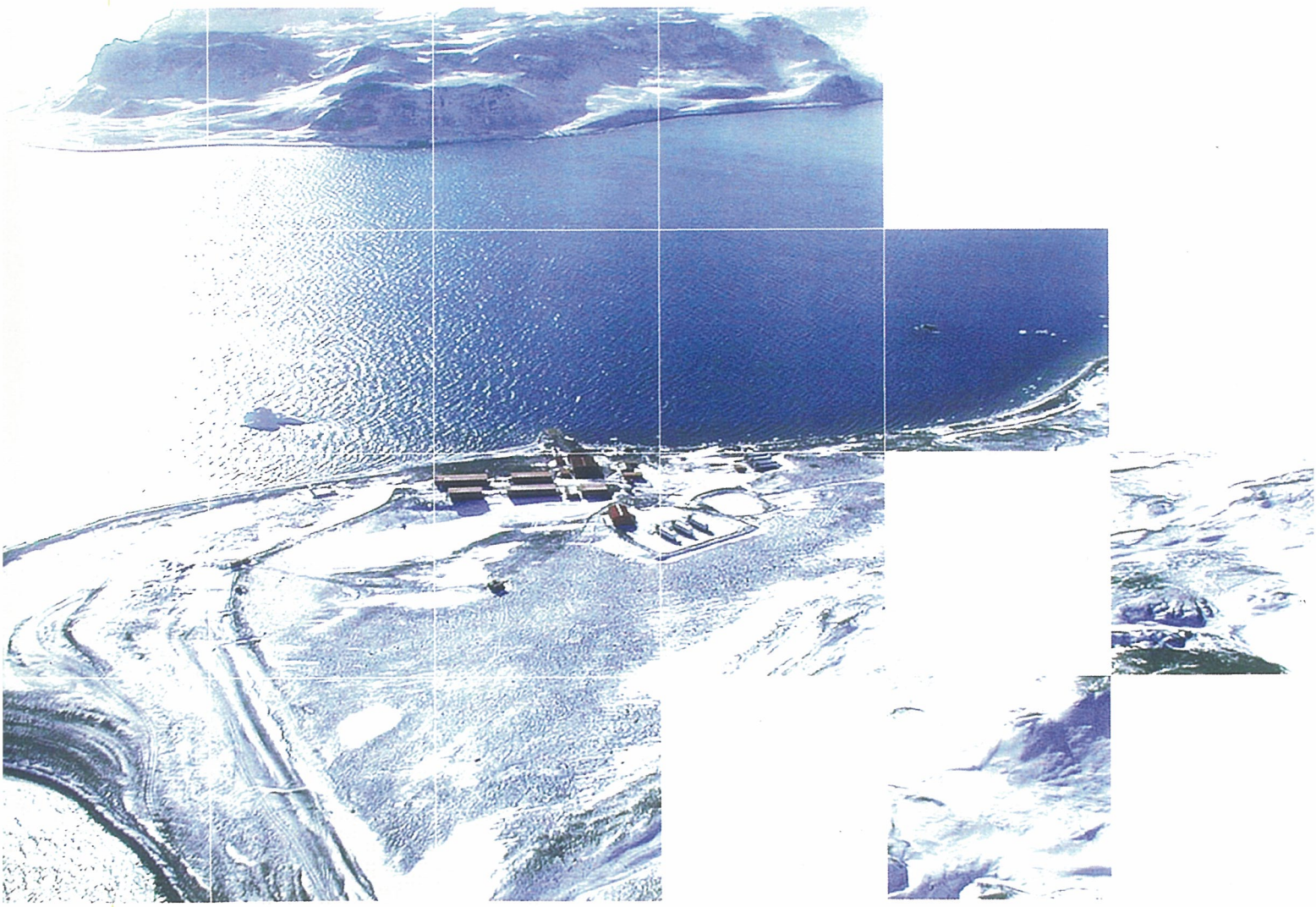
The 8th Seoul International Symposium on Antarctic Science

The Role of Antarctic Sciences in the Global Environmental Research

Editors: S. Hong and Y.I. Won

28-30 May, 2001



Polar Sciences Laboratory
Korea Ocean Research & Development Institute

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09:00-09:30	Registration	
09:30-09:45	Opening address	Dr. Sang-Joon Han (President of KORDI)
09:45-10:00	Welcoming speech	Prof. Byong-Kwon Park (Chairman, Korea Research Council of Public Science & Technology)
10:00-10:40	Keynote speech Antarctica, Greenhouse effect and climatic changes: an Archive of the Past and a Window on the Future	Dr. Dominique Raynaud (Director of LGGE/CNRS, France)
10:40-11:00	Coffee Break	
Session I : Petrology and Geochemistry		Chair: K. Kaminuma and B. K. Khim
11:00-11:25	Summary of the Geological Information of Barton and Weaver peninsulas, King George Island, Antarctica	**J. I. Lee**, S. D. Hur, C. M. Yoo, J. P. Yeo, H. Kim, M. Y. Choe, S. H. Nam, Y. Kim, B. K. Park, X. Zheng, J. López-Martínez
11:25-11:50	Antarctica South America relationships before Gondwana break-up	**H. Miller**
11:50-12:15	New radiometric dating of the dykes from Hurd Peninsula, Livingston Island, South Shetland Islands	**X. Zheng**, B. Kamenov, H. Sang, P. Monchev
12:15-12:40	Geochemical and Isotopic Study on the Intrusive rocks in Hurd Peninsula, Central Livingston Island, Antarctica	**Y. J. Jwa**
12:40-14:00	Lunch	
Session II : Sedimentology		Chair: Q. Wu and Y.-I. Won
14:00-14:25	A new geoarchaeological evidence for sea - level change, Isla Navarino, Canal Beagle, Southernmost Chile	**M. Pino**, C. Ocampo, P. Rivas
14:25-14:50	Volcaniclastic sedimentation of the Sejong Formation (Late Paleocene-Eocene), Barton Peninsula, King George Island, Antarctica	C. M. Yoo, **M. Y. Choe**, H. R. Jo, Y. Kim, and K. H. Kim
14:50-15:15	Debris flow-hyperconcentrated flow transition in a Cretaceous submarine channel, the Cerro Torro Formation, southern Chile	**Y. K. Sohn**, M. Y. Choe, H. R. Jo
15:15-15:30	Coffee Break	
Session III : Quaternary Geology and Paleoceanography		Chair: D. K. Cheong and K. Jiancheng
15:30-15:55	Geomorphology and Late Quaternary evolution of Barton and Weaver peninsulas, King George Island, Western Antarctica	E. Serrano, **J. López-Martínez**
15:55-16:20	The oceanography and palaeoceanography of diatoms	**A. Kemp**
16:20-16:45	Mineralogical characteristics and origin of smectite in the marine sediments around South Shetland Islands, Antarctica	**G.Y. Jeong**, H. I Yoon
16:45-17:10	Mass sinking of diatom flocs for the formation of diatom ooze layer in the northwestern Weddell Sea	**H. I. Yoon**, B.-K. Park, C. Y. Kang
19:00-	Welcome Party, hosted by President of KORDI	

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09:00-09:45	Registration	
Session IV : Geophysics		Chair: D. G. Lee and H. Miller
09:45-10:10	Magnetic Anomalies in Bransfield Strait in 2000 KARP Survey	**S. H. Nam**, K. J. Kim
10:10-10:35	Geophysical Research at Mt. Riiser-Larsen, Amundsen Bay, Enderby Land, Antarctica by the 42nd Japanese Antarctic Expedition under the SEAL Project	**M. Funaki**, N. Ishikawa, T. Matsuda, A. Yamazaki, and P. Dolinsky
10:35-10:50	Coffee Break	
10:50-11:15	Crustal Uplift and Microseismic Activity around Syowa Station, Antarctica	**K. Kaminuma**
11:15-11:40	Gravity and bathymetric study of the Antarctic-Phoenix Ridge and Hero Fracture Zone intersection, Drake Passage(Antarctica)	**K. J. Kim**, S. M. Lee, Y. G. Jin, S. H. Nam, Y. Kim
11:40-12:40	**Poster Presentation**	
12:40-14:00	Lunch	
Session V : Glaciology		Chair: S. T. Kim and J. López-Martinez
14:00-14:25	Difference of climatic change over the different regions of the east Antarctic ice sheet during the past decades, as evidenced by firn core records	**X. Cunde**, Q. Dahe, R. Jiawen, I. Allison
14:25-14:50	Detecting Sea Ice from Spaceborne Altimetry in the Weddell Sea, Antarctica	**J. W. Kim**, S. Hong, H. I. Yoon, Y. Kim
14:50-15:15	The warm interglacial called MIS 11 the Vostok ice core and the stability of Antarctica	**D. Raynaud**, C. Ritzl, M-F.Loutre, J. Chappellaz, J-M Barnola1, J. Jouzel, V. Y. Lipenkov, J-R Petit, F. Vimeux
15:15-15:40	Variations in Oxygen18, Deuterium, and Deuterium Excess in Surface Snow between the Coast and Plateau in East Antarctica	**K. Jiancheng**, J. Jouzel, M. Stievenard, Q. Dahe, W. Dali, L. Zhongqin, L. Jun
15:40-16:00	Coffee Break	
Session VI : Atmospheric Science		Chair: A. Kemp and H. I. Yoon
16:00-16:25	Precipitation anomalies around King Sejong Station in Antarctica associated with El Niño/Southern Oscillation	**T.Y. Kwon**, B. Y. Lee, Y.-I. Won
16:25-16:50	Progress in polar upper atmospheric research in china	L. Ruiyuan, **L. Yonghua**
16:50-17:15	Search for Gravity Waves in an Old Airglow Scan Database and with a New All-Sky Camera	**Y.H. Kim**, Y.-I. Won, B. Y. Lee
17:15-17:40	All Sky Camera and Fabry-Perot Interferometer Observations in the Northern Polar Cap	**Q. Wu**

30 May, 2001

09:00-10:00	Discussion
10:00-17:00	Korean Folk Village Tour
19:00-	Farewell Party, hosted by director of Polar Sciences Laboratory

Poster Presentation

Chair: J. I. Lee

29 May 11:50-12:40	Magnetic properties of 4 rocks collected from King George Island	T. Ogishima, **M. Funaki**
	Micro-particle distribution in Surface Snow at Princess Elizabeth Land, East Antarctica	**K. Jiancheng**, W. Jiahong, L. Leibao, S. Bo, W. Dali
	Diatom assemblages from the Bransfield Basin , Antarctica	**Y.-S. Bak**, J.-D. Lee, H. Yun, H.I. Yoon
	Depositional style of gravelly, deep-sea channels: Lago Sofia conglomerate, southern Chile	H. R. Jo, Y. K. Sohn, M. Y. Choe
	Geochemistry and Timing of Hydrothermal Alteration in the Barton Peninsula, King George Island, Antarctica	**S. D. Hur**, J. I. Lee, J. Hwang, M. Y. Choe
	Wind- and Rain-induced Variation of Water Column Characteristics and Dispersal Pattern of Suspended Particulate Matter (SPM) of Marian Cove, Antarctica during Austral Summer	**K.-C. Yoo**, H. I. Yoon, C. Y. Kang, B.-K. Khim
	Seasonal Mixing Processes and Water Column Properties of Marian Cove, King George Island, West Antarctica	**K.-C. Yoo**, C. Y. Kang, H. I. Yoon
	The preliminary study upon the Cenozoic sedimentary rocks found in the tills of the Grove Mountains, east Antarctica	**A. Fang**, X. Liu, J. Hao, L. Yu, L. Xiaoli, Y. Ju, W. Wang

ANTARCTICA, GREENHOUSE EFFECT AND CLIMATIC CHANGES: AN ARCHIVE OF THE PAST AND A WINDOW ON THE FUTURE

Dominique Raynaud

LGGE/CNRS, St-Martin d'Hères, France

The Antarctic ice contains the purest record of atmospheric changes in CO_2 and other greenhouse trace gases over the last glacial-interglacial cycles. The record offers a unique tool for investigating what are the active processes occurring under very different climatic conditions in the interplay between greenhouse gases (mainly CO_2 and CH_4) and climate, and what has been the role of these gases in driving the natural climate variability together with other radiative forcings as the orbitally induced changes in insolation (Milankovitch forcing) or the changes in the albedo due to the growth and decay of the northern ice sheets.

Beside greenhouse trace gases, the Antarctic ice contains fingerprints of Antarctic temperature, Northern Hemisphere temperature and global ice volume/sea level changes. This multi-parameter record allows us to investigate the sequence of climatic events at a global scale and the North-South teleconnection during the major climatic changes. The results highlight the strong coupling between CO_2 and Southern temperature changes at the scale of the glacial-interglacial cycles and the delay to the Northern temperature during the glacial to interglacial transitions.

The Antarctic ice record gives also the context for the dramatic changes in the concentration of the greenhouse gases induced by the anthropogenic activities since the pre-industrial era and shows that

the present-day levels have been unprecedented over the last 400,000 years. One of the lesson from the ice record is that the external orbital forcing can produce changes in the carbon cycle - and hence in atmospheric CO_2 - large enough to have contributed most significantly to the large past climatic changes. The understanding of such major feedbacks is important, whatever the cause of the changes in greenhouse gases is, when simulating the future climatic changes due to the fast anthropogenic increase in atmospheric CO_2 concentrations.

SUMMARY OF THE GEOLOGICAL INFORMATION OF BARTON AND WEAVER PENINSULAS, KING GEORGE ISLAND, ANTARCTICA

Jong Ik Lee[1], Soon Do Hur[1], Chan Min Yoo[2], Jeong Pil Yeo[1], Hyeoncheol Kim[3], Jeong Hwang[4], Moon Young Choe[1], Sang Heon Nam[1], Yeadong Kim[1], Byong-Kwon Park[1], Xiangshen Zheng[5], and Jerónimo López-Martínez[6]

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We present the compilation of the results of geological surveys performed during last ten years for Barton and Weaver peninsulas, King George Island, Antarctica.

The lowermost lithostratigraphic unit in Barton and Weaver peninsulas is the Sejong Formation (Yoo et al., 2001). The Sejong Formation is distributed in the southern and southeastern cliff of Barton Peninsula and the southern cliff of Weaver Peninsula. It is largely composed of volcaniclastic constituents with maximum thickness of about 100 m, and gently dipping to the south and

southwest. According to lithology, primary structure and bed geometries, the formation is divided into five sedimentary facies: disorganized matrix-supported conglomerate (Facies A), disorganized clast-supported conglomerate (Facies B), stratified clast-supported conglomerate (Facies C), thin-bedded sandstone (Facies D), and lapilli tuff (Facies E). Plant fossil leaves in fine-grained sandstones of the formation are suggestive of Late Paleocene to Eocene sedimentary age (Chun et al., 1994).

Mafic to intermediate volcanic lavas overlying the Sejong Formation are widespread in Barton Peninsula. They are mostly plagioclase-phyric or plagioclase- and clinopyroxene-phyric basaltic andesite to andesite with rare massive andesite. Several units of thick-bedded lapilli tuffs are intercalated with lava flows. Though the eruption ages were interpreted differently by many workers, it is likely that most lavas were erupted during Paleocene to Eocene. The volcanic rocks in Weaver Peninsula are subalkaline basalt to basaltic andesite, whereas those in Barton Peninsula are mostly basaltic andesite to andesite with trace basalt. According to the classification of Miyashiro (1974), the volcanic rocks are plotted in transitional zone between tholeiite and calc-alkaline series. All volcanic rocks are interpreted to have been formed volcanic arc environment.

A fairly large granodioritic stock with minor fine-grained diorite occurs in the northern Barton Peninsula. Park (1989) reported whole-rock K-Ar ages of 42 to 45 Ma for this granodiorite. Two K-Ar biotite ages of granodiorite are 41.9±0.9 Ma and 41.2±0.9 Ma, respectively (Lee et al., 1996). Kim et al. (2000) reported $^{40}Ar/^{39}Ar$ plateau age of 48.4±0.5 Ma for fine-grained diorite. The medium to fine-grained, small stocks of gabbro, diorite and quartz monzodiorite intruded the Sejong Formation and basaltic andesite in Weaver Peninsula.

At the Chottaebawi in Barton Peninsula, a moderate-size volcanic plug about 400 m in diameter cut the Sejong Formation. Vertical, platy joints trending to northeast are developed in the eastern part of

the plug, and become columnar fan-like shapes in the central part. The plug comprises very fine-grained, massive basalt. Several mafic dikes trending to north or northwest cut the Sejong Formation in the southeastern coast of Barton Peninsula. They are generally clinopyroxene-phyric or massive basaltic andesites, and commonly display flow structure. East-west trending basaltic dikes are abundant in Weaver Peninsula. They are plagioclase-phyric or plagioclase- and clinopyroxene-phyric basalts of 1 to 5 m in thickness, and generally cut by north-south trending dikes of similar compositions.

Pervasive hydrothermal alterations are found in Barton Peninsula. According to mineral assemblage, four hydrothermal alteration types are recognized; prophyllic, phyllic, argillic and advanced argillic. K-Ar ages of hydrothermally altered rocks have been determined as follows: prophyllic altered andesite from southwestern part (42 Ma), altered rocks contacted with quartz vein from southern part (28 to 33 Ma), and advanced argillic altered andesite from northeasten part (33 to 35 Ma) (Hur et al., 2001). Those K-Ar ages are about 10 My younger than intrusive age of granodiorite in Barton Peninsula.

Two major systems of strike-slip faults are developed in the area: NW-SE trending strike-slip faults in Barton Peninsula and NE-SW trending strike-slip fault in Weaver Peninsula.

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ANTARCTICA SOUTH AMERICA RELATIONSHIPS BEFORE GONDWANA BREAK-UP

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Antarctica forms the central part of the Gondwana supercontinent, being surrounded by Australia/New Zealand, India/Sri Lanka, Africa/Madagascar and South America.

Historically, the relation of Australia to Antarctica always has been clearly defined, not as well the exact pre-break-up position of India/Sri Lanka and Africa/Madagascar. When the paleo-position of the southern tip of South America was to be compared with West Antarctica, about a half dozen of sites of the Peninsula relative to South America have been constructed and often withdrawn by their own authors. However, it is generally accepted now, that the Peninsula was situated west of Tierra del Fuego or still more to the north, before Gondwana break-up. Several facts control this position:

1. The pre-break-up geology. - A general comparison of Antarctic and South American geology was presented by Alfred Wegener and by Du Toit (Samfrau geosyncline) early in the 20th century. In both parts Early Paleozoic intrusive and metamorphic rocks occur as well as Late Paleozoic (Hercynian) granites and metamorphism. The most similar development is shown just at the end of the Triassic when in both parts turbidites of identical characteristics formed, known as Trinity Peninsula Group in Antarctica and Patranca Formation in the

Chonos Archipelago of the Pacific coast of Patagonia.

2. The syn-break-up geology. Two characteristic events accompany the destruction of Gondwana and the formation of the South Atlantic Ocean: The silicic large igneous province of Patagonia/Eastern Peninsula, and the Upper Jurassic/Cretaceous intermediate to basic volcanic province of the western Antarctic Peninsula. This volcanism is lacking at the southern tip of South America, where large turbiditic sediments (Yaghan Formation) formed in the Cretaceous, a magmatic backarc existed, and exotic terranes of Carboniferous/Permian age occur (Madre de Dios Archipelago). However, a Mesozoic volcanic arc, like in Antarctica and in Central and North Chile, is not present at the southern tip of South America today. This can easily be explained by a southward movement of such former arc forming now the Antarctic Peninsula.

3. The role of the Weddell Sea. Recent geophysical work (Jokat, AWI) demonstrates the existence of an old, Jurassic, age of the central part of the Weddell Sea. Such situation can only be explained, if southernmost South America has moved out of the Weddell Sea to the north, say that it has been there, to the east of the Antarctic Peninsula, before the Jurassic. The final separation of both continents only occurred in the Early Tertiary giving way to the circum-Antarctic ocean currents which strongly influenced the climatic and oceanographic conditions around the isolated Antarctic continent.

NEW RADIOMETRIC DATING OF THE DYKES FROM HURD PENINSULA, LIVINGSTON ISLAND, SOUTH SHETLAND ISLANDS

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New K-Ar and $^{40}Ar/^{39}Ar$ age determination of the 18 samples selected from the dyke swarms widely exposed in Hurd Peninsula construct the age sequence of the dyke emplacements in the area. 15 new K-Ar ages within the range of 79-31 Ma are confirmed by 3 $^{40}Ar/^{39}Ar$ plateau and isochron data of 64.9±0.4 Ma, 55.5±0.1 Ma and 52.8±0.6 Ma. The new geochronological data reveal a much more detailed picture of the subduction imprint in Hurd Peninsula. Combining with the cutting relationship, the dyke emplacement history is divided into four episodes. The Late Cretaceous-Palaeocene dykes in the range of 80-60 Ma are related to the main magmatism in Livingston Island and most likely reflect the final stages of the subduction of the Proto-Pacific oceanic crust. Our results widen the first arc-building episode with span of dates from 79-61 Ma. The Early Eocene dykes (56-52 Ma) fill the gap of the volcanic activity from 70-50 Ma ago. They are the only one magmatic event manifested in these times in the region and indicate that the gap in the magmatic activity is not 70-50 Ma (Willan and Kelley, 1999) but much shorter (only ~5 Ma). The dykes of 45-42 Ma age are same as that of most of dykes emplaced during the Late Eocene and should

be related to the intrusion of the Barnard Point tonalite. They revealed a new episode in the dyke formation on the island. The three samples of Oligocene age appear to represent one of the last igneous activities on Hurd Peninsula prior to the opening of Bransfield Strait.

These datings are harmonized with group D dykes and epithermal carbonate veins (Willan and Kelley, 1999). The new finds should assist in the better understanding of the arc-building process in the South Shetland Islands, which presents an intriguing geodynamic setting with showing of subduction, cessation of island arc volcanism as well as apparent onset of back-arc rifting. It becomes obvious that Hurd Peninsula with its exposures of so different in age dykes is a key junction in every attempt to reconstruct the geological evolution of the South Shetland Islands.

Willan R.C.R.& Kelley, S. P., 1999. Mafic dike swarms in the South Shetland Islands volcanic arc: Unravelling multiepisodic magmatism related to subduction and continental rifting. J. Geophysic. Res. 104:B10, 23051-23068.

GEOCHEMICAL AND ISOTOPIC STUDY ON THE INTRUSIVE ROCKS IN HURD PENINSULA, CENTRAL LIVINGSTON ISLAND, ANTARCTICA

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In Hurd Peninsula Late Paleozoic-early Mesozoic Miers Bluff Formation distributed as a basement rock, which was intruded by granitic rocks and mafic dyke rocks. The granitic rocks are quartz diorite, tonalite, and granodiorite in modal compositions. The rocks seems likely to belong to marginal facies of the Barnard Point Tonalite Province which locates at the eastern part of Hurd Peninsula. The mafic dyke rocks are divided into porphyritic dyke and fine-grained dyke rocks. The porphyritic dyke rocks intruded into the granitic rocks, but the intruding relationship between the granitic rocks and the fine-grained dyke rocks is unclear.

SiO_2 contents of the Hurd Peninsula intrusive rocks range from 46 to 57 wt.%, showing mafic to intermediate compositions. The major and trace element compositional variations indicate that the granitic rocks, porphyritic, and fine-grained dyke rocks were differentiated from three different parental magmas, implying that there existed three intrusive events in Hurd Peninsula. The intrusive rocks in the peninsula represent tholeiitic nature. This fact indicates that the magma activities occurred at closer volcanic front during the subduction of oceanic plate(Aluk) to Antarctic Peninsula.

Comparing the Hurd Peninsula granitic rocks with the False Bay quartz diorite and tonalite in terms of major and trace element

contents as well as REE patterns , it is understood that each granitic rocks was differentiated from independent parental magma. The Hurd Peninsula granitic rocks and the False Bay quartz diorite seem like that the parental magmas were originated from the garnet-bearing source rocks(garnet peridotite) at deeper upper mantle. The contribution of fluid flux by dehydration of subducting oceanic slab and/or the partial addition of crustal materials was large for the magma genesis of the Hurd Peninsula granitic rocks, whereas the partial melting of oceanic slab or upper mantle which include high field strength element(HFSE)-rich minerals possibly led to the magma genesis of the False Bay quartz diorite. The parental magma of the False Bay tonalite seems likely to have formed from the plagioclase-rich source rock, that is plagioclase peridotite in shallow upper mantle or gabbroic rocks in the lower crust. In addition, the contribution of the fluid flux was negligible for the magma composition of the False Bay tonalite.

From the features that the Hurd Peninsula granitic rocks show tholeiitic nature and the False Bay quartz diorite and tonalite do calc-alkaline, it is considered that the nature of igneous activities in the southeastern Livingston Island spatially evolved from tholeiitic to calc-alkaline with distance relative to the trench.

The Barnard Point Tonalite Province (BPTP) locates in the central Livingston Island. The granitic rocks in the Hurd Peninsula belong to marginal facies of the BPTP. Potassium-argon radiometric ages of the granitic rocks in the BPTP are very dispersed from the oldest 102 Ma in the Half Moon Island to the youngest 28 Ma in the False Bay area. This age dispersion would indicate the resetting event caused by the successive intrusions as well as secondary hydrothermal alteration. This study reports an errorchron Rb-Sr whole-rock age and Sr initial ratio of the Hurd Peninsula granitic rocks as 99.2±75.2 Ma and 0.705364±456 (1σ error range and 3.57 of MSWD), respectively. Though the error range is quite large, the whole-rock age possibly suggests that the granitic magmatism which formed the BPTP

anteceded the middle Cretaceous time. Also the K-Ar reported ages younger than 99 Ma would have been the result of radiogenic Ar-loss by the granodiorite stock which intruded into the BPTP at the False Bay area and by the hydrothermal alteration within the BPTP. The ratios of $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ of the Hurd Peninsula granitic rocks digress to the right side from the Mantle Array. This digression indicates that the materials of higher $^{87}Sr/^{86}Sr$ and lower $^{143}Nd/^{144}Nd$ contributed to the isotopic composition of the mantle-originated granitic magma. Addition of the fluid flux from the oceanic crust and/or the seawater to the magma was likely to be the case for the characteristic Sr and Nd isotopic ratios of the Hurd Peninsula granitic rocks. This result from the isotopic nature of the granitic rocks is in accordance with the consideration from geochemical characteristics in terms of major, trace and rare earth elements.

A NEW GEOARCHAEOLOGICAL EVIDENCE FOR SEA-LEVEL CHANGE, ISLA NAVARINO, CANAL BEAGLE, SOUTHERNMOST CHILE

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2. Departamento de Antropología, Universidad de Chile
3. Wulaia Foundation, Isla Navarino.

The fjord formed by Canal Beagle (near 55° S) is about 200 km long between the Pacific and Atlantic Oceans, and is located in a way parallel to the limit of the plates of Southamerica and Scotland about 50 kilometers north of the fjord. The Beagle was one of the last regions of South America to be free of the last glaciation ice, about 9,000 ^{14}C yr BP (Heusser, 1998); opened before 8,200 ^{14}C yr BP the glacial lake was ocuppied by seawater (Rabassa et al., 2000). The intensive glacial erosion over a basement of metasedimentary rocks with a well defined foliation produced an indented rocky coast. Thus the coast is characterized by reflective gravel beaches, under microtidal regime and short period waves originated by the wind (Canal Beagle is only 5 km wide).

The archaeological record of Navarino Island was formed during the last 7 thousand years BP by canoe maritime hunter gatherer peoples that moved over large coastal extensions of the patagonian meridional channels, primarily concentrated in the Canal Beagle. This record is represented by shell middens distributed as a continuum along the different coastal altitudinal formations of the island, from the beach until the 50 m above modern-day sea level. These shell-middens can be characterized by depressions circumscribed by the shell mounds (dwellings) (Rivas et al., 1999, Rivas & Ocampo,

2000). One of the typical settlement pattern is recognized in a horizontal sequence of gravel beach ridge, shell midden and a frehwater swamp. Under reflective beach conditions, the beach ridge is near the spring high water level, no more than 1 m heigh over the berm.

At Punta Guerrico, Isla Navarino (3,914,544 N, 574,538 E), recent gravel mining created a cliff, about 290 m of the present-day shore. In this exposure was possible to describe a vertical sequence (Figure 1), from base to top composed by a till (exposed 2 m), a thin coluvial deposit formed by gravel derived from the till (2 cm), an organic soil very similar to the modern swamp deposits (14 cm) interfingering to a midden (1m). Soil and midden are buried by a gravel beach ridge (8 cm). Fine leveling every 2 m determined that the top of the beach ridge is 10, 6 m over the present day sea level (tide high of 1.2 m at the time of the leveling). The uncalibrated ^{14}C age of a shell sample is 6,495 ± 60 yr BP (Geoscience Department of the Arizona University #10918). This mean an uplif rate (tectonic or eustatic rebound, or both) of 1,64 mm/yr that agrees with the data published by Rabassa (1987). In the northern shore of the Canal Beagle there is a lot of old raised beaches in the range 8 - 10 m (Gordillo et al, 1992). In this case all the ^{14}C ages were obtained of shells deposited together with the gravel beach ridge. It is discussed the effect of reworking of the shells, because the age of recent beach shell deposits can vary ^{14}C 610 yr (González, 1989), 1,390 yr (Flessa & Kowalewski, 1994), or between 630 and 7355 ^{14}C yr BP (Jelgersma, 1979). In this new evidence for aold sea level stand all the shells were collected alive, without reworking.

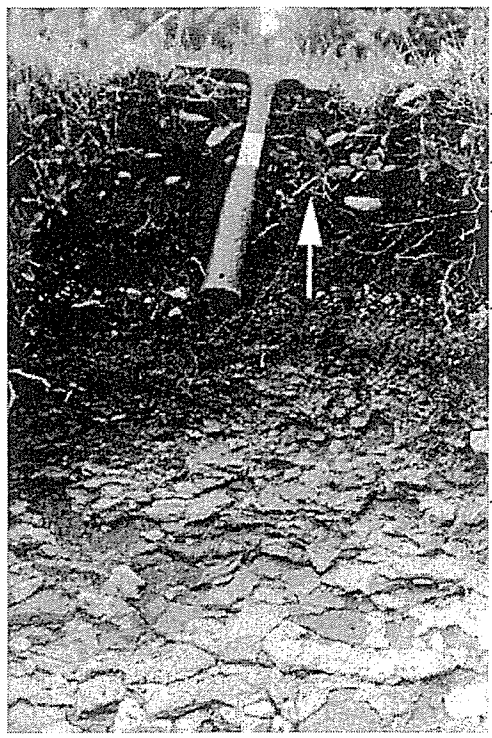

Figure 1: section of sediments exposed at Punta Guerrico. The arrow indicate the depth of the paleosoil under de gravel beach ridge.

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This results were funded by CONICYT, Project FONDECYT 1980654, granted to Ocampo and Rivas.

VOLCANICLASTIC SEDIMENTATION OF THE SEJONG FORMATION (LATE PALEOCENE-EOCENE), BARTON PENINSULA, KING GEORGE ISLAND, ANTARCTICA

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The Sejong Formation of Late Paleocene to Eocene age is a lower volcaniclastic sequence unconformably overlain by upper volcanic sequence, and distributed along the southern and southeastern cliff of the Barton Peninsula. The Sejong Formation is divided into five sedimentary facies: disorganized matrix-supported conglomerate (Facies A), disorganized clast-supported conglomerate (Facies B), stratified clast-supported conglomerate (Facies C), thin-bedded sandstone (Facies D), and lapilli tuff (Facies E), based on sedimentary textures, primary sedimentary structures and bed geometries. Individual sedimentary facies is characterized by distinct sedimentary process such as gravel-bearing mudflows or muddy debris flows (Facies A), cohesionless debris flows (Facies B), unconfined or poorly confined hyperconcentrated flood flows and sheet floods (Facies C), subordinate streamflows (Facies D), and pyroclastic flows (Facies E).

Deposition of the Sejong Formation was closely related with volcanic activity which occurred around this sedimentary basin. Four different phases of sediment filling were identified from constituting sedimentary facies. Thick conglomerate and sandstone were deposited

during inter-eruptive phases (stages 1, 3 and 4), whereas lapilli tuff was formed by pyroclastic flows during active volcanism (stage 2). These records indicate that active volcanism occurred around the Barton Peninsula during Late Paleocene to Eocene.

DEBRIS FLOW - HYPERCONCENTRATED FLOW TRANSITION IN A CRETACEOUS SUBMARINE CHANNEL, THE CERRO TORRO FORMATION, SOUTHERN CHILE

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Sediment gravity flows change their properties during flow almost continuously because of incorporation or removal of sediment and/or water. It is well documented that a subaerial debris flow transforms into a hyperconcentrated flow when it encounters a perennial streamflow. Such a transformation is assumed to be much more likely in subaqueous environments because the entire surface of a debris flow is always in contact with ambient water.

The mass-flow deposits in the Lago Sofia conglomerates, Cretaceous Cerro Torro Formation, southern Chile provide a good example of debris flow-hyperconcentrated flow transition in submarine environments. The Lago Sofia conglomerates represent a large submarine channel system consisting of a number of tributaries along the basin margin, which converged to form a trunk channel along the basin axis. Massive to variably graded mass-flow deposits, meters to tens of meters in thickness, are commonly intercalated between stratified or cross-stratified turbidity current deposits, suggestive of intermittent channel bank or slope failure within the channel system. The mass-flow deposits display peculiar sedimentary characteristics, such as overall normal grading with or without basal inverse grading,

imbrication of gravel clasts only in the clast-supported lower part of individual units, and abundance of meter-long intraformational clasts (mudstone chips and sandstone blocks) in the matrix-supported and disorganized upper part.

Synthesis of the sedimentary characteristics from a number of mass-flow deposits suggests that they basically comprise two distinct divisions: 1) lower division of clast-supported, imbricated pebble-cobble conglomerate with common basal inverse grading and 2) upper division of matrix-supported and disorganized pebble conglomerate or pebbly mudstone with abundant intraformational clasts. The bipartite beds are interpreted to represent a longitudinally segregated mass flow that comprised at least two different rheologies, i.e., an inertial frontal part dominated by active clast interactions and a viscoplastic rear part probably with a rigid plug. Such a longitudinal segregation resulted most likely from the dilution of a submarine debris flow probably involving hydroplaning, and the bipartite mass-flow deposits in the Lago Sofia conglomerates represent a submarine analogue of debris flow-hyperconcentrated flow transition.

GEOMORPHOLOGY AND LATE QUATERNARY EVOLUTION OF BARTON AND WEAVER PENINSULAS, KING GEORGE ISLAND, WESTERN ANTARCTICA

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A detailed (1:10,000 scale) geomorphological mapping has been carried out in Barton and Weaver peninsulas, King George Island. The geographical distribution of the existing landforms and surface deposits, classified according morphogenetic criteria, allows us to distinguish different marine, glacial and periglacial Quaternary episodes. The marine sediments and platforms have been classified as present day beach and Holocene raised beaches (0-20 m a.s.l.), and pre-Holocene platforms and deposits (> 20 m a.s.l.). In the second group they have been distinguished the following sets: middle platforms (25-60 m a.s.l.), upper platforms (68-105 m a.s.l.) and highest marine deposits (134-150, 180-202 and 242-260 m a.s.l.). Barton Peninsula is specially signified for the reconstruction of past sea levels because it contains some of the highest known marine deposits in the South Shetland Islands. The classification of the existing glacial deposits of both peninsulas in four groups (external moraines, set I of retreat moraines, set II of retreat moraines and inner moraines) supports the identification of different phases into the

deglaciation process of the area. The mapping of the periglacial landforms and deposits points out the altitudinal distribution of the different types (e.g. stone fields, gelifluction lobes, patterned ground), being most of them located above 50 m a.s.l. The comparison of the different marine, glacial and periglacial phases, established after geomorphological criteria, with the existing regional geochronological and palaeoenvironmental data obtained from other sources (e.g. lakes, coves), allows to assign tentative ages -most of them within the Holocene- to the morphogenetic phases distinguished in Barton and Weaver peninsulas.

THE OCEANOGRAPHY AND PALAEOCEANOGRAPHY OF DIATOMS

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Diatom algae dominate the workings of the biological carbon pump that draws down carbon dioxide from the atmosphere and exports it to the deep ocean. One of the great challenges to the field of palaeoceanography is not only to produce insights into past change but also to improve understanding of oceanographic processes on the timescales of modern oceanographic observations and experiments. Such insights have been produced by SEM-based research on laminated diatomaceous sediments that may be regarded as palaeo-sediment traps. Over the last decade, the Southampton group has analysed laminated sediments from near-shore basins and the deep-sea that represent more than 10,000 years of palaeo-sediment trap archive. The records generated afford valuable insights into inter-annual to decadal-scale climate variability e.g. the longevity of occurrence of the El Niño phenomenon (Bull et al. 2000). A major success of the Ocean Drilling Program has been to recover laminated diatomaceous sediments from open-ocean settings not previously associated with such deposits including the Eastern Equatorial Pacific, the Mediterranean and the Southern Ocean. Analysis of the records from these deep-sea settings together with those from marginal basins have shed a new light on the different styles of diatom production and the role of mat forming and giant diatoms in

export flux. Previous convention held that most oceanic diatom production was due to the relatively small rapidly reproducing species characteristic of upwelling areas and the Spring bloom and that large or mat-forming diatoms were typical of the sparse flora of stratified, oligotrophic zones. New insights from laminated sediments demonstrate that giant or mat-forming diatoms may actually dominate the export flux and are thus key drivers of oceanic biogeochemistry (Kemp et al., 1999; 2000; Smetacek, 2000). The recognition of the importance of diatom production at depth also has important implications for the interpretation of proxy records derived from planktonic foraminifer

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MINERALOGICAL CHARACTERISTICS AND ORIGIN OF SMECTITE IN THE MARINE SEDIMENTS AROUND SOUTH SHETLAND ISLANDS, ANTARCTICA

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Mineral composition and chemistry of the clay minerals in the three cores from the continental shelves of South Shetland Islands (NCS09) and Anberse Island (GC98-2), and from the fjord of King George Island (A10-01) were determined by X-ray diffraction and electron microprobe analysis in search of the distributions and origin of the clay minerals in the Antarctic marine sediments. Smectite content is relatively high in NCS09 without regard to core depths, but low in GC98-2. In A10-01, smectite content is higher in the upper section than in the lower section. Yellow to yellowish green clay granules were commonly scattered in the sediments of NCS09 cores. The clays contain 16.97 % Fe_2O_3 and 2.53% K_2O. Average structural formula of the clay indicates ferrian beidellite. The (Fe, K)-rich smectite of NCS09 must have been derived from relatively young basaltic volcanics altered by reaction with seawater near South Shetland Islands by glacial erosion or eolian process related to volcanic eruption. GC98-2 nearer to Antarctic continent is very low in smectite content. In A10-01, the lower diamicton was deposited from the glacial erosion of smectite-free ancient volcanics in the interior of King George Island, while the upper section was derived from the

smectite-bearing terrestrial debris and eolian materials around Marian Cove after retreat of glaciers.

MASS SINKING OF DIATOM FLOCS FOR THE FORMATION OF DIATOM OOZE LAYER IN THE NORTHWESTERN WEDDELL SEA

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The formation of LDO(Layered Diatom Ooze) in the Southern Ocean has been ascribed to the results of high production by a function of both low-salinity meltwater and protection from storm activity, both of which contribute to water column stability. A second possibility is that the layered diatom ooze formed as a consequence of higher settling fluxes of diatom flocs caused by water physics which sediments phytoplankton blooms advected towards a point above the area of ooze accumulation. Here, we report that in a sediment core from beneath frontal zone in eastern Bransfield Strait, northwestern Weddell Sea, layered diatom ooze that occur persistently through most of the core, indicative of presently forming diatom mat. We adduce evidences that this layered ooze can be caused by repeated episodes of increased primary production, on a scale that is documented in the modern ocean. It is surprising that the layered diatom ooze at a depth of sediment cores at two closely spaced sites might be resulted from the enhanced ice-edge blooms near the meltwater lense formed by climatic warming at 2,500 yrs BP, combined with mass sinking of phytoplankton blooms through the narrow column of deep convection. This remarkable deposits should enable quantification of ancient deep-sea fluxes and the study of short-term climatic fluctuations during the late Holocene.

MAGNETIC ANOMALIES IN BRANSFIELD STRAIT IN 2000 KARP SURVEY

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The northern Antarctic Peninsula is situated in the complex tectonic environments of a compact area, including the convergence along the South Shetland Trench, the active extension of Bransfield Strait, and transform of the Shackleton Fracture Zone and the South Scotia Ridge. The Bransfield Strait is a narrow and elongated active rift basin, located between the Antarctic Peninsula and the South Shetland Islands. The Bransfield Basin is composed of three small basin, the central, the eastern, and the western basin. In this area, a marine magnetic survey was carried out to study the crustal structure during 1990/91 summer season by KARP. The distinctive anomalies were interpreted to be caused by igneous bodies. The dykes model suggested that the amount of extension is greater and the process stopped earlier in the eastern basin than central basin. The morphostructure and evolution of the Bransfield Basin, by multibeam echosounding and magnetic survey by the spanish R/V Hesperdes, in 1993, was found as circular, semicircular and elongated edifices. And bathymetric data showed seamounts were identified some facies. In the same area, KARP had carried out 12-ch seismic survey, in 1994 ~ 1996. From the survey, the Bransfield Strait could be divided into some segments showing different fault geometry. The boundaries of those segments seem to be transfer faults across the strait, including the large fault zone.

In the last season, magnetic and 3.5 kHz seismic survey were

carried out by russian R/V Yuzhmorgeologiya. The purpose of this cruise is made up the past magnetic data and review the seismic results. From this preliminary results of magnetic and seismic survey, three stages of successive volcano-tectonic constructions is verified. And short wavelength and high amplitude positive magnetic anomalies may be associated with submarine volcanic edifices. This evolution will be analysed more details by magnetic model study and petrological analysis with dredges on seamounts, in future.

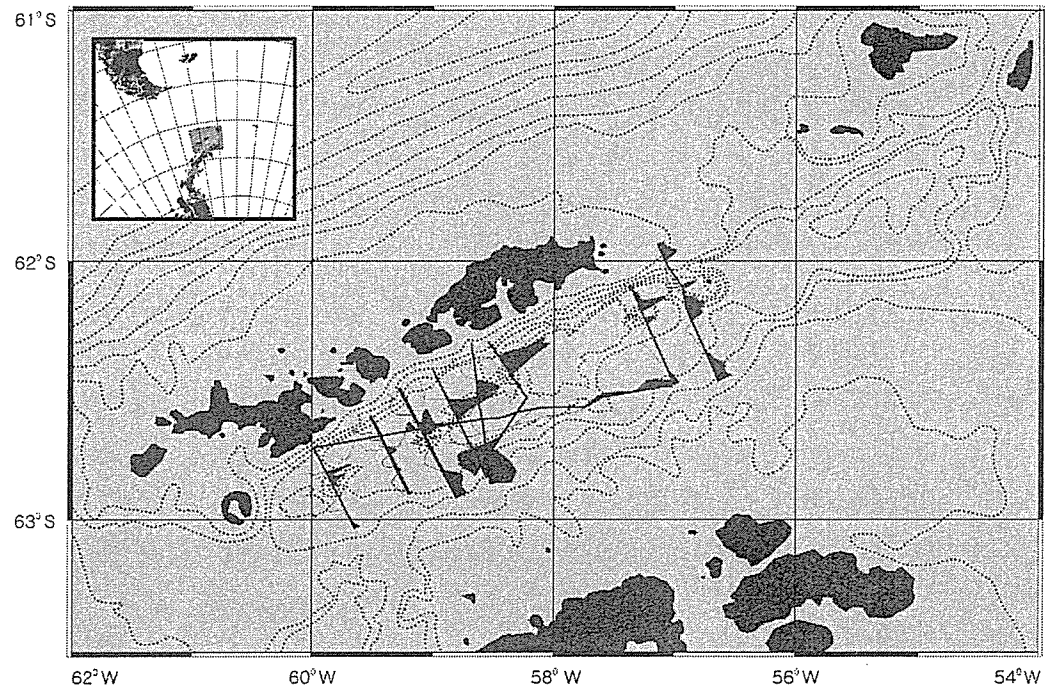

Fig. 1. Magnetic lines and anomalies in 2000 KARP survey

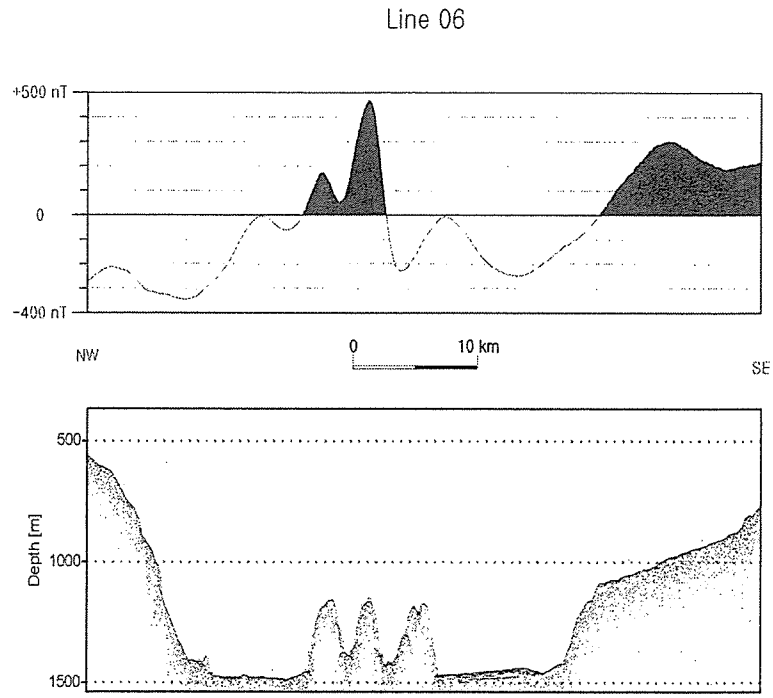

Fig. 2. Magnetic anomaly and 3.5 seismic profile in Line06

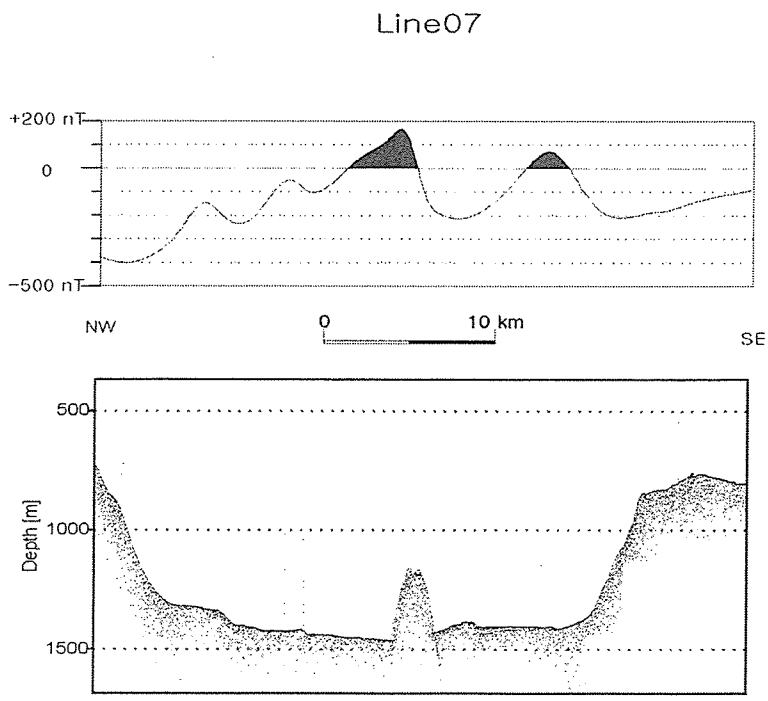

Fig. 3. Magnetic anomaly and 3.5 seismic profile in Line07

GEOPHYSICAL RESEARCH AT MT. RIISER-LARSEN, AMUNDSEN BAY, ENDERBY LAND, ANTARCTICA BY THE 42ND JAPANESE ANTARCTIC EXPEDITION UNDER THE SEAL PROJECT

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Japanese Antarctic Research Expedition (JARE) carried out earth scientific research at Amundsen Bay, Enderby Land, East Antarctica, from 1997 to 2002 in order to understand the Structure and Evolution of Antarctic Lithosphere (called SEAL Project). This area has been known one of the oldest crust in the world, as reported 3.9 ba. JARE established temporally camps at Mt. Riiser-Larsen and Tonagh Island in the Amundsen Bay, but these camps were damaged in summer and destroyed in the winter by the extremely strong wind. Nevertheless we re-made the camps and accomplished the original schedule by the JARE 38, 39, 40 and 42.

The fundamental geological and geochronological features in Mt. Riiser-Larsen were revealed by JARE 38. Based on the results, the JARE 42 summer party further studied Mt. Riiser-Larsen region focused on the paleomagnetism, geochronology, electro-magnetism and magnetic anomaly. A total of 25 tons of cargo was transported by helicopters from icebreaker SHIRASE to the camping site. Against strong wind we assembled a sturdy hut modified to the

commercialized freezer. The camp was operated to take the environmental protection into account, such as adopting burning-toilet and bringing back of every rubbish to Japan. Five persons stayed there during 63 days from Dec. 18, 2000 to Feb. 18, 2001 and finally every facility of the camps at Mt. Riiser-Larsen and Tounar Island was withdrawn. The maximum wind speed to 50.7 m/s was observed during our stay, although a temperature was very high as an average temperature was 0.8 °C.

Consequently the original research plane was accomplished almost completely. We collected 741 paleomagnetic samples, and 561 geochronological samples, magnetotelluric data at 5 sites and magnetic anomaly data along 100 km of survey lines.

CRUSTAL UPLIFT AND MICROSEISMIC ACTIVITY AROUND SYOWA STATION, ANTARCTICA

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The Antarctic coastal area and surrounding islands are places where crustal uplift has occurred after deglaciation. There is a great deal of evidence concerning crustal uplift in the vicinity of Syowa Station (69 ° S, 39.6 ° E) which is located on East Ongul Island in Lützow-Holm Bay, East Antarctica. Characterization of crustal movement and estimation of sea level change have been accomplished using a variety of classical high precision methods such as tide gauge and leveling data, seismic evidence etc. at Syowa Station. Holocene elevated beaches, marine terraces and their emergent marine deposits have been reported in the east coast of Lützow-Holm Bay. These elevated beaches and marine terraces have been formed by the relative lowering of sea level caused by the crustal uplift. Generally the highest elevation of elevated beaches in the coastal area of the Antarctic Continent is around 20 m asl (above sea level) and the rate of crustal uplift caused by deglaciation in Antarctica is estimated to be 2.5 mm/y on average, the possible maximum being 5~6 mm/y during last several thousand years. Two sea level falling rates at Syowa Station were obtained using tide gauge data. A trend of sea level falling at a rate of 9.5 mm/y was obtained using the data from 1981 to 1987. Considering the rise of global mean sea level at the rate of 1~2 mm/y, the falling rate of mean sea level at Syowa Station should be over 10 mm/y. This value is too big as the value of

crustal uplift on East Ongul Island to compare with the uplift rate estimated from the geomophological data. A rate of 4.5 mm/y was obtained using 18 years of data in 1975-1992. This value is consistent with the uplift rate estimated from the height of elevated beaches. Crustal uplift around Syowa Station are summarized as follows based on elevated beaches, oceanic tide, local earthquake activities and leveling survey:

- Elevated beaches around Syowa Station show that crustal uplift after deglaciation is still going on at present.
- The two falling rates of sea level are indicated that the falling is an intermittent phenomena.
- As the locations of epicenters are in the coastal and offshore areas, local earthquakes are inferred to be caused by tectonic stress accumulated by crustal uplift. The occurrence of local earthquakes is intermittent.
- Estimated from occurrence of local earthquakes, the crustal uplift occurs only for a few years during one decade/more.
- As there was no significant height change of leveling during 15 years in 1982-1997, crustal uplift is a block movement.

GRAVITY AND BATHYMETRIC STUDY OF THE ANTARCTIC-PHOENIX RIDGE AND HERO FRACTURE ZONE INTERSECTION, DRAKE PASSAGE (ANTARCTICA)

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During the austral summer of 1999/2000, new bathymetric data and gravity data are obtained in Antarctic-Phoenix Ridge(APR) and Hero Fracture Zone(HFZ) intersection. APR appears the median valley with 12-15km wide, 1000-2200m deep and the bull's eye Mantle Bouguer Anomaly(MBA) in the center of segment, which is the typical feature of the slow-spreading ridge. The southern flank shows steeper in slope, narrower in ridge width than the northern flank. The median valley progressively deepens across the extinct spreading center from the northern flank to southern flank. Free-Air Anomalies reflect major features observed on bathymetric map, it's range is -5 0~108 mgal. The highest anomalies appear over the volcano in the center of the spreading axis, and the lowest appear over the nodal basin at the western ridge-transform intersection. MBA computed by the layered structure, is in the range of -63 to 68 mgal, and the lowest value is found over the center of the segment. The center of segment show a characteristic "bull's eye" pattern with MBA lows and the HFZ appears the positive anomalies. This characteristic pattern means the crustal-thickness variations - thicker crust beneath the

middle of segment and thinner crust toward the distal ends. But the along-axis MBA gradient at APR is larger than at slow-spreading ridge and the bull's eye anomalies' zone is narrower. Therefore, we suggest that MBA reflects the effect of the volcanic cone more than the thermal effect by mantle upwelling; after the extinction of the ridge, reflects the effect of the mantle cooling.

DIFFERENCE OF CLIMATIC CHANGE OVER THE DIFFERENT REGIONS OF THE EAST ANTARCTIC ICE SHEET DURING THE PAST DECADES, AS EVIDENCED BY FIRN CORE RECORDS

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Ten firn cores, in which 5 locates at east sides and another 5 at west sides of Lambert Glacier basin (LGB), were contrasted for their records of snow accumulation and isotopic temperature for the recent 50 years. It shows that snow accumulation at the five sites at eastern sides (GC30, GD03, GD15, DT001 and DT085, which locate at Wilks Land and Princess Elizabeth Land) of LGB increases while the 5 sites at the western sides (Core E, DML05, W200, LGB16 and MGA, which locate at Dronning Maud Land, Mizuho Plateau and Kamp Land) decreases. For the past decades, the increase rate at the eastern sides was between 0.34 ~ 2.36kg a^{-1}, and the decrease rate at the western sides between 0.01 ~ -2.36kg a^{-1}. Temperature trends at the eastern sides of LGB were also increasing, with the rate around 0.02 a^{-1}. But at the western sides it was much more complex. Instrumental temperature records at coastal stations confirm this complexity.

Although statistic study and modeling display that both surface temperature and accumulation rate display increasing trends in Antarctic ice sheet for the period 1950 - 2000, but the regional distribution much different, even converse over different geographical

units. We believe that the ice-core records at Wilks Land and Princess Elizabeth Land reflect the real variations of SST and moisture change in the southern India Ocean. But for the Kamp Land and Dronning Maud Land, varied circulation pattern complexes the climate.

The International Trans-Antarctic Scientific Expedition (ITASE) has its initial aim to reveal an overall spatial pattern of climatic change on Antarctic ice sheet for the past 200 years. This study re-confirms the importance of continental to regional scaled circulation to annual-decadal scaled climatic change in Antarctica.

DETECTING SEA ICE FROM SPACEBORNE ALTIMETRY IN THE WEDDELL SEA, ANTARCTICA

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We investigated the distribution of sea ice using Topex/Poseidon(T/P) and ERS-1 radar altimeter data in the northwest Weddell Sea, Antarctica, between the area 45-75 °W and 55-66 °S. Using the Geo_Bad_1 flag of the Merged GDR of Topex/Poseidon, we classified the surface into ocean, land, and sea ice based on the return waveforms. Total 257 cycles of altimeter measurements between Oct. 1992 and Sep. 1999 (for nearly 2570 days) were analyzed to visualize the distribution of sea ice. We then calculated the surface area of ice coverage using SUTM20 map projection to quantify the periodic variations. Each year, the maximum and minimum coverages of sea ice were found in early October and March in the study area, respectively. We also studied the sea ice distribution using ERS-1 altimeter data between 45-75 °W and 55-81.5 °S. Using the Valid/Invalid flag of the Ocean Product, we studied the sea ice distribution between March and August of 1995, which showed very good coherence with the T/P measurements.

THE WARM INTERGLACIAL CALLED MIS 11 THE VOSTOK ICE CORE AND THE STABILITY OF ANTARCTICA

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The Marine Isotopic Stage 11 (MIS 11), around 400 kyr BP ago, has been suggested as an analogue for a future climate under natural forcing because of the similar conditions of orbitally driven insolation during this interglacial period and the one covering the Holocene and the near future. There are many open questions about unusual MIS 11 climatic conditions (length of the interglacial, temperature, sea level, marine carbonate system). Most of the previous information arises from marine and continental records. Recently, the Antarctic Vostok core provided an ice record extending back to MIS 11 and we will present here the sequence corresponding to the ice formed during MIS 11, which offers the only atmospheric record available for this interglacial period. The record is discussed in terms of extreme conditions of Antarctic temperature and atmospheric CO_2, as well as ice sheet stability in the central part of East

Antarctica.

Using modelling approaches we investigate the role of the interplay between insolation and CO_2 forcings on the length of the simulated interglacial, and the response of the Antarctic ice sheet to changing climate between MIS 11 and today conditions. The results indicate, in particular, that sea level stands during MIS 11 as high as 20 m above present level, as suggested by different elevated marine terraces, cannot be accounted for, except by assuming that the interglacial period was very dry over Antarctica.

VARIATIONS IN OXYGEN18, DEUTERIUM, AND DEUTERIUM EXCESS IN SURFACE SNOW BETWEEN THE COAST AND PLATEAU IN EAST ANTARCTICA

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Samples of fresh surface snow were taken about every 8 km along a 330 km traverse route starting near sea level near Zhongshan Station to an elevation of 2300 m at the outer edge of the Antarctic plateau. Samples were also taken from four snow pits excavated along the route. Analysis of the samples showed the expected linear relationship of the oxygen and hydrogen isotopic ratios with elevation. When samples from different elevations were analyzed, a linear relationship, with slope s1 and intercept d1, was found between the parameters δD and δ^{18}O. For the data set as a whole this relationship was well characterized with the parameters s_1 = 7.85 and d_1 = -3.71. When the data set was examined using a sliding window with a width of 5 samples, it was found that there

were two distinct linear relationships. The boundary between these two relationships occurred at an elevation of 2000 m. The deuterium excess (d= δ D-8 δ ^{18}O) value was determined from δ D and ^{18}O. Nearly half (47%) of the fresh-snow samples had negative deuterium excess (d) values, but few of the snow pit samples had negative values. This shows that variations of are quickly smoothed by isotopic diffusion in the near-surface firn. Analysis of the phase relationship between δ D and deuterium excess in the snow pit stratigraphies showed that they were mostly in phase for from Jan. 1994 to Sept. 1995, but mostly out of phase from Sept. 1995 to Jan. 1997.

PRECIPITATION ANOMALIES AROUND KING SEJONG STATION IN ANTARCTICA ASSOCIATED WITH EL NIñO/SOUTHERN OSCILLATION

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The precipitation variability around King Sejong station related with El Niño/Southern Oscillation (ENSO) is evaluated using the gauge-based monthly data of its neighboring stations. At first, the precipitation data for about 13 years (1988 - 2000) at King Sejong, Frei (Chile), Artigas (Uruguay) Antarctic stations which are all located within 10 km in King George Island are compared each other to examine the spacial coherence of precipitation. Among them the correlation in the annual and seasonal precipitation is mostly not significant or negative. The results indicates that the precipitation around King Sejong station is highly localized. It may be the biases imposed by the accumulation of blowing snow from snow fields surrounding the measurement sites. Even though in precipitation Frei station cannot represent the region around King Sejong station, its monthly precipitation data for 31 years (1970 - 2000) are analyzed for examining the ENSO signal in precipitation, because of its longer precipitation records compared to other two stations. It is found that there are a strong negative correlation between SST anomalies in the NINO 3.4 region and Frei station monthly precipitation in the periods from the late 1970 to the late 1980 and after 1994 and a weak

positive correlation in the early 1990. In general El Niño period tend to have about 30 % less than average precipitation. This dryness is more distinct in winter and spring. However the precipitation signal related with La Niña events is not significant.

PROGRESS IN POLAR UPPER ATMOSPHERIC RESEARCH IN CHINA

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Zhongshan Station (69° 22′ 24″ S, 76° 22′ 40″ E) is located under the ionospheric projection of the high latitude magnetospheric cusp region, an idea location for monitoring Geospace environment from the ground. A ground-based composite measurement system has been built, which consists of a digisonde DPS-4, a scanning photometer, an all sky TV camera, a surface ozone detector, a fluxgate magnetometer, an imaging riometer, a CCD monochromatic all sky TV camera and an induction magnetometer. The cooperative research on upper atmospheric physics with Japan and on the plasma wave studies with Australia have been very successfully implemented at Zhongshan Station. All the instruments have been installed on schedule and the measurement data are in good quality. Zhongshan Station has become one of the well-equipped stations on solar-terrestrial observations in Antarctica. Based on the measurement data from Zhongshan Station, a serial scientific result has been obtained and more than 40 papers have been published in recent 5 years. Zhongshan Station will make a significant contribution to high latitude ionospheric and magnetospheric studies. The cooperative research will be strengthen and extended. We will concentrate on the studies of cusp phenomena, the waves and precipitation, the post noon aurora properties and the ionospheric drifts by using the data from multi-instruments and multi-stations in Antarctica and the inter-hemispheric comparison of geophysical phenomena by using data from Zhongshan and some stations on Svalbard. The composite

measurement system will be further developed and improved in future.

SEARCH FOR GRAVITY WAVES IN AN OLD AIRGLOW SCAN DATABASE AND WITH A NEW ALL-SKY CAMERA

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We have searched disturbances in the airglow scan database of Dudley observatory that may be related to gravity waves in the upper atmosphere. The airglow scan observations were made with narrow band filters of OI 5577 and OI 6300 for 166 nights at Haleakala, Maui in the period of April 1965 through October 1968. The OI 6300 emissions are produced mostly via recombination of O2+ in the F-region, whereas the OI 5577 emissions are generated both in the E- and F-regions. We find disturbances in azimuthal scans of OI 6300 with scales longer than 100 km. The disturbances are mostly found to be aligned along north-south direction and exclusively in the southern azimuth (near the equator), implying that they are one of the equatorial ionospheric irregularities, known as equatorial spread F (ESF) caused by gravity waves in the lower altitudes. The disturbances occurred 21 nights out of total 166 nights of observations with a maximum occurrence in September. The disturbances do not appear to be related to geomagnetic activities or solar activities. The seasonal variation of the occurrence is consistent with the idea that the ESF is caused by gravity waves that were propagated from the troposphere after generated by strong convection in inter-tropical convergence zone.

Similar search for gravity waves will be made with a new all-sky camera over Korean Peninsular. The all-sky camera consists of a 37mm/F4.5 Mamiya fisheye lens with a 180 field of view, interference filters and 1024*1024 CCD camera. The all-sky camera is being tested near Daejon city, but will be installed in Mount Bohyun where the largest astronomical telescope is operated in Korea. Since all-sky cameras in Japan have already detected traveling ionospheric disturbances (TID) over the northeast - south west range of Japanese islands, we hope our all-sky camera extend the coverage of the TID's observations to the west direction. We plan to operate our all-sly camera all year around to study seasonal variation of wave acitivities over the mid-latitude upper atmosphere.

ALL SKY CAMERA AND FABRY-PEROT INTERFEROMETER OBSERVATIONS IN THE NORTHERN POLAR CAP

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All sky camera and Fabry-Perot interferometer (FPI) observations of the mesospheric nightglow and neutral wind at Resolute Bay, Canada (75° N) are designed to study the polar cap mesospheric gravity wave and tidal waves. The all sky camera data have shown occasional gravity wave activity, which are much weaker than its counterpart in the mid-latitude region. The FPI observation revealed frequent appearances of the 12-hour wave. There are two possible interpretations of the 12-hour wave: 1) semi-diurnal tide, 2) zonal wavenumber one 12-hour oscillation. The solar heating induced semi-diurnal tide has the zonal wavenumber two, which has the zero amplitude at the pole and small amplitude at high latitudes. The zonal wavenumber one oscillation can have non-zero amplitude at the pole and its cause is unknown at this point. Waves with period close to 10 hour were also observed. They are thought be to the free oscillation Lamb wave. A Lamb wave should have a zonal wavenumber one and a vertical wavelength about 100 km. A jointed observation from Resolute and Eureka (80° N) have shown that the 10-hour wave have a zonal wavenumber close to two and a vertical wavelength about 40 km. This result suggests that the 10-hour wave can be caused by other sources. Overall, the Resolute observations in combination with other observatories has reveal many new features

about the mesospheric gravity wave, tidal wave, and other oscillations.

MAGNETIC PROPERTIES OF 4 ROCKS COLLECTED FROM KING GEORGE ISLAND

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The results of magnetic studies of 4 rock samples collected from King Geogia Island are introduced, although paleomagnetic meaning is poor due to small number of samples. These samples are basalt or andesite provided by Y. Kim in 1998 (samples A and B, without orientation) and K. Kaminuma in 2000 (oriented samples C and D). They were demagnetized by alternating magnetic field more than 50 mT to evaluate their stability of the natural remanent magnetization (NRM). Consequently the stable NRM component was extracted in the samples A, B and D, but the unstable NRM was obtained in the sample C. Larger magnetic grains more than 0.3mm in diameter were included in the sample C, but fine-grained ones less than several micron meters were recognized in the other samples. The magnetic minerals of the samples C and D were inferred to be close composition to the magnetite estimated from the Curie points at about 550 °C.

In order to estimate the intensity of the ancient magnetic field when rocks acquired magnetization, paleointensity was measuted for the samples A and B by Thellier and Thellier method. The field intensities 5.21 and 5.81 uT were obtained from respective samples, although the precision is not so high because of the alteration of magnetic minerals during heat treatment. If the erupting age of the

rocks is clarified, the paleointensity is interesting subject in the analyses of the evolution of earths magnetic field. The paleointensity should be obtained from Antarctic region because of almost no data from the Antarctic.

MICRO-PARTICLE DISTRIBUTION IN SURFACE SNOW AT PRINCESS ELIZABETH LAND, EAST ANTARCTICA

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In the January 1997, a glaciological traverse from Zhongshan Station (69° 25′ S, 76° 21′ E, asl 100 m) to the plateau of the Antarctic ice sheet (71° 53′ S, 77° 57′ E, asl 2325 m) had been finished by Chinese Antarctic expedition. The traverse was about 330 km long. Total of 84 surface-fresh-snow-samples was collected along the route at an interval of 4 km. The samples were kept in a freezing room until analysis in the 100 class cleaning room. The concentration and size distribution from 0.5~12 μm of the micro-particles in the fresh snow samples were measured with the Coulter Multisizer II. The total concentration of the micro-particles in the fresh snow fluctuated largely at the area lower than 1000 m in elevation. The mean concentration decreased with the increasing of sampling elevation or distance from the coast. The large micro-particles concentrations (>1μm), decreased little. The mean per centageers of > 1μm particles concentrations were the same as that from coast to the plateau of Antarctic ice sheet. There was a relationship between particle concentration and Ca^{++} concentration in the fresh snow along the traverse route.

DIATOM ASSEMBLAGES FROM THE BRANSFIELD BASIN, ANTARCTICA

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The sediment core (GC98-08) from eastern basin of Bransfield Strait, Antarctica was micropaleontological analyzed for diatom assemblages. GC98-08 consists mainly of homogeneous mud and diatom ooze layers. A total of 75 species and varieties belonging to 27 genera are identified from core, and dominant species are *Actinocyclus actinochilus, Corethron crilophilum, Coscinodiscus asteromphalus, C. furcatus, Nizschia curuta, N. kerguelensis, N. obliquecostata, N. ritscheri, Odontella weissflogii, Rhizsolenia hebetata f. bidens, R. styliformis, Thalassiosira antarctica* and *T. lentignosa* (63% of the total).

These species such as *Actinocyclus actinochilus, Corethron criophilum, Coscinodiscus furcatus, Eucampia antarctica, Nizschia obliquecostata, N. sublineata, N. curta, N. cylindrus, N. lineata, have been grouped* as *sea-ice taxa,* because of live in sea-ice related environments. *Nizschia kerguelensis,* a characteristic species representing the influence of waters the Antarctic Circumpolar Current (ACC). Also, *Actinocyclus actinochilus, A. ingens, Chaetoceros spp, Coscinodiscus asteromphalus, C. furcatus, Eucampia antarctica, Nizschia curta, N. cylindrus, N. lineata, N. sublineata* and

Thalassiosira lineata are mainly deposited under the neritic environment.

The abundance pattern of the sea-ice taxa reflects the opposite behavior to that observed in *Nitzschia kerguelensis*. The decrease of *Nitzschia kerguelensis* and the increase of sea-ice taxa indicate cold events during the sedimentation periods (least 7 events). Therefore, the core sediments were deposited under the neritic environment, and during the cold events influenced by the change of Sea-ice coverages related to cold waters from the Western Weddell Sea into Bransfield Basin.

DEPOSITIONAL STYLE OF GRAVELLY, DEEP-SEA CHANNELS: LAGO SOFIA CONGLOMERATE, SOUTHERN CHILE

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The Lago Sofia conglomerate in southern Chile is a lenticular unit encased within mudstone-dominated, deep-sea successions (Cerro Toro Formation, upper Cretaceous), extending from north to south for more than 120 km. The Lago Sofia conglomerate is a unique example of long, gravelly deep-sea channels, which are rare in modern environments. In the northern part (areas of Lago Pehoe and Laguna Goic), the conglomerate unit consists of 35 conglomerate bodies intervened by mudstone sequences. Paleocurrent data from these bodies indicate sediment transport to the southeast, east, and northeast. The conglomerate bodies in the northern part are interpreted as triburary channel systems that drained down the eastward paleoslope. In the southern part (Lago Sofia section), the conglomerate unit comprises a thick (> 300 m) conglomerate body, which probably formed in axial channel systems of the northsouth-trending foredeep basin. The well-exposed Lago Sofia section allowed for detailed investigation of sedimentary facies and large-scale architecture of the deep-sea channel conglomerate. The conglomerate in Lago Sofia section comprises stratified conglomerate, massive-to-graded conglomerate, and diamictite, which represent bedload deposition under turbidity currents, deposition by high-density turbidity currents, and muddy debris flows, respectively.

The stratified and massive-to-graded conglomerate show various, large-scale, sedimentary structures, such as horizontal strata, laterally inclined strata, foreset strata, and hollow fill structures. These large-scale structures reflect a range of geomorphic elements in deep-sea channels. Imbricated clasts of stratified conglomerate beds indicate sediment transport to the southwest. In contrast, those in the basal zone of diamictite show commonly eastward paleocurrents, implying that the muddy debris flows were originated from the collapse of muddy bank or flank of axial channels. Large-scale stratal patterns of eastward offset stacking are suggestive of an eastward shift of axial channels related to tectonic movements.

GEOCHEMISTRY AND TIMING OF HYDROTHERMAL ALTERATION IN THE BARTON PENINSULA, KING GEORGE ISLAND, ANTARCTICA

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Pervasive hydrothermal alteration were recognized in the Barton Peninsula of the King George Island, South Shetland Islands. According to mineral assemblage, four hydrothermal alteration types are recognized; prophyllic, phyllic, argillic, and advanced argillic. Prophyllic alteration characterized by epidote+chlorite±calcite assemblage, is most widespread in the peninsula. The phyllic and argillic alterations are characterized by sericite, illite and kaolinite with minor prophyllic alteration assemblage, are developed in the northeastern and southwestern parts of the peninsula. The advanced argillic alteration is characterized by microcrystalline quartz, kaolinite, alunite and native sulfur, is developed at high levels in the northeastern part of the peninsula.

K-Ar ages of the altered rocks in the peninsula are below; prophyllic altered tuffaceous andesite from southwestern part is 42 Ma, altered rocks contact with quartz vein from southern part are 28 and 33 Ma, and advanced argillic altered andesite from north-easten part are 33 and 35 Ma. Those K-Ar ages are 10 My younger than granitic rocks of the Barton Peninsula. Hydothermal alteration of the

Barton Peninsula was originated from mixing of magmatic water from parent magma of granitic rocks with meteoric water.

The Al content in the hostrock is relatively constant during hydorthrmal alteration, on the contrary the Mg content is in proportion to total alkali. The variation of total alkali and Mg contents in hydrothermal alteration consider that those elements was washed out during hydrothermal alteration.

The sequence of hydothermal alteration of Barton Peninsula is chloritization of amphiboles, sericitization of feldspars and kaolitization of sericite.

WIND- AND RAIN-INDUCED VARIATION OF WATER COLUMN CHARACTERISTICS AND DISPERSAL PATTERN OF SUSPENDED PARTICULATE MATTER (SPM) OF MARIAN COVE, ANTARCTICA DURING AUSTRAL SUMMER

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Time-series CTDT (Conductivity /Temperature /Depth / Transmissivity) were obtained at one point near tidewater glacier of Marian Cove (King George Islands, Antarctica) to present water column properties and SPM (suspended particulate matter) dispersal pattern in relation with tide, current, meteorological data, and SPM concentration. Four layers were divided from water column characteristics measured in the interval of an hour for about 2 days: 1) cold, fresh, and turbid surface mixed layer between 0-20 m in water depth, 2) warm, saline, and relatively clean Maxwell Bay water between 20-40 m in water depth, 3) turbid/cold tongue of subglacial discharges compared with the ambient waters between 40-60 m in water depth, and 4) cold, saline, and clean bottom water above 60 m in water depth. On late January and February that is a plenty of vertical conduits, both upwelling water from englacial discharges and turbid/cold tongue from subglacial discharges were developed due to meltwater of surface heating and persistent rain, and consequently their input cause water column within the cove to change the properties. And their SPM are dependent with wind effect. The

properties and amount of input sources from land glacier, waterfalls, and beaches determine surface water mixed with input meltwaters, particularly on salinity and transmissivity.

SEASONAL MIXING PROCESSES AND WATER COLUMN PROPERTIES OF MARIAN COVE, KING GEORGE ISLAND, WEST ANTARCTICA

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Water properties (temperature, salinity, and transmissivity) were measured near the glacier within Marian Cove, a small fjord in King George Island (West Antarctica), from Jan through to Dec, 2000. The cove receives freshwater from the glacier wall and the grounding line of a tidewater glacier and from meltwater streams around the coasts. During the austral summer the upwelling buoyant plumes and supraglacial melting water mix with basin water, lowering the salinity throughout the water column. In winter, however, the upwelling buoyant plumes and turbid surface plume disappear within the water column. All the plumes are affected by tide and wind that produce their development. Deep water renewal occurs in spring because the water mass crossing the submarine sill (ca. 40 m in water depth) is denser than the deep basin water. Meltwater discharge from a glacier position and adjacent coast and the resultant circulation in summer result in high sedimentation rates than in winter. Vertical transmissivity profiles in winter show biological fluctuations (vertical migration, benthic flux, etc.).

THE PRELIMINARY STUDY UPON THE CENOZOIC SEDIMENTARY ROCKS FOUND IN THE TILLS OF THE GROVE MOUNTAINS, EAST ANTARCTICA

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A large quantity of sedimentary rocks have been found in its modern tills during the field works of the 1998-1999s Chinese National Antarctic Research Expedition upon the Grove Mountains which is about 400km inland from the Prydz Bay, east Antarctica. These sedimentary rocks can be subdivided into three kinds according to their different cemtation and consolidation, and all of them are of chaotic characteristics. The texture and structural characteristics of these sedimentary blocks are described in detail in this paper, which states that they are a kind of diamicton deposits. Furthermore, the geometry and the surface features of the quartz particles in some of the samples have been studied under the electric microscope, showing a glacial transportation factor has imposed to them. The mineral components of these sedimentary rocks are statistically summarized. Together with the geo-chemical analysis upon some of the clast, its sedimentary environment has been inferred as a glacial frontal zone. The spore-pollen analysis is conducted upon some of the samples, and a Late Tertiary assemblage

of plant microfossils has been recovered. By comparison, these sedimentary clast have the similar characteristics as the Sirius Group in Trans-Antarctica Mountains has. Thus, they present a kind of firm recorder, which can provide new evidence for the glacial retreat history in Grove Mountains, east Antarctica.

Key Words: Grove Mountains, East Antarctica, Cenozoic Sedimentary rocks, glacial retreat history, biotic fossils.

Contribution Schedule to the ***Ocean and Polar Research*** to be published in the beginning of 2002.

Special Issues for the 8th International Symposium on Antarctic Science:
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Thesis:

Lee, J.I. 1991. Petrology, mineralogy and isotopic study of the shallow-depth emplaced granitic rocks, southern part of the Kyoungsang basin, Korea. Ph.D. Thesis, University of Tokyo. 197 p.

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