most dominant inorganic species throughout the entire depth. However, near the sediment-water interface, REE^{3+} was also significant. Upward diffusion fluxes across the sediment-water interface were between 0.1 pmol m^{-2} y^{-1} (for Tm) and 11 nmol m^{-2} y^{-1} (for Ce).

INVESTIGATION INTO CO_2 DIFFUSION IN POLAR ICE FROM SIPLE DOME CORE, ANTARCTICA

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ABSTRACT

Smoothing of CO_2 records from ice coces by gas diffusion through ice matrix has been assumed to be negligible. Because it has not been determined accurately in laboratory, this assumption remains not clearly tested, limiting the exact reconstruction of ancient CO_2 concentrations. Previous studies show a large range of estimates for CO_2 permeation coefficient (diffusion coefficient times solubility), ranging from 1.3×10^{-22} to $3.5 \times 10^{-20}\, mol\, m^{-1}\, s^{-1} Pa^{-1}$. In this study we utilize elevated CO_2 profiles in and around refrozen melt layers from Siple Dome, Antarctica in order to quantify the CO_2 diffusion in ice. Melt layers are formed by snow melting on ice sheet surface and refreezing at tens of centimeters bellow the surface. Those layers provide natural CO_2 spikes due to high solubility of CO_2 in water and allow natural diffusion experiments. We are extending a previous study for melt layers at depth of 287m (corresponding to 2.74 ka) from Siple Dome [*Ahn et al*., 2008]. This work includes CO2 analysis extensive analysis of CO_2 around several melt layers from various depths and ages that cover 95.85 ~ 580.71m and 0.412 ~ 10.361 ka, respectively. This work also includes testing the validity of previous methods and investigating nature of diffusion in ice.

POSTER SESSION – DAY 2

ARCTIC / ANTARCTIC PALEOCLIMATE / PALEOCEANOGRAPHY

RECORDS OF LIPIDS BIOMARKERS IN THE WESTERN ARCTIC OCEAN SEDIMENTS AND THEIR IMPLICATIONS

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ABSTRACT

Multi-Biomarkers have been applied for the reconstruction of phytoplankton productivity and community structure. Our study reports phytoplankton biomarker ratios in Surface sediments sampled during the Second Chinese Arctic expedition from the Western Chukchi Sea in summer, 2003 and evaluates their potential as community structure proxies. The total biomarkers (sum of brassicasterol, dinosterol, alkenones) at the surveyed area were 20-3149ng/g, the average value was 1010ng/g.The distributions of biomarkers also indicates the primary productivity in Chukchi shelf was higher than Chukchi plateau. The brassicasterol to dinosterol ratios for different stations have an obvious diversification, but all stations show the brassicasterol is in the ascendant. In the station of Chukchi shelf, diatom is the mainly phytoplankton, the brassicasterol account for 42 to 74 percent of the total biomarkers, and the proportion of dinosterol is 17 to 37 percent in the total biomarkers. In the plateau,the dominant phytoplankton is also the diatom,but the ratio of dinosterol and coccolithophore has a significantly increased.In the Canada basin,dinosterol and coccolithophore is the dominant phytoplankton, the diatom is not the predominant population and this result is in accord with phytoplankton distribution patterns obtained by other methods such as microscope . Our study provide an important modern basis that these biomarkers can be used as proxies for community structure,and it also suggests that this method could be used for community structure reconstruction for the sediment cores.

PROVENANCE DISCRIMINATION IN ARCTIC OCEAN SURFACE SEDIMENTS CONSTRAINED BY QUANTITATIVE MINERALOGICAL ANALYSES

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ABSTRACT

This study focuses on the determination of potential source areas for the terrigenous material derived from Eurasia and North America to reconstruct the sedimentary environments in the Amerasian Basin of the Arctic Ocean. When compared to the potential source areas in the Arctic Ocean hinterland, spatial variations in bulk mineralogy of surface sediments may provide important information on the trajectories of sea-ice drift and oceanic currents.

Investigations are carried out on surface samples recovered from the Mendeleev Ridge and shelves of the East Siberian and the Chukchi seas. Mineralogical analysis was performed on bulk sediments by the X-ray diffraction (XRD) method. Dry powder samples were mixed together with corundum for further quantification of mineral contents. Raw XRD data were processed using the RockJock (Eberl, 2003) and QUAX (Emmermann & Lauterjung, 1990; Vogt, 1997) software to test the consistency of both methods. Additionally, composition of artificial mixtures was determined to test the accuracy of mineral standards.

Obtained results are used to identify mineralogical provinces in the surface sediments of the Amerasian Basin. This geographical distribution is also compared to the previously published studies, including the numerous research activities carried out in the Siberian shelf seas in the middle of the 20th century.

Bulk mineral composition of surface sediments will be further used for unmixing of the downcore mineralogical records for sediment cores recovered along two transects across the Mendeleev Ridge during the ARK-XXIII/3 Expedition of RV “Polarstern” (for details see Stein et al., 2010). Trends in mineralogical composition will be also compared to the grain-size distribution in order to attribute the provenance changes to different transportation mechanisms in variable sedimentary environments.

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SEASONAL VARIABILITY OF CENTRAL ARCTIC OCEAN SEA-ICE COVER: NEW BIOMARKER (IP_{25} AND PIP_{25}) DATA FROM SEDIMENT TRAPS DEPLOYED ON SOUTHERN LOMONOSOV RIDGE

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ABSTRACT

During the *Polarstern* 1995 Expedition, a long-term mooring system with two cone-shaped multi-sampling traps was deployed at the dominantly ice-covered western slope of the southern Lomonosov Ridge (81°04.5'N, 138°54.0'E, 1712 m water depth). One trap was installed at 150 m below the sea surface, the other at 150 m above the bottom at 1550 m depth; material was collected in 20 time intervals between September 1995 and August 1996. For background data see Fahl and Nöthig (2007). Here, we present new biomarker data recording the seasonal variability of sea-ice cover. This type of data representing modern seasonal variability of the sea-ice biomarker proxies, was not available so far but may help significantly the interpretation of these proxies to be used in sedimentary records for reconstruction of paleo-sea-ice distributions.

In this study, we have focused on the novel sea ice proxy IP_{25}, a direct proxy for sea ice coverage (Belt et al., 2007). Furthermore, we used the phytoplankton-IP_{25} index (PIP_{25} Index), a further development of the IP_{25} index, based on the coupling of the environmental information carried by IP_{25} (sea ice) and brassicasterol (open-water phytoplankton productivity) (Müller et al., 2011).

The interval November 1995 to June 1996 is characterized by the absence of the sea-ice proxy IP_{25} (except very minor values for January and April), suggesting a predominantly permanent sea ice cover at the trap location. During July/August 1996, maximum fluxes of the diatom-specific fatty acids and brassicasterol as well as maximum contents of biogenic opal (Fahl and Nöthig, 2007) indicate increased primary productivity. The marine organic matter (here POC, brassicasterol, and fatty acids) and the IP_{25} values decrease systematically from 150 to 1550m depth, indicating the typical biogeochemical degradation with increasing water depth. Due to the coincidence of maximum abundances of sea-ice proxies and open-ocean primary productivity proxies during the July/August time interval we propose a ice-edge situation characterized by increased phytoplankton productivity and sea-ice algae input. This interpretation is also supported by the phytoplankton-IP_{25} index (PIP_{25} Index), reaching quite high values of 0.5-0.8. It seems to be that in general PIP_{25} values do not change significantly between

the shallow and deep trap, i.e., with increasing water depth, an important observation when thinking about the interpretation of PIP_{25} sedimentary records.

The distinctly reduced September/October values of brassicasterol and fatty acids suggest a decrease in primary productivity, probably related to the start of new-ice formation in late September. This situation is reflected in high IP_{25} values and high PIP_{25} ratios. Whereas for October no IP_{25} was determined in the shallow trap, medium-high IP_{25} values were determined in the deep trap with maximum PIP_{25} ratio of about 0.7. This may indicate lateral IP_{25} input, but also means that in this case the PIP_{25} ratios should be interpreted with caution.

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THE SEDIMENTARY RECORD OF ORGANIC-WALLED DINOFLAGELLATE CYSTS AS INDICATORS OF PALAEOCEANOGRAPHIC CHANGES ACROSS THE CHUKCHI BORDERLAND AND SOUTHERN MENDELEEV RIDGE IN THE WESTERN ARCTIC OCEAN

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ABSTRACT

Palynological analysis of box- and multi-core sediment samples from the Chukchi Borderland and southern Mendeleev Ridge in the western Arctic Ocean were performed in order to document the distribution of dinoflagellate cyst assemblages and their relationship to palaeoceanographic conditions. A total of 9 genera and 23 dinoflagellate cysts were identified, mainly consisting of *O. centrocarpum*, *Brigantedinium* spp. and *Spiniferites elongatus*. The surface distribution of dinoflagellate cysts shows a sharp decrease from the inner (St. 01A) to the outer shelf areas. The vertical variations of dinoflagellate cyst concentrations in a multi-core sample from site 01A show a gradual increase from the bottom to the top of the core. In the lower part of the core, lower values of total organic carbon and nitrogen contents correspond to lower concentrations of dinoflagellate cysts. Emphasis has been placed on a prominent increase in dinoflagellate cyst concentrations accompanied by total organic carbon and nitrogen contents in the upper part of the core, probably suggesting increased nutrient inputs and marine productivity in the study area.

CHANGES OF SEA ICE AND SURFACE WATER TEMPERATURE IN THE BERING SEA DURING DEGLACIAL TO HOLOCENE TIMES: EVIDENCE FROM IP25 AND ALKENONE DATA

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ABSTRACT

Overall goal of our study of sediment material collected during RV Sonne Cruise 202 (INOPEX) in 2009 (Gersonde et al., Curise Report 2009), is the reconstruction of the short-term variability of sea-ice, sea-surface temperature (SST), primary productivity and terrigenous input in the subpolar North Pacific/Bering Sea and their relationship to global climate change, using organic-geochemical proxies (i.e. organic-geochemical bulk parameters and specific biomarkers such as: TOC, hydrogen indices; long-chain n-alkanes, sterols, alkenones; Uk37 and TEX86-Index; BIT-Index; HBIs, IP25, PIP25). In a first phase, these organic-geochemical proxies have been determined in surface sediments. The results show that the biomarker proxies reflect modern sea-ice and SST distributions as well as areas of increased primary productivity and increased input of terrigenous (organic) matter quite well. In a second phase of the project, the biomarkers have been determined in three selected sediment cores:

Core SO202-18-6 (Umnak Plateau/Bering Sea; 60.127°N, 179.444°W; water depth 1105 m; core length 7.21 m; age interval 0 to 14 kyr.BP).
Core SO202-07-6 (Detroit Seamount/western subpolar North Pacific; 51.272°N, 167.700°W; water depth 2340 m WD; core length 4.69 m; age interval MIS 1 to 3).
Core SO202-27-6 (Patton Seamount/eastern subpolar North Pacific; 54.296°N, 149.600°W; water depth 2919 m; core length 2.91 m: age interval MIS 1 to 3).

Here, we concentrate especially on the variability of sea-ice cover and sea-surface temperature, using the newly developed sea-ice proxy IP25 (Belt et al., 2007) and alkenone data, respectively, determined in the AMS14C-dated Core SO202-18-6. Based on these biomarker records, sea-ice cover and SST changed significantly in the northern Bering Sea during Deglacial-Holocene times. The Younger Dryas interval is characterized by extended sea-ice cover, coinciding with a drop in SST to 2-4°C. With the end of the Younger Dryas, between 460 and 420 cmbsf, sea-ice cover decreased with increasing SST. Betw

een 420 and 120 cmbsf representing the early Holocene Thermal Maximum, IP25 is absent and maximum SST of about 6°C was reached. During the upper 120 cmbsf representing the late Holocene, IP25 occurred again and increased towards the top, paralleled by a decrease in SST of about 3°C. A very similar contemporaneous trend of increasing sea-ice cover during the late Holocene was recorded in the northern North Atlantic, paralleled by an advance of glaciers in Norway (Müller et al., 2009; 2012).

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RECONSTRUCTION OF PALEOENVIRONMENTAL CHANGE BASED ON GDGT-PROXIES FROM THE CHUKCHI-ALASKA MARGIN DURING THE HOLOCENE

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Abstract

To reconstruct paleoenvironmental changes in the western Arctic Ocean, we tried to estimate sea surface temperature (SST), mean annual air temperature (MAAT), the contribution of soil organic matter (BIT index of Branched and Iso prenoid Tetraethers) and the soil pH in Holocene sediments from the Chukchi-Al aska margin based on GDGT (glycerol dialkyl glycerol tetraethers) proxies. We a pplied several calibrations including $TEX_{86}L$, MBT and CBT as recent approache s to paleotemperature estimation in the Arctic Ocean using 2 core samples. Reco nstructed values of SST and MAAT are not consistent with historically observed annual mean SST and MAAT in the study area, and showed much higher values than modern annual MAT in northern Alaska. The warming bias is related to a variety of different sediment from all over the world and biological features parti cularly in the polar region. Thus, we need future effort to create a calibration eq uation based on the data set in polar region with local factors to improve tempe rature estimates. Environmental change in the study area is divisible into 3 distin ct periods with major and minor change of the GDGT-based parameters includin g temperature, pH, BIT since early Holocene. The period between from 12 to 9. 7 ka show significantly TEX_{86}^{L}-derived SST and pH decreased, while GDGT-deri ved MAAT and BIT increased. The period between from 9.7 to 7 ka vary gradu ally with similar pattern except TEX_{86}^{L}-derived SST. In particular, the patterns fr om 9.7 to 7 ka are consistent with rapid climate changes observed globally and an area near northern Alaska margin, and in Southern Ocean partly. Parameters s ince 7ka show a relatively stable environment. These trends suggest that 1) the warming in northern Alaska began since 10 ka, 2) the contribution of marine O M became larger 3) changes in soil pH may have reflected changes in the prove nance of soil. Meanwhile, a discrepancy of pattern between two cores may have reflected influence by bottom currents and different delivery process. Therefore al though the exact patterns and timing of environmental change are yet examined, GDGT-based proxies is a potential indicator to reveal the environmental changes and understand mechanism.

THE NEXT PHASE OF SCIENTIFIC DRILLING IN THE ARCTIC OCEAN: KEY OBJECTIVES, AREAS, AND STRATEGIES

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ABSTRACT

In spite of the critical role of the Arctic Ocean in climate evolution, our understanding of the short- and long-term paleoceanographic and paleoclimatic history through late Mesozoic-Cenozoic times, as well as its plate-tectonic evolution, remains behind that from the other world's oceans. This lack of knowledge is mainly caused by the major technological/logistic problems in reaching this permanently ice-covered region with normal research vessels and in retrieving long and undisturbed sediment cores.

With the Arctic Coring Expedition – ACEX (or IODP Expedition 302), the first Mission Specific Platform (MSP) expedition within IODP, a new era in Arctic research began (Backman, Moran, Mayer, McInroy et al., 2006). ACEX proved that, with an intensive ice-management strategy, successful scientific drilling in the permanently ice-covered central Arctic Ocean is possible. ACEX is certainly a milestone in Arctic Ocean research, but – of course – further drilling activities are needed in this poorly studied ocean. Furthermore, despite the success of ACEX fundamental questions related to the long- and short-term climate history of the Arctic Ocean during Mesozoic-Cenozoic times remain unanswered. This is partly due to poor core recovery during ACEX and, especially, because of a major mid-Cenozoic hiatus in this single record. Since ACEX, a series of workshops were held to develop a scientific drilling strategy for investigating the tectonic and paleoceanographic history of the Arctic Ocean and its role in influencing the global climate system:

- „Arctic Ocean History: From Speculation to Reality" (Bremerhaven/Germany, November 2008; Convenors: R. Stein/AWI Bremerhaven; B. Coakley/Fairbanks University);
- "Overcoming barriers to Arctic Ocean scientific drilling: the site survey challenge" (Copenhagen/Denmark, November 2011; Convenors: N. Mikkelsen et al./GEUS Copenhagen);
- Circum-Arctic shelf/upper continental slope scientific drilling workshop on "Catching Climate Change in Progress" (San Francisco/USA, December 2011; C. Ruppel/USGS Woods Hole);

- "Coordinated Scientific Drilling in the Beaufort Sea: Addressing Past, Present and Future Changes in Arctic Terrestrial and Marine Systems" (Kananaskis, Alberta/Canada, February 2012; M. O`Regan et al./Cardiff University).

During these workshops, key areas and key scientific themes as well as drilling and site-survey strategies were discussed. Major scientific themes for future Arctic drilling will include:

- The Arctic Ocean during the transition from greenhouse to icehouse conditions and millennial scale climate and paleoenvironmental changes (e.g., sea-ice and ice-sheet history; changes in surface-water temperature, salinity and productivity; history of deep-water ventilation);
- Physical and chemical changes of the evolving Polar Ocean and Arctic gateways;
- Impact of Pleistocene/Holocene warming and sea-level rise on upper continental slope and shelf gas hydrates and on shelf permafrost;
- Land-ocean interactions;
- Tectonic evolution and birth of the Arctic Ocean basin: Arctic ridges, sea floor spreading and global lithosphere processes.

When thinking about future Arctic drilling, it should be clearly emphasized that for the precise planning of future Arctic Ocean drilling campaigns, including site selection, evaluation of proposed drill sites for safety and environmental protection, etc., comprehensive site survey data are needed first. This means that the development of a detailed site survey strategy is a major challenge for the coming years.

Here, an overview of perspectives and plans for future Arctic Ocean drilling will be presented.

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MODERN SPATIAL VARIABILITY OF SEA ICE COVER AND TERRIGENOUS INPUT IN THE KARA AND LAPTEV SEAS: RECONSTRUCTION FROM NEW BIOMARKER DATA DETERMINED IN SURFACE SEDIMENTS

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ABSTRACT

Sea ice is a fundamental component of Earth's climate system, contributing to heat reduction (albedo) and deepwater formation. In order to understand processes controlling the recent dramatic reduction in Arctic sea ice cover, it is essential to determine spatial and temporal changes in sea ice occurrence and its natural variability in the present and past. Here, we present new biomarker data from surface sediments and related to the modern spatial sea ice variability in the Kara and Laptev seas. That means, we determined concentrations of the sea ice diatom-derived biomarker „IP25" (isoprenoid with 25 carbon atom; Belt et al., 2007), phytoplankton-derived biomarkers (brassicasterol and dinosterol) and terrigenous biomarkers (campesterol and ß-sitosterol) to estimate recent sea ice conditions as well as terrigenous input in the study area. Assessment of sea ice conditions based on these biomarkers shows that a marginal ice zone exists along the continental shelf/slope of Kara and Laptev seas during summer/early fall. Elevated IP25 as well as brassicasterol and dinosterol values occurring in the central Kara and Laptev seas are related to extended sea-ice-cover and higher primary production (close to ice edge situation). Further to the north, lower IP25 and phytoplankton biomarker concentrations point to a more close sea ice cover situation. There are no IP25 and very low brassicasterol and dinosterol concentrations in the river mouths but high terrigenous biomarker (campesterol and ß-sitosterol) concentrations due to the fresh water inflow transporting terrigenous matter to estuaries. A combined phytoplankton-IP25 biomarker approach („PIP25 index"; Müller et al., 2009, 2011) is used to reconstruct the modern sea ice distribution more quantitatively.

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STABLE OXYGEN AND CARBON ISOTOPES FROM THE PLANKTONIC FORAMINIFERA *NEOGLOBOQUADRINA PACHYDERMA* IN WESTERN ARCTIC SURFACE SEDIMENTS

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ABSTRACT

Neogloboquadrina pachyderma (Np) is the most abundant planktonic foraminifera species found in the modern polar oceans. The $\delta^{18}O$ and $\delta^{13}C$ of Np from the western Arctic Ocean sediments collected during the 1^{st}-4^{th} Chinese Arctic expeditions were analyzed to reveal the paleoceanographic implications of the proxies. The $\delta^{18}O$ from Np in the Chukchi Sea reflect the water mass distribution in this area. Light $\delta^{18}O$ values in the central Chukchi Sea may be related to the freshwater signal from the Alaska Coastal Current and the Bering Sea Shelf Water. Light $\delta^{18}O$ values in the central and east Chukchi Sea may be related to the freshwater signal from the Alaska Coastal Current (ACC) and the Bering Sea Shelf Water (BSSW). Relatively heavier $\delta^{18}O$ in the Chukchi Shelf marginal area is likely influenced by the upwelled subsurface Atlantic water. The light $\delta^{18}O$ signature in the high Arctic Canadian basin may come from the freshwater stored in the surface layer. The $\delta^{13}C$ distribution pattern in the Chukchi Sea is also influenced by the current system. In the Chukchi Sea the $\delta^{13}C$ distribution pattern may reflect primary productivity pattern. Our data reveal the importance of well ventilated Pacific Water through the Chukchi Sea into the Arctic Ocean.

Keywords: $\delta^{18}O$, $\delta^{13}C$, *Neogloboquadrina pachyderma*, western Arctic Ocean, Chukchi Sea, Canadian Basin

MANGANESE CONTENT CYCLES IN ARCTIC OCEAN AND BERING SEA SEDIMENTS

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ABSTRACT

25 sediment cores from different sites of Arctic Ocean and Bering Sea were measured by XRF Core Scanner with 1cm measurement resolution to survey the Mn-rich brown layers in the sediments and investigate the formation mechanism of Mn content variation. The results show there are obvious relationship (R^2=0.12~0.76) between Mn content and a*/b* (a*, red-green color space; b*, blue-yellow color space) in 18 cores which confirm the brown-yellow color cycles in the sediments are mainly controlled by Mn content variation; while there is no relationship in other 7 cores from the sites close to lands (Fig. 1). In the 18 cores, Mn enrichments occur in association with enrichments of Mo, Cu, Co, Ni which are all sensitive trace metals deposite in oxic conditions; and Mn content variations also have close relationship with content of Br which is usually stick to organic matters; while Zr contents have reverse variation with Mn in most cores. Therefore, Mn deposition might relate to terrigeneous input and redox conditions, while the latter can be induced by variation of water clolumn ventilation and productivity caused by glacial/interglacial cycles.

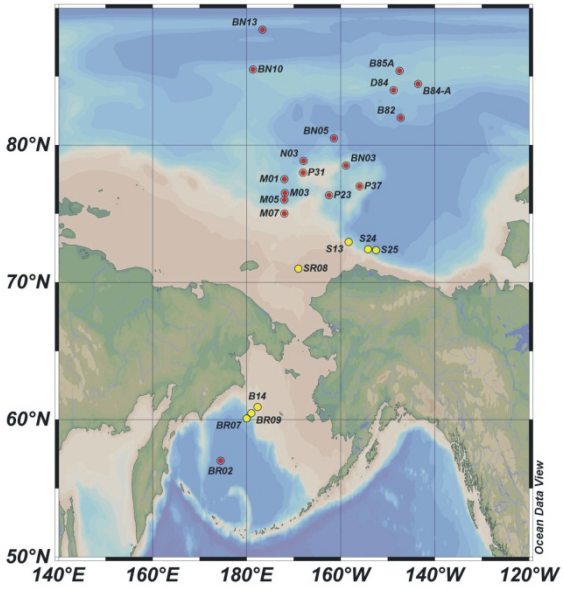

Fig. 1 Bathymetric map showing the location of cores in Arctic Ocean and Bering Sea

NEW SEDIMENTOLOGICAL AND MINERALOGICAL RECORDS FROM MENDELEEV RIDGE: IMPLICATIONS FOR RECONSTRUCTION OF LATE QUATERNARY HISTORY OF CIRCUM-ARCTIC ICE SHEETS AND ARCTIC OCEAN PALEOCEANOGRAPHIC CIRCULATION PATTERNS

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ABSTRACT

The Arctic Ocean plays an important role in the global climate system. However, due to the major technological and/or logistical problems in reaching this permanently ice-covered region and in retrieving long and undisturbed sediment cores, the knowledge of its short and long term paleoceanographic and paleoclimatic history is still limited. More well-dated and detailed records are needed to study the late Quaternary history of circum-Arctic ice sheets and its relationship to the paleoceanographic circulation pattern in the central Arctic Ocean. In this context, our research is aiming to answer the following key questions:

(1) Were extensive late Quaternary circum-Arctic ice sheets developed synchronously or asynchronously in North America, East Siberia, and Eurasia?
(2) How is the evolution of circum-Arctic ice sheets related to the paleoceanographic circulation patterns in the central Arctic Ocean, i.e. how did the major surface-water current systems (Beaufort Gyre and Transpolar Drift) evolve and change their extension?

For this research project, new sediment cores were recovered during the RV "Polarstern" ARK-XXIII/3 expedition (August-October 2008) along two transects from the Canada Basin across the central Mendeleev Ridge towards the Makarov Basin and the Lomonosov Ridge in the Eurasian Arctic (for background see Stein et al., 2010). Here, we mainly focus on the northern transect along 80_300N. In all studied sediment cores, Clark's standard lithological units A to M (Clark et al, 1980) could be clearly identified, and the prominent pink-white layers and more sandy intervals are the key sedimentary characteristics used for core correlation and development of a preliminary age model (Stein et al, 2010). According to this age model, the first onset of coarse-grained dolomite-rich material probably occurred during MIS 16. In general, MIS 16, 12, 10, and 8 are characterized by increased dolomite contents and high amount of sand (>63_m) indicating ice-rafted debris (IRD) input from the Laurentide Ice Sheet (LIS). MIS 6, on the other hand, is characterized by low dolomite and high quartz contents,

suggesting a different source region for the IRD input. In this poster, new XRD and grain-size data from the coarse-grained intervals related to major glaciations, are presented. These data allow a more detailed reconstruction of past Quaternary glaciations in North America, Siberia, and Eurasia.

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BIOGENIC SILICA RECYCLING IN SURFACE SEDIMENTS OF PRYDZ BAY, ANTARCTICA

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ABSTRACT

The biogenic silica (BSi) of marine sediments presents a potential proxy for past oceanic changes. The processes controlling preservation and recycling of BSi in surface sediments must be understood before BSi is used as a proxy in paleooceanographic studies. The Southern Ocean is certainly a key region of seafloor BSi deposits in the World Ocean. In order to understand the processes controlling preservation and recycling of BSi, sediments were collected with a multi-corer in the Prydz Bay during the CHINARE cruises. BSi concentrations in sediments, and pore water profiles of $Si(OH)_4$（DSi）Si were determined. The biogenic silica dissolution recycling in sediments were discussed based on pore water silica measurements and laboratory-based sedimentary BSi solubility experiments in batch reactors. The results show that the pore water concentrations of DSi display a larger range of variation, which range from 229.00 to 759.57μmol/dm3. Sharp gradients were observed near the sediment–water interface. The DSi concentration increased from 74.35 μM, which represents the mean DSi bottom water concentration to the value of 349.08μmol/dm3 at 0.5 cm below surface, and the concentration of DSi in pore water increased with depth, exponentially approached to a stable asymptotic concentration (C_d). The content of biogenic silica is ranged from 4.89% to 85.41%, and no strong decreasing trend of BSi in sediments was observed as would be anticipated by the extent of dissolution suggested from the pore water concentration profiles. The results of batch experiments indicate the apparent solubility of BSi in the top sediments were much higher than the value of C_d, and the apparent solubility decrease as sediment depth below the sediment-water interface increase.

WEATHERING IN SOUTH PATAGONIAN RIVERS : A COMBINED APPROACH OF MAJOR IONS, U-SERIES AND ^{10}BE ISOTOPES METHODS

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ABSTRACT

To study the weathering regime and for the quantitative analysis of weathering in south Patagonian rivers three methods were used, the conventional method using the major element composition of river water, U-series isotopic proxy and another approach using cosmogenic nuclide ^{10}Be. Chemical weathering rates and silicate weathering rates are calculated based on results of the forward model using dissolved major ion compositions of river water. CWR ranges 4.9 ~ 64.2 tons/km^2·yr and SWR vary from 0.2 to 22.1 tons/km^2·yr. U concentration of river water of south Patagonia ranges from 1.6 to 84.1 ppt and it is comparable to Iceland rivers. The dissolved Th concentration (0.273 ~ 0.659 ppt) is also comparable to Iceland rivers. The $(^{234}U/^{238}U)_A$ of dissolved phase ranges from 1.2398 to 2.1978 and the activity ratio of suspended material ranges from 1.0345 to 1.6652. The disequilibria regime is inconsistent with the simple leaching model including α-recoil effects. Erosion rates and apparent exposure ages were calculated from ^{10}Be concentrations of river bed loads. Erosion rates range from 0.009 to 0.555 mm/yr. The rapid erosion rates seem due to the anthropogenic erosion from mine and erosion by glacier of Andes. In contrast, samples from lowlands show much low erosion rates reached to < 10 fold. Inter-method comparison is available in respect to time scale of physical weathering. The physical weathering rates of short-term timescales (10 ~100 yrs) is calculated from river load gauging. Cosmogenic nuclide-derived erosion rates has mid-term timescales (1 ~ 100 ky) and exhumation rates from zircon and apatite fission track and (U-Th)/He cooling data has long-term timescales (1 ~ 10 My).

HOLOCENE OCEANOGRAPHIC RECORD FROM OUTER BARILARI BAY, WESTERN ANTARCTIC PENINSULA: INSIGHTS FROM DIATOMS

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ABSTRACT

As part of the LARISSA (Larsen Ice Shelf System, Antarctica) project, a suite of cores were collected in Barilari Bay, a fjord located at 65˚45'S on the western side of the Antarctic Peninsula. A paired jumbo kasten core, NBP1001 JKC55, and jumbo piston core, NBP1001 JPC127, provide an ~7000 years of paleoceanographic record that is consistent with cores from other fjords and the mid shelf along the western Antarctic Peninsula. This study focused on the diatom record, with supporting chronologic data based on a combination of 210Pb and radiocarbon analyses. In addition, a suite of magnetic susceptibility records, and sedimentologic, geochemical and foraminiferal data complement the diatom data.

From about 7,000 to 5,000 cal BP the Barilari Bay core records the presence of high concentrations of the "sub-polar" form of *Eucampia antarctica*, coupled to long *Eucampia* chain length, a proxy for low sea ice extent. These data suggest the southward movement of relatively ice-free, sub-polar waters into the bay in the mid-Holocene; similar data are observed in marine sediment cores that extend from Lallemand Fjord to the South Orkney Plateau. We speculate that the primary cause of this major oceanographic shift may be related to changes in strength of the westerly winds and impacts on the intrusion of the Antarctic Circumpolar Current.

From 5,000 cal BP to the present, sea ice extent is more variable and generally greater, and polar waters are uniformly present at the site, based on *Eucampia* proxies. The relative abundance of *Fragilariopsis kerguelensis*, a diatom characteristic of the Antarctic Circumpolar Current, shows a consistent decrease, while *Thalassiosira antarctica*, a common coastal species, generally increases, suggestive of a time of increased sea ice extent, and increased "polar" influence.

From ~1000 to 400 cal BP, a marked decrease in productivity is observed, recorded by decreased total organic carbon content and decreased diatom concentration. In particular, the absolute and relative abundance of a diatom commonly associated with productive coastal settings, *Chaetoceros*, decreases. Around 400 cal BP, organic

carbon content begins to increase, and the carbon isotopic composition of the organic material is markedly lighter, however absolute diatom abundance continues to be low. This “mis-match” between the carbon and diatom records suggests that other algal groups have become a more significant component of the phytoplankton assemblage over the past 400 years.

PRELIMINARY RESULTS OF SEDIMENTOLOGICAL ANALYSES OF GRAVITY CORES AND HIGH-RESOLUTION SUB-BOTTOM PROFILES FROM THE CHUKCHI SEA, THE WESTERN ARCTIC OCEAN

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ABSTRACT

In this study, we present preliminary results of sedimentary and echo facies analyses of gravity cores and high-resolution sub-bottom profiling (SBP) data obtained during the 2011 Arctic expedition of R/V Araon (operated by KOPRI) in the Chukchi Sea, the western part of the Arctic Ocean. The gravity cores (248-548 cm long) at 3 stations were collected from the continental shelf and slope areas of the sea, and X-radiographs of sediment slabs were taken from the lengthwise-cut split cores to observe sedimentary structures. Grain size of core sediment was analyzed using standard sieves and a Micrometrics Sedigraph 5000D. High-resolution sub-bottom profiling (SBP) survey was also deployed during the Araon cruise to obtain information on seafloor topography and acoustic characteristics of subsurface sedimentary sequences.

On the SBP data (ca. 70 m of the penetration depth), 3 stratigraphic units (SU-1, 2, 3 in ascending order) are recognized by 2 distinctive reflectors within the sequence. In some places, the lowermost boundary (5-20 m deep below seafloor) between SU-1 and 2 is characterized by channel-shaped erosional topography, which is interpreted to have been originated from incision by grounded glaciers or fluvial channels during the sea-level lowstand, most probably LGM. The boundary between SU-2 and 3 is characterized by a prolonged reflection with a relatively flat and low-relief topography in the inner continental shelf, whereas it gradually changes into a higher-relief reflector with small hummocks in the outer shelf and slope areas. Such acoustic and topographic characters are interpreted to indicate the irregular surface of cohesive mass-flow deposits (e.g. debrites and slump deposits).

More specifically, the acoustic characters in the SBP data are classified into 5 echo facies on the basis of clarity, continuity, and shape of bottom and sub-bottom echoes together with seafloor topography. Echo facies IIA is most prominent type in SU-3 recorded from the continental shelf and slope areas, where it is characterized by semi-prolonged bottom echoes with discontinuous and weak intermittent sub-bottom reflectors. The seafloor associated with this facies shows a smooth or undulatory

topography. This echo is interpreted to represent composite deposits consisting of several units of hemipelagites intercalated with turbidites or mud layers from turbid melt-water plumes. Echo facies IIB-2 consists of very prolonged bottom echoes with no discrete sub-bottom reflectors, showing hummocky, undulatory or irregularly-eroded seafloor topography. It commonly occurs in SU-1 and 2 of the continental shelf and the upper continental slope. The origin of this facies is interpreted as coarse-grained tills deposited directly from the bases or margins of the grounded glaciers. In some places of the continental slope, high-relief protruding seafloors are classified as echo facies IIIA which is characterized by distinct but irregular, overlapping hyperbolae with significantly varying vertex elevations (tens to hundreds of meters). This facies seems to be related with various irregular topography including structurally-deformed or deeply-eroded hard rock basement or semi-consolidated sediments, and volcanic edifices. Echo facies IIIB is mainly recorded from SU-2 and 3 in the restricted areas of the outer shelf and upper to mid continental slope. Acoustically, it is characterized by regularly-overlapping hyperbolic reflectors with slightly varying vertex elevations (tens of meters) and slightly prolonged sub-bottom reflection. This echo facies is interpreted to indicate deposits of slump/slide and debris flow.

Three sediment cores mostly recovered from the upper part of SU-3 consist mainly of clays (>60%) and silts with minor and occasional occurrence of sands and gravels. Based on grain texture and sedimentary structures of the core sediments, 5 sedimentary facies are classified: bioturbated or mottled mud, indistinctly- or wispy-layered mud, thinly-laminated mud or sandy mud, homogeneous mud, disorganized sandy mud. Bioturbated mud, the most predominant facies recognized in all cores, is attributed to hemipelagic deposition. Thinly-laminated mud/sand and homogeneous mud commonly occur as couplets, and are generally accepted as deposits of low-density fine-grained turbidity currents. Indistinctly- or wispy-layered mud was most likely emplaced by contour current, tail of turbidity current or melt water heavily laden with fine-suspended sediments. Disorganized sandy mud is interpreted to represent the settling of coarse debris from the drifting icebergs.

HIGH RESOLUTION STUDY FOR GEOCHEMICAL PROXIES IN NORTH ATLANTIC OCEAN: IMPLICATIONS FOR PALEOCEANOGRAPHIC EVOLUTION

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ABSTRACT

High resolution study for the geochemical proxies (total organic carbon, carbonate, and inorganic elements) were conducted with respect to drilled sediments from North Atlantic Ocean (ODP Leg 162, Site 980) and compared with previously reported results to reconstruct the paleoceaographic evolution since last 500 ka. The geochemical proxies (TOC and $CaCO_3$) had a larger fluctuation, showing cyclic variation. The results of spectral analysis indicate that both proxies in Site 980 have 100 ka cyclicity.

Previous study based on geochemical elements concentration also indicated 100 and 400 ka cycle in nearby ODP Site 983 in North Atlatnic Ocean. This kind of cyclicity can be interpreted as orbital eccentricity, even though the 40 ka and 23 ka cycles were not presented in their study. Also, these cyclic geochemical variations in North Atlantic Ocean may thought to be related to paleoceangoraphic and paleoclimatological variation in North Atlatic Ocean. In particular, the Milankovitch cycle like variation in North Atlantic Ocean shows a slightly different cycle from site to site may reflect the paleoclimatological variation. At present, geochemical proxies for reconstruction of past sea surface temperature as well as flux from terrestrial areas will be developed in near future.

POSTER SESSION – DAY 2

BIOLOGY 2

EFFECT OF TEMPERATURE GRADIENT ON THE MICROBIAL EXTREMOPHILES MORPHOLOGY AND BIOFILM FORMATION IN A MICROFLUIDIC CHANNEL

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ABSTRACT

Microbial extremophiles are able to survive in the extreme polar environments and have developed mechanisms for the variety of stressors. Specially, temperature change is known about psychrophilic and thermophile inhabitants or their specific adaptations to the environmental change. And the development of polar biofilm strategies requires knowledge of the various physic-chemical properties of the cell surface. We present a microfluidic device for rapid and efficient determination of polar bacterial biofilm formation and cell morphology in a range of temperatures at 4 to 40℃. In the present work, polar strains based on 16s rRNA gene sequence, isolated from the antarctica and arctica regions. Here, we report a robust microfluidic platform allowing characteristic of cell morphology and biofilm formation under the temperature gradient from 4 to 40℃. The enabling technical element for this study is a novel design for precise, temperature controled flow inside the microfluidic device by two fluid streams the hot and cold waterbath. The microchannels was effective mornitoring their specific adaptations to temperature change.

CONSERVATION STATUS OF MOSS SPECIES IN THE ADMIRALTY BAY AREA, KING GEORGE ISLAND, ANTARCTICA.

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ABSTRACT

The Antarctic plant distribution depends on the environmental factors, like geomorphological conditions, as surface's stability, rock type and aeolian erosion. It establishes clear home ranges, leading some mosses species to be highly correlated to local geomorphology. During the austral summer 2003/2004 and 2004/2005 we carried out ecological studies at the ice-free areas adjoining the Polish Station Henri Arctowski, Point Hennequim, Keller Penninsula and Ulmann Point localities, both in the Admiralty Bay, inside of the King George Island, to study community structure of mosses in these areas. This work presented potentials threats for the more representative moss species in these region, using the index of ecological significance (IES) as a tool for phytosociological and conservation studies. Nine for fifty-eigth species of mosses know for Admiralty Bay area occur more frequently. *Sanionia uncinata* (Hedw.) Loeske, *Syntrichia magellanica* (Mont.) R.H. Zander and *Polytrichastrum alpinum* (Hedw.) G. L. Smith show as low threats and *Bryum amblyodon* Müll. Hal., *Brachythecium austrosalebrosum* (C. Muell.) Kindb. *Ditrichum hyalinum* Mitt. Kuntze, *Pohlia drumondii* (Müll. Hal.) A.L. Andrews and *Schistidium falcatum* (Hook. f. et Wils.) B. Bremer appears as the most threatened species, especialy by the human presence in the region. Work developed with financial support of CNPq (process no. 574018/2008), FAPERJ (process E-26/170.023/2008), MMA, MCT and CIRM through of INCT-APA.