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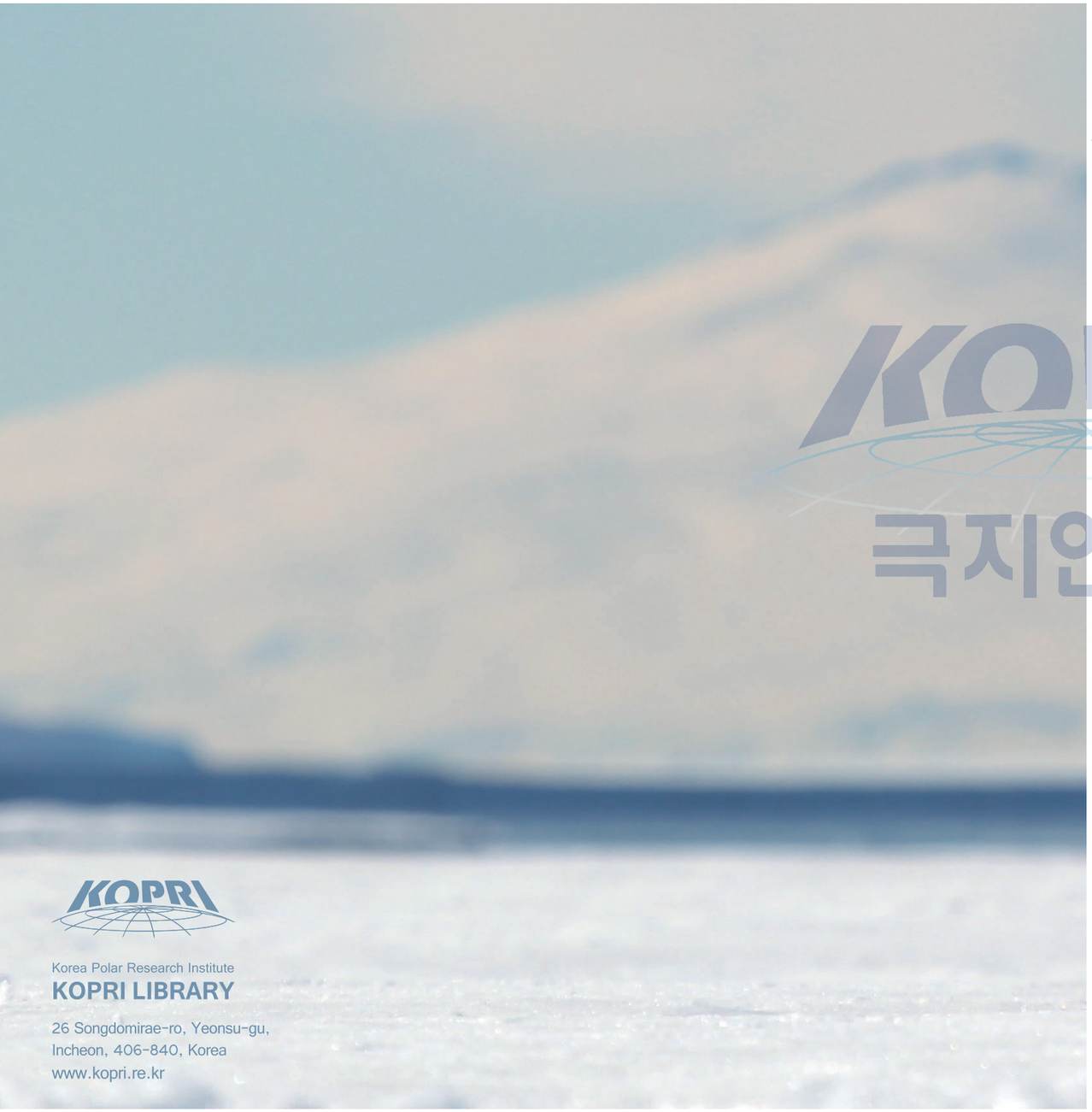

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KOPRI ABSTRACTS

Volume 1 (1985-2003)

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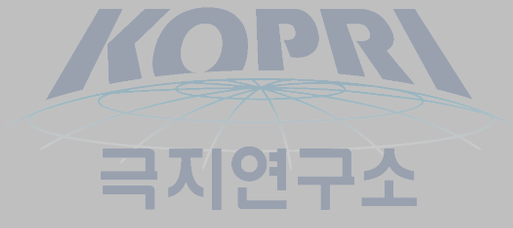
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PART 1

Climate Change Sciences

1-1 **Bae, Sung Ho**, **Ho Il Yoon**, **Byung-Kwon Park**, and **Cheon Yun Kang**. 2002. "Stable isotope record and depositional environments in the Antarctic Polar Front of Drake Passage, Western Antarctica". *Geosciences Journal*, 6(2): 117-123.

A high-resolution study including oxygen and carbon stable isotopes as well as planktonic foraminifera, carbonate, ice-rafted debris (IRD) contents, were performed on one core sediment (DP00-02) taken from the seamount top near Antarctic Polar Front (APF) in the Drake Passage, Western Antarctica. Based on the oxygen stable isotope records measured on *Neogloboquadrina pachyderma* (sin.), this sediment core is interpreted to represent a stratigraphic record back to the lower isotope stage 5 (−129 kyr). Isotope stages 5, 4 and 1 show a high abundance of carbonate and planktonic foraminifer with relatively low IRD content. In contrast, isotope stages 3 and 2 are characterized by low abundance of carbonate with remarkably high IRD content. This is probably attributed by a local/regional influence due to front structural changes, related to the fluctuation of APF, i.e., the south and northward migration of polar water mass. The glacial-interglacial shifts in $\delta^{18}O$ values of *N. pachyderma* (sin.) may reach up to 1 to 1.2‰ indicating that, global ice volume changes have affected the isotope records. However, the isotope stage 3, generally interpreted as the less warmer period in the global record than Holocene and stage 5, corresponds to much lighter values compared to the global climate curve. This may be resulted from change in the salinity rather than change in the global ice volume or the temperature.

1-2 **Bae, Sung Ho**, **Ho Il Yoon**, **Byong-Kwon Park**, **Yeadong Kim**, Jang Jun Bahk, and **Hyun Seok Seo**. 2003. "Meltwater discharge anomalies in marine isotope stage 3 from a sediment core in the south of Antarctic Polar Front, Drake Passage". *Geosciences Journal*, 7(1): 73-79.

Marine isotope stages (MISs) 1 to 5 were identified in the planktonic $\delta^{18}O$ record in sediment core DP00-02 just south of the Antarctic Polar Front within the Drake Passage, Antarctica. The oxygen isotope record based on *Neogloboquadrina pachyderma* sinistral is well correlated with the contemporaneous global $\delta^{18}O$ stratigraphy. Marked differences from the global climate curve suggest a local/regional overprint, particularly during the MIS 3, which is considered as a colder time period in the ocean record than the MIS 1 and MIS 5 interglacial periods. The comparison shows that negative $\delta^{18}O$ shifts in the core DP00-02 during the MIS 3 are larger than mean global changes that show a shift equal to or smaller than 0.5‰. The isotope shift, exceeding the glacial-interglacial ice volume effect, probably resulted from changes in the isotope composition of sea water which is linearly related to decreases in salinity rather than increases in sea-surface temperature. Increased ice-rafted debris (IRD) content during this period interval indicates strong influx of IRD from melting ice shelves and iceberg, which may be related to upwelling of warmer Circumpolar Deep Water.

1-3 Bahk, Jang Jun, **Ho Il Yoon**, **Yeadong Kim**, **Cheon Yun Kang**, and **Sung Ho Bae**. 2003. "Microfabric analysis of laminated diatom ooze (Holocene) from the eastern Bransfield Strait, Antarctic Peninsula". *Geoscience Journal*, 7(2): 135-142.

Selected intervals of laminated diatom ooze (Holocene) from the eastern Bransfield Strait, Antarctic Peninsula were analyzed using

high-resolution section images of impregnated samples to reveal potential annual-to-seasonal scale signatures of the lamination. The results show a probable seasonality within individual diatom ooze laminae which mainly reflects spring blooms of *Chaetoceros* followed by summer production of *Corethron* or *Rhizosolenia*. Alternating monospecific diatom ooze and terrigenous laminae are suggestive of annual cyclicities, representing alternation of diatom mass flux during the spring or autumn with terrigenous flux during the rest of year.

1-4 Bak, Young-Suk, Jong-Deock Lee, **Ho-Il Yoon**, and 2 others. 2002. "Quaternary Diatom Assemblages from Sediment Core GC 98-06 in the Southern Drake Passage, Antarctica". *Journal of Korean Earth Science Society*, 23(5): 442-453.

A total of 64 species belonging to 23 genera of diatom fossils are identified from the Core GC 98-06 in the southern Drake Passage, Antarctica. The diatom assemblages are dominated by *Actinocyclus actinochilus*, *Coscinodiscus asteromphalus*, *Eucampia antarctica*, *Fragilariopsis kerguelensis*, *Thalassiosira lentiginosa*, *T. ritscheri* and *T. anguste-lineata*, which are about 73% of the assemblage. Open water species are more abundant than sea ice species in the diatom assemblages of the core. *Fragilariopsis. kerguelensis* and *Thalassiosira lentiginosa* are valuable indicators of the habitats. Especially, *F. kerguelensis* represent the influence of waters from the Antarctic Circumpolar Current. Sea ice taxa represents the influence of cold waters from Bransfield Strait Water and melt water from the sea-ice at during warm periods. The reworked diatoms such as *Denticulopsis dimopha* (Miocene) and *D. hustedtii* (Pliocene) are occurred with Quaternary species (*Actinocyclus actinochilus*, *Fragilariopsis kerguelensis*, *Thalassiosira lentiginosa*, and *T. glacilis*). The presence of reworked diatoms indicates the transportation of the older diatoms into the Drake passage from the circumference sediments, due to strong bottom current activity of Antarctic circumpolar deep water.

1-5 Bak, Young-Suk, Jong-Deock Lee, **Ho-Il Yoon**, and Hyesu Yun. 2003. "Paleoenvironmental research of the Antarctic Core Sediment from the Antarctic Polar Front in Drake Passage, based on Diatom assemblage". *Journal of the Geological Society of Korea*, 39(3): 337-346.

56 diatom species belonging to 21 genera were identified from the core DP00-02, drilled in Drake Passage. *Actinocyclus actinochilus*, *Fragilariopsis kerguelensis*, *Thalassiosira rentiginosa* and *Thalassiothrix longissima* are the dominant species (56% of the total assemblage) in DP00-02 core sediments. The abundance pattern of diatom assemblages and paleoindicator species at the horizon of 144 cm suggests the position of Antarctic Polar Front migrated to the south of the modern site. Above this horizon, we believe that there is little effect by the sea-ice even in the glacial periods. The presence of neritic species (*Stephanopyxis* spp., *Odontella weisflogii* and *Cocconeis costata*) and reworked species (*Dentculopsis hustedtii*, *D. dimorpha, Fragilariopsis aurica* and *Thalassiosira striata*) due to strong current activity, i.e. Circumpolar Deep Water and Antarctic Bottom Current.

1-6 Bak, Young-Suk, Jong-Deock Lee, Hyesu Yun, and **Ho-Il Yoon**. 2001. "Paleoenvironmental significance of diatom assemblages from Core GC 98-08, Bransfield Strait, Antarctica". *Journal of the Paleontological Society of Korea*, 17(2): 99-111.

A total of 73 species and varieties belonging to 27 genera are identified from the core GC 98-08 of the Bransfield Strait, Western

Antarctica. The diatom assemblages are dominated by *Actinocyclus actinochilus*, *Corethron crilophilum*, *Fragilariopsis curta*, *F. kerguelensis*, *Odontella weissflogii*, *R. styliformis*, *Thalassiosira antarctica*, *T. lentiginosa* and *Chaetoceros* resting spores, comprising about 66% of the assemblage. The relative dominance of *Fragilariopsis obliquecostata* and Chaetoceros resting spores reflects the change of sea-ice coverage. The sea-ice taxa such as *Actinocyclus actinochilus*, *Corethron crilophilum*, *Coscinodiscus furcatus*, *Eucampia antarctica*, *Fragilariopsis curta*, *F. cylindrus*, *F. lineata*, *F. obliquecostata*, *F. sublineata* and *Odontella weissflogii* are influenced by sea-ice or sea-ice related environments and indicate a cooling event during the sedimentation periods. However, Fragilariopsis kerguelensis represents the influence of warm waters from Bellingshausen Sea and Antarctic Circumpolar Current. In GC 98-08, when the sea-ice taxa are abundant, the number of *Fragilariopsis kerguelensis* declines drastically. Throughout the core the sea-ice taxa and *Fragilariopsis kerguelensis* show an inverse relationship in relative abundance. Therefore, it is assumed that the diatom assemblages were influenced by the change in sea-ice coverages related to cold waters from the western Weddell Sea into Bransfield Strait.

1-7 Bak, Young-Suk, Jong-Deock Lee, Hyesu Yun, **Ho-Il Yoon**, and Hyang-Sook Kim. 2001. "Radiolarians from Core Sediments (A9-EB2) in Bransfield Basin, West Antarctica". *Journal of the Korean Earth Science Society*, 22(2): 130-137.

A total of 58 species of radiolarians belonging to 41 genera were identified in 44 samples from core A9-EB2 of the Bransfield Basin in the Antarctic. The radiolarian assemblages from A9-EB2 are generally very low in abundance. The dominant species are *Antarctissa denticulata*, *A. longa*, *A. strelkovi*, *Lithomelissa setosa*, *Lifhomitra lineata*, *Peridium longispinum* and *Phormacantha hystrix*, constituting 75% of the total assemblage. Genera *Challengeron* and *Protocystis* belonging to family Challeneriidae, found in core A9-EB2 have been recorded in the Quaternary sediments. Therefore, the geologic age of core A9-EB2 in Bransfield Basin is regarded to be Quternary (Pleistocene-Holocene). Typical circumpolar taxa such as *Antarctissa strelkovi*, *A. denticulata*, *Cycladophora davisiana* and *Larcopyle buetschlii* are representing the influence of waters from Bellingshausen Sea and Antarctic Circumpolar Current. *Plectacantha oikiskos* and *Phomacantha hystrix* are considered as a coastal indicator. Also, low amounts of *Lithomelissa setosa* are related to pelagic condition and entrance of cold waters from the Western Weddell Sea into Bransfield Basin. Therefore, the core sediments in Bransfield Basin were deposited under the coastal condition mainly influenced by the waters from Bellingshausen Sea and Antarctic Circumpolar Current. but also by the water from the Western Weddell Sea of the open-water condition.

1-8 Barbante, Carlo, Katja van de Velde, Giulio Cozzi, Gabriele Capodaglio, Paolo Cescon, Frederic Planchon, **SungMin Hong**, and 2 others. 2001. "Post-World War II Uranium Changes in Dated Mont Blanc Ice and Snow". *Environmental Science & Technology*, 35(20): 4026-4030.
doi: 10.1021/es0109186

Recent controversies concerning the possibility of environmental contamination due to the use of uranium in classical weaponry have led us to realize that there is a lack of time series for this metal from environmental archives. We have therefore performed analysis of a dated 140 m-long ice/snow core that was drilled in 1994 at a

cold high altitude site (4250 m) near the summit of Mont Blanc in the French— Italian Alps. Ultraclean analytical procedures were employed in our analyses. Uranium concentrations were determined by inductively coupled plasma sector field mass spectrometry. In ice dating from before the 1940s, uranium concentrations are found to have remained fairly constant and can be explained simply by a crustal contribution. For the post-World War II layers, on the other hand, the data show large excesses above crustal contributions. These uranium excesses are attributed to tropospheric transport of dust emitted during extensive mining and milling operations which took place in the GDR and to a smaller extent in France at that time. There is no enhancement in uranium concentrations in the ice layer in which fallout from the 1986 Chernobyl accident was previously identified from a gross β activity vs depth profile.

1-9 Burton, G. R., C. F. Boutron, **S. Hong**, and 2 others. 2003. "Strontium isotope measurement in Greenland ice from the last glacial maximum to the early Holocene". *Journal de Physique IV*, 107: 241-244. doi: 10.1051/jp4:20030287

Strontium isotopic composition and concentration have been measured by thermal ionisation mass spectrometry on a suite of samples from the GRIP ice core drilled at Summit, Greenland. The sample ages range from ~24 to ~7.3 ky BP extending from the last glacial maximum into the early Holocene. Less than 10 g of sample was used for each analysis. No attempt was made to separate soluble/insoluble species in the samples. Sr concentrations are between ~950 and ~1,550 pg.g^{-1} over the period ~24 ky to ~14 ky BP but fall dramatically to generally less than 150 pg.g^{-1} between ~14 to ~7.3 ky BP. The $^{87}Sr/^{86}Sr$ ratio shows a general rising trend from ~0.712 to ~0.715 over the entire period however there are a number of significant deviations from this trend which are most likely due to changing source regions for aerosol dust input to Greenland. Sr isotopic composition shows a strong correlation with $\delta^{18}O$ suggesting that climate plays a strong role in determining regions for dust release.

1-10 Cho, Hi-Ku, **Bang Yong Lee**, and 2 others. 2001. "A Seasonal Climatology of Erythemal Ultraviolet Irradiance over Korea". *Asia-Pacific Journal of Atmospheric Sciences*, 37(5): 443-566.

We have examined monthly and seasonal means of clear-sky noon and daily erythemal ultraviolet-B(EUV-B, 280-320 nm) (1994-2000), and UV-A(320-400 nm) irradiance (1996-1998) measured at Yonsei University, Seoul (37.57°N, 126.98°E), with UV-A and B-Biometers (Solar Light Model 501). The erythemally weighted daily UV exposure(EUV, 280-400 nm) data (1979-1999) estimated using stratospheric ozone amounts and reflectivity measured from Nimbus-7 and Earth Probe/TOMS(Total Ozone Mapping Spectrometer) are also analyzed to investigate seasonal and regional characteristics over the Korean Peninsula. Monthly mean diurnal variation of clear-sky EUV-B irradiance at Seoul shows a peak of 179.8 mWm^{-2} around local noon in August. Annual mean value of daily EUV-B irradiance is 1.6 kJm^{-2} with a maximum(2.7 kJm^{-2}) in June and a minimum(0.5 kJm^{-2}) in December. And the annual mean UV-A is 153.4 kJm^{-2} with maximum of 226.1 kJm^{-2} in May and minimum 71.2 kJm^{-2} in December. During this measurement period, extreme values are recorded with 308.7 mWm^{-2}(13 July 1994) for clear-sky noon, 6.2 kJm^{-2}(13 July 1994) for daily EUV-B and 378.6 kJm^{-2}(17 July 1998) for daily UV-A. We have also noted that annual mean EUV-B irradiance appears 1 % of the UV-A value with monthly variations ranging

from 0.6 %(January) to 1.3 %(June~August). It is found from the ratios that the UV-B is only weakly sensitive to cloud changes compared to EUV-A. All over the Korean Peninsula, all-sky daily EUV-B irradiance is distributed from 4.4 to 3.6 kJm^{-2} in summer and the value is relatively high (around 4.0 kJm^{-2}) along the west and south coastal zones but low (about 2.4 kJm^{-2}) in the land area. Such distributions are attributed by the solar zenith angle (SZA), cloudiness, and total ozone. The daily EUV-B isolines are in the ranges from 4.4 to 3.6 kJm^{-2} in spring and from 2.4 to 1.5 kJm^{-2} in autumn, and they are almost paralleled with latitudes. These distributions are mainly caused by the stronger influence of SZA than those of other factors. In winter the EUV-B ranges from 1.1 kJm^{-2} to 0.7 kJm^{-2} over the whole area. The gradient of the isoline with lattitude is the lowest of the seasons. The ratios of clear-sky noon time EUV-B, daily EUV-B and UV-A to TOMS-EUV are also analyzed for their estimates all over Korean Peninsula. And comparison of erythemally weighted UV irradiance and unweighted value have been performed to estimate unweighted UV irradiance. Such information will be very important to evaluate the UV index for prevention of skin cancer and ecosystem damages, and to understand UV climatology over Korea.

1-11 Choi, Kyungsik and **Ho Il Yoon**. 1994. "Mechanical Properties and Crystallographic Structures of Glacial Ice around King Sejong Station, King George Island, Antarctica". *Korean Journal of Polar Research*, 5(2): 29-35.

Basic information on the mechanical properties and crystallographic structures of Antarctic land-base ice is obtained from field survey and laboratory experiments at King Sejong, Korea Antarctic Station. In this study several ice samples are collected from the top layers of glacial ice, the icebergs stranded on the beach and from the first-year lake ice to compare their densities and air contents volume inside ice samples. The ice samples are also prepared to investigate their grain sizes and crystal formation pattern.

1-12 Choi, Tae Jin, Yong Il Lee, and **Ho Il Yoon**. 2003. "Characteristics of beach sands, King George Island, West Antarctica". *Journal of the Geological Society of Korea*, 39(3): 391-402.

1-13 **Chung, J. -K.**, Y. H. Kim, and **Y. -I. Won**. 2003. "OBSERVATION OF MESOSPHERIC WAVES WITH AN ALL-SKY CAMERA IN KOREAN PENINSULA". *Advances in Space Research*, 32(5): 825-830.
doi: 10.1016/S0273-1177(03)00414-9

We have carried out all-sky imaging of OH Meinel and OI 557.7 nm airglow layers in the period of July, 2001 through March, 2002 at Mt. Bohyun, Korea (36.2°N, 128.9°E). The all-sky camera consists of a 37 mm/F4.5 fisheye lens with a 180° field of view, 4 inch diameter narrow band filters and a back-illuminated 1024 × 1024 CCD. Mesospheric wavelike activities were recorded only for 6.4 % of a total of 243 hours of clear moonless nights, which is much fewer than other studies in Japan and North America. We, however, cannot exclude the possibility that our observation has missed frequent wave activity during summer observed in other sites due to cloudy weather: We detected 12 events of small wave packets, known as the ripple type wave and 10 events of horizon-to-horizon waves, known as the band type wave. The ripple type waves occur for less time but more often than the band type waves. We find that the ripple type waves can be classified into three different kinds in terms of their local environments: (1) ripples generated from a propagating band type wave, (2) ripples associated with a band type wave crest, and (3) ripples in isolation. We discuss different

causes for the three kinds of the ripples. The characteristics of observed band type waves are consistent with internal gravity waves, as other studies noted. No southward propagation of band type waves was observed in our dataset.

1-14 **Chung, J. -K.**, Y. H. Kim, **Y. -I. Won**, and **B. Y. Lee**. 2003. "Observation of Atmospheric Waves in the OH airglow layer with an All-Sky Camera". *Journal of the Korean Meteorological Society*, 39(3): 359-368.

Atmospheric waves in the upper mesosphere and lower thermosphere have been observed with a new all-sky camera system at Mt. Bohyun (36.2°N, 128.9°E) in Korea from July in 2001. Here first results from the observation with an OH airglow filter are reported. It is analyzed that a series of contiguous all-sky images obtained on July 18, 2001 that clearly show two kinds of waves, small wave packets and a large wave structure. It is found that the small wave packet has an average horizontal wavelength of 7.7 km and its most likely phase period of about 8 min. The large wave structure has bands from horizon to horizon with a wavelength of 43 km, which propagate toward the northeast with a period of about 16 min. Applying gravity wave theory, a derived vertical wavelength is 15 km for the large wave. The large wave structure bears characteristics of gravity waves, while the small wave packets do not. Our interpretation for the observed wave structures is consistent with Taylor and Hapgood (1990), who named the large waves and small wave packets as band and "ripple" type waves. Our observation is the first image detection of gravity waves in the mesosphere over Korean peninsula, and seasonal occurrence and other characteristics of gravity waves will be studied with continuing observation at Mt. Bohyun.

1-15 **Chung, Jong-Kyun**, **Young-In Won**, **Bang Yong Lee**, and Jhoon Kim. 1998. "OBSERVATIONS OF UPPER THERMOSPHERIC TEMPERATURES USING A GROUND-BASED OPTICAL INSTRUMENT AT THE KING SEJONG STATION, ANTARCTIC". *Journal of Astronomy and Space Sciences*, 15(1): 139-150.

We measured the terrestrial nightglow of OI 6300Å in the thermosphere(~250 km) using a ground-based Fabry-Perot interferometer at the King Sejong Station, Antarctic from March through September, 1997. The King Sejong Station is located at high latitude geographically (62.22°S, 301.25°E) but at mid-latitude geomagnetically (50.65°S, 7.51°E). It is therefore the strategic location to measure the temperatures of the thermosphere in the Southern Hemisphere associated with both solar and geomagnetic activities. In this study, we analyzed the observed temperatures in relation to F10.7 and Kp indices to examine the effect of the solar and the geomagnetic activities on high-latitude neutral thermosphere. During the observing period, the solar activity was at its minimum. The measured temperatures are usually in the range between about 600~1000 K with some seasonal variation and are higher than those predicted by semi-empirical model, VSH (Vector Spherical Harmonics) and empirical model, MSIS (Mass-Spectrometer-Incoherent-Scatter)-86.

1-16 **Chung, Jong-Kyun, Young-In Won**, Yong-Ha Kim, **Bang-Yong Lee**, and Jhoon Kim. 2000. "SOLAR CYCLE VARIATION OF UPPER THERMOSPHERIC TEMPERATURE OVER KING SEJONG STATION, ANTARCTICA". *Journal of Astronomy and Space Sciences*, 17(2): 241-248.

A ground Fabry-Perot interferometer has been used to measure atomic oxygen nightglow (OI 630.0 nm) from the thermosphere (about 250 km) at King Sejong

Station (KSS, geographic: 62.22°S, 301.25°E; geomagnetic: 50.65°S, 7.51°E), Antarctica. While numerous studies of the thermosphere have been performed on high latitude using ground-based Fabry-Perot interferometers, the thermospheric measurements in the Southern Hemisphere are relatively new and sparse. Therefore, the nightglow measurements at KSS play an important role in extending the thermospheric studies to the Southern Hemisphere. In this study, we investigated the effects of the geomagnetic and solar activities on the thermospheric neutral temperatures that have been observed at KSS in 1989 and 1997. The measured average temperatures are 1400 K in 1989 and 800 K in 1997, reflecting the influence of the solar activity. The measurements were compared with empirical models, MSIS-86 and semi-empirical model, VSH.

1-17 Ferrari, Christophe P., Thomas Clotteau, Lonnie G. Thompson, Carlo Barbante, Giulio Cozzi, Paolo Cescon, **Sungmin Hong**, and 3 others. 2001. "Heavy metals in ancient tropical ice: initial results". *Atmospheric Environment*, 35(33): 5809-5815.

Although a wealth of fascinating data have been obtained through the investigation of heavy metals in Greenland, Antarctic and Alpine snow and ice cores, heavy metals have until now never been measured in tropical snow and ice cores despite the great interest of such low latitude cores. We present here preliminary data on the occurrence of Al, Na, Ti, V, Cr, Mn, Co, Cu, Zn, Mo, Pd, Ag, Cd, Sb, Ba, Pt, Au, Pb, Bi and U in a dated ice core drilled at an altitude of 6542 m on the top of Sajama in Bolivia. These data were obtained by analysing four core sections dated 22,000 BP (Last Glacial Maximum, LGM), 8000 BP (early Holocene, EH), AD1650 and AD 1897, using ultrasensitive ICP-SF-MS. Concentrations observed in LGM ice are similar to those measured in EH ice. Al, Na, Ti, V, Cr, Mn, Co, Ba and U are found to derive mainly from rock and soil dust. For the other metals, additional contributions from other sources are needed to explain the observed concentrations.

1-18 **Hong, S.**, **J. K. Park**, and 4 others. 2003. "Changes in the natural lead, cadmium, zinc, and copper concentrations in the Vostok Antarctic ice over the last two glacial-interglacial cycles (240,000 years)". *Journal de Physique IV France*, 107: 629-632. doi: 10.1051/jp4:20030382

We present new ice core records showing the temporal variation in the natural Pb, Cd, Zn, and Cu concentrations in the Vostok Antarctic ice over the past 240,000 years. Our data show that concentrations of these heavy metals have varied remarkably over the last two glacial-interglacial cycles. The concentrations ranged from 0.9 to 21.3, 0.04 to 0.62, 3.12 to 126, and 2.27 to 37.4 pg/g for Pb, Cd, Zn, and Cu, respectively. These profiles provide a better understanding of climate-related variation in the occurrence of these heavy metals in ancient Antarctic ice. The concentrations were much higher during cold glacial periods than during interglacials, and peaked at the coldest glacial stages. The contribution of rock and soil dust is estimated to be close to the measured concentrations of Pb, Zn, and Cu, but not Cd, in the ice during cold glacial periods.

1-19 **Hong, S.**, **J. K. Park**, and 5 others. 2003. "Changes in the occurrence of heavy metals in the tropical atmosphere during the past 22,000 years as recorded in Bolivian ice core". *Journal de Physique IV France*, 107: 633-636.

Nine sections from the Sajama ice core recovered from the summit of an extinct Andean volcano in Bolivia were analysed for various heavy metals to assess anthropogenic

changes in the tropical upper troposphere over South America. These samples include two sections dating from 14,100 to 19,200years BP, corresponding to the Last Glacial Stage (LGS), one section dating from 2800 years BP (the late Holocene), and six sections dating from AD 790 to 1988. Our preliminary data, combined with data reported elsewhere, demonstrate that the heavy metal concentrations since the late Holocene are higher than in the period from the LGS to the early Holocene. The enrichment factors calculated by normalizing for crustal abundance using the metal/Al ratio in the mean upper continental crust indicate that a significant input of heavy metals attributed to anthropogenic contributions has occurred since the beginning of the 19th century for Pb and from the last century for Cd, Cu, and Zn.

1-20 **Hong, Sungmin**, and 2 others. 2000. "A Clean Protocol for Determining Ultralow Heavy Metal Concentrations". *Korean Journal of Polar Research*, 11(1): 35-47.

Clean laboratory facilities and procedures used to determine various heavy metals at or below the pg g^{-1} concentration level encountered in Antarctic snow are described . They include production of ultrapure water, careful choice of proper laboratory materials and reagents, and methods for cleaning sample storage bottles, containers and other labware in a Class 100 clean room. Preliminary results of Pb, Cd, Cu, Zn and Mn concentrations in ten Antarctic surface snow samples were obtained by graphite furnace atomic absorption spectrometry using the clean protocols described. Eight samples were collected at King Sejong Station in King George Island and two at Ruperto Elichiribehety Base at the northern tip of the Antarctic Peninsula through a joint research between Korea Ocean Research & Development Institute and Uruguayan Antarctic Institute. Our data represent that Cd and Zn in surface snow at King Sejong is derived mainly from sea salt spray and Mn from crustal aerosol. On the other hand, large part of Pb (and probably some part of Cu) in this local area is assumed to be anthropogenic in origin. At Ruperto Elichiribehety, the measured heavy metal concentrations are relatively high compared with those at King Sejong. This is due mainly to remarkable influence of local crustal inputs from nearby exposed rocks.

1-21 **Hong, Sungmin**, Albert Lluberas, Gangwoong Lee, and **Jun Kun Park**. 2002. "Natural and Anthropogenic Heavy Metal Deposition to the Snow in King George Island, Antarctic Peninsula". *Ocean and Polar Research*, 24(3): 279-287.

Successive 24 snow samples, collected from a 1.2 m snow pit at a site on the summit of Main Dome in King George Island, Antarctic Peninsula, were measured for heavy metals such as Pb, Cd, Cu, and Zn and other chemical species. The mean concentrations of heavy metals are 3.48 pg/g for Pb, 0.10 pg/g for Cd, 16.6 pg/g for Cu and 15.8 pg/g for Zn, respectively. Pb and Cd concentrations observed in our samples are very comparable to those reported for recent snow at other Antarctic sites, while Zn and Cu levels are much higher than those at other sites. The annual fallout fluxes of all heavy metals approximately calculated are, however, much greater in King George Island than at other sites. With respect to the estimates of natural contributions, sea salt spray is found to be a major contributor to Cd and Zn inputs to the snow and minor to Cu inputs. On the other hand, the anthropogenic input can account for a large part of Pb concentrations. A tentative estimate represents that local emissions could be responsible for more than half of the excess Pb flux to the snow in King George Island.

1-22 Hwang, Jong-Sun, **Bang Yong Lee**, Jae-Seol Shim, **Sungmin Hong**, **Ho-Il Yoon**, and 3 others. 2003. "Sea Ice Detection using Microwave Remote Sensing Techniques in the Weddell Sea, Antarctica". *Economic and Environmental Geology*, 36(2): 141-148.

We investigated the distribution of sea ice using various microwave remote sensing techniques including radar altimeter, radiometer, and scatterometer data in the part of Drake passage, Antarctica, between the area 45°-75°W and 55°-66°S. Topex/poseidon radar altimeter data were used to analyze the monthly distribution of sea ice surface area between 1992 and 1999 by using Geo_bad_1 flag or MGDR. From satellite radiometer measurements of DMSP's SSM/I, sea ice concentration was extracted during the period from 1993 to 1996. To select a value of ice concentration, normally ranging from 0 to 100%, that can be used as a critical value of judging the existence for ice, sea ice areas estimated from various ice concentrations of radiometer measurements were correlated with the area estimated from the radar altimeter measurements. As a result, 20% of ice concentration was selected, and, then this value was used to integrate radiometer data with radar altimeter and ERS-1/2 scatterometer data. To indirectly verify the result, the last 20 year's sea ice concentration was correlated with surface temperature data near Esper-anza Observation Station. The two data showed a high correlation coefficient of 0.86. The amount of sea ice and temperature variation were found to be closely related in the study area, and this indirectly verifies the result of this study. We provided a method to judge the existence of sea ice from ice concentration of satellite radiometer data and suggested a method to monitor more detailed temporal and spatial variation of sea ice distribution by integration of various microwave remote sensing techniques.

1-23 Hwang, S. H., J. Kim, J. K. Kim, S. J. Lee, Y. S. Jang, J. J Park, G. R. Cho, and **Y. I. Won**. 2001. "DEVELOPMENT OF LANGMUIR AND ELECTRON PROBE FOR KSR-III". *Journal of Astronomy & Space Sciences*, 18(3): 249-256.

KARI(Korea Aerospace Research Institute) has measured the ionospheric electron temperature and density over the Korean Peninsular with the Langmuir and Electron Probe(LEP) onboard the Korean Sounding Rocket-II(KSR-II) In 1998. The purpose of LEP is to measure the electron density and temperature profile in the ionosphere. LEP consists of the Langmuir probe(LP) and the Electron temperature Probe(ETP) which are widely used for the measurement of the ionospheric plasma environment . We discuss the development of the Langmuir and Electron Probe which will be onboard the KSR-III and some test results in a simulated space plasma environment with the plasma chamber at the ISAS in Japan. These measurements could contribute to the basic study of ionospheric environment which also can be compared with other reference models such as IRI and PIM.

1-24 Jeong, G. Y. and **H. I. Yoon**. 2001. "THE ORIGIN OF CLAY MINERALS IN SOILS OF KING GEORGE ISLAND, SOUTH SHETLAND ISLANDS, WEST ANTARCTICA, AND ITS IMPLICATIONS FOR THE CLAY-MINERAL COMPOSITIONS OF MARINE SEDIMENTS ". *Journal of Sedimentary Research*, 71(5): 833-842.

Clay minerals in the soils of King George Island, South Shetland Islands, West Antarctica, were investigated to evaluate their influence upon the composition of marine sediments derived from them. Paleohydrothermal activity has developed phyllic-argillic alteration zones in restricted areas of the volcanic bedrock. Illite and kaolinite show a highly localized distribution

in the soils of the phyllic-argillic zones, whereas chlorite dominates in the soils of unaltered bedrock. The localized distribution indicates that illite and kaolinite are residues from altered bedrock, whereas chlorite originates from unaltered bedrock. Smectite in the soils is rather uniformly distributed with no relationship to the phyllic-argillic zones. It is mostly the alteration product of eolian pumice shards, which are found scattered throughout the soils on a microscopic scale. The eolian provenance of smectite associated with pumice shards is supported by a uniform distribution of smectite, coexistence of fresh and altered pumice shards, and rather short exposure after deglaciation. Smectites likely have been formed in a remote source around volcanic craters and reworked by repeated eruptions. Formation of clay minerals by chemical weathering as suggested in previous studies appears to be insignificant on King George Island, even though the climate is warmer and more humid than in other Antarctic regions. Smectite and kaolinite in seafloor sediments around the South Shetland Islands do not indicate chemical weathering in the source area. Instead, their occurrence suggests that volcanism, igneous intrusion, and related hydrothermal alterations were active in the South Shetland Islands during the Cenozoic.

1-25 Jeong, G. Y., **H. I. Yoon**, and **B. -K. Park**. 1999. "Distribution and Origin of Clay Minerals in the Soils of the Barton Peninsula, King George Island, West Antarctica". *Journal of the Geological Society of Korea*, 35(4): 265-278.

Origin of clay minerals in the soils of the Barton Peninsula of King George Island, West Antarctica was studied with investigation of soil occurrence, analysis of clay mineral distribution, analysis of soil microtextures, and electron microprobe analysis. Mineralogical analysis of basal clays underlying glacier and bedrocks showed that dominant clay mineral in volcanic bedrocks is chlorite with minor illite Local ancient hydrothermal alteration disturbed the clay mineralogy of the bedrocks. The distributions of illite, kaolinite and pyrophyllite in the soils overlap the outlines of phyllic/argillic alteration zones, indicative of their hydrothermal origins. Eolian volcanic ashes comprising glass shards and micropumices of basaltic andesite composition arc abundant in the soils. Smectite partly replaced glass matrix or filled vesicles. Microtextures of the soils and occurrence of smectite support the eolian input of smectite which appears to have been formed in the source area and reworked by later eruption. Supergene clay minerals were not formed because of low mean-annual temperature, long winter freezing, and relatively short time after deglaciation. The diverse origins of clay minerals in the soils of the Barton Peninsula, such as metamorphism, hydrothermal alteration and eolian input, are ascribed to active volcanism and associated hydrothermal activity through Cenozoic in the South Shetland Islands located in tectonically active island arc.

1-26 Jeong, Gi Young and **Ho Il Yoon**. 2002. "Mineralogical Charcteristics and Origins of Smectite in the Marine Sediments around South Shetland Islands, Antarctica". *Journal of Mineralogical Society of Korea*, 15(1): 22-32.

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 regardless of core depths (av. 8.3%), but low in GC98-2(1.1%). In A10-01, smectite content is

higher in the upper section than in the lower section. Kaolinite was not detected from all the cores in this study. 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 after retreat of glaciers in Marian Cove and ice cover in Barton Peninsula. The high K contents of smectites suggest the interstratification of illite and smectite layers, which might be observed by future TEM lattice fringe imaging.

1-27 Khim, Boo-Keun, **Byong-Kwon Park**, and **Ho Il Yoon**. 1997. "Oxygen isotopic compositions of seawater in the Maxwell Bay of King George Island, West Antarctica". *Geoscience Journal*, 1(2): 115-121.

This paper reports on the oxygen isotope characteristics of seawater in the Maxwell Bay and Marine Cove of King George Island, Antarctica, and discusses the formation and mixing of water masses. In a transect across the Maxwell Bay, distinct water masses can be identified based on the vertical distribution of temperature, salinity, and $\delta^{18}O$ values. Surface layer of warmer, less saline and lower $\delta^{18}O$ water (i.e., Surface Water) overlies colder, more saline and higher $\delta^{18}O$ subsurface water mass (i.e., Winter Water) in the Maxwell Bay. A positive correlation between $\delta^{18}O$ and salinity suggests that water masses are formed through mixing of water from the tributaries (e.g., Marian Cove) and partly from the Bransfield Strait. In the Marian Cove, horizontal distribution of $\delta^{18}O$ clearly shows the dispersal patterns of low $\delta^{18}O$ meltwater. Based on the relationship between $\delta^{18}O$ and salinity, large amounts of freshwater ($\delta^{18}O$ = –44‰) are inferred to have been drained from the melting glaciers in the nearby coastal region during the austral summer. The oxygen isotopic composition of seawater in the Maxwell Bay can, thus, be used as a potential tracer for the formation and mixing of water masses.

1-28 **Khim, Boo-Keun**, **Byong-Kwon Park**, **Ho Il Yoon**, and **Kyu Cheul Yoo**. 2000. "Seawater $\delta^{18}O$ and Water Mass Identification in the Western Weddell Sea, Antarctic Ocean". *Korean Journal of Polar Research*, 11(1): 59-67.

Along a hydrographic transect in the western Weddell Sea, $\delta^{18}O$ values with temperature and salinity of the seawaters in the upper 400 m depth are measured. TS diagram distinguishes three different types of water masses (AASW, WW, and WDW) and shows the variation of properties. The $\delta^{18}O$ values of seawater also differentiate the water masses complement to temperature and salinity. However, along the hydrographic transect, the variation of $\delta^{18}O$ values is not straightforward, exhibiting the fluctuations. In spite of analytical errors on the isotope measurements, the change of $\delta^{18}O$ values along the hydrocasting transect reflects occurrence of certain water masses with different $\delta^{18}O$ values. Based on the correlation between salinity and $\delta^{18}O$ values, glacial melt is an important factor to contribute the low $\delta^{18}O$ values of waters. However, the more detail investigations are necessary to expect the degree of mixing among the water masses.

1-29 Khim, Boo-Keun, **Ho Il Yoon**, **Cheon Yun Kang**, and Jang Jun Bahk. 2002. "Unstable Climate Oscillations during the Late Holocene in the Eastern Bransfield Basin, Antarctic Peninsula". *Quaternary Research*, 58: 234-245.
doi: 10.1006/qres.2002.2371

Core A9-EB2 from the eastern Bransfield Basin, Antarctic Peninsula, consists of pelagic (diatom ooze-clay couplets and bioturbated diatom ooze) and hemipelagic (bioturbated mud) sediments interbedded with turbidites (homogeneous mud and silt–clay couplets). The cyclic and laminated nature of these pelagic sediments represents alternation between the deposition of diatom-rich biogenic sediments and of terrigenous sediments. Sediment properties and geochemical data explain the contrasting lamination, with light layers being finer-grained and relatively rich in total organic carbon and biogenic silica content. Also, the high-resolution magnetic susceptibility (MS) variations highlight distinct features: high MS values coincide with clastic-rich sections and low MS values correspond to biogenic sections. The chronology developed for core A9-EB2 accounts for anomalous ages associated with turbidites and shows a linear sedimentation rate of approximately 87 cm/10^3 yr, which is supported by an accumulation rate of 80 cm/10^3 yr calculated from ^{210}Pb activity. The late Holocene records clearly identify Neoglacial events of the Little Ice Age (LIA) and Medieval Warm Period (MWP). Other unexplained climatic events comparable in duration and amplitude to the LIA and MWP events also appear in the MS record, suggesting intrinsically unstable climatic conditions during the late Holocene in the Bransfield Basin of Antarctic Peninsula.

1-30 **Khim, Boo-Keun**, **Ho Il Yoon**, **Yeadong Kim**, and Im Chul Shin. 2001. "Late Holocene stable isotope chronology and meltwater discharge event in Maxwell and Admiralty bays, King George Island, Antarctica". *Antarctic Science*, 13(2): 167-173.

Two short gravity cores were retrieved to obtain palaeoclimatic information from Maxwell and Admiralty bays, King George Island, South Shetland Islands. AMS ^{14}C age dates, sediment properties (grain size, TOC and $CaCO_3$) and stable oxygen and carbon isotope compositions of benthic foraminifera (*Globocassidulina biora*) show downcore variations that characterize depositional conditions during the late Holocene. In particular, δ^{18}O values of benthic foraminifera are lowest at approximately 2500 yr_{BP} in both cores. A low δ^{18}O time-equivalent excursion in both cores is interpreted to reflect a distinct subglacial meltwater discharge intensified by warm climatic conditions. An increased proportion of fine-grained detritus and higher TOC in the cores at this level suggests that enhanced meltwater supply may have resulted in increased primary productivity. This meltwater discharge event provides evidence of climatic instability during the late Holocene at King George Island.

1-31 **Khim, Boo-Keun**, **Ho Il Yoon**, **Yeadong Kim**, and **Kyu-Cheul Yoo**. 1999. "Magnetostratigraphy and Paleoproductivity of Late Holocene Marine Sediments in the Eastern Bransfield Basin, Antarctic Peninsula". *Korean Journal of Polar Research*, 10(2): 77-83.

During the 9th (1995-1996) KARP (Korean Antarctic Research Program) Expedition, a laminated diatom-rich sediment core (A9-EB2) was obtained from the eastern Bransfield Basin, Antarctic Peninsula region. Total organic carbon (TOC) and magnetic susceptibility (MS) in the core sediments clearly record the oscillation of depositional

conditions. In particular, the high-resolution MS variation is a distinct feature to differentiate the high MS values for terrigenous (low TOC) hemipelagic part from the low values for biogenic pelagic (high TOC) part. In contrast to the anoxic condition under which the deep-sea laminated structures in the Santa Barbara Basin can be preserved completely without the obliteration by active bioturbation (Behl and Kennett, 1996), the oscillatory MS feature in the Bransfield Basin may be attributed to the climatically-forced and enhanced productivity cycles and less dilution of terrigenous particles. In spite of poor chronology due to the lack of available data as well as some contaminated datings, the core A9-EB2 shows the cyclic pattern of paleoproductivity in terms of MS signals which has been maintained in the Bransfield Basin, Antarctica during the late Holocene.

1-32 **Kim, Dongseon**, **Byong-Kwon Park**, **Ho Il Yoon**, and **Cheon Yun Kang**. 1999. "Geochemical evidence for Holocene paleoclimatic changes in Maxwell Bay of South Shetland Islands, West Antarctica". *Geosciences Journal*, 3(1): 55-62.

Total organic carbon (TOC), biogenic silica (Bsi), and total sulfur (TS) contents in core sediments of Maxwell Bay are examined in order to investigate paleoclimatic changes during the Holocene. Both TOC and Bsi contents generally show a downcore decrease, which reflects that primary productivity in surface waters has increased during the Holocene. In contrast, TS contents show a downcore increase, which is probably due to a decrease in terrigenous input of hydrothermal-origin pyrite. In Maxwell Bay, primary productivity was low prior to 4700 yr BP because sea ice permanently covered the surface. As the climate became relatively warm after 4700 yr BP, sea ice in surface waters sporadically melted, causing an increase in productivity. The climate probably became warm between about 4700 and 3000 yr BP, evidenced by the rapid increase in TOC and Bsi. Grounding glaciers were located near the core sites of Maxwell Bay prior to about 4700 yr BP. As the climate became warm, grounding glaciers have retreated and been located at the present site since about 3000 yr BP.

1-33 **Kim, Dongseon**, **Byong-Kwon Park**, **Ho Il Yoon**, and **Dong Yup Kim**. 1999. "Geochemistry of the Core Sediments in Maxwell Bay of the South Shetland Islands, West Antarctica". *Korean Journal of Polar Research*, 10(2): 67-75.

Downcore distributions of major, minor, and rare earth elements (REEs) were determined to investigate the major factors influencing their concentrations in Maxwell Bay core sediments. Sediment grain size is the primary factor constraining the concentrations of Ti, Cr, Na, and K at core A1, and Na, Mg, Zn, Cr, Ni, and K at core A2. At both cores, meanwhile, Fe, Co, and Cu concentrations are closely associated with sulfide minerals. The Ce and Eu anomalies and shale-normalized REE patterns indicate that the Maxwell Bay sediments are significantly influenced by the hydrothermal system, and oxidizing conditions have been maintained during the entire sediment deposition.

1-34 Kim, Jai S.. 1991. "Thermospheric Temperatures Measured at the King Sejong Station, Antarctica". *Korean Journal of Polar Research*, 2(1,Spec. Issue): 203-211.

Previous measurements and associated theoretical studies indicated that the polar region has a critical role in the overall thermospheric dynamics. Recently, in order to investigate the neutral temperatures and winds in the Antarctic thermosphere, we installed a high-resolution Fabry-Perot

interferometer at King Sejong Station, which is the Korean Antarctic Research Base, on King George Island, Antarctica. Interferometric measureoments during March 1989 showed unusually elevated thermospheric temperatures. This elevation may be due partly to major solar events that occurred in March. Initial comparisons of the observed temperature data with the calculated values from the semi-empirical MSIS thermospheric models showed consistent and significant differences, both qualitatively and quantitatively, between the measured temperatures and the calculated values.

1-35 Kim, Jeong Han, **Jong-Kyun Chung**, Yong Ha Kim, **Young-In Won**, and 2 others. 2003. "ALL-SKY OBSERVATION OF THE 2001 LEONID METEOR STORM: 1. METEOR MAGNITUDE DISTRIBUTION". *Journal of Astronomy & Space Sciences*, 20(4): 283-298.

The 2001 Leonid meteor storm has been observed all over the world, and its most intense flux since the last few decades has caused great interest among both laymen and experts. Especially, its maximum hours occurred at dawn hours of Nov. 19 in the east Asia, during which moonless clear night at the Mt. Bohyun allowed us near perfect condition of observation. Observation was carried out in the period of 01:00 ~ 05:40(KST), which include the predicted maximum hours, with all-sky camera installed for upper atmospheric airglow research. Tn this paper we analyze 68 all-sky images obtained in this period, which contain records of 172 meteors. Utilizing the zenith hourly rate(ZHR) of 3000 and magnitude distribution index of 2, which were reported to International Meteor Organization by visible observers in the east Asia, we estimate the limiting magnitude of about 3 for meteors detected in our all-sky images. We then derive magnitudes of 83 meteors with clear pixel brightness outlines among the initially detected 172 meteors by comparing with neighbor standard stars. Angular velocities of meteors needed for computing their passing times over an all-sky image are expressed with a simple formula of an angle between a meteor head and the Leonid radiant point. The derived magnitudes of 83 meteors are in the range of –6 ~ –1 magnitude, and its distribution shows a maximum new –3 mag. The derived magnitudes are much smaller than the limiting magnitude inferred from the comparison with the result of naked-eye observations. The difference may be due to the characteristic difference between nearly instantaneuous naked-eye observations and CCD observations with a long exposure. We redetermine magnitudes of the meteors by adjusting a meteor lasting time to be consistent with the naked-eye observations. The relative distribution of the redetermined magnitudes, which has a maximum at 0 mag., resembles that of the magnitudes determined with the in-principle method. The relative distribution is quite different from ones that decrease monotonically with decreasing magnitudes for meteors(1 ~ 6) sensitive to naked-eye observations. We conclude from the magnitude distribution of our all-sky observation that meteors brighter than about 0 mag., appeared more frequently during the 2001 Leonid maximum hours. The frequent appearance of bright meteors has significantly important implication for meteor research. We noted, however, considerably large uncertainties in magnitudes determined only by comparing standard stars due to the unknown lasting time of meteors and the non-linear sensitivity of all-sky camera.

1-36 Kim, Jeong Woo, **Sungmin Hong**, Jong-Sun Hwang, **Ho-Il Yoon**, **Bang Yong Lee**, and **Yeadong Kim**. 2002. "Distribution of Antarctic Sea Ice from Satellite Altimetry in the Weddell Sea: Preliminary Results". *Ocean and Polar Research*, 24(3): 255-261.

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 the T/P, we classified the surface into ocean, land, and sea. Total 257 cycles of altimeter measurements between Oct. 1992 and Sep. 1999 (for nearly 2570 days) were used to analyze the distribution of the Antarctic sea ice. We then calculated the surface area of ice coverage using SUTM20 map projection to monitor the periodic variations. Each year, the maximum and minimum coverage of the sea ice were found in late August and February 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 to compare with the T/P. Using the Valid/Invalid flag of the Ocean Product, we analyzed the sea ice distribution between March and August of 1995, which showed very good coherence with the T/P measurements. Our preliminary results showed that the altimeter measurements can be effectively used to monitor the distribution of the sea ice in the polar region. However, the size of radar footprint, typically 2-6 km depending on the roughness of the sea surface, may be too big to monitor the sharp boundary between ice and water/land. If more other altimeter mission data with dense coverage such as Geosat GM are analyzed together, this limitation can be significantly improved. If we also combine other microwave remote sensing data such as radiometer, and SSM/I, the result will be significantly enhanced.

1-37 **Kim, Jeong Woo**, **Yeadong Kim**, and **Bang Yong Lee**. 1991. "A Study on the Upper Atmosphere using Fabry-Perot Interferometer at King Sejong Station, Antarctica". *Ocean Research*, 13(1): 1-11.

In order to study the neutral temperatures and winds in the Antarctic thermosphere, a 6-inch high-resolution Fabry-Perot interferometer was installed at King Sejong Station (geographic lat. And long.: 62.2°S, 58.8°W; geomagnetic lat. and long.: 50.7°S, 7.5°E), Antarctica in January 1989. Interferometric measurements during March 1989 showed elevated thermospheric temperatures. These high temperatures may be partly due to the major solar event that occurred in March 1989. Wind vectors constructed from neutral wind components measured at the time showed some definite trends in direction and magnitude.

1-38 Kim, Jhoon, Soo Jin Lee, Jae Deuk Lee, Gwang Rae Cho, **Young In Won**, and Hi-Ku Cho. 2001. "MEASUREMENT OF MIDDLE ATMOSPHERIC OZONE DENSITY PROFILE BY ROCKET-BORNE RADIOMETER ONBOARD KSR-II". *Advances in Space Research*, 27(12): 2025-2030.

KSR-II, a two-stage sounding rocket of KARI was launched successfully at the Korean Peninsula on June 11, 1998. The apogee of the rocket was 137 km. For the ozone measurement, 8-channel UV and visible radiometers were onboard the rocket. The rocket measured an *in situ* stratospheric and mesospheric ozone density profile over Korea during its ascending phase using the radiometer and transmitted the data to ground station in real time. The maximum ozone density occurs near 25 km. Retrieved profile has a random error (1σ) of approximately 15% for altitude below 20 km, 7 % between 20-50 km and 10 % greater than 50 km. The retrieved data were compared with Dobson spectrophotometer, ozonesonde, and HALOE onboard the UARS. Our results are in reasonable agreements with others.

1-39 Kim, Ki-Hyun, W. H. Schroeder, Min-Young Kim, **Sungmin Hong**, and Zang-Ho Shon. 2003. "Atmospheric Chemistry of Mercury in the Polar Regions and its Environmental Implications". *Journal of Korean Earth Science Society*, 24(5): 420-427.

The results of recent studies indicate that atmospheric distribution of Hg in the arctic environment is unique enough to show strong depletion during spring followed by notable increases during summer. The observations of this abnormal trend contrast quite sharply with what had been recognized as Hg geochemical behavior in air over the past decades. Using the long-term measurement data of Hg obtained from both the Arctic and Korea, we attempted to provide valuable insights into the unique mercury depletion phenomenon (MDP) in the polar regions of the globe.

1-40 Kim, Yong Ha, Jong-Kyun Chung, **Young-In Won**, and **Bang-Yong Lee**. 2002. "Search for Gravity Waves with a New All-sky Camera System". *Ocean and Polar Research*, 24(3): 263-266.

Gravity waves have been searched for with a new all-sky camera system over Korean Peninsular. The all-sky camera consists of a 37 mm/F4.5 Mamiya fisheye lens with a 180 deg field of view, interference filters and a 1024 by 1024 CCD camera. The all-sky camera has been tested near Daejeon city, and moved to Mt. Bohyun where the largest astronomical telescope is operated in Korea. A clear wave pattern was successfully detected in OH filter images over Mt. Bohyun on July 18, 2001, indicating that small scale coherent gravity waves perturbed OH airglow near the mesopause. Other wave features are since then observed with Na 589.8 nm and OI 630.0 nm filters. Since a Japanese all-sky camera network has already detected traveling ionospheric disturbances (TID) over the northeast-southwest range of Japanese islands, we hope our all-sky camera extends the coverage of the TID's observations to the west direction. We plan to operate our all-sky camera all year around to study seasonal variation of wave activities over the mid-latitude upper atmosphere.

1-41 Kwon, Tae-Yong and **Bang Yong Lee**. 2002. "Precipitation anomalies around King Sejong Station, Antarctica associated with El Niño/Southern Oscillation". *Ocean and Polar Research*, 24(1): 19-31.

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. Though three Antarctic Stations of King Sejong (Korea), Frei (Chile), and Artigas (Uruguay) are all closely located within 10 km, their precipitation data show mostly insignificant positive or rather negative correlations among them in the annual, seasonal and monthly precipitation. This result indicates that there are locally large variations in the distribution of precipitation around King Sejong Station. The monthly data of Frei Station for 31 years (1970-2000) are analyzed for examining the ENSO signal in precipitation because of its longer precipitation record compared to other two stations. From the analysis of seasonal precipitation, it is seen that there is a tendency of less precipitation than the average during EI Niño events. This dryness is more distinct in fall to spring seasons, in which the precipitation decreases down to about 30 % of seasonal mean precipitation. However, the precipitation signal related with La Niña events is not significant. From the analysis of monthly precipitation, it is found that there is a strong negative correlation during 1980s and in the late 1990s, and a weak positive correlation in the early 1990s between normalized monthly precipitation at

Frei Station and Sea Surface Temperature (SST) anomalies in the NINO 3.4 region. However, this relation may be not applied over the region around King Sejong Station, but at only one station, Frei.

1-42 **Lee, Bang Yong** and Ik Soon Chang. 1992. "Studies on the Characteristics of Meteorological Phenomena and Cold Wave at King Sejong Station, Antarctica". *Korean Journal of Polar Research*, 3(1/2): 1-16.

The meteorological observation at King Sejong Station(62° 13'S, 58° 47'W) has been operated since February 1988. At the observatory, data of surface meteorological elements and phenomena have been acquired with the Automatic Meteorological Observation System(AMOS) and the visual observation, also, has been performed to understand meteorological characteristics at the Station, in particular, relation of climatic change between Antarctica and the surrounding area. Surface observation elements are as the following details : station level pressure, temperature, relative humidity, wind, dewpoint temperature, precipitation, global horizontal solar radiation by using sensors and horizontal visibility, cloud, sea condition, ground condition, distribution of sea ice, seasonal variation of natural phenomena by human eyes. According to the observation and analysis from January to December 1991, the mean temperature, mean maximum and minimum temperatures are –3.0℃, –0.6℃ and –5.3℃ at the Station, respectively. Also, the lowest temperature is –24.4℃ (recorded on the 5th of August 1991). The mean wind speed is 8.0 m/s with the greatest gust was 46.6 m/s (recorded on the 11th of September 1991). The major wind direction is North-West during summer season and South-East during winter season. The mean station pressure is 989.8 mb, relative humidity 85 %, fractional cloudiness 6.7 octas, and total precipitation 537.1 mm, respectively. At King Sejong Station severe weather condition (blizzards), which is characterized by low temperatures and strong winds bearing a great amount of snow, has been generally with either south-easterly winds from rear or on the way of depressions. During the aforementioned period blizzards have been observed 29 times with total period of 424 hours 50 minutes, in which the most cases have been occurred in winter season between February and October. During the cold wave period, from the 2nd to the 5th on August, the record-break lowest temperature(–28.7℃) was observed since the meteorological observation was started at the King George Island (61° 50' ~ 62° 15'S, 57° 30' ~ 59° 00'W). During this period. also. the lower temperature(–24.4℃) was observed at King Sejong Station on 02:07LST of August 5. All area near the King George Island was affected by the polar high pressure which extended to 60°S.

1-43 **Lee, Bang Yong** and Jae-Cheol Nam. 1991. "Studies on the Characteristics of Meteorological Elements at King Sejong Station". *Korean Journal of Polar Research*, 2(2): 3-27.

Various surface meteorological elements are being observed at King Sejong Station continuously. In this study, emphasis is given to the analysis of wind, pressure, temperature and blizzards recorded in 1990. According to the analyzed data, annual average wind speed was 7.8 m/s and predominant wind direction was north-west. During the period from January to December in 1990, the greatest gust was 46.6 m/s at 20:00LST of the 16th, June. Annual average pressure was 986.7mb (maximum 1027 mb, minimum 951 mb) and annual average temperature was –1.9℃(maximum 8.1℃, minimum –21.6℃). At King Sejong Station, blizzards were observed 22 times for 296 hours from

January to October, 1990. Among them, the longest blizzard persisted for 58 hours and 30 minutes from 07:30LST(11:30 GMT)on the 6th of April to 18:00ST on the 8th of April. During the blizzards, the strongest pressure gradient was recorded as 23 mb (953~976 mb) on the 20th of August. Most of blizzards occurred with winds from SE and were found either to be located behind depressions or to follow the depressions. The meteorological phenomena around the coast of Antarctica is almost always affected by a polar anticyclone and by four or six semi-permanent cyclones. They are located in the Antarctic continent and in the area between 60° and 65°S respectively. These semi-permanent cyclones are usually developed over Bellingshausen, Weddell, Ross Sea and Prydz Bay, and move to the east or southeast along the coast, rotating about 5° in longitude per day. The polar anticyclone weakens during the austral summer, but strengthens during the austral winter. When the polar anticyclone intensifies, it brings about severe weather conditions around the South Shetland Islands along with cyclones over Bellingshausen and Weddell Sea. The Antarctic Peninsula plays an important role as the topographical barrier which blocks the path of cyclones. Moreover, subtropical high pressure, which is expanded toward Weddell Sea, stands against the intensified polar high pressure, blocking the passage of cyclones. Therefore, many cyclones over Bellingshausen Sea, in the west of the Antarctic Peninsula, or Weddell Sea are delayed in their movement Thus, they are strengthened through joined efforts.
In another situation, strong winds blow northward along the east coast of the Peninsula whenever an intense low pressure system is situated over the central Weddell Sea In the Southern Hemisphere, the Coriolis force to the wind acts to gradually deflect the airstream to the left. Forceful winds which carry the drifting and blowing snow, blow from the glacier areas, which are located east and southeast of the Station. As a result of the aforementioned situations, severe weather phenomena were observed frequently in the vicinity of the Peninsula, including the area of King George Island. In summary, severe weather phenomena are caused by remarkable pressure patterns and topographical effects at King Sejong Station as well as at other stations in the Antarctic. These phenomena, such as blizzards or other various storms, occur frequently, almost year-round, and hinder much of the Antarctic researcher's studies and living conditions.

1-44 **Lee, Bang Yong**, Dong Ho Kim, and **Yeadong Kim**. 1990. “A study on the climate characteristics over King Sejong Station, Antarctica (1988~1989)”. *Korean Journal of Polar Research*, 1(1): 47-57.

The analysis of meteorological data collected from February 1988 to December 1989 at King Sejong Station on King George Island, Antarctica is as follows. The mean station level pressure was recorded as 989.9 mb during the period of observation. The mean air temperature was –1.5℃ and the mean wind speed was 8.0 m/s. Predominant wind direction was northerly and the mean relative humidity was 88 %. The mean value of the cloud amount was 6.7 octas. During the period of observation, days of precipitation and fogginess were 357 and 229, respectively. This type of weather pattern is due to the latitudinal and geographical position of the station, the station being under the effect of the ocean and belonging to the high latitudinal area where strong cyclones frequently generate.

1-45 **Lee, Bang Yong**, Hi-Ku Cho, Young Joon Yoon, and **Youngin Won**. 1996. “Variations of the Total Ozone Amount over Antarctic King Sejong Station Analyzed from the NIMBUS 7/TOMS Data”. *Ocean Research*, 18(1): 47-53.

Characteristic features of total ozone variations using the data measured by the NIMBUS 7/TOMS(Total Ozone Mapping Spectrometer) over King Sejong Station(62.20°S, 58.8°W), Antarctica are obtained for the period of 1978-1991. During the period, the total ozone level has decreased by the rate of 11 % per decade at King Sejong Station. Maximum decrease of seasonal total ozone levels occurred in austral Spring (September, October, November) with the rate of 15.9 % per decade and the minimum in austral Autumn (March, April, May) with 5.7 % over King Sejong Station. The maximum decrease of the monthly total ozone level occurred in October with the trend of 25.5 % per decade while the minimum decrease was found in March with the trend of 2 % over King Sejong Station.

1-46 **Lee, Bang Yong**, Tae-Yong Kwon, Jeong-Soon Lee, and **Young-In Won**. 2002. "Surface Air Temperature Variations around the Antarctic Peninsula: Comparison of the West and East Sides of the Peninsula". *Ocean and Polar Research*, 24(3): 267-278.

This study investigated the spatial characteristics of warming trends and the dipole-like pattern of temperature field in the Antarctic Peninsula using surface air temperature (SAT) of 10 stations in the vicinity of the Antarctic Peninsula. SAT data for the 1962-2001 period at 6 stations (Rothera, Faraday/Vernadsky, Bellingshausen, Orcadas, Esperanza, Halley) revealed in general the larger warming trends in autumn and winter except for Halley. The largest warming was shown for August in the west side of the Peninsula (more than 0.9℃/decade). On the other hand, the recent 14-year SAT data showed the strong warming trends at 9 stations except for Halley in the earlier period (April-June) than August for the 1962-2001 period. The largest warming appeared in May at Esperanza and Butler Island. SAT of the two sides showed significant positive correlations over most of the period except for the mid- and the late 1970s, in which significant negative correlations were found. In the correlation analysis between SAT and sea surface temperature (SST) anomalies in the NINO 3.4 region, strong negative correlation was found in the west side of the Peninsula. Details of the correlation analysis exhibited that the negative correlation was significantly strong from the early 1980s to the mid-1990s. However, it was difficult to find significant correlations of ENSO with SAT in the east side of the Peninsula. So, in this study it failed to find out clearly the out-of-phase relationship of SAT across the Antarctic Peninsula.

1-47 Lee, Gangwoong, Juyoung Park, and **Sungmin Hong**. 1999. "Major Ionic Species in a Snow Pit in Livingston Island, Antarctica". *Korean Journal of Polar Research*, 10(2): 59-65.

Snow samples were collected at a snow pit, 5 km inland a coast of Livingston Island (60°37'W, 62° 37'30''S) down to 1.5 m depth With intervals of about 5 cm in December 1998. Samples were estimated to represent snow falls accumulated during at least austral winter in 1998. Concentrations of major ions, MSA (Methanesulfonic Acid), Cl^-, NO_3^-, SO_4^{2-}, Na^+, NH_4^+, K^+, Mg^{2+}, and Ca^{2+} showed ranges of 0.003-0.066 μg/g, 0.17-26.94 μg/g, 0.01-0.24 μg/g, 0.03-4.88 μg/g, 0.14-13.85 μg/g, nd-0.07 μg/g, 0.01-3.14 μg/g, 0.01-1.81 μg/g, nd-0.48 μg/g, respectively. The results showed. that the major ionic compositions of snow were remarkably similar to those of sea water, with much higher concentrations. While concentration levels of all ionic species measured sharply increase at depths of 30 cm, 60 cm and 130 cm, the oxygen isotope ratios do not indicate any distinct seasonal variation. These layers of high ions could be attributed to either one or combining acts of three factors: dry depositions, wet

depositions, and partial melting and movements of ionic species with depth. The mean molar ratio (R) of MSA/nss-sulfate (non sea salt sulfate) was 0.11, which was approximately 20-30 % higher than those in remote open ocean, but it was about one third of those in inland Antarctica.

1-48 **Lee, Jae Il**, **Yeadong Kim**, and **Ho Il Yoon**. 2003. "Late Quaternary paleoenvironment of the Saint Anna Trough, Kara Sea in the Arctic". *Journal of Geological Society of Korea*, 39(1): 65-80.

Three gravity core samples obtained from the Saint Anna Trough, Russian Arctic Kara Sea in September 2001 were analyzed for the paleoceanographic reconstruction. Sedimentary facies were identified with the aid of X-radiography. Water content, magnetic susceptibility, organic matter content, total nitrogen and sulfur content, and grain size distribution were analyzed. For the identification of mineral composition X-ray diffraction analysis for bulk and clay-size fraction were carried out. To understand change in sedimentary provenance, trace and rare earth element concentrations were measured. Dark gray massive diamicton facies were observed in the lower part of cores from two locations. They were interpreted to be glaciogenic diamicton deposited during the Last Glacial Maximum in the Saint Anna Trough. Mineral composition and trace and rare earth element concentrations of these two cores suggest that there was a change in sediment provenance between glacial and interglacial periods. Type of organic matter had also changed from dominantly terrestrial to marine origin during this period. Diamicton faices observed in the two cores differ in the mineral composition and trace and rare earth elements, and it was interpreted to reflect different sedimentary provenance. It implies that there had been more than two sediment-transporting paths flowing into the Saint Anna Trough.

1-49 Lee, Jeong-Soon, Tae-Yong Kwon, **BangYong Lee**, **Ho-Il Yoon**, and Jeong-Woo Kim. 2003. "Change of Regional Atmospheric Circulation Related with Recent Warming in the Antarctic Peninsula". *Ocean and Polar Research*, 25(4): 503-518.

This study examines the relationship among temperature, wind, and sea level pressure to understand recent warming in the vicinity of the Antarctic Peninsula. To do this, the surface air temperature, NCEP/NCAR reanalysis wind data and sea level pressure data for the period of 40 years are analyzed. The 40-year surface air temperature data in the Antarctic Peninsula reveals relatively the larger warming trends for autumn and winter than other seasons. The variability of the surface air temperature in this region is compared with that of the regional atmospheric circulation. The surface air temperature is positively correlated with frequency of northwesterlies and negatively correlated with frequency of southeasterlies. This relation is more evident in the northern tip of the Antarctic Peninsula for autumn and winter. The trend analysis of wind frequency in the study area shows increasing and decreasing trends in the frequency of northwesterlies and southeasterlies, respectively, in the northwestern part of the Weddell Sea for autumn and winter. And also it is found that these winds are closely related with decreasing of sea level pressure in the southeastern region of the Antarctic Peninsula. Furthermore from the seasonal variation of sea level pressure in this area, it may be presumed that decreasing of sea level pressure in the southeastern region of the Antarctic Peninsula is related with warming in the vicinity of the Antarctic Peninsula for autumn and winter. Therefore it can be explained that recent warming in the vicinity

of the Antarctic Peninsula is caused by positive feedback mechanism, that is, the process that warming in the vicinity of the Antarctic Peninsula can lead to the decrease of sea level pressure in the southeastern region of the Antarctic Peninsula and these pressure decrease in turn lead to the variation of wind direction in northwestern part of Weddell Sea, again the variation of wind direction enhances the warming in the Antarctic Peninsula.

1-50 Lee, Kyu-Tae, **Bang Yong Lee**, **Young-In Won**, and 3 others. 2003. "Radiative properties at King Sejong Station in West Antarctica with the radiative transfer model : A Surface UV-A and Erythemal UV-B Radiation Changes". *Ocean and Polar Research*, 25(1): 9-20.

A solar radiation model was used to investigate the UV radiation at the surface offing Sejong Station in West Antarctica. The results calculated by this model were compared with the values measured by UV-Biometer and UV-A meter during 1999-2000. In this study, the parameterization of solar radiative transfer process was based on Chou and Lee(1996). The total ozone amounts measured by Breve. Ozone Spectrophotometer and the aerosol amounts by Nakajima *et al.*(1996) was used as the input data of the solar radiative transfer model. And the surface albedo is assumed to be 0.20 in summer and 0.85 in winter. The sensitivity test of solar radiative transfer model was done with the variation of total ozone, aerosol amount, and surface albedo. When the cosine of solar zenith angle is 0.3, Erythemal UV-B radiation decreased 73 % with the 200 % increase of total ozone from 100 DU to 300 DU, but the decrease of UV-A radiation is about 1 %. Also, for the same solar zenith angle, UV-A radiation was decreased 31.0 % with the variation of aerosol optical thickness from 0.0 to 0.3 and Erythemal UV-B radiation was decreased only 6.1 %. The increase of Erythemal W-B radiation with the variation of surface albedo was twice that of UV-A increase. The surface Erythemal UV-B and UV-A radiation calculated by solar raditive transfer model were compared with the measured values fer the relatively clear day at King Sejong Station in West Antarctica. The model calculated Erythemal UV-B radiation at the surface coincide well with the measured values except for cloudy days. But the difference between the model calculated UV-A radiation and the measured value at the surface was large because of cloud scattering effect. So, the cloud property data is needed to calculate the UV radiation more exactly at King Sejong Station in West Antarctica.

1-51 Lee, Seung Hyoun, Yong Il Lee, **Ho Il Yoon**, **Cheon Yun Kang**, and **Yeadong Kim**. 2003. "Occurrence of vivianite in late Pleistocene lacustrine sediments at Sogwipo area, Jeju Island, Korea". *Journal of the Geological Society of Korea*, 39(1): 133-142.

1-52 Li, Baohua, **Ho-Il Yoon**, and **Byong-Kwon Park**. 2000. "Foraminiferal assemblages and $CaCO_3$ dissolution since the last deglaciation in the Maxwell Bay, King George Island, Antarctica". *Marine Geology*, 169: 239-257.

Three sediment cores (A10-01, -02 and -08) from the Maxwell Bay, King George Island, Antarctica were quantitatively analyzed for foraminiferal fauna. Planktonic foraminifera of three cores are rare due to the special Antarctica environment. Benthic foraminifera is mainly composed of *Globocassidulina biora*, *Globocassidulina crassa rossensis*, *Cassidulinoides parkerianus* and *Miliammina arenacea*. *G. biora* and *G. crassa rossensis* show high percentages in the shallower Core A10-08 while *M. arenacea* displays obviously high percentage in deeper Core A10-02. The lower parts of the cores have a lower

abundance of foraminifera, while the upper parts have a relatively higher abundance. The down-core variations of benthic foraminifera reflect the contrast of surface water environment between the last deglaciation and post glacial. During the last deglaciation (lower parts of the cores), the lower abundant foraminifera was consistent with the lower TOC, which reflected that the extensive sea ice prevented the production of primary organisms, and, therefore, lower flux of organic particles was delivered to the sea floor. Abundant foraminifera together with higher TOC in the upper parts of the cores suggested a higher primary productivity after the glaciation.

The shallowest-water-depth Core A10-08 (45 m), displayed a better carbonate preservation than the other two cores (A10-01 and -02) from the depths of 85 and 105 m, respectively. The disparity in carbonate dissolution reflected the remarkable shallow lysocline and carbonate compensation depth (CCD) in the Antarctic area, and also reflected significant variations in water properties even within such a difference only about 60 m in water depth. Down-core variations of benthic foraminifera dissolution index (BDI) and $CaCO_3$ content indicated the existence of stronger carbonate dissolution in the upper parts than those in the lower parts of the cores. The down-core variations of carbonate dissolution suggested changes of water properties linked to the shallow CCD in this area. It was supposed that the less influence of the Saline Shelf Water during the last deglaciation enhanced the carbonate preservation. With the sea-level increasing and retreat of the coastal ice after the glacial, erosive water masses and the higher CO_2 accumulated by the increased flux of organic material led to severe dissolution of $CaCO_3$ and foraminiferal shells in the sediment.

1-53 Nam, Jae-Cheol and **Bang Yong Lee**. 1991. "A Case Study of Blizzard at King Sejong Station, Antarctica". *Asia-Pacific Journal of Atmospheric Sciences*, 27(3): 291-300.

Two cases of blizzards (on 6-9 April and 14-17 July, 1990) are selected to investigate the characteristics of blizzards which occurred over the King Sejong Station(KASS) in Antarctica. Analyses of the surface pressure charts, satellite cloud pictures and time variations of pressure, temperature and wind show that topographical effects between the Antarctic Peninsula and the South American Continent and the high latitude low pressure systems play an important roles on the intensification of the blizzards that produce heavy snow falls and strong winds.

1-54 Park, Byong-Kwon, **Soon-Keun Chang**, **Ho Il Yoon**, and **Hosung Chung**. 1998. "Recent retreat of ice cliffs, King George Island, South Shetland Islands, Antarctic Peninsula". *Annals of Glaciology*, 27: 633-635.

Comparison of aerial photos shows that the ice cliff in Marian Cove, Maxwell Bay, southwestern King George Island, retreated approximately 250 m between 1956 and 1986, but advanced about 40 m between December 1986 and January 1989. The advance in the late 1980s seems to be related to the cold austral winters of 1986-88. A topographic survey in January 1994 revealed that the ice cliff in Marian Cove had again retreated around 270 m since January 1989; approximately the same as from December 1956 to December 1986. In Potter Cove, the ice cliff retreated approximately 400 m from 1956-89. The more pronounced retreat here may be attributable to shallower water depths (<30 m). These ice cliffs retreats are discussed as a possible consequence of recent regional warming.

1-55 Rosman, K. J. R., **S. Hong**, and 7 others. 2003. "Pb and Sr isotopes from an ice-core provides evidence for changing atmospheric conditions at the Sajama icecap, South America". *Journal de Physique IV France*, 107: 1157-1160.

Measurements of Pb and Sr isotopes and Pb, Sr, Ba and Rb concentrations in ice-core samples from the Sajama icecap in Bolivia were made to investigate the changing environmental conditions in the region over the past 22 ky. The Pb isotopic measurements indicate there has been a significant change in the $^{206}Pb/^{207}Pb$ ratio in the ice by 1700 AD which can be attributed to human activity. This change was also accompanied by increasing Pb/Ba ratios that reach ~10 times natural values by the beginning of the 20th century, confirming an increase of anthropogenic Pb levels. Sr and Rb concentrations are highly enhanced in 3 ky and 0.5 ky BP ice relative to the upper-crustal rock indicating a different origin for a significant proportion of the dust in these samples. Likely sources of this dust are dry lake beds that occur on the Altiplano as a result of changing climatic conditions. This dust adds to the background level of dust accumulating on the Sajama icecap.

1-56 **Shin, Y. N.**, **B. K. Khim**, K. Ikehara, **H. I. Yoon**, **Y. Kim**, and K. S. Woo. 2000. "Occurrence of Diatom in the Late Quaternary Sediments of the Northeastern East Sea (Sea of Japan) and its Paleoceanographic Changes". 「*The Sea*」 *Journal of the Korean Society of Oceanography*, 5(4): 305-319.

A total of 50 diatom species and 1 subspecies belonging to 31 genera except *Chaetoceros* resting spores were identified in the 45 sediments subsampled from a gravity core GH98-1223 collected from the western Hokkaido Island located in the northeastern East Sea (Sea of Japan). The most dominant species is *Thalassionema nitzschioides* (Grunow) Hustedt, ranging 29 to 59 % of the total assemblages, and most species including *Denticulopsis seminae* (Simonsen and Kanaya) Simonsen and *Pseudoeunotia doliolus* (Wallich) Grunow were less than 5 % in average. Frequencies of cold-water species are generally higher than those of warm-water species and the vertical distribution of cold-water species was largely opposite to that of warm-water species in spite of ecological habitat difference. Frequency of cold-water species, *D. seminae* is reverse to that of *P. doliolus*, an indicator of the Tsushima Warm Current, which is consistent with diatom temperature value (T_d value). The variation of T_d values shows that the upper part of core with greater-than-average T_d values represents postglacial warming trend. These T_d values clearly demonstrate that the study area located in the northern part of the East Sea is gradually influenced by Tsushima Warm Current. In addition, the zig-zag variation in the lower part reflects the unstable seawater for diatom habitat. Chaetoceros resting spores indicating productivity and upwelling was 5.3 to 40 %, with maximum peak at 80 cm. *Chaetoceros* resting spores/*Chaetoceros* vegetative cells, an indicator of relative amounts of biogenic material in the sediments was high at the upper 80 cm level, corresponding to the change of T_d values. On the basis of diatom assemblages, the northeastern part of East Sea has experienced the effects of Tsushima Warm Current during the postglacial period of Holocene, which is similar to the modem climatic environment. However, the variation of *P. doliolus* reflects that the intensity of Tsushima Warm Current has been oscillated in the East Sea.

1-57 **Shin, Yuna**, **Ho Il Yoon**, **YeaDong Kim**, and **Cheon Yun Kang**. 2001. "Diatom Assemblages and its Paleoceanography of the Holocene Glaciomarine Sediments from the Western

Antarctic Peninsula shelf, Antarctica". 「*The Sea*」 *Journal of the Korean Society of Oceanography*, 6(3): 152-163.
Based upon the sedimentological, geochemical and micropaleontological analyses of two sediment cores from the Antarctic Peninsula (AP), three distinct lithological units can be recognized: (1) ice-proximal an/or ice-distal diamictons in the lower part of the cores, accumulated just seaward of the grounding line of the ice shelf until 11,000 yrs BP; (2) diatomaceous mud between 6,000 and 2,500 yrs BP in the middle part, resulted from a large influx of organic materials by enhanced production of open marine condition; (3) diatomaceous sandy mud since 2,500 yrs BP, characterized by an increase in sand content and decrease in TOC and diatom abundance in the lower layers, which reflects the formation of more extensive and seasonally persistent sea ice. Based on the C-14 radiocarbon dating, the sub-ice shlef deposition of the diamicton on the AP western shelf completed around 11,000 yrs BP. Colder condition was reinstated between 12,800 and 11,600 BP with a drop in TOC content and diatom abundance, which is coincident with the Younger Dryas event in the North Atlantic region. At this time, the ice shelf, that is now absent in the study area, appears to advance as evidenced by an abrupt increase in sea-ice taxa. A climatic optimum is recognized between 9,000 and 2,500 BP, coincide with a mid-Holocene climatic optimum 'Hypsithermal Warm Period' from the other Antarctic sites. During this time, diatomaceous mud accumulated by a large influx of organic materials by enhanced production occurred in open marine condition. Around 2,500 BP, diatomaceous sandy mud reflects the formation of more extensive and seasonally persistent sea ice, coincident with the onset of the Neoglacial in the Antarctic. Our results provide evidence of climatic change from the Antarctic Peninsula's western shelf that helps in determining the existence and timing of Holocene millennial-scale climatic events in the Southern Hemisphere.

1-58 **Won, Y. -I.**, J. Kim, R. J. Niciejewski, **B. Y. Lee**, and 2 others. 2003. "MEASUREMENTS OF ATMOSPHERIC WAVES IN THE UPPER MESOSPHERE AT CHUNGWON, KOREA". *Advances in Space Research*, 32(5): 849-853.

We have used a Fourier Transform Spectrometer (FTS) to study atmospheric waves in upper mesosphere over Chungwon (36.6°N, 127°E), Korea. Measurements of the OH(3-1) bands were used to derive temperature and airglow intensity information of upper mesosphere. For this study, we analyzed OH measurements taken between April and June 2001, and performed spectral analysis to get wave information. We report characteristics of observed waves and compare the results with existing theoretical reports.

1-59 **Won, Y. -I.**, Q. Wu, Y. M. Cho, G. G. Shepherd, T. L. Killeen, P. J. Espy, **Y. Kim**, and B. Solheim. 2003. "Polar cap observations of mesospheric and lower thermospheric 4-hour waves in temperature". *Geophysical Research Letters*, 30(7): 1377.

Lower thermospheric and upper mesospheric rotational temperatures have been derived from ground-based measurements of the O_2(0–1) and OH(6–2) nightglow emissions over Resolute Bay, Canada (74.68°N, 94.90°W) and OH(4–2) nightglow emission over Kiruna, Sweden (67.90°N, 21.10°E). From measurements taken during two nights in November, 2001, we have observed a dominant and coherent 4-hr oscillation in both the O_2 and OH airglow emission rates and rotational temperatures. The phases for the two oscillation events remain almost constant at each location, indicating that

these oscillations may not be caused by transient passage of instantaneous gravity waves. More importantly, there is little phase difference in universal time between the 4-hr oscillations in temperature at Resolute and Kiruna. The small phase difference gives a strong indication that the oscillation maybe related to a zonally symmetric tide, since any tidal waves in temperature with a nonzero zonal wavenumber are very weak at high latitudes. Waves in both events have large vertical wavelengths (76 and 175 km). The 4-hr wave shows almost no latitudinal variation from Resolute to Kiruna.

1-60 **Won, Youngin**, **Bang Yong Lee**, **Yeadong Kim**, and 2 others. 1996. "A Preliminary Meteorological Observation on the Upper Atmosphere using a Radiosonde System at King Sejong Station, Antarctica". *Ocean Research*, 18(2): 165-171.

The balloon-borne measurement for investigating vertical structure of the atmosphere in austral summer season was performed at King Sejong Station (62.2°S, 58.8°W, elevation 9.85 m), Antarctica, from 23LST December 21 to 23LST 23, 1994. Among the common features is the occurrence of jet stream at about 8km where the tropopause is located. The observed maximum wind speed with about 270° wind direction which lie between 5 to 15km height have much higher wind speeds than northerly winds with rapid changes of wind directions above and below tropopause height. Lower tropospheric jet streams were also observed at about 5 km above ground, under the severely reductions of maximum wind speeds and the occurrences of lower tropospheric jet-like winds. The formations of lower tropospheric jet streams can be attributed to the downward momentum transportation from the upper tropospheric jet streams. In a way, vertical profile of temperature was inversely shown from 10 km to 30 km where is the maximum height of balloon ascent, and temperature was 50℃ below zero near 10 km height and 0℃ at surface.

1-61 **Won, Young-In**, **Jong-Kyun Chung**, **Bang Yong Lee**, **Yeadong Kim**, and 2 others. 1999. "An Application of a Michelson Interferometer to Measurements of OH Rotational Temperatures". *Journal of the Korean Physical Society*, 34(4): 344-349.

The Polar Research Center, Korea Ocean R & D Institute, recently equipped a Michelson interferometer to study the Earth's upper atmospheric region as a complement to a Fabry-Perot interferometer which had already been used for thermospheric study. This Michelson interferometer was used to observe terrestrial nightglow (Meinel bands) emitted by hydroxyl (OH) radicals in the upper mesosphere. Altitude profiles of the Meinel bands obtained by rocket-borne photometers and satellite-borne instruments place the peak emission near 87 km. Rotational relaxation is sufficiently rapid in this region so that the distribution of rotational lines within a band represents the kinetic temperature of the gas. Nightglow spectra were observed at Ansan, Korea, and were used to retrieve the rotational temperatures, as well as the band intensities, of the OH molecules in the upper mesosphere. The observed upper mesospheric temperatures were in the range of 160~210 K with uncertainties of less then 7 K.

1-62 **Won, Young-In**, **Young-Min Cho**, and 2 others. 2001. "OBSERVATIONS OF OH(3,1) AIRGLOW EMISSION USING A MICHELSON INTERFEROMETER AT 62° S". *Advances in Space Research*, 27(6-7): 1165-1170.

A Michelson interferometer was used to observe the hydroxyl (OH) emission in the upper mesosphere at the King Sejong Station

(62.22° S, 301.25° E), Antarctica. The instrument was installed in February 1999 and has been in routine operation since then. An intensive operational effort has resulted in a substantial data set between April and June, 1999. A spectral analysis was performed on individual data to examine the information of dominant waves. A harmonic analysis was also carried out on the monthly average data to investigate the characteristics of the major low frequency oscillations. The 12-hr temperature oscillations exhibit a striking agreement with a theoretical tidal model, supporting the tidal (migrating) origin. The 8-hr wave is found to be persistent and dominant, reflecting its major role in the upper mesospheric dynamics at the given latitude. The 6-hr oscillation is observed only in May with its value close to the prediction for zonally symmetric tides.

1-63 **Won, Young-In**, **Young-Min Cho**, and Yong-Ha Kim. 2000. "STUDIES OF HIGH-LATITUDE THERMOSPHERE UTILIZING OPTICAL INSTRUMENTS". *Publications of the Korean Astronomical Society*, 15S2: 27-35.

The investigation of the space environment requires the use of experimental and theoretical tools and resources in order to perform the research task. Understanding of these research tools is imperative for proper interpretation of the results. In this paper, we discuss on research tools that are widely used in the field of aeronomy; Fabry-Perot interferometer and Michelson interferometer. These instruments have been used extensively as passive optical devices, spectrally monitoring the natural atmospheric emissions (airglow). This function has made both instruments valuable tools in upper atmospheric studies since they provide the ability to determine the dynamic and thermodynamic properties of the upper atmosphere by monitoring naturally occuring emission.

1-64 **Won, Young-In**, **Young-Min Cho**, **Bang Yong Lee**, and J. Kim. 2001. "STUDIES OF GRAVITY WAVES USING MICHELSON INTERFEROMETER MEASUREMENTS OF OH(3-1) BANDS". *Journal of Astronomy & Space Sciences* , 18(1): 21-26.

As part of a long-term program for polar upper atmospheric studies, temperatures and intensities of the OH(3-1) bands were derived from spectrometric observations of airglow emissions over King Sejong station (62.22°S, 301.25°E). These measurements were made with a Michelson interferometer to cover wavelength regions between 1000nm and 2000 nm. A spectral analysis was performed to individual nights of data to acquire information on the waves in the upper mesosphere/lower thermosphere. It is assumed that the measured fluctuations in the intensity and temperature of the OH (3-1) airglow were caused by gravity waves propagating through the emission layer. Correlation of intensity and temperature variation revealed oscillations with periods ranging from 2 to 9 hours. We also calculated Krassovsky's parameter and compared with published values.

1-65 **Won, Young-In**, **Young-Min Cho**, **Bang Yong Lee**, Jhoon Kim, **Jong Kun Chung**, and Yong Ha Kim. 1999. "OBSERVATIONS OF TERRESTRIAL NIGHTGLOW (MEINEL BANDS) AT KING SEJONG STATION, ANTARCTICA". *Journal of Astronomy and Space Sciences*, 16(2): 149-158.

A Fourier Transform Spectrometer was used to study upper mesospheric thermodynamic by observing the hydroxyl (OH) emission. Rocket-born and satellited-born photometers place the peak emission near 87 km. The instrument was installed in February 1999 at King Sejong station (62.22° S, 301.25° E), Antarctica and has been in routine operation since then. An intensive operational effort has

resulted in a substantial data between April and June, 1999. A harmonic analysis was carried out to examine information on the tidal characteristics. The measured amplitudes of the 12-hour oscillation are in the range of 2.4-3.7 K, which are in resonable agreement with theoretical model outputs. The harmonic analysis also revealed 8-hour oscillation which is not expected from the traditional theoretical studies. In addition, the observed 8-hour oscillations are apparent and sometimes dominate the temperature variation in the upper mesosphere.

1-66 Yoo, Kyu-Cheul and Jae-Kyung Oh. 1999. "Transport Paths of Nearshore Surface Sediments of Coast of the East Sea, Korea". *Journal of Korean Society of Coastal and Ocean Engineers*, 11(1): 50-55.

Gao and Collins method (two-dimensional sediment transport trend-vector model) using grain-size parameters (mean grain size, sorting coefficient, and skewness) calculated by the statistical moment method is introduced to understand semi-quantitatively the sandy and surficial sediment transport trends on a coast of the East Sea. The result is the sediment transport vectors which indicate transport paths of surficial sediment by wave-induced currents. The corresponding morphological feature is a spit developed at the mouth of the Namdae stream, which is a resultant sediment transported by longshore current and is blocking the circulation of ocean. After this, it is thought that seasonal research and hydrodynamic measurements are needed for verification of the results.

1-67 **Yoo, Kyu-Cheul**, **Cheon Yun Kang**, **Ho Il Yoon**, and 2 others. 2002. "Seasonal Water Column Properties and Dispersal Pattern of Suspended Particulate Matter(SPM) in Marian Cove, King George Island, South Shetland Islands". *Journal of the Geological Society of Korea*, 38(4): 573-593.

Vertical CTDT measurements were conducted for one year (February-November, 2000) to present seasonal water-column properties and SPM (suspended particulate matter) dispersal pattern in Marian Cove, a tributary embayment of Maxwell Bay, South Shetland Islands. Warm air temperature and much precipitation in the austral summer (December-February) brought the input of fresh meltwater of supraglacial, englacial and subglacial discharges into the cove. This input produced the cold, fresh, and turbid surface and the fresh and cold mid plume. On the contrary, the character of glacial discharges was not appeared in the winter. Most of the surface water input from Maxwell Bay over the summer may have been affected by warm surface water of southern Antarctic Polar Front but over the winter cold surface water in Bellingshausen Sea occupied the cove. There was no variation of water column properties in spite of temporary freezing ice above the surface in August and October. Consequently, seasonal water column characteristics was determined by seasonal Maxwell Bay inflow, glacial discharges rate, and the period of freezing ice and, particularly, water column structures in summer was controlled by tide, wind, air temperature, precipitation, and floating ices. SPM in summer was mainly consisted of terrigenous clastic particles while that in winter biomass generated by primary production and biogenic input source of the outer bay. Seasonal dispersal pattern of the SPM was mainly controlled by tide, wind, and floating ice. High turbidity irrelevant with season down to the bottom of the front of tidewater glacier was due to resuspension of fine sediments as the result of active floating ice at front of glacier.

1-68 Yoo, Kyu-Cheul, **Ho Il Yoon**, Jae-Kyung Oh, **Cheon Yun Kang**, and **Boo-Keun Khim**. 2000. "Water Column Structure and Dispersal Pattern of Suspended Particulate Matter (SPM) in a floating ice-dominated fjord, Marian Cove, Antarctica during Austral Summer". 「*The Sea*」 *Journal of the Korean Society of Oceanography*, 5(4): 295-304.

Vertical measurement of CTDT at about 30 min intervals and spatial surface temperature, salinity, and concentration of suspended particulate matters were conducted to elucidate the character of water column and the dispersal pattern in a floating ice-dominated fjord, Marian Cove, West Antarctica. Marian Cove showed two distinct water layers in terms of turbidity; 1) cold, fresh, and turbid surface plume in the upper 2m, 2) warm, saline, and relatively clean Maxwell Bay inflow between 15-45 m in water depth. Thermal melting of Maxwell Bay inflow and tidewater glacier/floating ices developed the surface mixed layer and the activity of floating ices cause Maxwell Bay inflow to be unstable. Due to the unstable water column, the development of Maxwell Bay inflow and subsequent surface plume are not influenced by tidal frequency. Coastal current generated by strong northwesterly wind may extend warm, saline, and turbid surface plume into the central part of the cove along the northern coast via the western coast of Weaver Peninsula. Terrigenous sediments of meltwaters from the glaciated ice cliffs near the corner of tidewater glacier and some coasts enter into the cove and their dispersion depends upon the hydrographic regimes (tide, wind, wave etc.). At the period of spring tide, the strong wind stress with the northwesterly wind direction reserve suspended sediment-fed surface plume and so allow the possibility of deposition of terrigenous sediments within the basin of cove.

1-69 **Yoo, Kyu-Cheul**, **Ho Il Yoon**, Jae-Kyung Oh, **Cheon Yun Kang**, **YeaDong Kim**, and **Sung-Ho Bae**. 2003. "Wind- and Rain-induced Variations of Water Column Structures and Dispersal Pattern of Suspended Particulate Matter (SPM) in Marian Cove, the South Shetland Islands, West Antarctica during the Austral Summer 2000". 「*The Sea*」 *Journal of the Korean Society of Oceanography*, 8(4): 357-368.

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 the 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 inflow between 20-40 m in water depth, 3) turbid/cold tongue of subglacial discharges compared with the ambient waters between 40-70 m in water depth, and 4) cold, saline, and clean bottom water beneath 70 m in water depth. Surface plume, turbid freshwater at coastal/cliff area in late summer (early February), had the characteristic temperature and SPM concentration according to morphology, glacial condition, and composition of sediments. The restrict dispersion only over the input source of meltwater discharges was due to calm wether condition. Due to strong wind-induced surface turbulence, fresh and turbid surface plume, englacial upwelling cold water, glacier-contact meltwater, and Maxwell Bay inflow was mixing at ice-proximal zone and the consequent mixed layer deepened at the surface. Large amount of precipitation, the major controlling factor for increasing short-term glacial discharges,

was accompanied by the apparent development of subglacial discharge that resulted in the rapid drop of salinity below the mid depth. Although amount of subglacial discharge and englacial upwelling may be large, however, their low SPM concentration would have small influence on bottom deposition of terrigenous sediments.

1-70 Yoo, Kyu-Cheul, **Ho Il Yoon**, Jae-Kyung Oh, **YeaDong Kim**, and **Cheon Yun Kang**. 1999. "Water Column Properties and Dispersal Pattern of Suspended Particulate Matter (SPM) of Marian Cove during Austral Summer, King George Island, West Antarctica". 「*The Sea*」 *Journal of the Korean Society of Oceanography*, 4(4): 266-274.

Vertical CTDT measurement at one point near tidewater glacier of fjord-head in Marian Cove, a tributary embayment of Maxwell Bay, South Shetland Islands was performed for 24 hours during the austral summer (January 21-22, 1998) to present water-column properties and SPM (suspended particulate matter) dispersal pattern in subpolar glaciomarine setting. Marian Cove shows three distinct water layers: 1) cold, freshened, and highly turbid surface plume in the upper 2 m, 2) warm, saline, and relatively clean Maxwell Bay water between 15-35 m in water depth, and 3) cold and turbid mid plume between 40-65 m in water depth. The surface plume is composed of silt-sized clastic particles mixed with flocculated biogenic detritus, and appears to originate from either supraglacial discharge by meltwater streams along the coast or water fall of ice cliff. Freshened and turbid mid plume consists exclusively of silt-sized clastic particles, resulting from subglacial discharge beneath the tidewater glacier. The disappearance of the two turbid plumes during the earlier period of measurement seems to be largely due to the breakup of the plumes by upwelling caused by strong easterly wind (> 8 m s^{-1}). Thus, wind coupling over tidal effects regionally plays a major role in dispersal pattern of SPM as well as water exchange in Marian Cove.

1-71 **Yoon, H. I.**, **B. -K. Park**, **Y. Kim**, and **D. Kim**. 2000. "Glaciomarine sedimentation and its paleoceanographic implications along the fjord margins in the South Shetland Islands, Antarctica during the last 6000 years". *Palaeogeography, Palaeoclimatology, Palaeoecology*, 157: 189-211.

Two 3 m long cores were collected from Maxwell and Admiralty Bays on King George Island, one of the South Shetland Islands, West Antarctica. These cores were examined for their benthic foraminifer (*Globocassidulina biora*), $\delta^{18}O$ and $\delta^{13}C$ records, diatom abundance counts and biogenic constituents (carbon and silica). These high-resolution data were used to reconstruct the paleoceanography of the bays and to link the marine record with deglaciation of the South Shetland Islands Ice Cap. In Maxwell Bay, extremely low diatom abundance, the depletion of total organic carbon (TOC) and biogenic silica (bioSi), and enriched $\delta^{18}O$ between 6200 and 4000 BP indicate that this period was characterized by cold conditions with deposition of waterlain till (unit 1) just seaward of the grounding line, low sedimentation, limitation of primary production on surface water, and lack of meltwater supply. Deglaciation along the Maxwell Bay margin was dated from about 4000 BP until at least 2700 BP, with increasing TOC, bioSi and diatom abundance, and decreasing the C/N ratio up core. At this time, subglacial meltwater streams began to emanate from the glacier front. Sediment-laden meltwater plumes from these streams deposited interlaminated sand and mud (unit 2) in the ice-proximal zone. Deglaciation was followed by marked climatic warming at around 2700 BP, with evidence of

TOC and bioSi maxima, depleted-$\delta^{18}O$, and markedly increased diatom valves. With further glacier recession, diatomaceous pebbly mud (unit 3) was deposited in open marine conditions. A large influx of organic materials by enhanced production during this period caused both rapid depletion of $CaCO_3$ in sediment and resulted in marked increase in sedimentation since 2700 BP at 200 m water depth along the Maxwell Bay margin (Core S-19). In contrast, the shallower platform along the Admiralty Bay margin (Core S-2) was deglaciated later about 1900 BP, that is, 2000 years after the Maxwell Bay margin. This is possible, as Core S-19 is situated (> 200 m water depth) more distal to the fjord head glacier, while Core S-2 in Admiralty Bay lies on a shallower platform (< 45 m water depth). In spite of certain correlation problems, we tentatively correlate our results to other studies of Holocene environments in Antarctica, and from that it can be suggested that the climatic optimum at 4000 to 2700 BP and preceding cold event at 6200 to 4000 BP were of circumpolar significance. Since 2700 BP, the contrast between the maritime position of the South Shetland Islands and the continental climate of Antarctic Peninsula, where the Neoglacial appears to have begun ca. 2700 BP, however, implies that the westerly stormtracks transporting humid, warm air from northwest would not be weakened and displaced northwards from the South Shetland Islands.

1-72 **Yoon, H. I.**, M. W. Han, **B. K. Park**, **S. J. Han**, and J. K. Oh. 1992. "Distribution, Provenance, and Dispersal Pattern of Clay Minerals in Surface Sediments, Bransfield Strait, Antarctica". *Geo-Marine Letters*, 12(4): 223-227.

Clay minerals of the surface sediments of Bransfield Strait, Antarctica, exhibit distinctive geographical distributions: kaolinite has the highest concentration near the shore of the South Shetland Islands in the northern strait (20%); chlorite, near Smith Island in the northwestern strait; illite, on the continental shelf off the Antarctic Peninsula in the southern strait (80%); and smectite, close to the Penguin and Bridgeman islands in the northeastern strait (25%). This distribution pattern, combined with hydrographic and climatic data for the strait, are used to infer clay mineral provenance and dispersal patterns.

1-73 **Yoon, H. I.**, **B. -K. Park**, M. W. Han, **B. -K. Khim**, **Y. Kim**, and **C. Y. Kang**. 2001. "Origin of laminated diatom ooze in King George Basin sediments from Bransfield Strait, Antarctica". *Geosciences Journal*, 5(3): 225-231.

Diatom and porewater data of two (3-m long) piston cores from the King George Basin in Bransfield Strait, Antarctica are used to infer the depositional mechanism of the laminated diatom ooze. The higher content of total organic carbon and sulfide sulfur and their positive relationship in diatom ooze sediments suggest an oxidizing condition during the deposition of diatom ooze. The occurrence of intact diatoms, *Chaetoceros* resting spore, in the ooze implies that the laminated diatom ooze resulted from a mass sedimentation after diatom blooms near the sea-ice edges during cold period at around 2500 yrs BP.

1-74 **Yoon, Ho Il**, **Byong-Kwon Park**, **Boo-Keun Khim**, **Yeadong Kim**, **Cheon Yun Kang**, **Soon-Do Hur**, and **Kyu-Cheul Yoo**. 2001. "Glaciomarine sedimentation in sediment cores from the Bellingshausen Sea, West Antarctica". *Journal of the Geological Society of Korea*, 37(2): 217-234.

Sedimentological, geochemical and micropaleontological analyses of the two piston cores were carried out to understand

late Quaternary glaciomarine sedimentation in the western continental shelf of the Antarctic Peninsula. Seven sedimentary facies resulting from the advance and retreat of ice shelf are observed in the inner-shelf core, whereas the sediments of the outer-shelf are composed exclusively of diamicton including gravels and coarse sands transported by gravel-bearing drifting icebergs. In the lower part of the inner-shelf core, occurs a structureless, clast-rich diamicton that was deposited beneath the ground ice by glacial advance. Such a diamicton is characterized by uniform grain size, low organic carbon content, and high gravel content. This is overlain by the structureless, clast-poor diamicton formed by release of the debris entrained in the basal debris zone beneath the ice shelf during the glacial retreat. Variations of grain size, organic carbon content, and gravel content within this facies represents changes in depositional processes and biological productivity during the deposition of the diamicton. Ice-proximal laminated sand and mud overlies the clast-poor diamicton, and was derived from lower part of the grounded ice by subglacial meltwater discharge. Above this sediment, structureless glacial marine sandy mud was deposited at a null zone under the large and wide ice shelf. In the uppermost core, clast-poor diatomaceous sandy mud of pelagic origin is dominant, reflecting the present-day surface ocean condition. The AMS C-14 dating for the lower part of the topmost sediment in the diatomaceous, clast -poor sandy mud, shows an age of about 15,000 yrs BP, indicating the timing of deglaciation of the inner shelf in the west Antarctic Peninsula. During the deposition of the outer-shelf sediments, depositional processes and biological production seem to vary based on the distinct change of grain size, sorting, organic carbon content, and water content. Total sulfur content and abundance of clay mineral types are different from those of inner-shelf core sediments, suggesting the different sources for the outer-shelf core sediments. The drifting icebergs detached from fast-flowing outlet glaciers in the southwestern part of the study area would have supplied gravels to the outer-shelf area, showing a dominant flow direction and an extent of developed ice sheet at the depositional stage.

1-75 **Yoon, Ho Il**, **Byong-Kwon Park**, **Yeadong Kim**, and **Cheon Yun Kang**. 2002. “Glaciomarine sedimentation and its paleoclimatic implications on the Antarctic Peninsula shelf over the last 15000 years”. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 185: 235-254.

Analyses of sedimentological, geochemical and micropaleontological parameters from radiocarbon-dated sediment cores retrieved from the Antarctic Peninsula’s western continental shelf reveal a detailed paleoclimatic and/or paleoceanographic history over the last 15000 radiocarbon years. Deglaciation of the outer shelf off Anvers Island commenced prior to at least 15000 yr BP, marked by the deposition of distal glaciomarine diamicton (facies 2) beneath a floating ice shelf, and lasted for 3800 years with increasing diatom abundance and total organic carbon (TOC) over time. A return to colder conditions occurred between 12800 and 11600 yr BP with a drop in TOC content and diatom abundance, which is coincident with the Younger Dryas event in the North Atlantic region. At this time, an abrupt increase in percentage sea-ice taxa as well as in the ratio of (*Fragilariopsis curta* + *Fragilariopsis cylindrus*)/*Thalassiosira antarctica* suggests renewed ice-shelf advance. In contrast, the inner shelf was deglaciated somewhat later about 11000 yr BP, that is, 3000 years after the outer shelf. Prior to 11000 yr BP, deposition of proximal glaciomarine diamicton (facies 1) close to the grounding line under a floating ice shelf and/or

persistent sea ice may have occurred on the inner shelf. After this date, deposition of distal glaciomarine diamicton (facies 2) followed. A climatic optimum is recognized between 6000 and 2500 yr BP, coinciding with a 'mid-Holocene climatic optimum' from several other Antarctic sites, e.g. the Palmer Deep. During this time, as the glacial system receded from the shelf, greatly enhanced primary productivity occurred in open marine conditions, resulting in the deposition of diatomaceous mud (facies 3) and causing post-depositional dissolution of calcareous benthic and planktonic foraminifers in sediment. Around 2500 yr BP (the onset of the Neoglacial), diatomaceous sandy mud (facies 4), characterized by a decrease in TOC and diatom abundance, reflects the formation of more extensive and seasonally persistent sea ice, as evidenced by an increase in percentage of sea-ice taxa and in the ratio of (*F. curta* + *F. cylindrus*)/*T. antarctica*. Our results provide evidence of climatic change on the Antarctic Peninsula's western shelf that helps to refine the existence and timing of late Pleistocene and Holocene millennial-scale climatic events in the Southern Hemisphere.

1-76 Yoon, Seok Hoon, **Ho Il Yoon**, and John Howe. 2002. "High-resolution Echo Facies Analysis of Glacial-marine Deposits in Bransfield Strait, Antarctica". *Journal of the Geological Society of Korea*, 38(4): 537-550.

High-resolution (3.5 kHz) echo facies were analyzed to present acoustic characters and sedimentation pattern of the late Quaternary glacial-marine deposits in the Bransfield Strait, Antarctica. The high-resolution echo characters are classified into 6 echo facies on the basis of clarity, continuity, and shape of bottom and subbottom echoes together with seafloor topography. In the shelf and the upper continental slope, echo facies IA is characterized by relatively distinct, sharp bottom echoes without subbottom reflectors, showing hummocky seafloor topography less than a few meters high. Echo facies IC is mainly recorded from the upper slope, where it is characterized by mounded, sharp bottom echoes and acoustically transparent internal reflection. The deep basin floor of Bransfield Strait and the middle to lower slope of Antarctic Peninsula are dominated by echo facies IIA which shows semi-prolonged bottom and several parallel subbottom echoes. The contour-parallel zonal distribution of these echo facies suggests that the Bransfield Basin received large amounts of sediments from the grounded glaciers extended to the upper slope during the last glacial maximum. Unsorted basal debris was accumulated as subglacial tills beneath the grounded glaciers (IA) and grounding-zone moraines in front of the grounding line (IC); suspended fine sediments released from the glacial margin were further transported basinward by meltwater plumes and accumulated as distal glacial-marine deposits together with hemipelagic sediments IIA). On the steep mid-to-lower slope, glacial deposits were reworked and transported downslope by mass flows including slide, slump and debris flow. The mass-flow deposits are characterized by acoustically transparent internal reflection (IIC) and regular, overlapping hyperbolae with slightly varying vertex elevations (IIIB). In some places of the lower continental slope, irregular volcanic edifices and faulted basement are exposed recording echo facies IIIA, which is characterized by irregular, overlapping hyperbolae with significantly varying vertex elevations.

1-77 Khim, Boo-Keun and **Ho Il Yoon**. 2003. "Postglacial marine environmental changes in Maxwell Bay, King George Island, West Antarctica". *Polar Research*, 22(2): 341-353.

Sediment textural properties and total organic carbon (TOC) contents of three

sediment cores from Maxwell Bay, King George Island, West Antarctica, record changes in Holocene glaciomarine sedimentary environments. The lower sedimentary unit is mostly composed of TOC-poor diamictons, indicating advanced coastal glacier margins and rapid iceberg discharge in proximal glaciomarine settings with limited productivity and meltwater supply. Fine-grained, TOC-rich sediments in the upper lithologic unit suggest more open water and warm conditions, leading to enhanced biological productivity due to increased nutrient-rich meltwater supply into the bay. The relationship between TOC and total sulfur (TS) indicates that the additional sulfur within the sediment has not originated from in situ pyrite formation under the reducing condition, but rather may be attributed to the detrital supply of sand-sized pyrite from the hydrothermal-origin, quartz-pyrite rocks widely distributed in King George Island. The evolution of bottom-water hydrography after deglaciation was recorded in the benthic foraminiferal stable-isotopic composition, corroborated by the TOC and lithologic changes. The $\delta^{18}O$ values indicate that bottom-water in Maxwell Bay was probably mixed gradually with intruding ^{18}O-rich seawater from Bransfield Strait. In addition, the $\delta^{13}C$ values reflect a spatial variability in the carbon isotope distribution in Maxwell Bay, depending on marine productivity as well as terrestrial carbon fluxes by meltwater discharge. The distinct lithologic transition, dated to approximately 8000 yr BP (uncorrected) and characterized by textural and geochemical contrasts, highlights the postglacial environmental change by a major coastal glacier retreat in Maxwell Bay.

PART 2

Earth-System Sciences

2-1 Bahk, J. J., S. K. Chough, **K. S. Jeong**, and **S. J. Han**. 2001. “Sedimentary records of paleoenvironmental changes during the last deglaciation in the Ulleung Interplain Gap, East Sea (Sea of Japan)”. *Global and Planetary Change*, 28: 241-253.

The Ulleung Basin in the East Sea (Sea of Japan) is a semi-enclosed basin surrounded by shallow sills and straits. Detailed observation of X-radiographs and thin sections of core sediments from the Ulleung Interplain Gap reveals five mud facies: laminated mud, crudely laminated mud, homogeneous mud, bioturbated mud and laminated Mn-carbonate mud. The laminated and homogenous muds were most likely deposited from turbidity currents, whereas the bioturbated and crudely laminated muds were formed by pelagic/hemipelagic sedimentation under oxic and anoxic bottom-water conditions, respectively. The laminated Mn-carbonate mud occurs at the lithologic boundary between the turbidite and hemipelagic laminated mud (last glacial) and the pelagic bioturbated mud (Lateglacial to Holocene). Mn-carbonates were formed at the sediment–water interface, probably reflecting an abrupt change in bottom-water oxygenation caused by sea-level rise during the last deglaciation. Profiles of redox-sensitive elements also support an anoxic to oxic change of bottom-water conditions during this period.

2-2 Byun, Hyunsook, Hyesu Yun, Songsuk Yi, and **Soon-Keun Chang**. 1996. “REWORKED DINOCYSTS FROM THE BRANSFIELD STRAIT, ANTARCTICA”. *Journal of The Paleontological Society of Korea*, 12(1): 22-56.

Upper Cretaceous and Lower Tertiary reworked dinocysts are abundantly encountered in the Recent sediments of the Bransfield Strait (cores S4 and S7) and the Admiralty Bay, west of King George Island (core AB2). These allochthonous assemblages are compared with those of the cores SI5 and SI6 which were previously reported, and their sedimentological implications and provenances are discussed.

2-3 **Chang, Soon-Keun**. 2000. "Paleoenvironments from the Late Cretaceous to the Early Miocene of King George Island, South Shetland Islands off the Antarctic Peninsula". *Journal of the Paleontological Society of Korea*, 16(1): 13-26.

2-4 **Chang, Soon-Keun**. 1997. "Characteristics of Land Surface in the Vicinity of King Sejong Station, Korean Antarctic Research Station". *Journal of the Korean Earth Science Society*, 18(5): 443-449.

Korea Antarctic Research Station, King Sejong (62°17'S, 58°47'W) is located in the northwestern tip of the Barton Peninsula, King George Island, South Shetland Islands, West Antarctica. King George Island with the dimension of 72 km long, 27 km wide, and 1,338 km^2, smaller than Cheju Island, and it is the biggest island among South Shetland Islands. 95% of the island is covered with ice, and the island is in the middle of the South Shetland Islands located 120 km off the Antarctic Peninsula. The general geomorphology of the Barton Peninsula shows that the area is so glacially eroded that the area is somewhat plane with several hills such as Noel Hill with 266.3 meters high, the highest peak in the Barton Peninsula. The King Sejong Hill which is seen from King Sejong Station and is a typical cirque with the altitude of 252.2 meters is the end of an extended ridge of Noel Hill and it seems to be exposed by melting of ice during Holocene. Physical weathering is dominant on land surface around the station. Because the surface has been incessantly eroded the poles and ramps of buildings were slanted, and buried materials were exposed. Both of patterned ground and patterned beach are also formed on the relatively high plane surface and western beach to the station, respectively. Paleobeaches and old marine terraces are also shown. The beach in front of the station is being eroded away due to the attacking waves of Marian Cove fringing Maxwell Bay. Moraine deposit is also developed at the foot of the ice margin in the northern coast of Potter Cove.

2-5 **Chang, Soon-Keun**. 1986. "Korean Antarctic Research Expedition 1985/86". *Journal of the Korean Earth Science Society*, 7(1): 56-58.

2-6 **Chang, Soon-Keun**. 1986. "Terra Australis Incognita; Antarctica: Its Natural Environment, Petroleum, and Mineral Resources". *Journal of the Korean Earth Science Society*, 7(2): 117-128.

Seventy-five years have passed since the Norwegian polar explorer Ronald Amundsen put the first human footprint on the South Pole in his South Pole Expedition in 1911. Natural environment, petroleum, and mineral resources of Antarctica are briefly reviewed. No petroleum or mineral deposits with economic value are discovered yet in Antarctica. However, it is thought that petroleum (and probably including minerals of Dufek stratiform gabbros) would be most promising in several decades. International stewardship of Antarctica associated with systematic investigations strengthened by modern techniques and facilities will show further possibility in other minerals.

2-7 **Chang, Soon-Keun**. 1987. "Natural Environment and Human Activities in King George Island, West Antarctica". *Journal of Korean Earth Science Society*, 8(1): 53-71.

Natural environment and human activities in King George Island, South Shetland Islands in West Antarctica have been briefly reviewed. It is sure that human being can live a normal life in the Island, although the insufficiency in space and water resources might be a hampering factor to further human activities in the Island. It seems necessary to protect natural environment against the recent frequent visit of human beings to the Island.

2-8 **Chang, Soon-Keun**. 1986. "Korean Antarctic Research Expedition 1985/86". *Journal of the Geological Society of Korea*, 22(2): 161-163.

2-9 **Chang, Soon-Keun**. 1985. "KOREAN ANTARCTIC SEARCH EXPEDITION 1985/1986". *Journal of the Paleontological Society of Korea*, 1(2): 189-192.

2-10 **Chang, Soon-Keun**. 1991. "Human Elements for Successful Overwintering". *Korean Journal of Polar Research*, 2(2): 117-124.

This paper discusses the human elements for the successful overwintering in accordance with the Korea Antarctic Research Program. Overwintering could be regarded as either wonderful of dull according to the personal mentality of participating members. However, it is evident that individual attitude toward wintering life apparently monotonous is the key to a successful overwintering. The following characters are required for a desirable overwintering:
- Curiosity as well as attention paid to everything occurred around in the station are very effective in decreasing dullness and monotony of wintering life. They also create pleasures and give refreshments to the individual as well as the wintering community;
- Positive way of thinking and resultant actions are helpful for the solution of unexpected hardships occurred in the community;
- Mental and physical endurances are also necessary in terms of nearly invariable shortage and unpreparedness in remote and harsh environments.
On the other hand, persons who do not like a collective life are not desirable for overwintering. The same statement is applied to the persons whose character are remarkably aggressive, impulsive, defiant, self-centered, or of no observance of regulations. Persons who lack a sense of responsibility are also not desirable.

2-11 **Chang, Soon-Keun**. 1999. "The Species of Penguins and Penguins Occurring in the Vicinity of King Sejong Station". *Ocean Research*, 21(2): 137-147.

Penguins are one of the key constituent organisms in the Antarctic ecosystem. A total of 18 species of penguins occur only in the southern hemisphere from the Galapagos Archipelago to southern area off Australia and New Zealand, South Africa, South America, and the islands scattered in the Southern Ocean to the coast along the Antarctic Continent. In the Antarctic Treaty area, there are only 5 species of penguins such as Emperor (*Aptenodytes forsteri*), Gentoo (*Pygoscelis papua ellsworthi*), Adelie (*P. adeliae*), Chinstrap (*P. antarctica*), and Macaroni (*Eudyptes chrysolophus*) penguins. Two additional species, the King (*Aptenodytes patagonicus patagonicus*) and Rockhopper (*Eudyptes chrysocome*) penguins, however, are distributed within the Antarctic Convergence. In the vicinity of King Sejong Station located in King George Island, the South Shetland Islands off the Antarctic

Peninsula, 5 species are observed, among which 2 *Pygoscelis* species such as the Gentoo and Chinstrap penguins hatch their eggs and raise their chicks at the rookery 2 km south of King Sejong Station in summer. Adelie penguins hatch their chicks in other place in King George Island. One Emperor penguin roamed on the frozen Maxwell Bay which has been frozen every two or three years with the approximate thickness of 60 cm. And one Macaroni penguin also visited the rookery in summer. We should carry out researches on the penguins occurring in the vicinity of King Sejong Station to monitor the environmental changes around King Sejong Station and the South Shetland Islands.

2-12 **Chang, Soon-Keun** and **Ho-Il Yoon**. 2000. "Holocene Glaciomarine Sedimentation in Marian Cove, King George Island, West Antarctica". *Journal of the Korean Earth Science Society*, 21(3): 276-286.

A 2.3 m-long core obtained from Marian Cove, King George Island in the South Shetland Islands, West Antarctica shows clues to the glaciomarine sedimentation during the Holocene. The lower part below 115 cm-deep of the core is predominated by coarser material such as diarnictons compared with the higher part above 105 cm dominated by finer material (rhythmite and massive muds). Based on the granulometric features the coarse materials are generally supposed to be glacially-driven and basal tills, whereas the finer materials appear to originate from various sources such as meltwater-supplied, glacially-supplied, wind-blown, and organic origins. However, the presence of erratic coarse particles in the finer materials suggests the ice-rafted origin of the relevant materials. The lower part below 105cm-deep of the core was characterized by lower TN, TC, and TOC contents, and by higher TS and $CaCO_3$ contents compared with its upper part. No significant changes in C/N ratio were shown throughout the core. The ice cliff along the east side of Marian Cove seemed to locate to the west by 1.6 km at 8,300 years B. P. on the basis of the repetitive occurrence of rhythmite and diamicton. Since the retreat of ice cliff in 7,970±70 years B. P. the sediments of Marian Cove were dominated by fine materials and ice-rafted materials. The abrupt increase of coarse materials in 175 cm deep seems to result from supply of coarse materials due to earthquake or Other drastic phenomena.

2-13 **Chang, Soon-Keun**, and 2 others. 1988. "Eastern Beach Sediments of Fildes Peninsula, King George Island, South Shetland Islands, West Antarctica". *Journal of the Korean Earth Science Society*, 9(2): 113-122.

This paper discusses heavy mineral assemblages, organisms and micropaleontology from the eastern beach sediments of Fildes Peninsula, King George Island, South Shetland Island. The aims of this paper are to present preliminary results and to give clues to future research of the study and/or related areas.
Heavy mineral assemblages are composed mainly of altered mineral and opaque minerals, clinopyroxenes, amphiboles and epidote. Most of the heavy minerals are derived from volcanic rocks present in Fildes Peninsula. However, relatively high content of mica suggests it might be originated not to be from volcanic rocks of Fildes Peninsula, but to be from. acidic rocks present in other areas around Maxwell Bay Cluster analysis of the data(Q-mode) using UPG method shows three facies: represented by Ardley Cove Hydrographers Cove, and the southern tip of Fildes Peninsula. Hydrographers Cove is separated from Ardley Cove by Ardley Island, and is somewhat protected from the strong wave action of Maxwell Bay. On the other hand, Ardley Cove and the southern tip of Fildes Peninsula are open to the strong wave

action of Maxwell Bay.
The benthic organisms of the study area is mainly consist of interstitial animals such as very small-sized polychaetes, gastropods, turbellarians and nemertines. Polychaetes are the dominant faunal group as seen in other areas of South Shetland Islands Occurrence of Foraminifera and Ostracoda seems to reflect faunal ecology and sedimentary environment of the study area. It is recommended that a rather large sample size(> 1 liter) be made for a quantitative study of micropaleontology and benthic ecology of the areas similar to the study area.

2-14 **Chang, Soon-Keun**, **Bang Yong Lee**, **Ho Il Yoon**, and **Young-In Won**. 1998. "Changes related to Earth Sciences Parameter Observed in the Vicinity of the King Sejong Station off the Antarctic Peninsula". *Journal of the Korean Earth Science Society*, 19(5): 533-548.

The changes related to earth sciences observed at the King Sejong Station, the Korean Antarctic Research Station located in King George Island, South Shetland Islands approximately 120 km off the northern tip of the Antarctic Peninsula were summarized and discussed. During the summer seasons, air temperature at the station is above freezing point with rainy and foggy days, and northwest wind is predominant, while during the winter the temperature falls down to –25.6℃ with southeast wind accompanied by severe blizzards. Sea surface temperature in front of the station is above freezing point during summer, while is below the point during winter. The sea in the vicinity of the station has been covered by sea ice every 2 or 3 years. The ice cliff along the trunk glacier of Marian Cove retreated much more fast during the recent 5 years than during the past 30 years. This recent ice-retreat from Marian Cove may be related to the ice retreat that span last few thousand years, based on core sediments from Marian Cove which shows distinctive lithological sequences formed by ice retreat in the area during the last 6,000 years. The upper atmospheric temperature observed by a Fabry-Perot interferometer showed a marked variation (as much as 600 K) depending on the solar and geomagnetic activities. No auroras were observed.

2-15 **Chang, Soon-Keun**, **Bang Yong Lee**, **Hosung Chung**, and **Sung-Ho Kang**. 2003. "Global Environmental Changes and the Antarctic". *Journal of the Korean Earth Science Society*, 24(3): 216-233.

This study delineates the phenomena related with global environmental changes such as global warming, ozone depletion, and El Niño/Southern Oscillation (ENSO) noted in the Antarctic. Retreat of ice cliffs, glaciers, and calving of ice shelves indicate the effects of recently aggravated global warming. The ice cliff located at Marian Cove, King George Island, South Shetland Islands off the Antarctic Peninsula has been observed to be retreating faster in the last 7 years than in the previous 38 years since 1956. There are some indications of temperature and precipitation changes associated with ENSO around King Sejong Station. The regression analyses indicate significant trends such as a decrease in the total amount of ozone and an increase in ultraviolet radiation which was seen by a satellite (TOMS-EUV) in September and October which correspond to ozone-hole season over King Sejong Station. Increase of UV radiation due to the ozone depletion in the Antarctic has changed the growth rate of marine organisms. It may also result in changes to the productivity, biomass, and species composition of marine organisms which can affect the whole marine ecosystem. The recent ice-core drilling over Lake Vostok has been reviewed with emphasis on the four cycles of glacial stages over the past 420,000 years. It is time to show more interest in mainland Antarctica through investigations of

the coring and vast ice sheet, terrestrial geology, and upper atmospheric sciences in order to understand the pas environmental changes and to predict possible changes to the environment in the future.

2-16 **Chang, Soon-Keun**, **Dong-Yup Kim**, **Bang Yong Lee**, and **Hosung Chung**. 1990. "Environment around King Sejong Station, King George Island, Antarctica in 1988/89". *Korean Journal of Polar Research*, 1(1): 59-65.

Environmental changes around King Sejong station (62°13'S , 58°45'W), Korea Antarctic research station were observed from February 1988 to February 1989. A mean temperature of 1.9℃ below zero was observed; a minimum of –19.9℃ and a maximum of 10.4℃ were measured in late August and mid-December, respectively. A mean wind speed of 7.3 m/s was measured, in late December the greatest gust of 43.3 m/s was observed. Raised beach and moraine deposits were developed in the vicinity of the station. A rookery of two species of Penguin (Gentoo and Chinstrap penguin) was observed and several species of sea - birds breed at 2 km south from the station. Growth of *Deschampsia antarctica* was found at the northern flat area of Potter Cove. Several families of elephant seal were found at the northern beach of Potter Cove. Year-round field activities are possible except during June due to short day-time and frequent blizzards. A good preparation against unexpected wind, fog, and sleet is needed because of the abrupt change of weather, particulary, in the summer season. Maxwell Bay and Marian Cove were frozen from early July to late September, when the sea-ice was broken and carried away by strong wind. It is necessary to carry out year-round surveys around the station.

2-17 **Chang, Soon-Keun**, **Ho Il Yoon**, and **Hosung Chung**. 1998. "Global Warming and Recent Retreat of an Ice Cliff on King George Island, South Shetland Islands, West Antarctica". *Journal of the Korean Earth Science Society*, 19(1): 101-106.

Global warming was briefly discussed in terms of history, observed phenomena, and incurring hazards. Marian Cove is a fjord situated in Maxwell Bay on the southwestern coast of King George Island, South Shetland Is-lands, West Antarctica. The comparison of aerial photographs clearly shows that the ice cliff of Marian Cove retreated approximately 250 m between December 1956 and December 1986, but advanced around 40 m between December 1986 and January 1989. A topographic survey carried in January 1994 again revealed that the ice cliff of Marian Cove had retreated around 270 m since January 1989. The extent of retreat during the recent 5 years (1989~1994) is ap-proximately the same as during the former 30 years (December 1956 to December 1986). This ice cliff retreat is indicative of a possible evidence for the procession of recent regional atmospheric warming.

2-18 **Chang, Soon-Keun**, **Jong Ik Lee**, **Moon Young Choe**, and **Soon Do Hur**. 2003. "Geology around the King Sejong Station, King George Island off the Antarctic Peninsula". *Journal of the Geological Society of Korea*, 39(2): 271-286.

The topography, geology, and hydrothermal alteration around the King Sejong Station, the Korean Antarctic Research Station located in the Barton Peninsula, King George Island, the South Shetland Islands off the Antarctic Peninsula were reviewed. The topography around the station is of glaciomarine origin, evidenced by fjords, cirque, flatforms, and hanging valleys. The area is also covered with bedrocks, rock fragments, moraines, raised

beaches, pattered ground, and patterned beach exposed from raising due to melting of ice. The Sejong Formation, forming the lowermost part of the Barton Peninsula, has a thickness of about 100 m and slightly dips south to southwest. The formation mainly comprises lapillistone and lapilli tuff with minor amounts of gray to purple mudstone. Based on lithology, sedimentary structure and composition, the formation can be divided into five sedimentary facies : structureless matrix-supported conglomerate, structureless clast-supported conglomerate, well-stratified clast-supported conglomerate, thin-bedded sandstone and lapilli tuff. Dark gray to greenish, mafic to intermediate, subalkaline volcanic rocks overlying the Sejong Formation have been formed in volcanic arc environment. The plutonic rocks have wide compositional variations, and generally occur as isolated bodies. The common occurrences of miarolitic cavities and micrographic intergrowths indicate that the plutonic rocks have been emplaced in the very shallow level of the crust. The magmatism in King George Island is similar to that of island arc rather than continental arc. According to the classification of evolutional stages of island arc volcanism,the volcanism in King George Island is identical to the intermediate stage between primitive and matured stages. Pervasive hydrothermal alteration in the Barton Peninsula is epithermal alteration related to the intrusion of granodiorite, based on K-Ar ages and geochemical characteristics.

2-19 **Choe, Moon Young**, Young Kawn Sohn, **Hyung Rae Jo**, and **Yeadong Kim**. 2002. "The Lago Sofia Conglomerate : Debris Flow to Hyperconcentrated Flow Deposits in a Cretaceous Submarine Channel, Southern Chile". *Ocean and Polar Research*, 24(3): 289-300.

The Lago Sofia conglomerates encased in the Cretaceous Cerro Toro Formation, southern Chile, represent a gigantic submarine channel system developed along a foredeep trough. The channel system consists of several tributaries along the trough margin and a trunk channel along the trough axis. Voluminous debris flows were generated ubiquitously along the tract of the submarine channel mainly by the failure of nearby channel banks or slopes. The flows transformed immediately into multiphase flows and resulted in very thick-bedded mass-flow deposits with a peculiar structure sequence. The mass-flow deposits commonly overlie fluted or grooved surfaces and consist of a lower division of clast-supported and imbricated pebble-cobble conglomerate with common basal inverse grading, and an upper division of clastto matrix-supported and disorganized pebble conglomerate or pebbly mudstone with abundant intraformational clasts. The structure sequence suggests a temporal succession of a turbidity current, a bipartite hyperconcentrated flow with active clast collisions near the flow base, and a cohesive debris flow probably with a rigid plug. The multiphase flow is interpreted to have resulted from transformation of clast-rich but cohesive debris flows. Cohesive debris flows appear to transform more easily into dilute flow types in subaqueous environments because they are apt to hydroplane. This is in contrast to the flow transitions in sub-aerial environments where noncohesive debris flows are dominant and difficult to hydroplane.

2-20 Choi, Seong Hee, **Jong Ik Lee**, and 2 others. 2002. "Geochemistry of peridotite xenoliths in alkali basalts from Jeju Island, Korea". *The Island Arc*, 11: 221-235.

Ultramafic xenoliths in alkali basalts from Jeju Island, Korea, are mostly spinel lherzolites with subordinate amounts of spinel harzburgites and pyroxenites. The

compositions of major oxides and compatible to moderately incompatible elements of the Jeju peridotite xenoliths suggest that they are residues after various extents of melting. The estimated degrees of partial melting from compositionally homogeneous and unfractionated mantle to form the residual xenoliths reach 30%. However, their complex patterns of chondrite-normalized rare earth element, from light rare earth element (LREE)-depleted through spoon-shaped to LREE-enriched, reflect an additional process. Metasomatism by a small amount of melt/fluid enriched in LREE followed the former melt removal, which resulted in the enrichment of the incompatible trace elements. Sr and Nd isotopic ratios of the Jeju xenoliths display a wide scatter from depleted mid-oceanic ridge basalt (MORB)-like to near bulk-earth estimates along the MORB–oceanic island basalt (OIB) mantle array. The varieties in modal proportions of minerals, (La/Yb) N ratio and Sr-Nd isotopes for the xenoliths demonstrate that the lithospheric mantle beneath Jeju Island is heterogeneous. The heterogeneity is a probable result of its long-term growth and enrichment history.

2-21 Chun, Seung Soo, **Moon Young Choe**, and Sung Kwun Chough. 2002. "Armored mudstone boulders in submarine debris-flow deposits, the Hunghae Formation, Pohang Basin: An evidence for the large-scale slumping of adjacent area of a submarine channel or scar wall". *Geosciences Journal*, 6(3): 215-225.

In the Hunghae Formation of the Pohang Basin, some heavily armored, calcareous mudstone balls (boulders) occur in a chaotic conglomerate bed which was deposited from debris flow on a steep slope. Sparsely armored or unarmored mudstone balls are also found in the same bed. Also some isolated armored mudstone boulders occur in a homogeneous mudstone bed of the formation which is interpreted as hemipelagite. The armored mudstone balls were most likely formed by retrogressive failures of submarine channel or scar wall and subsequent rolling over sand and pebble pavement along the submarine channel floor prior to incorporation into the debris flow. Their occurrence also suggests that a large-scale slumping should be happened on the upper slope apron or lower prodelta including the submarine channel and be evolved into debris flows, resulting in the corporation of the boulders into them. Some armored mud boulders rolled along and passed away the channelized gravel pavement, and deposited on hemipelagic mud in lower slope, not having been reworked.

2-22 Clift, Peter D., **Jae Il Lee**, and 7 others. 2002. "Nd and Pb isotope variability in the Indus River System: implications for sediment provenance and crustal heterogeneity in the Western Himalaya". *Earth and Planetary Science Letters*, 200: 91-106.

The Indus River system is the only major drainage system in the western Himalaya, and erodes not only the High Himalaya, but also topographically high regions within and north of the Indus Suture Zone, most notably the Karakoram. Ion microprobe analysis of Pb isotopes in detrital K-feldspar grains taken from the tributaries of the Indus, together with bulk Nd isotope analysis of those same sediments, is here used to identify distinct sediment source regions. These span the very radiogenic Nanga Parbat and associated Lesser Himalaya, the relatively radiogenic-intermediate High Himalaya, the unradiogenic Ladakh and Kohistan Batholiths and intermediate values in the Hindu Kush, Karakoram and Lhasa Block. The range of compositions reflects differing degrees of recycling of older continental crust during petrogenesis. K-feldspars from the Ladakh and Kohistan Batholiths are less radiogenic than the laterally equivalent Gangdese granite

of Tibet, interpreted to reflect the preferential recycling of accreted oceanic arc units within the western Transhimalaya prior to India-Asia collision. Similarly the Zanskar High Himalaya are less radiogenic than their equivalents in Nepal. Isotope values from Pleistocene Indus Fan sediment are compatible with a dominant source in the Karakoram, with additional important contributions from the arc batholiths and High Himalaya, reflecting both the area and modern rates of tectonic uplift within the drainage basin. In contrast, radiogenic grains are common in the lower reaches of the modern Indus River, possibly as a result of the damming of the main river channel where it reaches the foreland.

2-23 Fang, AiMin, JiLing Li, XiaoHan Liu, **Jong Ik Lee**, and 4 others. 2003. "Tectonic settings of the basic igneous rocks in the Kudi ophiolite zone of West Kunlun Mountains, Xingjiang Province". *Acta Petrologica Sinica*, 19(3): 409-417.

The basic igneous rocks, outcropped in Yexikegou, northwest of Kudi, is one of the most important components of the tectonically separated Kudi ophiolite in west Kunlun which is considered the northernmost border of the Gandwana plate as well as the oldest suture zone found in Tibet Plateau. So far, a lot of different opinions about its tectonic settings have been presented by different researchers, which gives rise to much confusion on the understanding upon its origin and evolutionary history. To clarify such confusion, a detailed field survey upon the geological section of the igneous rocks in Yexiekegou was conducted. In this paper, we use geochemical data from XRF, ICP-MS and Sm/Nd isotope analysis as well as the published data in this area to make a synthetical determination upon its tectonic settings. Through different tectonic discriminant diagrams based upon major and trace element compositions of Yexiekegou basic igneous rocks together with their isotopic characteristics, accordant results can be obtained that they were formed in an oceanic island-arc tectonic environment. Therefore, it provides some new evidences for the constraint on the origin of Kudi ophiolite.

2-24 Fang, Aimin, Xiaohan Liu, **Jong Ik Lee**, and 2 others. 2003. "THE SIGNIFICANCES OF THE CENOZOIC SEDIMENTARY ROCKS FOUND IN THE GROVE MOUNTAINS, EAST ANTARCTICA". *Chinese Journal of Polar Research*, 15(2): 138-150.

Antarctic Ice Sheet has been one of the most important components of the global environmental regime ever since its formation in the Antarctic continent from the early Cenozoic. Its dynamic evolution not only controls all the geological processes including weathering, transportation, and sedimentation happened in Antarctic region, but also reflects and partly controls the global change. Therefore, it is of great significance to study its evolutionary history. So far, a lot of efforts have been made in the studying on the reconstruction of Antarctic Ice Sheet evolutionary history. In this paper, the authors reviewed the former research works in different regions over Antarctic continent and its surrounding sub Antarctic off shore continental shelf, slope and rise, and some deep sea basins. By summarizing the achievements so far have been made in the studies upon the Cenozoic sedimentary strata both in the Antarctic continents and the surrounding oceans, we can conclude that a combination of circum-Antarctic, pan Antarctic and basin specific zonations will be necessary to date and correlate sediments and events within and between polar basins and to assess the impact of Antarctic Cenozoic climate fluctuations on the geological records at hemispheric and global scales in the future.

Special significance of the Cenozoic sediments and sedimentary rocks recently found in Grove Mountains of east Antarctica by Chinese Antarctic Exploration Team has been discussed briefly in the end of this paper.

2-25 Han, Uk and Hyun-Chul Jung. 1994. "Temperature Response in the Permafrost at the Sejong Station, Antarctica". *Journal of the Korean Earth Science Society*, 15(3): 170-176.

Borehole temperature measurements at Sejong station were made by the geothermal datalogger which was designed by the investigator. During December 31, 1991-February 1, 1992 six temperature data (at the depth of 28 cm, 8 cm, –12 cm, –32 cm, –52 cm, and –70 cm) were obtained by resistive sensors of CR1O and SM716 every one minute. Fast Fourier Transformation was made on seven temperature data including surface air temperature of meteorological center at Sejong Base every thirty minutes. Profiles of surface and subsurface temperature variations represent freezing, thawing, and heat transfer mechanism at the boundary between active layer and permafrost table. The thermal diffusivities are determined by the Angstrom method using underground temperatures. The thermal conductivities of the drilled cores and outcrops are measured by the transient method. The thermal diffusivity and conductivity measurements of rock and soil samples give a significant signal on the inferred climatic temperature of the past millenium at Sejong Base by the inversion technique with well-documented meteorological data. The geothermal data in ice-bearing permafrost at Sejong scientific station are interpreted in terms of the temperature history on a time scale of 2,000 years. Two theories are developed: a "forward" theory to calculate the response of ice-bearing permafrost to the surface temperature disturbance, and an "inverse" theory to calculate parameters characterizing the surface temperature history from suitable measurements in the permafrost.

2-26 **Hong, Sungmin**, **Yeadong Kim**, and 6 others. 2003. "Climate-related variations in lead concentrations and sources in Vostok Antarctic ice from 65,000 to 240,000 years BP". *Geophysical Research Letters*, 30(22): 2138.

Pb has been measured in various sections of the 3,623-m Vostok deep Antarctic ice core dated from 65,000 to 240,000 years BP, i.e. back to the beginning of the penultimate ice age and the preceding interglacial (isotopic stage 7.5). Pb concentrations were highly variable during this time interval, with low values down to ~0.5 pg/g during warm climatic stages and much higher values up to ~20 pg/g during cold climatic stages, especially isotopic stages 4.2 and 6.2 to 6.6. Rock and soil dust accounts for virtually 100% of Pb measured in the ice during cold climatic stages, while the contribution from volcanoes might be significant during warm stages.

2-27 Huh, Sik, **Yeadong Kim**, Dae-Kyo Cheong, **Young Keun Jin**, and **Sang Heon Nam**. 1997. "Tectonic Structures and Hydrocarbon Potential in the Central Bransfield Basin, Antarctica". *Korean Journal of Petroleum Geology,* 5(1, 2): 9-15.

The study area is located in the Central Bransfield Basin, Antarctica. To analyze the morphology of seafloor, structure of basement, and seismic stratigraphy of the sedimentary layers, we have acquired, processed, and interpreted the multi-channel seismic data. The northwest-southeastern back-arc extension dramatically changes sea-floor morphology, volcanic and fault distribution, and basin structure along the

spreading ridges. The northern continental shelf shows a narrow, steep topography. In contrast, the continental shelf or slope in the south, which is connected to the Antarctic Peninsula, has a gentle gradient. Volcanic activities resulted in the formation of large volcanos and basement highs near the spreading center, and small-scale volcanic diapirs on the shelf. A very long, continuous normal fault characterizes the northern shelf, whereas several basinward synthetic faults probably detach into the master fault in the south. Four transfer faults, the northwest-southeastern deep-parallel structures, controlled the complex distributions of the volcanos, normal faults, depocenters, and possibly hydrocarbon provinces in the study area. They have also deformed the basement structure and depositional pattern. Even though the Bransfield Basin was believed to be formed in the Late Cenozoic (about 4 Ma), the hydrocarbon potential may be very high due to thick sediment accumulation, high organic contents, high organic contents, high heat flow resulted from the active tectonics, and adequate traps.

2-28 **Hur, Soon Do**, **Jong Ik Lee**, Jeong Hwang, and **Moon Young Choe**. 2001. "K-Ar age and geochemistry of hydrothermal alteration in the Barton Peninsula, King George Island, Antarctica". *Ocean Polar Research,* 23(1): 11-21.

K-Ar ages of the altered rocks from the Barton Peninsula are belows; altered tuffaceous andesite from southwestern part is 42 Ma, altered rocks contacted with quartz vein from southern part are 28 and 33 Ma, and advanced argillic altered andesite from northeastern 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 hydrothermal alteration, on the contrary the Mg content is in proportion to total alkali. The variation of total alkali and Mg contents in hydrothermal alteration indicates that those elements was washed out during hydrothermal alteration. The sequences of hydrothermal alteration of the Barton Peninsula is chloritization of amphiboles, sericitization of feldspars and kaolitization of sericite.

2-29 **Hur, Soon Do**, **Jong Ik Lee**, **Mi Jung Lee**, and **Yeadong Kim**. 2003. "Determination of Rare Earth Elements Abundance in Alkaline Rocks by Inductively Coupled Plasma Mass Spectrometry (ICP-MS)". *Ocean and Polar Research,* 25(1): 53-62.

Inductively coupled plasma mass spectrometry (ICP-MS) is useful instrument for determining abundance of rare earth elements, due to very low detection limits and rapid data acquisition. In this article, two methods are used for decomposition of alkaline rocks; close vessel acid digestion and Na_2Co_3 fusion. The two analytical results show good agreements. Considering total dissolved solids and detection limits, the most adequate dilution factor is 5,000 times. Polyatomic ion interferences during analysis can give rise to Inaccuracies. After correction from oxide and hydroxide interference, the analytical result show 20-30% decrease for Gd and Tm, 10-20% decrease for Tb and Er. In comparing the analytical results from KORDI with other institutes, most rare earth elements abundance show good agreements except Lu.

2-30 Hwang, Jeong and **Jong Ik Lee**. 1998. "Hydrothermal Alteration and Mineralization in the Granodioritic Stock of the Barton

Peninsula, King George Island, Antarctica". *Economic and Environmental Geology,* 31(3): 171-183.

Early Tertiary volcanics, volcanoclastics and granodiorite occur in the Barton Peninsula, King George Is-land, Antarctica. In the granodioritic stock and volcanic rocks, propylitic alteration characterized by actinolite, epidote, chlorite and calcite is widespread, and disseminations and veinlets of sulfide minerals such as pyrite, chalcopyrite and bornite are ubiquitious. The study on the hydrothermal alteration near granodioritic stock can be summarized as follows; (1) granodiorite intrusion is a small, high level stock associated with calc-alkaline volcanism, and have high copper con-tent, (2) high temperature type of propylitic alteration and common occurrence of copper sulfides in and around granodiorite intrusion, (3) low $\delta^{34}S$ values of pyrites by oxidational conditions of sulfide deposition, (4) low $\delta^{18}O$ values of quartz and feldspar in the granodiorite, and isotopic non-equilibrium by hydrothermal alteration. It suggest that hyrothermal alteration and mineralization near granodiorite stock should be genetically related to granodiorite intrusion in the Barton Peninsula.

2-31 Hwang, Jeong and **Soon Do Hur**. 2003. "The As-removal Effects of Pyrite Including Arsenopyrite after Process for Use in Medicine". *Economic and Environmental Geology,* 36(6): 537-543.

As pyrite is commonly associated with arsenopyrite, the use of pyrite including arsenopyrite for medicine requires close attention on arsenic toxicity. The toxicity was reduced by traditional processing operations include heating and quenching in vinegar. To verify the scientific effects of this process, pyrite containing many crystals of arsenopyrite was processed at temperatures from 450℃ to 850℃ and through as many as 5 processing cycles. Arsenopyrite completely disappeared when processed only once at 650℃ while it remained even after 5 processing cycles at 450℃. Arsenic was most abundant in medicinal mineral samples processed at 450℃ and sharply decreased when processed at 650℃ or 850℃. And arsenic extraction test in water was carried out from the processed pyrite medicine on the assumption that pyrite medicines with the lowest As metal content would be most desirable. Arsenic were most abundant in water extracted from medicinal mineral samples processed at 450℃ and sharply decreased when processed at 650℃ or 850℃. But the extracted As concentrations in water exceeded drinking water standards even when processed at 850℃. Increasing temperature promoted elimination of arsenopyrite and reduction of As in medicinal minerals and the extraction solutions. But the effects of processing cycles at the same processing temperature were not clear. Heating temperature is more important than number of processing cycles for the removal of arsenic, and it is necessary to heat pyrite to over 650℃ to remove it.

2-32 Hyeoncheol Kim, Moonsup Cho, and **Jong-Ik Lee**. 2002. "Thermal metamorphism of volcanic rocks on Barton Peninsula, King George Island, Antarctica". *Geosciences Journal,* 6(4): 303-317.

Barton Peninsula is mainly composed of Tertiary metavolcanic rocks and granodiorite. The metavolcanic rocks underwent thermal metamorphism up to upper greenschist facies, producing calcic-amphibole (Amp), epidote, chlorite (Chl), calcite (Cc), plagioclase, prehnite and laumontite. Two metamorphic zones, Cc-Chl and Amp-Chl, are defined on the basis of mineral assemblages (+plagioclase, quartz, opaque minerals), characterized by epidote+chlorite±calcite and

actinolite±hornblende+epidote+chlorite± calcite, respectively. The distribution coefficient of Mg–Fe* (total Fe) between actinolite and chlorite, defined by K_D = $(Mg/Fe^*)_{Act}/(Mg/Fe^*)_{Chl}$, ranges from 0.56 to 1.03, suggesting low-pressure metamorphism. The coexistence of actinolite and oligoclase also supports low-pressure metamorphism. Chlorite geothermometry and T-X_{CO_2} analysis suggest that metamorphic temperatures reached ca. 300℃ at fluid pressures less than 1 kbar. Thermal metamorphism in Barton Peninsula probably was associated with magmatic-arc plutons emplaced during the Tertiary subduction of the southeast Pacific plate under Antarctic Peninsula.

2-33 Jeon, Hui Yeong, **Soon-Keun Chang**, and **Jong Ik Lee**. 1994. "Biostratigraphic Study on the Plant Fossils from the Barton Peninsula and Adjacent Areas". *Journal of the Paleontological Society of Korea,* 10(1): 69-84.

2-34 **Jin, Y. K.**, and 2 others. 2002. "Relationship of gas hydrate concentration to porosity and reflection amplitude in a research well, Mackenzie Delta, Canada". *Marine and Petroleum Geology,* 19: 407-415.

Well logs acquired at the Mallik 2L-38 gas hydrate research well, Mackenzie Delta, Canada, reveal a distinct trend showing that the resistivity of gas-hydrate-bearing sediments increases with increases in density porosities. This trend, opposite to the general trend of decrease in resistivity with porosity, implies that gas hydrates are more concentrated in the higher porosity. Using the Mallik 2L-38 well data, a proportional gas hydrate concentration (PGHC) model, which states that the gas hydrate concentration in the sediment's pore space is linearly proportional to porosity, is proposed for the general habitat of gas hydrate in sediments. Anomalous data (less than 6% of the total data) outside the dominant observed trend can be explained by local geological characteristics. The anomalous data analysis indicates that highly concentrated gas-hydrate-bearing layers would be expected where sediments have high proportions of gravel and coarse sand. Using the parameters in the PGHC model determined from resistivity-porosity logs, it is possible to qualitatively predict the degree of reflection amplitude variations in seismic profiles. Moderate-to-strong reflections are expected for the Mallik 2L-38 well.

2-35 **Jin, Y. K.**, M.W. Lee, **Y. Kim**, **S. H. Nam**, and **K. J. Kim**. 2003. "Gas hydrate volume estimations on the South Shetland continental margin, Antarctic Peninsula". *Antarctic Science,* 15(2): 271-282.

Multi-channel seismic data acquired on the South Shetland margin, northern Antarctic Peninsula, show that Bottom Simulating Reflectors (BSRs) are widespread in the area, implying large volumes of gas hydrates. In order to estimate the volume of gas hydrate in the area, interval velocities were determined using a 1-D velocity inversion method and porosities were deduced from their relationship with sub-bottom depth for terrigenous sediments. Because data such as well logs are not available, we made two baseline models for the velocities and porosities of non-gas hydrate-bearing sediments in the area, considering the velocity jump observed at the shallow sub-bottom depth due to joint contributions of gas hydrate and a shallow unconformity. The difference between the results of the two models is not significant. The parameters used to estimate the total volume of gas hydrate in the study area were 145 km of total length of BSRs identified on seismic profiles, 350 m thickness and 15 km width of gas hydrate-bearing sediments, and 6.3% of the

average volume gas hydrate concentration (based on the second baseline model). 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).

2-36 **Jin, Young Keun** and **Yeadong Kim.** 1996. "Tectonic Implication of the Crustal Structure in the South Shetland Trench, Antarctic Peninsula". *Journal of the Geological Society of Korea,* 32(2): 146-161.

Multichannel seismic data show that convergence along the northeastern South Shetland Trench (SST) was the low-stress type characterized by a horst and graben structure and a relatively thin accretionary wedge. As thick accumulation of sediments is not generally expected in active subduction zones with a horst and graben structure. the existence of thick trench sediments in the SST implies that they have been accumulated after subduction stopped. Subduction along the SST presumably stopped at the same time or shortly after spreading stopped in Drake Passage at about 4 Ma. The active extension in Bransfield Strait after the cessation of subduction suggests that this extension is not a subduction-related back-arc extension. but probably a result of recent transtension from left-Iateral strike-slip motion between the Antarctic and Scotia plates along the South Scotia Ridge. The Bransfield Strait extension behind the South Shetland Islands arc may be accommodated by diffuse shortening in the trench area. This shortening at the SST is indicated by the frontal thrust and deformation in the oceanic basement and overlying sediments. The inner trench slope can be divided into three slopes. The lower slope is a frontal accretionary wedge having a series of imbricate thrust faults. Bottom simulating reflector (BSR) due to gas hydrates appears within the midslope. In the upper slope forearc basin is a half-graben bounded seaward by large-scale fault.

2-37 **Jin, Young Keun**, Jong Kuk Hong, and **Duk Kee Lee.** 1999. "Characteristics of Water-bottom Reflection Coefficients in Bransfield Strait , Antarctic Peninsula". *Journal of the Korean Physical Society,* 2(4): 241-250.

Reflection coefficients of the seafloor have been calculated from the amplitude ratio of secondary to primary water bottom reflection in seismic data obtained from Bransfield Strait, Antarctic Peninsula. Test processing for the coefficients shows that moving average is effective to reduce severe fluctuation of the coefficient measured at each point. Relationship between the coefficients and the properties of water bottom is analyzed to illuminate geological environment. In the central Bransfield Basin, the magnitude of reflection coefficients decreases as it is distant from the sedimentary sources. Reflection coefficients range from 0.12 to 0.2 near the continental slope of the basin, and from 0.1 to 0.12 in the basin floor. In the western Bransfield basin, reflection coefficients between 0.2 to 0.3 are obtained from the area eroded by glacial movement. On the volcanic structures near Deception Island, the coefficients show relatively high values more than 0.2. Paleo-geological structures uplifted by tectonic movement and outcropped by glacial erosion have relatively high coefficients.

2-38 **Jin, Young Keun**, Robert D. Larter, **Yeadong Kim, Sang Heon Nam**, and **Kyu Jung Kim.** 2002. "Post-subduction margin structures along Boyd Strait, Antarctic Peninsula". *Tectonophysics,* 346: 187-200.

The Pacific margin of the Antarctic Peninsula to the southwest of the Hero Fracture Zone

(HFZ) is a former subducting margin which became inactive following the arrival of ridge crest segments of the Antarctic–Phoenix ridge at the margin during the Tertiary. In contrast, the part of the margin to the northeast of the HFZ remains active. Tertiary convergence was approximately perpendicular to the margin and ongoing motion is thought to have the same orientation. A new seismic reflection profile running along Boyd Strait, just northeast of the landward projection of the HFZ, shows major structural components similar to those typically observed along the margin to the southwest of the HFZ. In order of increasing proximity to the margin, these components are: the inner shelf, the shelf basin, the mid-shelf basement high (MSBH), and the outer shelf. The continuation of the post-subduction margin structures to the active margin suggests that the boundary between crust with passive and active margins characteristics is not sharply defined. Our postulated scenario for tectonic evolution along Boyd Strait is that: (1) before the arrival of the last ridge crest segment to the southwest of the HFZ, the inner shelf and the shelf basin were part of a Cretaceous–Tertiary arc and forearc area, (2) after the arrival, thermal effects resulting from interaction of the ridge crest with the margin just southwest of the HFZ lead to the formation of the MSBH to the northeast, but MSBH uplift in Boyd Strait did not prevent concurrent cross-shelf sediment transport contributing to development of an extensive outer shelf on the seaward flank of the MSBH, (3) Recent extension in Bransfield Strait, a marginal basin to the northeast of the landward projection of the HFZ, has caused about 10 km of seaward deflection in the strike of the part of the MSBH to the northeast of the projection of the HFZ.

2-39 **Jin, Young Keun**, **Sang Heon Nam**, **Yeadong Kim**, **Kyu Jung Kim**, and **Joo-Han Lee**. 2003. "Gas hydrate BSR-derived heat flow variations on the South Shetland continental margin, Antarctic Peninsula". *Ocean and Polar Research,* 25(2): 201-211.

Bottom simulating reflectors (BSR), representing the base of the gas hydrate stability field, are widespread on the South Shetland continental margin (SSM), Antarctic Peninsula. With the phase diagram fur the gas hydrate stability field, heat flow can be derived from the BSR depth beneath the seafloor determined on multichannel seismic profiles. The heat flow values in the study area range from 50 mW/m^2 to 85 mW/m^2, averaging to 65 mW/m^2. Small deviation from the average heat flow values suggests that heat flow regime of the study area is relatively stable. The landward decrease of heat flow from the South Shetland Trench to the continental shelf would be attributed to the landward thickening of the accretionary prism and the upward advection of heat associated with fluid expulsion. The continental slope 1500m to 3000m deep, where BSRs are most distinguished in the SSM, shows relatively large variation of heat flow possibly due to complex tectonic activities in the study area. The local high heat flow anomalies observed along the slope may be caused by heat transport mechanisms along a NW-SE trending large-scale fault.

2-40 **Jin, Young Keun**, **Yea Dong Kim**, **Sang Heon Nam**, and **Kyu Joong Kim**. 2000. "Morphotectectics of the Shackleton Fracture Zone around the Antarctic-Scotia plate boundary off the northern Antarctic Peninsula". *Journal of the Korean Geophysical Society,* 3(3): 141-152.

In the vicinity of the Antarctic-Scotia plate boundary off Elephant Island(EI), geophysical data (multichannel seismic and gravity data) reveal rapid structural variation of the Shackleton Fracture Zone(SFZ) along its strike. The SFZ ridge terminates in front of the

Antarctic Peninsula margin, whereas the transform fault of the SFZ continues farther southeast near E1 and the width of the SFZ broadens toward the southeast. Accordingly, the SFZ transform fault changes its morphology along its strike as (1) a graben structure along the high Shackleton ridge in Drake Passage, (2) a half-graben structure in oceanic crust just southeast of the Antarctic-Scotia plate boundary, and (3) splay faults deforming the margin of EI. Two phases of tectonic deformation are clearly observed along the transform fault. Major extensional deformation had formed a large-scale half-graben during roughly about 10~20 Ma when Drake Passage had opened. And then, the Shackleton fault has been reactivated with reverse sense, which has been caused by recent convergence between Antarctic and Scotia plates due to westward movement of the Scotia plate since 6 Ma.

2-41 **Jin, Young Keun**, **Yeadong Kim**, **Sang Heon Nam**, **Duk Kee Lee**, and Kiehwa Lee. 1997. "Gravity models for the South Shetland Trench and the Shackleton Fracture Zone, Antarctica". *Geoscience Journal,* 1(2): 89-98.

Four deep crustal models of the South Shetland Trench (SST) and the Shackleton Fracture Zone (SFZ) off the northern Antarctic Peninsula are presented based on gravity data. The gravity models of the SST suggest that the dip of the subducting crust increases from southwest to northeast rang-ing from 25° in Line KSL93-5 to 30° in Line KSL93-6 as the age of crust increases along the trench axis. The gravity low observed near the island arc is directly associated with the deep forearc basin bounded seaward by a large fault. In the SFZ, the thin crust is concentrated primarily beneath the ridge, where Moho shallows by 2.5 km. A low-density material (about 2.56 g/cm^3) assigned to the SFZ ridge is presumably due to serpentinite intrusion. The gravity low associated with the trough is due to the relatively low-density sediments filled in the trough. The crustal thickening to the western slope of the ridge near the triple junction was probably caused by the collision of the SFZ ridge with Shetland Platform.

2-42 Jun, H. K., S. H. Haam, Y. S. Eoh, J. I. Lee, and I. T. Kim. 1992. "Installation of the Ground-based Telecommunications System with Polar Orbiting Satellites at King Sejong, Antarctic Station". *Korean Journal of Polar Research,* 3(1/2): 95-102.

The ground-based system to communicate with the first Korean Telecommunication satellite(KITSAT-1) was installed at King Sejong Station. Antarctica by Korea Ocean Research & Development Institute (KORDI) and SaTellite Research Center (STRC) of Korea Advanced Institute of Science & Technology(KAIST).
The system was composed of highly efficient machineries including softwares (tracking, packet, telemetry, CCD image) and hardware (PC 386, modem, TNC, LNA, HPA, transceive, polarizer, antenna, tower, etc). In near future. scientific data and information will be telecommunicated with this system.

2-43 Jwa, Yong-Joo. 1992. "Geochemical Evolution of Tertiary Magmatism in the western King George Island, Antarctica: A Review". *Journal of the Geological Society of Korea,* 28(5): 504-509.

Major and rare earth element geochemistry of the volcanic rocks in the western King George Island indicates that the chemical natures of volcanic magmas change with distance from the trench. The volcanics in the western part of Fildes Peninsula, the closest to the trench, strongly show tholeiitic nature, while as the distance increases they exhibit not only tholeiitic but calc-alkaline affinities. This kind

of variation can be explained by the increase of fractional crystallization degree of tholeiitic magma. Also, the shift of magma composition towards calc-alkaline has closely related to the age of the magrnatism. In other words, the initial volcanic magma generated near the trench has tholeiitic natures, but as time passes and the distance increases the later volcanic magma that experienced fractional crystallization represents calc-alkaline affinities, too. Different from the volcanics, the granitic rocks intruded into the Barton Peninsula area exclusively show calc-alkaline natures. The volcanic magmas erupted in the western King George Island were probably generated at the upper mantle, but the granitic magmas were originated by the partial melting of lower crust or by the mixing of the magma derived from the upper mantle with crustal material.

2-44 Jwa, Yong-Joo and **Jong-Ik Lee**. 1992. "Geochemistry of the Volcanic Rocks from the Fildes Peninsula, King George Island, Antarctica". *Journal of the Korean Earth Science Society,* 13(2): 200-211.

Tertiary volcanic activity in the Fildes Peninsula can be divided into three stages (I,II,III) of magmatism. Evolutionary process of each stage was examined from the geochemical characteristics. For stage I, olivine, orthopyroxene and clinopyroxene of low Fe/Mg ratio as well as Ca-plagioclase begin to crystallize and fractionate. Stage II magma, which is more differentiated than stage Ⅰ magma, shows the fractionation of Ca-plagioclase and olivine and orthopyroxene of high Fe/Mg ratio. Stage III magma, which is slighÙy more differentiated than stage I magma but less than stage II magma, intruded into the area when stage II magmatism was weakened. The volcanic rocks on the Fildes Peninsula show, as a whole, tholeiitic natures. From the previous studies on Sr isotopic ratio, the origin of the volcanic magma in the area was assumed to be upper mantle. Accordingly, the volcanic rocks in the area were originated from tholeiitic magma which generated by the partial melting of upper mantle under island-arc environment.

2-45 Jwa, Yong-Joo, **Jong-Ik Lee**, and Xiangshen Zheng. 2003. "A study on the eruption ages of Baekdusan: 1. Radiocarbon (^{14}C) age for charcoal and wood samples". *Journal of the Geological Society of Korea,* 39(3): 347-357.

Cheonji (Tianchi) Volcano in Baekdusan, located on the border of China and Korean Peninsula, is a worldwide famous active volcano for its scale and potential danger of eruption. The historic Plinian eruption of Cheonji Volcano formed airborne pumice deposits to the east and huge pyroclastic flows to all directions. This euptive stage can be identified as Baiyunfeng stage by Zheng (1997). We collected charcoal and wood samples from the pumice deposits and determined radiocarbon ages of them using Accelerator Mass Spectrometer (AMS). Radiocarbon and calibrated ages for the wood samples from Ssangmokbong (Shuangmofeng) area, 18 km east from the Cheonji caldera, reveal 1080~1360 BP and 660~960 AD, respectively. Radiocarbon and calibrated ages for the charcoal samples from Hyupgok Buseoklim (Xiagu Fushilin), 12 km northeast from the caldera, are 1080~1360 BP and 710~880 AD. The dendrochronological information from tree-ring correlation made it possible to get a more precise age determination through wiggle matching on a charcoal sample. The wiggle matched ages for the sample which has well preserved tree-ring structure indicate a gradual younging from the core (705±45 AD), the middle (740±70), the rim (765±85) and to the outer branch (860±100). The youngest age, 860±60 AD would imply for the eruptive age of Baiyunfeng stage. Therefore the Holocene eruption of Cheonji Volcano would

have occurred during the period between 760 and 960 AD. The range of the eruptive age is quite accordant with the reported ages for the eruption.

2-46 Kim, Hyoung-Soo, **Sang Heon Nam**, and **Yeadong Kim**. 1996. "Near-Surface Geophysical Surveys using Seismic and Electric Methods in Barton Peninsula of King George Island, Antarctica". *Journal of the Geological Society of Korea,* 32(2): 131-145.

Geophysical surveys using seismic reflection and electrical resistivity methods were conducted in the Barton Peninsula of King George Island. Antarctica for the study of near-surface geological structure. Results of the surveys gave useful geological information on the near-surface structure of the area. The data suggest that the depth to the top of permafrost in the study area is about 1 to 2 m during austral summer season. According to the result of seismic survey. the velocity of permafrost top is about 5,000 m/s The upper boundary of the permafrost in the study area is clearly observed in the reflection seismic section and the thickness of permafrost is estimated to be several meters. The electrical survey results show that the low resistivity zone, where values are a few tens or hundreds ohm-m, exists below the permafrost. This low resistivity zone is believed as partially-saturated zone with groundwater. The basement may be located at the depth between 10 and 50 m, and has the resistivity value greater than 500 ohm-m. This study shows that the electrical and seismic methods are useful tools in mapping the permafrost or the basement of near-surface even in the polar regions.

2-47 Kim, Jai Soo, **Yeadong Kim**, G. S. N. Murty, and **Jeong Woo Kim**. 1990. "Interferometric Measurements of Thermospheric Temperature at the King Sejong Station, Antarctica-Preliminary Results". *Journal of the Korean Physical Society,* 23(3): 253-261.

A 15-cm high-resolution Fabry-Perot interferometer system was installed in January 1989 at the King Sejong Station (geographic: 62.22°S, 301.25°E; geomagnetic: 50.65°S, 7.51°E), which is the Korean Antarctic Research Base on King George Island, Antarctica. An initial survey of the temperatures measured using this interferometer during February-March 1989, a period of high solar and geomagnetic activity, indicates unusually elevated temperatures in the Antarctic thermosphere. The mean temperatures range between 1390 and 1493 K, which are consistently higher by 114 to 226 K compared to those experimentally measured from a mid-latitude station, Albany (42.68°N, 286.18°E; 54.25°N, 353.97°E), New York, in the Northern Hemisphere during the period 1978-82. The semi-empirical MSIS-83 and MSIS-86 models underestimated the thermospheric temperatures by almost 280-465 K, and they qualitatively differed significantly from the temperature variations measured under varying solar and geomagnetic conditions.

2-48 Kim, Jeong Woo, Seong-Jae Doh, **Sang Heon Nam**, Soonwook Youn, and **Young Keun Jin**. 2002. "Gravity-Geologic Prediction of Bathymetry in the Drake Passage, Antarctica". *Economic and Environmental Geology,* 35(3): 273-284.

The Gravity-Geologic Method (GGM) was implemented for bathymetric determinations in the Drake Passage, Antarctica, using global marine Free-air Gravity Anomalies (FAGA) data sets by Sandwell and Smith (1997) and local echo sounding measurements. Of the 6548 bathymetric sounding measurements, two thirds of these points were used as control depths, while the remaining values were used as checkpoints. A density contrast

of 9.0 gm/cm^3 was selected based on the checkpoints predictions with changes in the density contrast assumed between the seawater and ocean bottom topographic mass. Control depths from the echo soundings were used to determine regional gravity components that were removed from FAGA to estimate the gravity effects of the bathymetry. These gravity effects were converted to bathymetry by inversion. In particular, a selective merging technique was developed to effectively combine the echo sounding depths with the GGM bathymetry to enhance high frequency components along the shipborne sounding tracklines. For the rugged bathymetry of the research area, the GGM bathymetry shows correlation coefficients (CC) of 0.91, 0.92, and 0.85 with local shipborne sounding by KORDI, GEODAS, and a global ETOPO5 model, respectively. The enhanced GGM by selective merging shows imploved CCs of 0.948 and 0.954 with GEODAS and Smith & Sandwell (1997) s predictions with RMS differences of 449.8 and 441.3 meters. The global marine FAGA data sets and other bathymetric models ensure that the GGM can be used in conjunction with shipborne bathymetry from echo sounding to extend the coverage into the unmapped regions, which should generate better results than simply gridding the sparse data or relying upon lower resolution global data sets such as ETOPO5.

2-49 Kim, Ki Young, **Sang Heon Nam**, and **Byong-Kwon Park**. 1996. "Gas hydrates and their reflection characteristics". *Journal of the Geological Society of Korea,* 32(7): 519-525.

Gas hydrates are ice-like solids composed of water molecules surrounding a gas molecule, mainly methane. The materials are considered as an important future energy source owing to their immense amounts and worldwide occurrence. The large volume of methane in hydrates would have a significant effect on the global environment change if the pressure/temperature condition changes. In the United States, Canada, Japan, Russia, and some European countries , both geophysical and geochemical studies have been conducted on the material for recognition, mapping, delineation of the origin. and accessment. Since gas hydrates are stable at relatively low temperature and high pressure conditions, they occur in two distinct locations: in polar regions associated with permafrost and in marine sediments where water depths exceed about 300 m. The stiffness in hydrate-bearing layers is dramatically increased due to intergranular cementation of gas hydrates. Accordingly, the gas-hydrate layers show seismic characteristics such as velocity reduction at their lower boundaries, polarity reversal, large amplitude, amplitude blanking, bottom-simulating reflection, and VAMP' structures. Owing to such distinct seismic characteristics , multichannel reflection methods have been utilized to identify and locate gas hydrates in sedimentary layers. Seismic sections, obtained using the 96-channel system on R/V *Onnuri* as part of the 1993 Korean Antarctic Research Program' show characters which coincide with those of gas-hydrate layers. A research project on gas hydrate commenced in 1996 will reveal detailed seismic characters of the hydrate-bearing layers in the region.

2-50 Kim, Won Hyung and **Byong-Kwon Park**. 1988. "MARINE DIATOMS FROM THE LATE QUARTERNARY SEDIMENTS IN THE MARIAN COVE, KING GEORGE ISLAND, ANTARCTICA". *Journal of the Paleontological Society of Korea,* 4(2): 135-159.

Antarctic diatom floras are analyzed from the Quarternary sediments collected near the Antarctic Convergence in austral summer, 1988. The floras are well preserved and diverse, comprising fifty to fifty-nine species in each sediment. Common dissolution prone

species and rare dissolution resistant species included also indicate good preservation and represent the oceanographic conditions where they derived. The diatom floras include no extinct species, in turn, indicating that no reworking has occurred in the sampling sites. The diatom assemblages consist of Antarctic endemics, Subantarctic indicators, bipolar species, neritic dwellers, cosmopolitans, and cryophilic/epontic species. Among them, Antarctic endemics comprise 18.2% to 24.7% and Subantarctic indicators 6.9% to 13.4% of the total population well representing the sampling localities and the peculiarity of Antarctic diatom assemblage. The dominant species is *Pseudogomphonema groenladicum* while the dominant genus *Nitzschia*. Several age diagnostic species included suggest that the sediments were deposited during late Quarternarty.

2-51 **Kim, Yeadong** and **Byong-Kwon Park**. 1988. "Tectonics of the Scotia Sea Area, West Antarctica: A Review". *Journal of the Geological Society of Korea*, 24(3): 243-250.

During the periods from the late Paleozoic to Triassic and from mid-Jurassic to mid-Cretaceous, the Scotia Sea was a part of the active Pacific margin of Gondwanaland. Widespread calc-alkaline volcanism prevailed related with the subduction of the Pacific plate. Back-arc basins were also formed in the southern South America and the western Weddell Sea. The West Antarctica was composed of several land masses of relatively thin crust (25-30 km). Gondwana reconstruction in the Scotia Sea area based on microplate movements is more favorable than that based on the present-day continental configuration because the relative movement of the microplates is assumed during Gondwana breakup. Following the cessation of subduction, there were alkaline volcanisms associated with the episode of crustal extension in the mid-Cenozoic time. During the extensional tectonics, the Drake Passage and the Bransfield Strait were opened, and the South Sandwich Trench was formed. At the same period, there were strike-slip motions along the North and South Scotia Ridge. Especially the opening of the Drake Passage is closely related to the formation of the Antarctic ice cap. The South Shetland Islands were separated from the Antarctic Peninsula by the opening of the Bransfield Strait. The late-Cenozoic Antarctic Peninsula may represent eruptions along the weak zone of extensive Mesozoic transform faults.

2-52 **Kim, Yeadong** and Soo Jae Kwon. 1992. "GPS Positioning of the King Sejong Station, Antarctica". *Ocean Research,* 14(1): 35-39.

GPS positioning of the reference survey point at the King Sejong Station was carried out during the 90/91 austral summer season. The latitude and longitude of 62° 13' 23.587'' S and 58° 47' 21.287'' W in WGS-84 were obtained from the average of 74 GPS readings. The obtained longitude differs by 2 minutes from the point projected on the Chilean hydrographic chart. The difference is assumed to be come partly from a different geodetic system used for each positioning on the earth's surface. It is more reasonable to use the global geodetic system, WGS-84, for positioning in the Antarctic area in that Antarctica is totally separated from other continents.

2-53 Kwon, Byung-Doo, **Yong-Joo Jwa**, and Ki-Won Lee. 1992. "Magnetic Investigation at the Barton Peninsula of King George Island in Antarctica". *Journal the of Korean Earth Science Society*, 13(1): 29-40.

A magnetic survey was carried out at the Barton Peninsula in King George Island, Antarctica. To analyze geological features in

the study area, several filtering methods in 2-dimensional wavenumber domain were used. The Barton Horst associated with volcanic activities is well revealed on the low-pass filtered anomaly map. Possible existence of small volcanic plugs or , presumably, mineralized zones are apparent at northern parts and south-western part by reduction-to-the-pole and pseudo-gravity filtering. On the 1 st vertical derivative and directional filtered anomaly maps, the geological boundaries on the surface are well identified, and fault strikes along E-W or NW-SE direction appeared to be mostly dominant throughout the study area. Density and susceptibility mapping were performed using the inversion method. The apparent densities of tuffaceous rocks distributed in the southern parts and those of quartz-diorite or crystal tuff in the northern parts were computed as values up to about 2.69 g/cm^3 and 2.73 g/cm^3, respectively, and the apparent susceptibilities of those rocks are appeared to be about 250 × 10^{-6} CGS and 1870 × 10^{-6} CGS, respectively. These results are in accordant with those of samples measured by Garrett (1990). Therefore, it is concluded that the studied area of the Barton peninsula has been influenced by crustal movement associated with active volcanism and the surface lithology is extended to the considerable depth.

2-54 Kwon, Tae-Yong, **Bang Yong Lee**, and Jeong-Soon Lee. 2001. "Statistical analysis of NOAA/AVHRR high resolution weekly SST in the East Sea: Regional variability and relationships with ENSO". *Ocean and Polar Research*, 23(4): 361-376.

The characteristics of SST variability in the East Sea are analyzed using NOAA/AVHRR weekly SST data with about 0.18° × 0.18° resolution (1981-2000) and reconstructed historical monthly SST data with 2° × 2° resolution (1950-1998). The distinct feature of wintertime SST is high variability in the western and eastern parts of 38°~40°N latitudinal band, which are the northern boundary of warm current in the East Sea during winter. However, summertime SST exhibits variability with similar magnitude in the entire region of the East Sea. The analysis of remote correlation also shows that SST in the East Sea is closely correlated with that in the region of Kuroshio in winter, but in summer is related with that in the western and eastern regions of the same latitudes. From these results it is postulated that the SST variability in the East Sea may be related with the variations of East Korean Warm Current and Tsushima Warm Current in winter, but in summer probably with the variations of atmospheric components. In the analysis of ENSO related SST anomaly, a significant negative correlation between SST anomalies in the East Sea and SST anomalies in the tropical Pacific is found in the months of August-October (ASO). The SST in the ASO period shows more significant cooling in El Niño events than warming in La Niña events. Also, the regional analysis shows by the Student's t-test that the negative SST anomalies in the El Niño events are more significant in the southwestern part of the East Sea.

2-55 Lee, D. K., **Y. K. Jin**, **Y. Kim**, and **S. H. Nam**. 2000. "Seismicity and tectonics around the northern Antarctic Peninsula from King Sejong station data". *Antarctic Science*, 12(2): 196-204.

Local earthquakes recorded at the King Sejong station (62°13'31"S, 58°47'07"W) from 1995-96 have been analysed to study the seismicity and tectonics around the northern Antarctic Peninsula. The nature of shallow-focused normal fault earthquakes along the South Shetland Platform is still unclear. Dominant normal fault earthquakes and minor strike-slip earthquakes in the Eastern Bransfield Basin suggest 1) ongoing

extension, and 2) transtensional stress transmitted from the Antarctic-Scotia transform boundaries, the South Scotia Ridge and the Shackleton Fracture Zone. A lack of seismicity in the Central Bransfield Basin supports that active seismicity in the Eastern Bransfield Basin is not a result of subduction along the South Shetland Trench. Shallow focused earthquakes have been observed along the NW-SE trending gravity low line between the Central and the Eastern Bransfield Basins that approximately coincides with the landward projection of a fracture zone in the former Phoenix Plate.

2-56 Lee, Dong-Young. 1992. "Topographic Evidences of Raised Beach Along the Baton Peninsula, Antarctica". *Korean Journal of Polar Research*, 3(1/2): 71-84.

During the 91/92 Antarctic summer field campaign. geomorphic features related with glacial isostasy were observed at the Baton Peninsula and its surrounding coastal area of the King George Island. There are several types of geomorphic evidences to indicate the former beach strand such as marine terrace, sea notch or beach deposits. The ancient beach deposits consist of well rounded but slightly flat gravels. These outcrops are subdivided into three different series by outcrop location and gravel shapes. The lower series consist of the succession at the level of 3.1, 5.4, 6.0, 7.2, 14~15, 17~18 m. The middle series are characterized by ice pushed reworked gravels at the level of 24~25, 32~33, 38~40, and 57~58. The upper series reach up to the level of 135 and 185m. The age of the lower series must be Holocene. the middle series for the early Holocene. and the higher series are considered belonging to pre-Holocene based on the level of the outcrop and the different gravel shape morphology. The gravel shapes of these beach deposits are characterized by rounded or flat types depending on the selection activity of gravel shapes from wave action. They are more spherical at the lower altitude but more flat at the higher level of ancient beach. and these gravel shapes are also compared with gravel shapes of fluviatile origin.

2-57 **Lee, Jong Ik**, **Soon Do Hur**, and 2 others. 2001. "Geochemistry and K-Ar Age of Alkali Basalts from Weno Island, Caroline Islands, Western Pacific". *Ocean Polar Research*, 23(1): 23-34. Geochemical and Sr-Nd isotopic compositions and K-Ar ages are analyzed in volcanic rocks from Weno Island, Caroline Islands. Seven Weno lava samples of alkali basalt and basaltic trachyandesite are aphyric or sparsely phyric comprising olivine, plagioclase, and clinopyroxene phenocrysts. Whole-rock geochemical variation of Weno lavas reflects main fractional crystallization of olivine and Cr-spinel phenocrysts. Newly determined K-Ar ages of Weno lavas range from 6.7 to 11.3 Ma (late Miocene), indicating their formation during primary volcanic stage of Chuuk Islands. Trace element compositions of Weno lavas are very similar to those of typical ocean island basalts (OIBs), suggesting their formation during intra-plate mantle plume activity. The plume composition is isotopically very similar to that of Hawaiian hot spot. However, the age span of Chuuk volcanism is longer than that of the other individual volcanoes in the Pacific.

2-58 **Lee, Jong Ik**, **Soon Do Hur**, **Mi Jung Lee**, Chan Min Yoo, Byong-Kwon Park, **Yeadong Kim**, and 2 others. 2002. "Petrology and Geochemistry of Dokdo Volcanic Rocks, East Sea". *Ocean and Polar Research*, 24(4): 465-482.

Petrological, geochemical, and geochronological studies of Dokdo volcanic rocks, East Sea, have been carried out to understand their petrogenesis. Dokdo volcanic activity is divided into three stages according to occurrences and eruption ages of

rocks. The second-stage activity is accompanied by large volume of pyroclastics and lavas of intermediate composition, and occupies most of the East and West islets. K-Ar biotite and whole-rock ages indicate that Dokdo volcanic activity occurred during late Pliocene and became systematically younger toward later stages: namely, 2.7-2.4 Ma for the first-stage trachyte, 2.4-2.3 Ma for the second-stage trachyandesite and 2.2-2.1 Ma for the last-stage trachyte and dikes. Dokdo volcanic rocks are of intermediate to felsic compostions, and have OIB-like alkaline nature. The geochemical similarities between Dokdo and Ulleungdo volcanic rocks suggest that they were formed from the same mantle plume. However, considering the difference of eruption ages between Dokdo (2.7-2.1 Ma) and Ulleungdo (1.4-0.01 Ma) volcanic rocks, the former seems to have been formed by earlier hot spot activity.

2-59 **Lee, Jong Ik**, **Soon Do Hur**, **Mi Jung Lee**, **Kyu Jung Kim**, and Keisuke Nagao. 2003. "Axial Seamount Basalts in P3 Segment of Phoenix Ridge, Drake Passage, Antarctica: K-Ar Age Determination and Geochemistry". *Ocean and Polar Research*, 25(1): 107-118.

The axial seamount basalts in the P3 segment of the Phoenix Ridge were obtained from dredging and the K-Ar age determination and whole-rock geochemical analyses have been done for understanding their origin. The K-Ar ages for PRS basalts sampled from 1,000 m below sea level are 2.6 - 2.2 Ma and those for PR3 basalts from 800 m are 1.6-1.5 Ma. The younger ages towards the crest of the seamount indicate that this submarine volcano has been grown by central eruptions. The youngest age of about 1.5 Ma for PR3 basalts corresponds to the final eruption period of this volcano. The seamount basalts contain small amounts of normative quartz and olivine. They have transitional geochemical nature between alkaline- and subalkaline-series basalts. Trace and rare earth elements compositions of the seamount basalts are very similar to those of ocean island basalts (OIB), and indicate that this seamount has been formed by a hotspot activity, not in association with a seafloor spreading. The melting degree from the source has decreased with time, and finally the volcanic activity has stopped when the basaltic magma reached mild alkaline composition.

2-60 **Lee, Mi Jung**, Daniel Garcia, Jacques Moutte, and **Jong Ik Lee**. 2003. "Phlogopite and tetraferriphlogopite from phoscorite and carbonatite associations in the Sokli massif, Northern Finland". *Geosciences Journal*, 7(1): 9-20.

The phoscorite—carbonatite complex (PCC) in the Sokli massif, northern Finland, is divided into 5 stages according to mineral assemblages and occurrences. The earlier three stages comprise phoscorites and calcite carbonatites (P1 to P3 and C1 to C3, respectively), and they usually occur as pairs with the same mineral assemblage (calcite, apatite, megnatite, olivine, and mica). The latter two stages consist of only dolomite carbonatites called D4 and D5. All micas investigated from the Sokli PCC fall in the range of the phlogopite-tetraferriphlogopite series. Tetraferriphlogopite begins to crystallize from late stage 2 and becomes a dominant silicate in the P3C3 rocks and D4-D5 dolomite carbonatites. Although tetraferriphlogopites occur as primary or secondary products, discrete and euhedral (magmatic) tetraferriphlogopites are considered to have crystallized from a melt strongly depleted in aluminum and saturated in Ti-bearing phases under low temperature condition. The chemical variation of phlogopites shows that Fe and F contents increase, whereas Al, Ba, Ti and Mg contents decrease from stage 1 to stage 5. The

progressive depletion in aluminum and the enrichment in fluorine towards the later stages seem to be a specific feature of the Sokli phlogopite. The difference of phlogopite rim compositions between phoscorites and paired carbonatites indicates that there was a slight difference of elemental partitioning into the interstial melts during the segregation of the rocks from a parental magma.

2-61 **Lee, Mi Jung**, **Jong Ik Lee**, and **Yeadong Kim**. 2003. "Occurrence and Petrogenesis of Phoscorite-Carbonatite Complexes in the Kola Alkaline Province, Arctic". *Ocean and Polar Research*, 25(1): 119-128.

Although phoscorites and carbonatites form only a minor proportion of the earth's crustal rocks, these unusual rocks and their intimate relation are of both academic and economic importance. Rare metal (Nb, Zr, Ta) and REEs mineralizations are in close relation with the differentiation of these phoscorite-car-bonatite complexes (PCCs). Recent integrated petrological and geochemical data on PCCs in the Kola Alkaline Province, Arctic, indicate that phoscorites and associated carbonatites are differentiated from common 'carbonated silicate patental magma'. Various hypotheses for the genesis of phoscorite-carbonatite complexes have been proposed during the last half-century. A simple magmatic fractionation scheme can not explain the chemical and mineralogical characteristics of phoscorite and conjugate carbonatite. Instead, the hypotheses involving liquid immiscibility and coeval accumulation processes are favored to explain the mineralogical and geochemical characteristics of phoscorite and carbonatite association.

2-62 **Lee, Mi Jung**, **Jong Ik Lee**, Jaques Moutte, and **Yeadong Kim**. 2003. "Petrography and geochemistry of the Devonian ultramafic lamprophyre at Sokli in the northeastern Baltic Shield (Finland)". *Journal of the Petrological Society of Korea*, 12(4): 170-183.

The Sokli complex in the northeastern Baltic Shield (Finland) forms a part of the extensive Devonian Kola Alkaline Province. The complex contains ultramafic lamprophyres occurring as dikes of millimetric to metric thickness. The Sokli ultramafic lamprophyres have petrographical and geochemical affinities with aillikite. High concentrations of Cr and Ni with low Al_2O_3 content of the Sokli aillikites indicate a strongly depleted harzburgitic source. However, compared to the kimberlites, the lower Cr and Ni contents and mg-number with weaker HREE depletion of the Sokli aillilkites imply a smaller proportion of garnet in the source and thus suggest a shallower melting depth of the source. In order to account for high concentrations of all incompatible elements and LREEs, with high volatile content (especially CO_2), an additional enriched material is thought to have been incorporated into the Sokli aillikite source. An anomalous enrichment of K in the Sokli aillikite, compared to nearby ultrapotassic rocks and world-wide ultramafic lamprophyres, indicate a presence of K-rich phase (probably phlogopite) in the source mantle.

2-63 Lee, Min-Sung, **Byong-Kwon Park**, **Sang Heon Nam**, and **Yong-Joo Jwa**. 1990. "Tectonics of the South Shetland Islands and Geology of King George Island: A Review". *The Journal of the Oceanological Society of Korea*, 25(2): 74-83.

The similarity in Mesozoic geology between the Antarctic Peninsula and South America indicates the possibility that they had situated along the same tectonic line before the separation of southwestern Gondwanaland. The igneous activity around the Antarctic Peninsula, including the South Shetland

Islands, can be correlated with the South American Cordillera Orogeny due to the subduction of Farallon/Phoenix plate until late Mesozoic. However igneous activity in Tertiary correlates with the tectonic movement accompanying the formations of Drake passage and Scotia sea. The South Shetland Islands form a Jurassic-Quaternary magmatic island arc on the sialic basement of schist and deformed sedimentary rocks. Forming of the South Shetland Islands arc began during the latest Jurassic or earliest Cretaceous from the southwestern part of the archipelago. The igneous activity migrated northeasterly and continued in most areas until late Tertiary. The entire arc-forming period, between late Jurassic and late Tertiary times, was characterized by emplacement and eruption of magmas of intermediate between island-arc tholeiite and calc-alkaline types. However, Quaternary volcanic rocks show strong alkaline affinities which corresponds to the switch from compressional to intra: plate tensional tectonics.
The rocks of late Cretaceous to Tertiary, mainly found in King George Island, consist of lava of basalt to andesite and intercalated pyroclastic rocks. Some of the volcanic rocks, which often called 'quartz-pyrite lodes' are severely altered and include much content of calcite, silica and pyrite. The stratigraphic succession of King George Island can be divided into two formations: Fields formation and Hennequin formation. The Fildes formation crops out at the west side of Admiralty Bay in King George Island, while the Hennequin formation at the east side of the bay. These two formations are thought to be formed contemporaneously. The Fildes formation consists of altered olivine-basalt and basaltic andesite, whereas the Hennequin formation consists of fine-grained hypersthene-augite-andesite. Both formations intercalate pyroclastic rocks.

2-64 Lee, Young Gil. 1996. "MICROPALEONTOLOGICAL (DIATOMS) STUDY OF THE CORE SEDIMENTS IN THE BRANSFIELD STRAIT, ANTARCTICA". *Journal of the Paleontological Society of Korea*, 12(1): 1-21.

The paleoenvironments, biostratigraphy, and geologic age of the five piston cores sediments (S16, S15, S4, S7, and AB2") collected from the Bransfield Strait, Antarctica are studied by basis of diatoms. The results are summarized as follows : (1) A total of 79 species and varieties. belonging to 23 genera were identified from core S15, 90 species and varieties of 28 genera from core S 16, 83 species and varieties of 33 genera from core S4, 79 species and varieties of 31 genera from core S7, 94 species of 33 genera from core S4, 79 species and varieties of 31 genera from core S7, and 94 species of 33 genera from core AB2". Among them, *Thalassiosira antarctica* is the most abundant species in core S16, S4, and S7 (making 25-50% in core S16, 10-38% in core S4, and 34-55% in core S7). *Nitzschia kerguelensis* is also very abundant species in core S15 (18-38%) and core AB2" (10-23%). Except for a few species, the species composition of five cores is nearly similar to each other but the proportion of individual species is different from core to core. (2) The diatom assemblages in this study area are mainly composed of Antarctic and Subantarctic endemics or indicators which are oceanic and neritic species. Benthic-littoral species in core AB2" are more abundant than that of the other cores. Bipolaris species, and cryophilic and epontic diatoms are also common taxa. The percentage of reworked diatom frustules due to bottom current activity is very low (less than 1 %) in this sedimentary sequences. These indicate that the sediments were deposited under cold-water and neritic to inner oceanic environments. the bottom current activity was not strong. and the sedimentary basin was more or less

influenced by the sea ice. (3) Based on the diatom datum levels and biostratigraphic ranges of important taxa. two diatom Zones are recognized in the sedimentary sequence ; *Tralassiosira lentiginosa* Partial range Zone and *Actinocyclus ingens* Partial range Zone. The geological age of these sedimentary sequences ranges from Pleistocene to Holocene.

2-65 **Nam, Sang Heon**. 1994. "Gravimetric Connection to Benchmark at King Sejong Station". *Korean Journal of Polar Research*, 5(2): 9-13.

During '93/'94 field season, the gravimetric connection was carried out from gravity station at Frei Base, Chilien Base, Antarctica, as an object of the establishment of absolute gravity base at King Sejong Station(KSS, 60° 13' 23"S, 58° 47' 21"W, 9.869 m). Using the G-905 by L&R Inc., 19 data including 5 times going and returning was gathered on Jan.25, on Feb.1, and on Feb.3, 1994. After tidal correction and drift correction, of which coefficient was 0.001308 mgal/hour, the connection value on benchmark at KSS is verified to be 982203.27 ± 0.1 mgal. The difference between the GRS 80(Geodetic Reference System 1980) value and the connected value at benchmark is +104.91 mgal, and it is due to excess mass buried around King Sejong Station.

2-66 **Park, Byong-Kwon**. 1989. "Potassium-Argon Radiometric Ages of Volcanic and Plutonic Rocks from the Barton Peninsula, King George Island, Antarctica". *Journal of the Geological Society of Korea*, 25(4): 495-497.

2-67 **Park, Byong-Kwon** and **Yong-Joo Jwa**. 1991. "Potassium-Argon Radiometric Ages of Volcanic Rocks from the Fildes Peninsula, King George Island, Antarctica". *Journal of the Geological Society of Korea*, 27(4): 409-415.

From the K-Ar radiometric age determination, it is concluded that the volcanic rocks on the Fildes Peninsula have ages of 53~61 Ma (early Tertiary). K-Ar whole-rock ages show 59.5 Ma, 61.4 Ma, 56.2 Ma, 53.2 Ma from the lower to the upper part of the Fildes Group, in general accordance with stratigraphical division. By processing the age data from this study and previous studies, it is recognized that the volcanic activities in the Fildes Peninsula were vigorous during Paleocene~Eocene time, and migrated progressively south to north and west to east. Tertiary volcanism in western King George Island, which initiated in southern Fildes Peninsula on late Cretaceous of early Tertiary period, migrated northward and eastward over time. The eastward migration of the volcanism is observed in the Barton and Potter Peninsula.

2-68 Park, Byong-Kwon, Chang-Sik Cheong, **Ho Il Yoon**, and Kye-Hun Park. 1994. "Sr, Nd and Pb Isotopic Compositions in the Sediments of Admiralty Bay and Bransfield Basin, Antarctica". *Journal of the Geological Society of Korea*, 30(6): 602-612.

Isotopic composition (Sr, Nd and Pb) of the core sediments from Admiralty Bay and Bransfield Basin, the South Shetland Islands were analysed with their Nd-model ages. Samples were taken at depth of 20 cm, 220 cm, and 420 cm from the sediment surface. The average isotopic compositions of the sediments are as follows: $^{87}Sr/^{86}Sr$=0.70540, $\varepsilon_{Sr}(0)$=12.8, $^{143}Nd/^{144}Nd$=0.51280, $\varepsilon_{Nd}(0)$=3.1, $^{206}Pb/^{204}Pb$= 18.700, $^{207}Pb/^{204}Pb$= 15.612, and $^{208}Pb/^{204}Pb$=38.531. Based on these values, we suggest that the sediments represent the mixture of surrounding Cenozoic volcanics and the older continental crustal components, and the lead isotopic compositions of both are similar to each other. The isotopic

compositions of the sediments are similar to those of sediments from back arc basin not surrounded by old continental crust, which is the case of Celebes basin, Phillippine. The average Nd-depleted mantle model age (T_{DM}) of the sediments is 0.59 Ga. This value suggests that the sediments of Admiralty Bay and Bransfield Basin originated from rather young geologic realm.

2-69 Sohn, Y. K., **M. Y. Choe**, and **H. R. Jo**. 2002. "Transition from debris flow to hyperconcentrated flow in a submarine channel (the Cretaceous Cerro Toro Formation, southern Chile)". *Terra Nova*, 14(5): 405-415.

It is important to understand the exact process whereby very large amounts of sediment are transported. This paper reports peculiar conglomerate beds reflecting the transition of submarine debris flows into hyperconcentrated flows, something that has been well documented only in subaerial debris-flow events until now. Voluminous debris flows generated along a Cretaceous submarine channel, southern Chile, transformed immediately into multiphase flows. Their deposits overlie fluted or grooved surfaces and comprise a lower division of clastsupported and imbricated pebble–cobble conglomerate with basal inverse grading and an upper division of clast- to matrixsupported, disorganized conglomerate with abundant intraformational clasts. The conglomerate beds suggest temporal succession of turbidity current, gravelly hyperconcentrated flow, and mud-rich debris flow phases. The multiphase flows resulted from progressive dilution of gravelly but cohesive debris flows that could hydroplane, in contrast to the flow transitions in subaerial environments, which involve mostly non-cohesive debris flows. This finding has significant implications for the definition, classification, and hazard assessment of submarine mass-movement processes and characterization of submarine reservoir rocks.

2-70 Woo, Han Jun, **Byong-Kwon Park**, **Hyun-Do Chang**, **Soon-Keun Chang**, and **Ho Il Yoon**. 1996. "Late Holocene paleoenvironments of the King George Island, West Antarctica, using benthic foraminifera". *Journal of the Geological Society of Korea*, 32(5): 393-406.

To investigate the Late Holocene paleoenvironments of the King George Island. West Antarctica. two piston cores from the Admiralty and Maxwell Bays (Cores S–2 and S–19) were micropaleontologically analysed using benthic foraminifera. In the two cores. calcareous species. *Globocassidulina biora*, were dominant. Core S–19 from the Maxwell Bay, however, two agglutinated species. *Miliammina arenacea* and *Portatrochammina antarctica*. were dominant with *G. biora*. The ecological characteristics of the foraminiferal species from the cores show that the inhabitation and distribution of the benthic foraminifera in the study area seems to be related with the surface water masses which pass the Bransfield 8trait rather than water depth. The differences in the benthic foraminiferal assemblages between the cores suggest that the post-mortem processes were more severe in the Maxwell Bay than in the Admiralty Bay. The vertical distribution of the foraminifera in the cores were characterized by the alternative occurrence of foraminifera-rich (*G. biora* - biofacies) and rare zones. indicating the effects of inhabitation and preservational potential for benthic foraminifera caused by advancement and retreatment of ice sheet due to the climatic fluctuations during the Late Holocene. Therefore, the benthic foraminiferal data can be used to interpret paleoenvironmental and paleoclimatic history of the King George Island, West Antarctica through the Holocene.

2-71 Yi, Songsuk, Hyesu Yun, Hyunsook Byun, and **Soon-Keun Chang**. 1995. "Quaternary Silicoflagellates from the Core Sediments of the Bransfield Strait, Antarctica". *Journal of The Paleontological Society of Korea*, 11(1): 61-78.

2-72 Yoo, Chan Min, **Moon Young Choe**, **Hyung Rae Jo, Yeadong Kim**, and Ki Hyune Kim. 2001. "Volcaniclastic Sedimentation of the Sejong Formation (Late Paleocene-Eocene), Barton Peninsula, King George Island, Antarctica". *Ocean and polar Research*, 23(2): 97-107.

The Sejong Formation of Late Paleocene to Eocene is a lower volcaniclastic sequence unconformably overlain by upper volcanic sequence, and distributed along the southern and southeastern cliffs 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 to volcanic activity which occurred around the 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.

2-73 **Yoon, Jong-Ryeol** and **YeaDong Kim**. 2001. "Reviews on Natural Resources in the Arctic: Petroleum, Gas, Gas Hydrates and Minerals". *Ocean and Polar Research*, 23(1): 51-62.

The Arctic consists of numerous sedimentary basins containing voluminous natural resources and two of the world's major oil and gas producing areas. The western Siberia Basin in the Arctic region has the largest petroliferous province with an area of 800 × 1,200 km and produces more than 60% of total Russian oil production. The North Slope of Alaska produces about 20% of the U.S. output, i.e., 11% of the total U.S. consumption. Being small compared to those regions, the Canadian Northwest Territories and the Pechora Basin in Russia produce only fair amount of oil and natural gas. There are also many promising areas in the northern continental shelf of Russia. In addition to Russia, Svalbard and Greenland have been investigated for oil and gas. Gas hydrates are widespread in both permafrost regions and arctic continental shelf areas. The reserves of gas hydrates in the Arctic Ocean are about 20~32% of total estimated amounts of gas hydrates in the world ocean. Mineral mining is well developed, especially in Russia. The major centers are located around the Kuznetsk Basin and Noril'sk. They are major suppliers of gold, tin, nickel, copper, platinum, cobalt, iron ore, coal as well as apatite. There are also some minings of lead-zinc in Alaska and Arctic Canada.

PART 3

Ocean Environment Sciences

3-1 Lee, Yong-Seok, **In-Young Ahn**, and 2 others. 2002. "An Immunohistochemical Ultrastructural Study of the Heavy Metals accumulated in the Kidney of an Antarctic clam, *Laternula elliptica*". *Korean Journal of Malacology*, 18(1): 15-21.

The kidney of bivalve mollusks often contains remarkably high concentrations of both essential and non-essential metals and perform regulating and detoxicating activities. The kidney has also been proposed as a biological indicator for radioactive as well as for stable metals in the sea. The present study of the Antarctic clam, *Laternula elliptica*, concerns the functional morphology of the kidney epithelium, which contains highly accumulated heavy metals. The immunohistochemical and ultrastructural study was unertaken in order to find out the localization of metallothinonein and heavy metals accumulated in the kidney of *Laternula elliptica*. In the immunohistochemical investigation, an intense metallothionein immunostaining reaction was found in the epithelial cells of the kidney of *Laternula elliptica*. Transmission electron microscopy showed that the epithelial cells contained numerous electron-dense inclusion bodies which were considered to be accumulated heavy metals.

3-2 **Ahn, In-Young**. 1993. "Enhanced particle flux through the biodeposition by the Antarctic suspension-feeding bivalve *Laternula elliptica* in Marian Cove, King George Island". *Journal of Experimental Marine Biology and Ecology*, 171: 75-90.

The infaunal lamellibranch *Laternula elliptica* (Laternulidae), one of the most common Antarctic bivalves, is widely distributed in shallow waters around the Antarctic Continent. In order to evaluate the contribution of this species to organic carbon flux in an Antarctic coastal ecosystem, biodeposition rates by *L. elliptica* were measured and compared with sedimentation without this bivalve species in laboratory experiments during one austral summer. The amount of deposited material increased in the presence of *L. elliptica*. Weight-specific biodeposition rates varied from 0.26 to 2.17 mg dry wt·g wet wt^{-1}·d^{-1} and the rate decreased with increase in body weight. Due to massive inflows of terrigenous sediment through coastal meltwater stream into the coastal water, fecal and pseudofecal material contained a considerable amount of mineral particles and only a small percentage of organic carbon (1.6–5.2%). Estimated particulate organic carbon flux through the biodeposition of *L. elliptica* is ≈ 95 mg C·m^{-2}·d^{-1}, an amount comparable to that of a typical suspension-feeding bivalve, *Mytilus edulis*. *L. elliptica* is apparently an important agent for sedimentation of both lithogenic particles and organic particles. Thus, this study suggests that *L. elliptica* play an important role in enhancing particle flux from water column to sea bed through biodeposition and possibly nourishing other benthic fauna, particularly in phytoplankton-impoverished nearshore waters.

3-3 **Ahn, In-Young**. 2000. "Gross Biochemical Composition in Various Tissues of the Antarctic Clam, *Laternula Elliptica* (Bivalvia: Laternulidae) during One Austral Summer in King George Island, South Shetland Islands". *Korean Journal of Polar Research*, 11(1): 13-18.

Biochemical composition was determined in various tissues of the Antarctic clam *Laternula ellipitica* during one austral

summer. At the time of sampling, most of *L. elliptica* were at spawning or ready to spawn. Protein (NaOH-soluble) was the major organic constituent in most tissues, with relatively high levels in the siphon (47.4% of tissue dry weight, TDW) and the mantle (45.0% of TDW). Lipid level was highest in the gill (14.9% of TDW), followed by the gonad (10.9%) and the digestive glands (9.9%). Carbohydrate level was highest in the digestive glands (10.5%) and ranged from 3.9 to 7.9% in the other organs. Ash levels were relatively even among the tissues (18-26%). For the whole soft tissues, the average levels of protein, carbohydrate, lipid and ash were 39.3%, 7.7%, 8.2% and 23.1%, respectively. The protein levels were within the ranges reported for the temperate bivalves, but carbohydrate levels were much less compared with the values from temperate bivalves at similar reproductive stages. The lipid levels were also relatively low. It was noteworthy that the largest proportions of protein (58.6% of total body burden), carbohydrate (50.4%), lipid (36.2%) and ash (54.7%) were retained in siphon which constitutes almost half (48.6%) of total soft tissue dry mass.

3-4 **Ahn, In-Young**. 1997. "Some Ecological and Physiological Strategies for Energy Conservation of the Antarctic Clam, *Laternula elliptica*". *Korean Journal of Polar Research*, 8(1, 2): 77-83.

This paper reviews on the recent investigation on the feeding and metabolic strategies of the Antarctic filter-feeding bivalve, *Laternula elliptica* in relation to extremely seasonal food avail-ability (primary production) in the Antarctic waters. An experimental study revealed that *L. elliptica* has an exploitation strategy, viz. a high food consumption rate in summer during which food is in sufficient supply. Reduced summer metabolism of *L. elliptica* as compared with temperate bivalves, despite the apparent high feeding rates, appears to be another important strategy for enhancing the scope of growth, since this clam inhabits Antarctic nearshore waters where food may be in short sup-ply for up to 9 months of the year.

3-5 **Ahn, In-Young**. 1994. "Ecology and Biology of the Antarctic Soft-shelled Clam, *Laternula elliptica* (Bivalvia: Laternulidae)". *The Korean Journal of Malacology*, 10(2): 41-46.

The Antarctic soft-shelled clam, *Laternula elliptica* is widely distributed in shallow waters around the Antarctic Continent and islands. This bivalve species occurs in dense patches particularly in sheltered but frequently ice-impacted areas. This species mostly occurs at around 20-30 m depth and is rarely found at depths shallower than 5 m where ice abrasion by drifting or grounded icebergs is severe. It burrows deep into sediment (frequently >50 cm), which seems to be primarily a means for avoiding ice impacts. A pair of stout and highly extendable siphons appear to be a morphological feature to feed in the ice-scoured substrates while staying deep in the sediment. As one of the largest bivalves in the Antarctic waters, *L. elliptica* appears to grow rapidly, reaching to a shell length of approximately 100 mm in 12 or 13 years. *L. elliptica* feeds actively during summer when food is sufficiently provided, implying that food may be the most important factor regulating the growth. Seasonal variations in food availability, and metabolic process in starvation condition possibly during winter, however, are yet to be further investigated.

3-6 **Ahn, In-Young** and **Jeong Hee Shim**. 1998. "Summer metabolism of the Antarctic clam, *Laternula elliptica* (King and Broderip) in Maxwell Bay, King George Island and its

implications". *Journal of Experimental Marine Biology and Ecology*, 224: 253-264.

Oxygen consumption of the Antarctic lamellibranch *Laternula elliptica* was determined in a closed system for a summer period during which food was relatively abundant. For a standard 2.6-g AFDW (equivalent to 60 mm in shell length) individual, oxygen consumption rate was 414 μg $O_2 h^{-1}$. Weight-specific rates decreased with increase in body weight; the rate for a 1-g AFDW (45 mm) individual (206 μg O_2 g $AFDW^{-1}$ h^{-1}) was 1.3 times higher than the rate for a 2.6-g AFDW individual (159 μg O_2 g $AFDW^{-1}$ h^{-1}). The overall metabolic rates of *L. elliptica* are well below those of temperate bivalve species and comparable to those of the Antarctic bivalve species. Reduced summer metabolism as compared with temperate bivalve species appears to be an important strategy of energy conservation of *L. elliptica* inhabiting Antarctic nearshore areas where food may be in short supply for up to 9 months of the year.

3-7 **Ahn, In-Young** and **Young-Chul Kang**. 1991. "Preliminary Study on the Macrobenthic Community of Maxwell Bay, South Shetland Islands, Antarctica". *Korean Journal of Polar Research*, 2(2): 61-71.

Microbenthic faunas were grab-sampled from 11 stations in Maxwell Bay, South Shetland Islands, Antarctica February 4 through 6, 1989. Substrate type is varied, ranging from mud to gravelly muddy sand. Biomass ranges from 0.3 to 154 g wet wt per 0.1 m^2 (79 inds. × 0.1 m^{-2}). The highest biomass occurred in muddy bottom on the bed slope at a depth of 342 m and the lowest in anoxic muddy bottom of the central deep basin (400~500 m). Polychaetes are the most abundant faunal group, comprising 68 % of the total biomass. Echinoderms are the next commonly occurring group, making up 22 % of the total biomass. Bivalves comprise 5 % of the samples in terms of numbers but form only 1.4 % of the total biomass due to their small body sizes. Species composition seems to be related to the sediment type. In muddy bottom the deposit-feeders such as the tube-building polychaete *Maldane sarsi antarctica* are well represented. On the other hand, in sandy bottom of Bransfield Strait Benthic fauna is more diverse although only a few individuals were sampled for each of the majority of the species. The large polychaete species *Pista spinifera* and *Neoamphirite affinis antarctica*, the mobile epifauna such as decapods, amphipods, isopods and pycnogonids, the deposit-feeding holothuroids, and the suspension-feeding cirripedes occur in sandy bottom.

3-8 **Ahn, In-Young**, and 4 others. 2000. "Lipid content and composition of the Antarctic lamellibranch, *Laternula elliptica* (King & Broderip) (Anomalodesmata: Laternulidae), in King George Island during an austral summer". *Polar Biology*, 23: 24-33.

Total lipid content, lipid classes and fatty acid composition were studied in various tissues of the Antarctic clam *Laternula elliptica* in an early austral summer. A histological examination of the gonads revealed that most of the clams examined were spawning or ready to spawn. Lipid content was highest in gills (14.9% of tissue dry weight), followed by gonads (10.9%) and digestive glands (9.9%), and averaged 8.2% for the soft tissues. The overall lipid contents were relatively low compared to temperate bivalves at a similar reproductive stage. Lipid class composition in the total lipid of *L. elliptica* was quite similar to those of most marine bivalves at lower latitudes, being dominated by triacylglycerols (19.3–41.4% of total lipids) and phospholipids (18.9–28.3%) in most of the organs. Large amounts of triacylglycerol deposits in non-reproductive tissues,

particularly in siphon and gill, indicate a potential role of lipid as maintenance energy reserve, although the low lipid contents suggest that lipid may not serve as an energy reserve for any food-limited periods. Fatty acid composition in *L. elliptica* was also typical of marine bivalves with predominance of 16:0 (26%) and 20:5n-3 (18%) acids. Total fatty acids from the soft tissues showed a moderate level of unsaturation (50.6%), and about 35% of the total fatty acids were polyunsaturated. These values were not significantly different from, or even lower than those of marine bivalves in warmer waters. However, the content of 20:5n-3 (18.2% of total fatty acids), which dominated n-3 polyunsaturated fatty acids, was similar to those reported for other marine bivalve species in temperate waters. The fatty acid composition of *L. elliptica* reflected dietary input of some microalgal species. The nanoflagellates *Cryptomonas* spp., which were reportedly rich in 16:0, 18:3n-3 and 20:5n-3, predominated in the water column during the present investigation.

3-9 **Ahn, In-Young**, **Heeseon J. Choi**, and **Ko-Woon Kim**. 2003. "Heavy Metal Pollution Monitoring at King Sejong Station, King George Island, Antarctica". *Ocean and Polar Research*, 25(4): 645-652.

The coastal environment of King George Island is potentially subject to contamination by pollutants arising from station operations, such as emissions from fossil fuel burning, oil spills, waste disposal, etc. As a preparatory step to assess such impacts on the marine environment and living organisms of this island, two molluscan species (the bivalve *Laternula elliptica* and the gastropod *Nacella concinna*) were selected as biomonitors for metal pollution monitoring, and their baseline levels have been investigated for the past several years at King Sejong Station. In this review, variability of the baseline levels is discussed in relation to body size, tissue type, and sex. Natural elevations of some metals are also discussed with respect to the environmental characteristics of this region.

3-10 **Ahn, In-Young**, **HoSung Chung**, and Kwang-Sik Choi. 2001. "Some Ecological and Physiological Features of the Antarctic Clam, *Laternula elliptica* (King and Broderip) in a Nearshore Habitat on King George Island". *Ocean and Polar Research*, 23(4): 419-424.

The Antarctic clam *Laternula elliptica*, is one of the most representative benthic invertebrates in the Antarctic nearshore waters. Endemic to the Antarctic, *L. elliptica* is widely distributed around the Antarctica occurring as dense patches in shallow sheltered areas and exhibits high biomass. Despite its apparent ecological importance, *L. elliptica* has rarely been studied until recently probably due to difficulties in sampling in the ice-impacted waters. Recent studies have revealed various aspects of its ecology and physiology. In this review, some physiological and ecological characteristics of this species are discussed in relation to some prevailing features of its habitat environment, in particular physical instability of habitat substrates and extreme seasonality of food availability.

3-11 **Ahn, In-Young**, **Hosung Chung**, **Jae-Shin Kang**, and **Sung-Ho Kang**. 1997. "Diatom composition and biomass variability in nearshore waters of Maxwell Bay, Antarctica, during the 1992/1993 austral summer". *Polar Biology*, 17: 123-130.

Diatom composition and biomass were investigated in the nearshore water (< 30 m in depth) of Maxwell Bay, Antarctica during the 1992/1993 austral summer. Epiphytic or epilithic diatoms such as *Fragilaria striatula*, *Achnanthes brevipes* var. *angustata* and *Licmophora* spp. dominated the water column

microalgal populations. Within the bay, diatom bio-mass in surface water was several times higher at the nearshore (2.4–14 μg Cl^{-1}) than at the offshore stations (> 100 m) (1.2–3.2 μg Cl^{-1}) with a dramatic decrease towards the bay mouth. Benthic forms ac-counted for > 90% of diatom carbon in all nearshore stations, while in the offshore stations planktonic forms such as *Thalassiosira antarctica* predominated (50–> 90%). Microscopic examination revealed that many of these diatoms have become detached from a variety of macroalgae growing in the intertidal and shallow subtidal bottoms. Epiphytic diatoms persistently dominated during a 19-day period in the water column at a fixed nearshore station, and the biomass of these diatoms fluctuated from 0.86 to 53 μg Cl^{-1}. A positive correlation between diatom biomass and wind speed strongly suggests that wind-driven resuspension of benthic forms is the major mechanism in-creasing diatom biomass in the water column.

3-12 **Ahn, In-Young**, **Hosung Chung**, **Jae-Shin Kang**, and **Sung-Ho Kang**. 1994. "Preliminary Studies on the Ecology of Neritic Marine Diatoms in Maxwell Bay, King George Island, Antarctica". *The Korean Journal of Phycology*, 9(1): 37-45.

Species composition and density of neritic diatoms were studied in Maxwell Bay, King George Island during the austral summer months of 1992/1993. A total of 30 genera and 54 species were identified. Epiphytic of epilithic diatoms such as *Synedra* spp., *Achnanthes brevipes* var. *angustata*, *Licmophora* spp., and *Pseudogomphonema kamtschaticum* predominated the water column microalgal populations in the nearshore waters (< 30 m). Many of these diatoms were found to attach on a variety of macrolagae including *Desmarestia* spp., brown algae dominant at the depth range of 5 to 20 m. In surface water, the proportion of the benthic diatoms decreased from > 98% in the nearshore waters to 20% at the bay mouth (> 500 m). At the bay mouth, a planktonic form *Thalassiosira antarctica* predominated (80%). The density of diatoms in the surface waters was also nigher at the nearshore waters (2.4–14.0 μg C/l) than at the rest of the bay (1.2–3.2 μg C/l). The results of this study show that even within coastal waters species composition and biomass of diatoms could vary considerably. The present study also suggests that in the Antarctic nearshore waters benthic diatoms may play a major role as a primary producer when and where water column production is low.

3-13 **Ahn, In-Young**, **Jaekyoon Kang**, and **Dong-Yup Kim**. 1999. "A Preliminary Study on Heavy Metals in the Antarctic Limpet, *Nacella concinna* (Strebel, 1908) (Gastropoda: Petellidae) in an Intertidal Habitat on King George Island". *Korean Journal of Polar Research*, 10(1): 1-8.

Concentrations of five metals (Cu, Cd, Mn, Zn, Fe) were determined in the tissues of the Antarctic limpet *Nacella concinna*. Limpets were collected from intertidal zones close to the King Sejong Station (Monitoring Site) and at a remote site 1.4 km away from the station which was considered to have been least affected by human activities (Reference Site). Tissue concentrations of these metals in *N. concinna* were relatively high compared to those of other limpets in temperate waters, and decreased with the increase in body size. Fe and Mn concentrations were higher in the limpets from the monitoring site, while Cd was higher in those from the reference site. This seems to be associated with regional variations in input of ice-melt water laden with heavy metals which have originated from erosion of terrestrial volcanic rocks, and the results of this study indicate higher input of ice-melt water into the monitoring site. The results of the present study, combined with

the fact that *N. concinna* is abundant along the Antarctic Peninsula and the adjacent islands and easily collective, suggest that this limpet species can be used as a useful indicator for metal pollution monitoring in the Antarctic intertial areas. However, regional variation in geochemical processes and size-effect should be taken into consideration in establishing a framework for an environmental monitoring program.

3-14 **Ahn, In-Young**, **JaeKyoon Kang**, and **Ko-Woon Kim**. 2001. "The effect of body size on metal accumulations in the bivalve *Laternula elliptica*". *Antarctic Science*, 13(4): 355-362.

Variations of metal concentrations with body size were investigated in kidney, digestive gland and gill of the Antarctic clam, *Laternula elliptica*, collected from a near-shore habitat at King George Island. Positive relationships for metal concentrations with body size were common among the three organs for most of the metals, while an inverse relationship was found only in the digestive gland for Cu, Zn and Mn. In the gill, concentrations of eight out of the ten metals increased linearly with body size, whilst in the kidney concentrations of Cd, Zn, Pb, Co and Ni were best fitted by quadratic regression curves, viz. increasing continuously until reaching a peak at around an 80 mm shell length. This may reflect specific regulatory activities for the extremely high accumulation of these metals in the kidney, particularly Cd (28–354 μg g^{-1} tissue dry weight). The overall prevalence of positive relationships indicate net accumulation of these metals throughout life, which may be at least in part associated with the slow growth and long life span of this cold-water bivalve species. The study demonstrates distinct body size-metal concentration relationships in the three organs of *L. elliptica*, and suggests they may be useful as biomonitors for assessing changes in metal concentrations in Antarctic waters.

3-15 **Ahn, In-Young**, **Jae-Shin Kang**, and **Sung-Ho Kang**. 1993. "Primary Food Sources for Shallow-water Benthic Fauna in Marian Cove, King George Island during an Austral Summer". *Korean Journal of Polar Research*, 4(2): 67-72.

Primary food sources for benthic fauna were investigated in an Antarctic nearshore water (< 30 m) in King George Island in February of 1993. The suspension-feeding bivalve *Laternula elliptica*, one of the most common infauna in the Antarctic nearshore waters, was chosen as a species representing the benthic communities. Algal composition was microscopically analyzed in the ambient seawater, trap sediment, Laternula-inhabiting sediment and gut content during a 16-day period. Benthic diatoms com prised the majority of the microalgal biomass in all samples, but algal composition varied considerably among samples. *Synedra* spp. and *Licmophora* spp. were the most dominant diatoms in the surface water and in the trap sediment. In particular, *Synedra* spp. (62-100%) predominated in the seawater throughout the 16-day period. On the other hand, surface sediment of *L. elliptica* habitat was dominated by *Biddulphia* spp., *Trachyneis aspera* and *Cocconeis* spp. In the gut content, *Cocconeis* spp., *Licmophora* spp. and *Trachyneis* sp. were abundant. Thus the dominant diatom species in water column and bottom sediment were also found as major gut content of *L. elliptica*. The results of this study suggest that benthic diatoms may be utilized as primary food source by benthic fauna in the Antarctic nearshore waters when other food sources are not available.

3-16 **Ahn, In-Young**, Jeonghee Surh, You-Gyoung Park, Hoonjeong Kwon, Kwang-Sik Choi, **Sung-Ho Kang**, **Heeseon J. Choi**, **Ko-Woon Kim**, and **Hosung Chung**. 2003. "Growth and seasonal energetics of the Antarctic bivalve *Laternula elliptica* from King George Island, Antarctica". *Marine Ecology Progress Series*, 257(1): 99-110.

The Antarctic marine environment is characterized by extreme seasonality in primary production, and herbivores must cope with a prolonged winter period of food shortage. In this study, tissue mass and biochemical composition were determined for various tissues of the bivalve *Laternula elliptica* (King & Broderip) over a 2 yr period, and its storage and use of energy reserves were investigated with respect to seasonal changes in food level and water temperature. Total ash-free dry mass (AFDM) accumulated rapidly following phytoplankton blooms (with peak values immediately before and after spawning) and was depleted considerably during the spawning and winter periods. Most of the variation was in the muscle, gonads and digestive gland. Spawning peaked in January and February and caused considerable protein and lipid losses in the muscle, gonads and digestive gland. In winter (March to August), the muscle and digestive gland lost considerable mass, while gonad mass increased; this suggests that the muscle tissue and digestive gland serve as major energy depots for both maintenance metabolism and gonad development in winter. There were also marked year-to-year differences in the seasonal patterns of mass variation and reproduction. Overall, the relative and absolute tissue-mass values were positively correlated with chlorophyll concentration, and were not related to water temperature; thus, for the first time, this study clearly shows that food is an important, factor governing growth and gonad maturation in this bivalve. It is also noteworthy that protein, constituting ~75% of AFDM, served as the major energy reserve throughout the study, closely following the AFDM variation. In particular, during the winter months, protein comprised > 60% of AFDM loss, while lipids and glycogen served as minor (< 20% each) reserves. Protein loss was most substantial in the muscle tissue, which comprised half of the body tissue. Thus, protein use, with muscle tissues as a depot for protein reserves, may be a result of selective pressure on Antarctic marine herbivores undergoing a prolonged period of food shortage in winter.

3-17 **Ahn, In-Young**, **Ko-Woon Kim**, and **Heeseon J. Choi**. 2002. "A baseline study on metal concentrations in the Antarctic limpet *Nacella concinna* (Gastropoda: Patellidae) on King George Island: variations with sex and body parts". *Marine Pollution Bulletin*, 44(5): 424-431.

3-18 **Ahn, In-Young**, Soo Hyung Lee, Kyung Tae Kim, **Jeong Hee Shim**, and **Dong-Yup Kim**. 1996. "Baseline Heavy Metal Concentrations in the Antarctic Clam, *Laternula elliptica* in Maxwell Bay, King George Island, Antarctica". *Marine Pollution Bulletin*, 32(8/9): 592-598.

Baseline heavy metal concentrations were determined in various tissues of the Antarctic soft-shelled clam *Laternula elliptica* and compared with literature values for temperate and Antarctic bivalve species. *Laternula elliptica* tends to strongly accumulate most heavy metals with tissue concentrations being comparable to those of mussels and oysters in temperate waters. For the majority of the metals, significantly higher concentrations were measured in the kidney than in any other soft tissues. In addition, Cd concentration in the kidney was positively correlated with that of Zn, Pb and Mn, reflecting the detoxification of the accumulated heavy metals. Thus, these

results suggest that *L. elliptica* can be used as a suitable biomonitor for long-term monitoring of heavy metal contamination in the Antarctic coastal waters. However, habitat sediment is highly elevated with Cu (77 μg g^{-1} dry weight), which has apparently been derived from lithogenic sources in the surrounding land via meltwater inflow during austral summer. No comparative data, however, are yet available for *L. elliptica* in other regions, and possible influence of the Cu elevation in this region on the body burden of *L. elliptica* is discussed in comparison with those of another common Antarctic bivalve, *Adamussium colbecki*.

3-19 Choe, Byung Lae, Jong Rak Lee, **In-Young Ahn**, and **Hosung Chung.** 1994. "Preliminary Study of Malacofauna of Maxwell Bay, South Shetland Islands, Antarctica". *Korean Journal of Polar Research,* 5(2): 15-28.

A preliminary study of Antarctic mol1usks was conducted as a part of an evaluation of program of environmental conditions and conservation ai Maxwell Bay, South Shetland Islands, Antarctica. Twenty-three species of 1 chiton, 12 gastropods, and 9 bivalves were identified and redescribed.

3-20 **Choi, H. J.**, **I. -Y. Ahn**, **K. -W. Kim**, and 2 others. 2003. "Subcellular distribution of naturally elevated cadmium in the Antarctic clam *Laternula elliptica*". *Bulletin of Environmental Contamination and Toxicology*, 71: 83-89.

Antarctic marine environment, though one of the most pristine environments on earth, shows high levels of Cd in surface water accounted for by the upwelling of nutrient rich deep water (Honda et al. 1987). Cadmium which has a high affinity to phosphate seems to be taken up by phytoplankton, and accumulated in various organisms of higher trophic levels through the food web. Elevation of Cd, as a result, is likely a unique feature of Antarctic marine organisms (Honda et al. 1987; De Moreno et al. 1997).

3-21 **Choi, HeeSeon J.**, **In-Young Ahn**, and 4 others. 2001. "Preliminary Evidence for a Metallothionein-like Cd-binding Protein in the Kidney of the Antarctic Clam *Laternula elliptica*". *Ocean and Polar Research*, 23(4): 337-345.

A Cd-binding protein was identified in the renal cytosol of the Antarctic clam *Laternula elliptica* which naturally contains high concentrations of Cd. The Cd-binding protein showed similar characteristics of metallothionein (MT) in molecular weight (about 10-12 kDa) and low spectral absorbance at 280 nm with relatively high absorbance at 254 nm. Results of immuno-histochemical staining suggested that the MT-like Cd-binding protein was mainly located in the epithelial cells of the kidney. The MT-like protein was a major ligand of cytosolic Cd as shown in the elution profiles of chromatography and may play an important role in Cd sequestration and accumulation in *L. elliptica* kidney. A considerable amount of Cd was also found to be associated with particulate fraction, indicating the sequestration to particulate fraction is as important as binding to the cytosolic MT-like protein in Cd accumulation in the kidney.

3-22 **Choi, Heeseon J.**, **In-Young Ahn**, **Ko-Woon Kim**, and 3 others. 2003. "Subcellular accumulation of Cu in the Antarctic bivalve *Laternula elliptica* from a naturally Cu-elevated bay of King George Island". *Polar Biology,* 26(9): 601-609.

Subcellular Cu sequestration was examined in the digestive gland, kidney and gill of the Antarctic bivalve *Laternula elliptica* collected

from a Cu-elevated bay in King George Island. Cu was associated with both the soluble cytosolic and insoluble particulate cell fractions in all three organs, but their relative contributions to Cu sequestration varied with tissue type and the total amount of Cu accumulated. Low-molecular-weight (10–13 kDa) metallothionein-like proteins were the major Cu-binding ligands in the cytosol of all three organs. Significant portions of the cytosolic Cu were also bound to proteins with different molecular weights in the kidney and gill. A strong immunological response to a metallothionein (MT) antibody confirmed the presence of MTs in all three organs. Numerous electron-dense granules, which are likely to be metal-rich, were observed in renal epithelial cells by transmission electron microscopy, suggesting that these granules also play a role in Cu sequestration.

3-23 **Choi, Heeseon J.**, **In-Young Ahn**, Yong-Suk Lee, **Ko-Woon Kim**, and Kye-Heon Jeong. 2003. "Histological Responses of the Antarctic Bivalve *Laternula elliptica* to a Short-term Sublethal-level Cd Exposure". *Ocean and Polar Research,* 25(2): 147-154.

To develop fast and sensitive biomarkers for metal exposures in Antarctic marine organisms we examined histological alterations of an Antarctic sentinel bivalve species *Laternula elliptica* following a short-term exposure to a sublethal-level of Cd. Distinct histological alterations of tissues and cells of the gills, kidneys, and digestive glands were observed after 8- to 16- hours of exposure to Cd while an increase of Cd concentrations in tissues was not detectable. Most alterations were highly localized in the epithelium of the three tissues; epithelia were found to be detached from the remaining tissue parts. In addition ultra-structural changes such as cytosolic vacuolization, dilation of nucleus and rER membranes were detected in all three tissues, which suggested that the clams are subject to sublethal stresses. Thus, histological and ultrastructural changes on localized tissue parts were rapid and sensitive, suggesting that they may serve biomarkers for Cd exposures. Linkages between the shown ulrastructural changes and higher biological organization level responses are to be established by longer-term exposure experiments.

3-24 Chung, Chang Soo, Gi Hoon Hong, Dong-Jin Kang, Suk Hyun Kim, **Sung-Ho Kang**, and Moon Sik Suk. 1993. "Distribution and Dynamics of Dissolved Inorganic Nutrients in the Bransfield Strait, Antarctica during Austral Summer 1993". *Korean Journal of Polar Research*, 4(2): 1-10.

Distribution of plant major inorganic nutrients and Chlorophyll a in the Bransfield Strait between the Antarctic Peninsula and the South Shetland Islands was investigated during February 1993. In general, contents of nitrate, phosphate and silicate are > 25 μM, > 3.0 μM, > 60 μM, respectively in both a warm and saline Upper Circumpolar Deep Water ($T > 0.2$℃, 34.3 ‰; depth > 700 m) and a cold and saline Weddell Sea Surface Water ($T < 0.6$℃, $S > 34.4$‰; depth > 500m). In Bellingshausen Sea Water of higher temperature and lower salinity ($T > 1.6$ ℃, $S < 34$ ‰), contents of nitrate, phosphate, and silicate are < 20 μM, < 2.0 μM, < 30 μM, respectively. In general chlorophyl-a concentration is higher (0.8 g/l) in the surface mixed layer (50 m) and lower (0.2 g/l) below the surface mixed layer. Despite of the richness of nutrients, phytoplanktonic biomass is quite small. If we assume that carbon to Chlorophyll a ratio is 50, 19 μM of nitrate should support 30 g/l of Chlorophyll a according to Mitchell and Holm-Hansen Model (1991). Chlorophyll a concentration is lower 2 g/l in all the stations occupied during survey period. Therefore, phytoplankton

growth is not limited by the availability of major inorganic nutrients in this region. Approximately 80% of total chlorophyl-a standing crop is found in the upper 30 m of water column. But chlorophyl-a concentrations in productive less unproductive stations with the comparatively low stability of surface water are nearly uniform in the upper 100 m below the 1% light level. The comparatively low stability of surface waters prevent the organisms from remaining in the optimum light zone long enough for extensive production. This may partly answer one of possibilities of relatively poor productivity despite high nutrient level in the Antarctic waters. Owing to the subdued utilization of nutrients, salinity-nutrients property plots in the western Bransfield Strait show similar characteristic features to those of T-S diagrams. Therefore, nutrient concentrations are proposed here as a useful tracer to identify the water masses in the Bransfield Strait.

3-25 **Chung, Kyung Ho**, **Sung-Ho Kang**, **Jae-Shin Kang**, **SangHoon Lee**, and **Dong-Yup Kim**. 2000. "Photosynthetic Parameters of Phytoplankton Assemblages in the Surface Water of Maxwell Bay and the Weddell Sea during the 1996/97 Austral Summer". *Korean Journal of Polar Research*, 11(1): 19-26.

Photosynthetic parameters (P_m, α, β and I_m) were estimated from the relationship between photosynthesis (P) and irradiance (I) for natural phytoplankton assemblages in the surface water of Maxwell Bay and the Weddell Sea in order to understand regional photosynthetic characteristics between Antarctic coastal waters and deep pelagic waters during the 1996/97 austral summer. P_m values of the Weddell Sea were generally lower than Maxwell Bay, and it is likely to be associated with low temperature in the Weddell Sea. On the other hand, relatively high α and β values and low I_m values were observed at Maxwell Bay. These results indicate that phytoplankton assemblages in the surface waters of Maxwell Bay were more efficiently adapted to lower light intensity and have higher susceptibility to inhibition than that of the Weddell Sea. However, the variations of photosynthetic parameters in relation to environmental factors at each region were negligible.

3-26 Han, Taejin, Seon-Joo Park, Minsoo Lee, Young-Seok Han, **Sung-Ho Kang**, **Hosung Chung**, and **Sang Hoon Lee**. 2001. "Effects of Artificial UV-B and Solar Radiation on Four Species of Antarctic Rhodophytes". *Ocean and Polar Research*, 23(4): 389-394.

During austral summer 1998 we examined the impacts of artificial UV-B and solar radiation on chlorophyll a content and fresh weight of four species of Antarctic red algae namely, *Georgiella confluens*, *Iridaea cordata*, *Pantoneura plocamioides* and *Porphyra endiviifolium*. These subject species were taken in consideration of clear demarcations of their vertical distribution and classified as shallow water group (*Iridaea* and *Porphyra*) and deep water group (*Georgiella* and *Pantoneura*). When irradiated with artificial UV-B at the irradiance of 2.0 Wm^{-2} the shallow water inhabitants were much more resistant than the algae from deep water the fresh weight of which was reduced by 40-50% relative to control apart from loss of pigmentation. Direct solar radiation was lethal to the deep water group with a sign of complete bleaching whereas the shallow water group did not show any change in the physiological parameters. We were unable to discriminate difference in the algal sensitivity between UV-filtered and UV-transparent treatments since samples tested were either all unaffected or dead. Spectrophotometric measurements of methanolic extracts revealed a strong absorption peak in the UV range in the shallow water group of algae,

Iridaea and *Porphyra*, but not in the deep water counterparts. Species difference in sensitivity to artificial UV-B and solar radiation is discussed in relation to biochemical and morphological characteristics and the role of the radiation in the algal vertical distribution is suggested from ecological perspective.

3-27 Han, Taejun, Byeong-Jik Park, Young-Seok Han, **Sung-Ho Kang**, and **Sang Hoon Lee**. 2002. "Photosynthesis and Formation of UV-absorbing Substances in Antarctic Macroalgae Under Different Levels of UV-B Radiation". *Korean Journal of Environmental Biology*, 20(3): 205-215.

Effects of artificial and solar UV-B radiation on five rhodophytes (*Curdiea racovitzae*, *Gigartina skottsbergii*, *Mazzaella obovata*, *Myriogramme manginii*, *Palmaria decipiens*) from Antarctica have been investigated using PAM fluorescence in laboratory and in the field. Laboratory studies showed that there were significant differences in the UV sensitivity between different species, and that the differences appeared to be correlated with the depth of collection of the specimens. It was apparent from the observations that the samples such as *M. manginii* and *P. decipiens* collected from 20~30 m depths were more sensitive to UV-B radiation compared with those collected from shallower depths. The present study confirmed that an acclimation to the surrounding light regime could be an important factor to determine the UV-sensitivity of a species or individuals and that PAM measurements are rapid and non-destructive methods to evaluate UV influences. From field studies on *M. manginii* and *P. decipiens* it was observed that both plants exhibited changes in the effective quantum yield, with the minimum values at noon followed by a recovery in the evening. Photoinhibition occurred in these species could therefore be accounted for by so- called dynamic photoinhibition. It seems likely that this protective mechanism may contribute to survival of the species in shallow water where they may encounter intense solar radiation. The presence or absence of the UV-B component under solar radiation differently affected the photosynthetic recovery process, and the rate of recovery was much slower in UV-present than in UV-absent conditions. Functional role of UV-B appears to delay the recovery of photosynthesis in the studied macroalgae. Differential sensitivity to UV - B recognised between *M. manginii* and *P. decipiens* seemed to correspond well with the amount of UV-absorbing substances (UV AS) contained in the respective species. Higher tolerance to solar radiation by the latter species may be due to the higher amount of UV AS. There were variations of UVAS concentrations in algal thalli depending on the season and depth of collection.

3-28 Han, Taejun, **Hosung Chung**, and **Sung-Ho Kang**. 1998. "UV Photobiology of Marine Macroalgae". *Korean Journal of Polar Research*, 9(1): 37-46.

3-29 Ho, King-Chung, **Sung-Ho Kang**, and 2 others. 2003. "Distribution of *Alexandrium tamarense* in Drake Passage and the Threat of Harmful Algal Blooms in the Antarctic Ocean". *Ocean and Polar Research*, 25(4): 625-631.

While phytoplankton diversity and productivity in the Southern Ocean has been widely studied in recent years, most attention has been given to elucidating environmental factors that affect the dynamics of micro-plankton (mainly diatoms) and nano-plankton (mainly *Phaeocystis antarctica*). Only limited efforts have been given to studying the occurrence and the potential risks associated with the blooming of dinoflagellates in the relevant waters. This

study focused on the appearance and toxicological characteristics of a toxic dinoflagellate, *Alexandrium tamarense*, identified and isolated from the Drake Passage in a research cruise from November to December 2001 The appearance of *A. tamarense* in the Southern Ocean indicates the risk of a paralytic shellfish poisoning (PSP) outbreak there and is therefore of scientific concern. Results showed that while the overall quantity of *A. tamarense* in water samples from 30meters below the sea surface often comprised less than 0.1% of the total population of phytoplankton, the highest concentration of *A. tamarense* (20 cells L^{-1}) was recorded in the portion of the Southern Ocean between the southern end of South America and the Falkland Islands. Waters near the Polar Front contained the second highest concentrations of 10-15 cells L^{-1}. *A. tamarense* was however rarely found in waters near the southern side of the Polar Front, indicating that cold sea temperatures near the Antarctic ice does not favor the growth of this dinoflagellate. One strain of *A. tamarense* from this cruise was isolated and cultured for further study in the laboratory. Experiments showed that this strain of *A. tamarense* has a high tolerance to temperature variations and could survive at temperatures ranging from 5-26℃. This shows the cosmopolitan nature off. tamarense. With regard to the algal toxins produced, this strain of *A. tamarense* produced mainly C-2 toxins but very little saxitoxin and gonyailtoxin. The toxicological property of this *A. tamarense* strain coincided with a massive death of penguins in the Falkland Islands in December 2002 to January 2003.

3-30 **Jung, Woongsic**, **Youn-ho Lee**, **Hyung Chul Shin**, and 2 others. 2001. “Species identification of the chum salmon (*Oncorhynchus keta*) and pink salmon (*O. gorbuscha*) by use of genetic markers”. *Journal of the Korean Society of Fisheries Resources*, 4: 30-41.

Although the live chum salmon (*Oncorhynchus keta*) is discernable from the pink salmon (*O. gorbuscha*). processed salmon meat in the market place is hard to be distinguished from one species to the other. In order to resolve this situation, we analyzed microsatellite DNA Ogo5 and Ogo6 of the chum salmon and compared their sequences with those of the pink salmon. Four alleles of Ogo5 were identified in the chum salmon, which have distinct SNPs(Single Nucleotide Polymorphisms) and different numbers of repeat of (GT)n from the pink salmon: allele A, $(GT)_2GCATGC(GT)_2GCAC(GT)_3TCGGTTGCTTTT$: allele B1, $(GT)_2GTGTTT(GT)_2GCAT(GT)_6TTTTTT$: allele B2 $(GT)_2GTGTTT(GT)_2GCAT(GT)_7TTTTTT$: allele B3 $(GT)_2GTGTTT(GT)_2GCAT(GT)_7TTTTTTT$: the pink salmon. $(GT)_2GTGTTT(GT)_2GCAT(GT)_8TTTT$. Ogo6 of the chum salmon also has a distinct SNP and different numbers of repeats of (CT)n from that of the pink salmon: the chum salmon, $(CA)_5AA(CA)_5CG$ and $CTCA(CT)_2GT$: the pink salmon, $(CA)_5AA(CA)_6$ $AA(CA)_5CG$ and $CTCA(CT)_3GT$. These results suggest that the microsatellite DNA Ogo5 and Ogo6 would be good means of discrimination for the salmon meat in the market. Use of genetic markers as shown in this study could be applied to many different kinds of fish products for the identification of the species and their origins.

3-31 Kang, Do-Hyung, **In-Young Ahn**, and Kwang-Sik Choi. 2003. “Quantitative assessment of reproductive condition of the Antarctic clam, *Laternula elliptica* (King & Broderip), using image analysis”. *Invertebrate Reproduction and Development*, 44(1): 71-78.

We quantitatively assessed the reproductive state of the Antarctic clam, *L. elliptica*, collected from a small cove on King George

Island in the spawning season. Using computer-based image analysis, percentage gonad area (PGA), percentage egg area within a follicle (FI), and mean oocyte diameter (MOD) were determined from gonadal cross-sections prepared for histological studies. These indices were then compared on the basis of scores from 1 to 6 on a conventional maturity index (MI), which is scored using subjective criteria determined by microscopic examination. Clams collected during two different spawning periods were analyzed. The FI and MOD values differed significantly between the two groups, but MI and PGA values did not, suggesting that FI and MOD are the more reliable and sensitive indicators for differentiating reproductive condition. This study also showed that a planimetric technique using computer-based image analysis is fast, convenient to use, and better than the conventional MI at providing reliable quantitative information about *L. elliptica* reproduction. We also investigated whether these indices varied with body size. The FI and MOD values peaked in clams of 76 to 85 mm shell length, indicating that clams of this size have the highest reproductive output at spawning time. Therefore, animals of a standard size (76 to 85 mm) should be monitored seasonally or over a longer term.

3-32 Kang, Dong-Jin, Chang Soo Chung, Lee W. Cooper, **Cheon Yoon Kang**, **YeaDong Kim**, and Gi Hoon Hong. 1992. "Oxygen-18 and Nutrients in the Surface Waters of the Bransfield Strait, Antarctica during Austral Summer 1990/91". *The Journal of the Oceanological Society of Korea*, 27(3): 250-258.

The oxygen isotope composition of surface waters in the Bransfield Strait was determined as one extra state variable in order to characterize water masses in the region, since salinity is significantly modified due to the freezing and ice-melting in the polar region. The salinity, temperature, and $\delta^{18}O$ values vary from 34.0 to 34.5 ‰, −0.5 to 2.1℃ and −0.50 to −0.26 ‰, respectively. The combined effects of evaporation, precipitation, freezing, ice-melting are reflected in the widely scattered data. Although it is small, the distribution of $\delta^{18}O$ of the Bransfield Strait is strongly affected by the freezing-ice melting rather than the evaporation-precipitation. The ice melted fresh water which has higher temperature, depleted salinity and nutrients may be injected to the Bransfield Strait from the north. The concentrations of nutrients are decreasing gradually from the north to the south. The waters were characterized by two groups of higher (about 19.4) and lower N/P ratio (about 16.7). The lower N/P ratio is found in the northem part where ice-melted fresh water is injected. and the higher N/P ratio is found in the southem part of the Bransfield Strait. Although more precise work is needed, the difference of N/P ratio can be an evidence of the ice melted water injection to the Bransfield Strait Chlorophyll α concentrations, in general, increase from northwest (Weddell Sea) to the southeast (Smith and Hosseason Islands). Probably the injection of nutrient depleted fresh water from the ice melting reduce the chlorophyll α concentration.

3-33 Kang, Donhyug, **Hyoung-Chul Shin**, Suam Kim, **Yoonho Lee**, and Doojin Hwang. 2003. "Species Identification and Noise Cancellation Using Volume Backscattering Strength Difference of Multi-Frequency". *Journal of Korean Fisheries Society,* 36(5): 541-548.

Species identification in hydroacoustic survey is one of the key requirements to estimate biomass of organism and to understand the structure of zooplankton community. Feasibility of species identification using two frequencies (38 and 120 kHz) was investigated on the basis of mean volume

backscattering strength difference (MVBS). Virtual echogram technique was applied to two frequencies data sets that obtained from surveys in the Antarctic Ocean and Yellow Sea. Virtual echogram method using MVBS revealed the possibility of species identification, which species identification relying on visual scrutiny of single frequency acoustic data resulted in significant errors in biomass estimation. Through noise cancellation using MVBS, much of the acoustic noise caused by acoustic instruments could be removed in new virtual echogram, and the biomass estimation and data quality was improved.

3-34 **Kang, Jae-Shin**, **Sung-Ho Kang**, **Dongseon Kim**, and **Dong-Yup Kim**. 2003. "Planktonic centric diatom *Minidiscus chilensis* dominated sediment trap material in eastern Bransfield Strait, Antarctica". *Marine Ecology Progress Series*, 255: 93-99.

The planktonic centric diatom *Minidiscus chilensis* Rivera was collected over 1 yr in a sediment trap at 1000 m depth in one of the deep basins in the eastern Bransfield Strait, Antarctica. The valves of this diatom are 3 to 8 μm in diameter and quadrangular in girdle view. The center of each valve is prominently hyaline with 3 strutted processes and a labiate process. *M. chilensis* was observed in all of the sediment trap samples collected between December 25, 1998 and December 24, 1999. The flux of *M. chilensis* into the trap varied considerably according to season, with the highest flux of 2.4×10^9 valves m^{-2} d^{-1} (87% of total diatom valve flux) occurring in mid January when the mooring area was free of sea-ice. The dominance of *M. chilensis* among planktonic diatoms in Antarctic open waters has not been previously recorded. Our study suggests that *M. chilensis* should be included in future quantitative analyses and should be considered an important species for under-standing the ecological structure of Antarctic waters.

3-35 **Kang, Jae-Shin**, **Sung-Ho Kang**, Jin Hwan Lee, Don Won Choi, and **SangHoon Lee**. 2000. "Seasonal Variation of Microalgae in the Surface Water of Marian Cove, King George Island, the Antarctic 1998/1999". *Korean Journal of Environmental Biology*, 18(1): 21-31.

We investigated seasonal variation of microalgal assemblages, sea water temperature, salinity and suspended solid and the parameters measured daily from January 1998 to October 1999 at a nearshore shallow-water in Marian Cove, Maxwell Bay, King George Island, the Antarctic. Annual mean surface water temperature was –0.30℃ and the highest water temperature was 4.53℃ (22 January 1999) and the lowest water temperature was –2.07℃ (23 August 1998). Annual mean salinity was 33.38 psu, ranging from 42.80 psu (6 January 1999) to 19.50 psu (6 June 1999). Annual mean suspended solid (SS) during two years was 34.14 mg^{-1}, ranging from 60.62 mg^{-1} (7 March 1998) to 12.90 mg^{-1} (26 December 1998). Chlorophyll α (Chl α) concentrations were measured in order to know seasonal variations of microalgae in the surface seawater. Annual mean of total Chl α concentration was 0.55 $\mu g \cdot l^{-1}$, the highest Chl α concentration (12.16 $\mu g \cdot l^{-1}$) appeared in 4 October 1998, the lowest Chl α concentration appeared 0.19 $\mu g \cdot l^{-1}$, Monthly mean total Chl α concentration was high in October 1998 (1.32 $\mu g \cdot l^{-1}$) and low in July on 1998 (0.28 $\mu g \cdot l^{-1}$). Annual mean nano-sized Chl α concentration was 0.40 $\mu g \cdot l^{-1}$, monthly mean nano -sized Chl α concentration was high in November 1998 (0.90 $\mu g \cdot l^{-1}$), and low in July 1999 (0.22 $\mu g \cdot l^{-1}$). Annual mean micro-sized Chl α concentration was 0.15 $\mu g \cdot l^{-1}$ monthly mean micro-sized Chl α concentration was high in October 1998 (0.81 $\mu g \cdot l^{-1}$), and low July 1998, January, February and September 1999 (0.05 $\mu g \cdot l^{-1}$).

More than 65% of total Chl α was concentrated during spring and summer time between October and March. Microalgal variation appeared to be due to physical factors of seawater in the Antarctic nearshore from 1998 to 1999. The reason why micro-sized Chl α did not increase during austral summer was the bay had been frozen by decrease of water temperature. We think that total microalgal abundance was decreased because the summer microalgal abundance was determined by variation of water temperature during winter season. [Chl α concentration, Microalgal assemblages, Seasonal variation, the Antarctic nearshore].

3-36 **Kang, Jae-Shin**, **Sung-Ho Kang**, Jin Hwan Lee, **Kyung Ho Chung**, and **Mi-Young Lee**. 1997. "Antarctic Micro- and Nano-sized Phytoplankton Assemblages in the Surface Water of Maxwell Bay during the 1997 Austral Summer ". *Korean Journal of Polar Research*, 8(1, 2): 35-45.

Micro- and nano-sized phytoplankton composition and biomass were investigated in the surface water of Maxwell Bay, Antarctica during the 1997 austral summer. In the Micro-sized plankton (>20 μm), benthic diatoms such as *Fragilaria Striatula*, *Licmophora belgicae*, and *Pseudogomphonema kamchaticum* dominated in the central zone of the bay (>200 m water depth). Variations in phytoplankton canbon biomass were strongly correlated with chl α concentration. In the nano-sized plankton (<20 μm), *Cryptomonas* spp., *Minidiscus trioculata*, *Phaeocystis antarctica*, and siliceous cyst dominated in all of the stations. Benthic diatom biomass in surface water was decreased from the nearshor (0.71-5.58 μg C l^{-1}) toward the bay mouth of Maxwell Bay (0.08-1.04 μg C l^{-1}), whereas planktonic diatoms such as *Corethron criophilum* and *Thalassiosira* spp. dominated in the offshore (>1.0 μg C l^{-1}). *Navicula glaciei*, a nano-sized cryophilic diatom, was increased dramatically at stations near glacier cliffs. Nano-sized phytoplankton accounted for 47-86% of total phytoplankton carbons. Although this study was dealt with a day phenomenon, this study emphasizes the importance of benthic diatoms as major primary producer in nearshore environment.

3-37 **Kang, Jae-Shin**, **Sung-Ho Kang**, Jin Hwan Lee, **SangHoon Lee**. 2002. "Seasonal variation of microalgal assemblages at a fixed station in King George Island, Antarctica, 1996". *Marine Ecology Progress Series*, 229: 19-32.

Microalgal assemblages were measured daily from January to December 1996 at a fixed neritic station in Marian Cove, King George Island, Antarctica. The abundance of microalgae and carbon biomass exhibited clear seasonal variation. Annual mean of total microalgal abundance in surface water was 2.43×10^4 cells l^{-1}. Microalgal cell abundance in Marian Cove showed a multimodal distribution of standing crop during the study period. Microalgae started to bloom in October and increased abruptly during November. More than 45% (avg. 3.5 mg m^{-3}) of chl a was present in the 2 months November and December, dominated by microplanktonic diatoms (>20 μm) such as *Fragilaria striatula* Lyngbye, *Licmophora belgicae* Peragallo, and *Achnanthes groenlandica* Grunow. The increase of these diatoms were mainly due to resuspension of benthic microalgae by wind and tidal currents in spring and summer. In contrast, microalgal assemblages in winter were characterized by the dominance of pico- and nanoplanktonic microalgae (<20 μm) such as *Phaeocystis antarctica* Karsten, *Navicula glaciei* Van Heurck, and *Navicula perminuta* Grunow.

3-38 **Kang, Jae-Shin**, **Sung-Ho Kang**, **Youn-Ho Lee**, **Jung-Hee Shim**, and **Sang-Hoon Lee**. 2003. "UV-B effects on growth and nitrate dynamics in Antarctic marine diatoms *Chaetoceros neogracile* and *Stellarima microtrias*". *Algae*, 18(1): 13-20.

Two isolated Antarctic marine diatoms, *Chaetoceros neogracile* VanLandingham and *Stellarima microtrias* (Ehrenberg) Hasle and Sims were examined to show changes of growth and uptake rate of nitrate due to UV-B irradiance. Chlorophyll (chl) a concentration was regarded as the growth index of diatom. The diatoms were treated with UV-B radiation and cultured for 4 days under cool-white fluorescent light without UV-B radiation. Two levels of UV-B exposures were applies: 1 and 6 W m^{-2}. Durations of UV-B treatment were 20, 40 and 60 minutes under 6 W m^{-2} and 1, 2, 3, 4 and 5 hrs under 1 W m^{-2}. The control groups were cultured at the same time without UV-B radiation. The growth rates of two diatoms decreased under 1 and 6 W m^{-2} UV-B irradiances than that of control group. After 4 days, chl a concentrations of *C. neogracile* were increased more than 4 times from 133 μg·l^{-1} to 632 μg·l^{-1} in control group. However, the concentration of experimental groups under 1 W m^{-2} UV-B were only increased from 139 μg·l^{-1} to 421 μg·l^{-1} during one hour and the chl a concentrations were decreased from 144 μg·l^{-1} to 108 μg·l^{-1} during five hour. Growth of diatom dramatically more decreased under 6 W m^{-2} UV-B than 1 W m^{-2} UV-B. The chl a concentration of experimental groups under 6 W m^{-2} UV-B for one hour was only increased from 111 μg·l^{-1} to 122 μg·l^{-1}. In the case of *S. microtrias* showed also similar pattern to *C. neogracile* by UV-B radiation. The uptake rates of nitrate by the two strains were decreased abruptly under 6 W m^{-2} UV-B irradiances. When two strains were treated under 1 and 6 W m^{-2} UV-B during one hour, the strains were only continued growth and uptake of nitrate under 1 W m^{-2} UV-B. This experimental evidence shows that exposure to UV-B radiation especially to high irradiance of UV-B decreases diatom survival and causes lower decrease of nutrient concentrations by microalgae in Antarctic water. Furthermore, evidence suggests that microalgal communities confined to near-surface waters in Antarctica will be harmed by increased UV-B radiation, thereby altering the dynamics of Antarctic marine ecosystems.

3-39 **Kang, Sung-Ho** and **Jae-Shin Kang**. 1998. "*Phaeocystis antarctica* Karsten as an Indicator Species of Environmental Changes in the Antarctic". *Korean Journal of Polar Research*, 9(1): 17-35.

Phaeocystis antarctica Karsten is widely distributed in Antarctic waters, and forms mas-sive near-surface blooms in the marginal ice-edge zone. Because of the location and timing of the *P. antarctica* bloom, this prymnesiophyte has been exposed to high levels of UV-B (280 to 320 nm) radiation. UV-B-induced changes in species composition favouring the colonial stage of *P. antarctica* would be the potential for altered trophodynamics and carbon flux in Antarctic waters as a result of ozone depletion. The overall physiological impact of increased UV-B exposure on *P. antarctica* would presumably shift the balance between photosynthesis and respiration, resulting in consequent changes in species composition. In this paper, we briefly review *P. antarcitca*-dominated ecosystem in the Antarctic, taxonomic identity and life cycle of *P. antarctica* microbial degradation of *P. antarctica* material in the water column, sedimentation and regeneration of *P. antarctica* blooms, and the trophic significance of *P. antarctica* blooms. Then we review dimethyl sulfide (DMS) and *P. antarctica*, response of *P. antarctica* to UV-B fluctuations. The observed long-term increase of *Phaeocystis* bloom occurrences in the

Antarctic waters gives support of the good adaptability of colony forms to growth in the changing environment, rendering *Phaeocystis* appears to be useful as indicator species of long-term and/or chronic environmental changes, such as climate and environmental changes (e.g. eutrophication, UV-B effects, global warming).

3-40 **Kang, Sung-Ho** and **SangHoon Lee**. 1995. "Antarctic phytoplankton assemblage in the western Bransfield Strait region, February 1993: composition, biomass, and mesoscale distributions". *Marine Ecology Progress Series*, 129: 253-267.

The Bransfield Strait region shows complex patterns of water circulation due to mixing of diverse water masses. Physicochemical properties of the different water types should affect the distribution, biomass, and species composition of the phytoplankton assemblages. We examined these features of phytoplankton in the western Bransfield Strait region during early February 1993. Diversity of the phytoplankton species was low. Only 5 or 6 species accounted for more than 95 % of the total phytoplankton carbon biomass. Integrated phytoplankton biomass in the upper 100 m ranged from 407 to 3605 mg C m^{-2} (average 1906 mg C m^{-2}). Areas with the higher biomass values (2000 to 3500 mg C m^{-2}) were located in the northern part of the study area including waters to the north of the South Shetland Islands, and were generally related to increased stability of the surface water originating from the Bellingshausen Sea featuring lower salinity (33. 69 to 33.78 ‰) and higher temperature (1.89 to 2.36℃). Distribution of autotrophic nanoflagellates (<20 μm) showed a marked contrast to that of diatoms. Waters in the Bransfield Strait region were characterized by a dominance of nanoflagellates such as *Cryptornonas* sp. and *Phaeocystis antarctica* (motile stage) accounting for 83% of the total phytoplankton carbon. In the Drake Passage area, however, diatoms such as the nanoplanktonic *Fragilanopsis pseudonana* and the microplanktonic (>20 μm) *Rhizosolenla antennata* f. *semispina* accounted for 84 % of the total phytoplankton carbon. From measurements of upper ocean physical parameters and nutrients in combination with the data on composition, biomass, and distribution of the major phytoplankton species, it was found that mesoscale distributions of phytoplankton species reflect the physical conditions of the upper water column, particularly the profile of vertical stability of the water.

3-41 **Kang, Sung-Ho**, **Jae-Shin Kang**, **Won-Choel Lee**, and Chang-Soo Chung. 1996. "Surface Phytoplankton in the Bering Sea During Summer 1994 and 1995 : Relationships to Physical and Chemical Environmental Parameters". *Ocean Research*, 18(Special): 13-36.

Surface phytoplankton with their physiochemical environments were sampled in the intemational zone of the Bering Sea and in the Bogoslof Island region during summer(July) 1994 and 1995. Surface chl α concentrations ranged from 0.54 to 10.2 μg l^{-1} during the study period. Areas with the higher chl α values(3.4–10.2 μg l^{-1}) were located in the continental shelf break and in the Bogoslof Island region. Waters in the Bogoslof were characterized by a dominance of microplanktonic(>20 μm) diatoms such as *Corethron criophilum*, *Chaetoceros* spp., and *Rhizosolenia* spp. The highest chl α value was measured at Station 6 in the Bogoslof with 10.21 μg l^{-1} which was about 15 to 20 times higher value compared to that in the international zone of the Bering Sea. It is speculated that such a high phytoplankton biomass in the Bogoslof region was caused by water column stability which was developed near the continental shelf break. Less saline

waters(32.2-32.5 ‰) in the northeastern part of the Bering Sea seem to be intruded to the open waters and created a front to cause increase of phytoplankton biomass. Surface temperature ranged from 5.3 to 8.7 (average 7.2±0.6℃) in 1994 and from 9.8 to 12.4℃ (average 10.7±0.8℃) in 1995, respectively. Surface temperatures showed weak influence on phytoplankton distribution, but about 3℃ surface temperature difference between 1994 and 1995 may affect on the phytoplankton growth. Mean values of major nutrients such as nitrate. phosphate, and silicate were 6.2±3.2 μm, 0.87±0.4 μm, 14.5±7.0 μm in 1994, respectively. With increase of phytoplankton decrease of the major nutrients was observed.

3-42 **Kang, Sung-Ho**, **Dong-Yup Kim**, **Jae-Shin Kang**, **Mi-Young Lee**, and **Sang Hoon Lee**. 1995. "Antarctic Phytoplankton in the Eastern Bransfield Strait Region and in the Northwestern Weddell Sea Marginal Ice Zone during Austral Summer". *Korean Journal of Polar Research*, 6(1/2): 1-30.

Phytoplankton on three north-south transects of the 7th Korean Antarctic Research Program (KARP) expedition in the eastern Bransfie1d Strait region and in the northwestern Weddell Sea marginal ice zone were sampled during austral summer from 3 to 10 January 1994. Phytoplankton cells from discrete water bottle samples from 22 stations were counted to gain quantitative information on the composition, biomass, and distribution in water column assemblages. The mean integrated total phytoplankton carbon biomass in the upper 100 m was 5.8 g Cm^{-2} during the study period. The richest phytoplankton areas (7.9-14.4 g Cm^{-2}) were located at stations near the Weddell Sea ice-edge zone, and were found to be associated with increase number of prymnesiophyte *Phaeocystis antarctica* in colonial form. The colonial *P. antarctica* dominated phytoplankton stocks, reaching biomass of 7.6 g Cm^{-2}, and average integrated biomass (3.0 g Cm^{-2}) of *P. antarctica* from the three N-S transects was about 51% of total phytoplankton carbon biomass. Composition, biomass, and distribution of phytoplankton showed a marked difference between the Bransfield Strait region and the Weddell Sea ice-edge zone. Waters in the Bransfield Strait region were characterized by a dominance of nanoplanktonic species such as *P. antarctica* in motile stage, *Fragilariopsis* "*nana*". and *Cryptomonad* sp., and autotrophic picoflagellates accounting for 75% of total phytoplankton carbon biomass. In the Weddell Sea margina1 ice zone, however, *P. antarctica* in colonial stage, *Thalassiosira gravida*, and *Fragilariopsis* spp. accounted for 83% of the total phytoplankton carbon. From measurements of structure of phytoplankton assemblages at the species-specific level, it was found that *Phaeocystis antarctica* in colonial stage, *Thalassiosira gravida*, *Fragilariopsis* spp., *Proboscia truncata*, *Chaetoceros socialis*, *C. dichaeta*, *C. neglectum*, *Corethron criophilum*, *Cylindrotheca closterium*, *Pseudonitzschia subcurvata*, *P. turgiduloides* were sea ice related species, while *Phaeocystis antarctica* in motile stage, *Fragilariopsis* "*nana*", *ryptomonas* sp., autotrophic picoflagellates, *Proboscia alata*, *Pyramimonas* sp., and *Nitzschia lecointei* were more closely related in open waters of the Bransfield Strait region away from the marginal ice zone where there is little impact from melt waters.

3-43 **Kang, Sung-Ho**, **Jae-Shin Kang**, **Kyung-Ho Chung**, **Mi-Young Lee**, **Bang-Yong Lee**, **Hosung Chung**, **Yeadong Kim**, and **Dong-Yup Kim**. 1997. "Seasonal Variation of Nearshore Antarctic Microalgae and Environmental Factors in Marian Cove, King George Island, 1996". *Korean Journal of Polar Research*, 8(1, 2): 9-27.

Nearshore microalgal assemblages and physicochemical factors (meteorological para-meters, sea water properties, and macronutrients) have been measured daily from January to December 1996 at a nearshore shallow-water in Marian Cove, King George Island in the martitime Antarctic. Microalgal biomass (size-fractionated at 20 μm) and the environmental factors all exhibited clear seasonal variability. Seasonal variation of nearshore microalgal biomass was affected by the combination of the environmental factors, and increase of microalgal biomass during austral summer affected on bacteria and macronutrients. Chlorophyll a determinations demonstrated a marked seasonality in microalgal biomass. The summer peak of microplankton chlorophyll was dominated by large diatoms. Peak concentrations of pico- and nanoplankton chlorophyll, predominantly from flagellates, were much lower but the bloom lasted longer and winter biomass was higher than in the microplankton. The summer increases of nearshore planktonic microalgae have not been the result of in situ production and growth of phytoplankton, but attributed to resuspension of benthic microalgae by wind and tidal currents. The resuspension seems to be an important mechanism to affect the diversity of nearshore phytoplankton assemblages. The tychoplanktonnic forms the intertidal and subtidal diatom communities seem to contribute substantially to important carbon source to sus-tain the nearshore ecosystem of Marian Cove.

3-44 **Kang, Sung-Ho**, **Jae-Shin Kang**, **Sang Hoon Lee**, and **Youn Ho Lee**. 2001. “Effects of the Antarctic Ozone Depletion on the Marine Phytoplankton”. *Algae*, 16(3): 303-314.

The Antarctic ecosystem has been affected by continuous ozone depletion. Increase of UV radiation due to the ozone depletion in the Antarctic has changed growth environment for the marine organisms, resulting in various effects on the Antarctic marine ecosystem whether adverse or not. Especially, fast growing primary producers, phytoplankton which use solar light as energy source are the most sensitively affected organisms against the UV increase. The UV radiation increase may result in change of the productivity, biomass, and species composition of phytoplankton. In addition, UV radiation could cause physiological, genetic, and ecological changes of phytoplankton cells. It is necessary to accumulate baseline data which will be compared with the future data to estimate the degree of changes in the Antarctic marine ecosystem. The Antarctic phytoplankton which have adapted for a long time to the extreme environment can be used as continuous biological indicator to detect and monitor the environmental changes. We have reviewed recent research papers about effects of the ozone depletion on the Antarctic marine phytoplankton.

3-45 **Kang, Sung-Ho**, **Jae-Shin Kang**, **SangHoon Lee**, **DongSeon Kim**, and **Dong-Yup Kim**. 2000. “Importance of Polar Phytoplankton for the Global Environmental Change”. *Korean Journal of Environmental Biology*, 18(1): 1-20.

There are increasing evidences of climate change in the Antarctic and Arctic Oceans, especially elevated temperature due to the continuous burning of the fossil fuels and ultraviolet B(UV-B) flux within the ozone hole. Light-dependent, temperature-sensitive, and fast-growing organisms respond to these physical and biogeochemical changes. Polar marine phytoplankton, which are pioneer endemic species and important carbon contributors in the polar waters, are therefore highly suitable biological indicators of such changes. By virtue of light requirement, the primary producers are exposed to extreme seasonal

fluctuations in temperature, photosynthetically active radiation, and UV radiation. Local environmental warming and increased UV-B radiation during ozone depletion may have profound effects on the primary producers that are primary carbon producers in the polar water. Small changes in climate temperature and solar radiation may have profound effects on the activity threshold of the polar phytoplanktion. To demonstrate biological response to the environmental changes, standardized representative natural and biological parameters are needed so that replicate samples (including controls) can be taken over extended periods of time. In this paper, we review general characteristics of polar phytoplankton, their environment, environmental changes in the polar waters, the effects on the environmental changes to the polar phytoplankton, and the importance of the polar phytoplankton to understand the global environmental changes.

3-46 **Kang, Sung-Ho**, **Jae-Shin Kang**, **SangHoon Lee**, **Kyung Ho Chung**, **DongSeon Kim**, and Myung Gil Park. 2001. "Antarctic phytoplankton assemblages in the marginal ice zone of the northwestern Weddell Sea". *Journal of Plankton Research*, 23(4): 333-352.

The waters around the northern tip of the Antarctic Peninsula show complex patterns of water circulation due to mixing of diverse water masses. Physicochemical properties of the different water types should affect the distribution, biomass and species composition of the phytoplankton assemblages. We examined these features in the marginal ice zone (MIZ) of the northwestern Weddell Sea. Areas with the higher biomass were located in the Weddell Sea MIZ where the surface waters were relatively stable due to the sea-ice melting. In these waters, the colonial stage of Phaeocystis antarctica and micro-sized chain-forming diatoms accounted for 70% of the total phytoplankton carbon. Waters in the Bransfield Strait region, in contrast, were characterized by a dominance of nanoflagellates, which accounted for 80% of the total phytoplankton carbon. Our observations support the hypothesis that the species composition of phytoplankton communities is a function of the different water mass, reflecting the physical conditions of the upper water column, particularly its stability.

3-47 **Kang, Sung-Ho**, **Kyung Ho Chung**, **Jae-Shin Kang**, and **Yeadong Kim**. 2003. "Distribution of phytoplankton biomass and nutrient concentrations in the Barents and Kara Seas during the 1st Korea-Russia Arctic Expedition in August, 2000". *Ocean and Polar Research*, 25(3): 315-329.

During the 1st Korea-Russia Arctic Expedition from 3 to 26 August, 2000 phytoplankton biomass and nutrient concentration were measured in the Barents and Kara Seas. Total of 57 surface samples were collected for the phytoplankton related measurements. Chlorophyll a (chl a) concentrations were measured to investigate the relations between physico-chemical factors and phytoplankton biomass distribution. Chl a values ranged from 0.14 to 2.34 mg m^{-3} (mean of 0.65 ± 0.42 mg m^{-3}) over the surface stations. The elevated values of the chi a concentrations (1.49~2.34 mg m^{-3}) were found in the southeastern Barents Sea near the Pechora River. Nanoplanktonic (<20 μm) phytoflagellates were the important contributors for the increase of the chi a. The nano-sized phytoflagellates accounted for more than 80% of the total chi a biomass in the study area. Mean chi a concentration in the Barents Sea (0.72 ± 0.57 mg m^{-3}) was higher than in the Kan Sea (0.52 ± 0.45 mg m^{-3}), but there was no big difference between two areas. Surface temperatures and

salinities ranged from 4.1 to 11.7℃ (mean of 8.8 ± 1.9℃) and from 23.8 to 32.5 psu (mean of 30.3 ± 1.9 psu), respectively. The physical factors were not highly correlated with phytoplankton distribution. It is speculated that the insignificant correlation between phytoplankton biomass and physical factor was due to the same current which introduced similar water mass with higher water temperature and lower salinity into the study area. The mean values of major nutrients such as ammonia, nitrite, nitrate, phosphate, and silicate were 0.42 ± 0.31 μM, 0.10 ± 0.03 μM, 0.35 ± 0.12 μM, 10.99 ± 3.45 μM, respectively. The relations between phytoplankton biomass and nutrient concentration were not close, indicating that the surface nutrient concentrations during the study seem to be controlled by other physical factors such as input of fresh water (i.e. dilution effects).

3-48 **Kang, Sung-Ho**, Moon Sik Suk, Chang Soo Chung, Soo Yong Nam, and **Cheon Yoon Kang.** 1993. "Phytoplankton Populations in the Western Bransfield Strait and the Southern Drake Passage, Antarctica". *Korean Journal of Polar Research,* 4(2): 29-43.

The quantitative composition, biomass and mesoscale distribution of phytoplankton were studied in the western Bransfield Strait region including the southern portion of Drake Passage during the austral summer (February) of 1993 as part of the 6th Korea Antarctic Research Program (KARP). Dominant phytoplankton species in terms of biomass (carbon) were phytoflagellates such as *Cryptomonas* sp. and *Phaeocystis* sp. (motile form) and diatoms such as *Fragilariopsis pseudonana* and *Rhizosolenia antennata* fo. *semispina*, accounting for about 87% of total phytoplankton carbon. The distribution and biomass of the phytoplankton populations within the study area were variable, with the higher total phytoplankton cell carbon values generally being found northern portion of the study area near Snow and Livingston Islands Shelves and in Drake Passage waters, while the lower values were generally in Bransfield Strait waters. Phytoflagellates and diatoms showed different distribution patterns. The relative and absolute values of carbon biomass of phytoflagellates were higher in Bransfield Strait region, while the diatoms were more dominant in the southern Drake Passage region. Principal component analysis (PCA) using cell carbon density of the dominant phytoplankton species ($\mu g \cdot C \cdot l^{-1}$) from 144 discrete water samples as variables revealed that the samples from the western Bransfield Strait region were not only separated based on depth (above pycnocline vs. below pycnocline), but also separated based on horizontal water mass differences such as fine-scale temperature gradients between stations.

3-49 **Kang, Sung-Ho**, **Yeadong Kim**, **Jae-Shin Kang**, **Kyu-Cheul Yoo**, **Ho Il Yoon**, and Wonchoel Lee. 2003. "Monitoring on the Marine Environment and Phytoplankton of Kongsfjorden, Svalbard, Arctic". *Ocean and Polar Research*, 25(2): 213-226.

Kongsfjorden near Korean Arctic Station, Dasan, is a glacial fjord in the Svalbard archipelago, Arctic that is influenced by both Atlantic and Arctic water masses. During the Arctic field season August 2002, surface temperature, salinity, density, and phytoplankton biomass (chl a) was measured in Kongsfjorden. A total of 15 surface samples were collected for the phytoplankton related measurements. Chl a values ranged from 0.08 to 1.4 mg chl a m^{-3} (mean of 0.53 mg chl a m^{-3}) in the overall surface stations. The highest values of the chl a concentrations (>1.0 mg chl a m^{-3}) were found near glacier in the northeastern part of Kongsfjorden. Nanoplanktonic (<20 μm) phytoflagellates

were important contributors for the increase of the chl a. The nano-sized phytoflagellates accounted for more than 90% of the total chi a biomass in the study area. Surface temperatures and salinities ranged from 2.5 to 7.18℃ (mean of 4.65℃) and from 22.55 to 32.97 psu (mean of 30.16 psu), respectively. The physical factors were not highly correlated with phytoplankton distribution. The character of surface water due to down-fjord wind was highly similar to phytoplankton distribution. Drifting ice, freshwater, and semdiment inputs from large tidal glaciers located in the inner part of Konsfjorden create steep physico- and biogeochemical environmental gradients along the length of this ford. The glacial inputs cause reduced biodiversity biomass and productivity in the pelagic community in the inner fjord. Primary production of benthic and pelagic microalgae is reduced due to the limited light levels in the turbid and mixed inner waters. The magnitude of glacial effects diminishes towards the outer fjord. Kongsfjorden is an important feeding ground fer marine mammals and seabirds. Especially, seabirds play the largest energy intake and also export nutrients for primary production of the marine microalgae. Kongsfjorden has received a lot of research attention as a site for exploring the impacts of climate changes. Dasan Station in Kongsfjorden will be an important Arctic site for monitoring and detecting future environmental changes.

3-50 **Kim, Dongseon**, **Byong-Kwon Park**, and **Ho Il Yoon**. 1998. "Vertical Variations of Major, Minor, and Rare Earth Elements in the Maxwell Bay Sediments of the South Shetland Islands, West Antarctica". *Ocean Research*, 20(1): 9-18.

Vertical distributions of major, minor, and rare earth elements were determined to investigate the major factors controlling these element concentrations in Maxwell Bay sediments. Na, Mg, K, Cr, and heavy rare earth element concentrations are mostly controlled by sediment texture. On the other hand, Fe, Co, Cu, Mn, V, Cd, Zn, Pb and light rare earth element concentrations are mainly influenced by sulfide minerals. The negative Ce anomalies with no distinct vertical trend suggest that oxidizing conditions are dominant in the sediment column of the Maxwell Bay, and the redox conditions have not significantly changed during the sediment deposition. The positive Eu anomalies and shale-normalized rare earth element(REE) patterns which are similar to those of the hydrothermal solution indicate that the Maxwell Bay sediments are significantly affected by the hydrothermal system. The rapid increase of total sulfur contents in the Maxwell Bay sediments indicates the *in situ* formation or existence of sulfide minerals. The sulfide minerals seem to be derived from the King George Island by the advance of sea ice before 4,000 *yr* B.P.

3-51 **Kim, Dongseon**, **Dong-Yup Kim**, **JeongHee Shim**, **Sung-Ho Kang**, and **Young-Chul Kang**. 2001. "Particle Flux in the Eastern Bransfield Strait in 1999, Antarctica". *Ocean and Polar Research*, 23(4): 395-400.

A time-series sediment trap was deployed at 1,034 m water depth in the eastern Bransfield Strait from December 25, 1998 to December 24, 1999. About 99% of total mass fluxes were observed during the austral summer and fall (January, February, and March). The annual total mass flux was 49.2 g m^{-2}. Biogenic materials including biogenic silica, organic matter, and carbonate accounted for about 67% of total particle flux, and lithogenic materials contributed about 29%. Biogenic silica was the most dominant (42% of the total flux) in these components. The next most important biogenic component was organic matter, comprising 24% of total mass flux. Calcium carbonate contributed a

small fraction of total mass flux, only 0.6%. The annual organic carbon flux was 5.2 g C m^{-2} at 1,034 m water depth. The annual primary production was estimated to be 21.6 g C m^{-2} at the sediment trap site, which seems to be highly underestimated. About 5.5% of the surface water production of organic carbon sinks below 1,034 m water depth.

3-52 **Kim, DongSeon**, **Dong-Yup Kim**, **JeongHee Shim**, **Young-Chul Kang**, and TaeRim Kim. 2003. "Downward particle flux in the eastern Bransfield Strait, Antarctica". *Journal of the Korean Society of Oceanography*, 38(1): 1-10.

A time-series sediment trap was deployed at a depth of 1034 m in the eastern Bransfield Strait from December 25, 1998 to December 24, 1999. Particle fluxes showed large seasonal variation; about 99% of the annual total mass flux (49 g m^{-2}) was collected during the austral summer and fall (January-March). Settling particles consisted primarily of biogenic silica, organic carbon, calcium carbonate, and lithogenic material. Biogenic silica and lithogenic material predominated settling particles, comprising 36% and 30% of the total mass flux, respectively, followed by organic carbon, 11% and calcium carbonate, merely 0.6%. The annual organic carbon flux was 5.4 g C m^{-2} at 1000 m in the eastern Bransfield Strait, which is greater than the central Strait flux. The relatively lower flux of organic carbon in the central Bransfield Strait may be caused by a stronger surface current in this region. Organic carbon flux estimates in the eastern Bransfield Strait are the highest in the Southern Ocean, perhaps because of the fast sinking of fecal pellets, which leads to less decomposition of organic material in the water column. Approximately 5.8% of the organic carbon produced on the surface in the eastern Bransfield Strait is exported down to 1000 m; this percentage exceeds the maximum EF_{1000} values observed in the Atlantic and Southern Oceans. The eastern Bransfield Strait appears to be the most important site of organic carbon export to the deep sea in the Southern Ocean.

3-53 **Kim, DongSeon**, **Dong-Yup Kim**, **JungHee Shim**, Hwan-Seok Song, and **Young-Chul Kang**. 2001. "The Distributions of Nutrients, Chlorophyll-a, and Primary Productivity in the South Pacific Ocean". 「*The Sea*」 *Journal of the Korean Society of Oceanography*, 6(1): 40-48.

The vertical distributions of temperature, salinity, dissolved oxygen, nutrients, chlorophyll, and primary production were investigated within the top 200 m water depth in the south Pacific Ocean in February, 2000. The study area (24°–41°S, 81°–168°W) can be hydrologically divided into two regions. Upwelling was actively occurring in the eastern region of the 110°S line, meanwhile it was not active in the western region. Accordingly, chemical properties in the surface waters were different between the two regions; nitrate+nitrite and phosphate concentrations were much higher in the eastern region than in the western region due to the active upwelling, but silicate concentration was higher in the western region. Among the nutrients, the major element influencing primary production was also different between the two regions; silicon would be a major element influencing primary production in the eastern region, but nitrogen may act as a major element for primary production in the western region. Primary production showed similar values in the two regions in spite of the large differences of nutrient concentrations in the surface waters, but the total chlorophyll integrated within the 200 m water depth was almost twice as much as in the western region than that in the eastern legion.

3-54 **Kim, Dongseon**, **Dong-Yup Kim**, Young-June Kim, and **Young-Chul Kang**. 2002. "Seasonal Variations of Particle Fluxes in the Bransfield Strait, Antarctica". *Ocean and Polar Research*, 24(2):153-166.

Particle fluxes were measured by using time-series sediment traps in the Bransfield Strait from December 27th, 1999 to December 26th, 2000. Total mass fluxes showed distinct seasonal variations with high fluxes in the austral summer and low fluxes in the austral winter at a 678 m water depth in the eastern Bransfield Strait, while they were high only in January and fairly low in other months at a 960 m water depth in the central Bransfield Strait. The reason that total mass fluxes occurred only in January at a 960 m water depth in the central Bransfield Strait seems to be the strong current in the surface waters, which leads to a substantial amount of terrestrial materials and locally produced organic matter being advected away from the mooring site. Total mass fluxes were very high from January to October at a 1678 m water depth in the eastern Bransfield Strait, while they were high only in January and February at a 1860 m water depth in the central Bransfield Strait. The fact that total mass fluxes were higher at the deep water in the both sites than at the intermediate water depth may reflect that a substantial amount of terrestrial and organic materials are laterally transported by strong tidal current from the shallow environments to the deep basins.

3-55 **Kim, Dongseon**, **Dong-Yup Kim**, Young-June Kim, **Young-Chul Kang**, and **JeongHee Shim**. 2003. "Behaviors of metals in the settling particles in the Bransfield Strait, Antarctica". *Ocean and Polar Research*, 25(1): 41-52.

Sediment trap samples were collected to find out characteristic behaviors of metals in the settling particles by using time-series sediment traps at 678 m and 1678 m water depths in the Bransfield Strait from December 27th, 1999 to December 26th, 2000. Total mass fluxes at the intermediate water depth (678 m water depth) were high in the austral summer and low in the austral winter, whereas at the deep water depth (1678 m water depth) they showed high values in both the summer and winter. Total mass fluxes were generally higher in the deep water depth than in the intermediate water depth, which indicates that a substantial amount of sediments are laterally transported by strong currents into the deep basin from the shallow water depths. Aluminium contents also showed large seasonal variations with high values in the winter and low values in the summer. On the contrary, organic carbon contents were high in the summer and low in the winter. Al contents were negatively correlated with organic carbon contents, which may be ascribed that detrital particles are diluted by organic matter produced by phytoplankton in the surface waters. Metals measured in this study exhibited three characteristic behaviors; 1) a positive correlation with Al-Ti, Fe, Mn, V, Co, and Ba, 2) a negative correlation with Al-Cd and Zn, 3) no relationship with Al-Sr, Cu, Cr, Ni. Terrestrial materials may act as a major source fer metals that are positively correlated with Al, and organic matter may be a major source for metals that are negatively correlated with Al. Enrichment factor (EF) of Fe, Mn, Ba, Vi Co, Sr, Cr, and Ni ranged from 0.5 to 1.5, whereas EF of Zn, Cu, and Cd showed much higher values than 1.

3-56 **Kim, DongSeon**, **Sung-Ho Kang**, **Dong-Yup Kim**, **Youn-Ho Lee**, and **Young-Chul Kang**. 2001. "Distribution of nutrients and phytoplankton biomass in the area around the South Shetland Islands, Antarctica". *Ocean Polar Research*, 23(2): 77-95.

Temperature, salinity, nutrients, chlorophyll-a, and primary production were

measured within the upper 200 m water column in the area around the South Shetland Islands in January, 2000. Surface temperature was relatively high in the Drake Passage north of the South Shetland Islands and low in the northeastern area of the Antarctic Peninsula. In contrast, surface salinity was low in the Drake Passage and increased toward the Antarctic Peninsula, reaching the maximum value in the northeastern area of the Antarctic Peninsula. Surface nutrients were low in the Drake Passage and high in the area near the South Shetland Islands. Surface chlorophyll-a was also low in the Drake Passage and near the Antarctic Peninsula and high in the area of the northern King George Island. The study area could be classified as four geographical zones based on the characteristic shape of the T/S diagrams; the Drake Passage, the Bransfield Strait, the mixed zone, and the Weddell Sea. Each geographical zone showed apparently different physical, chemical, and biological characteristics. Phytoplankton biomass was relatively low in the Drake Passage and the Weddell Sea and high in the Bransfield Strait and the mixed zone. The low phytoplankton biomass in the Weddell Sea could be explained by the low water temperature and deep surface mixing down to 200 m. The high grazing pressure and low availability of iron could be responsible for the low phytoplankton biomass in the Drake Passage.

3-57 **Kim, DongSeon**, **Sung-Ho Kang**, **Kyung Ho Chung**, **Dong Yup Kim**, and Byong-Kwon Park. 2000. "Nutrient Depletion and Primary Productivity in the Marginal Ice Zone of the Northwestern Weddell Sea During Austral Summer". *Journal of the Korean Society of Oceanography*, 35(1): 34-45.

Spatial distributions of phytoplankton biomass and nutrients were examined to investigate the magnitude of phytoplankton blooms along the marginal ice zone (MIZ) in the northwestern Weddell Sea during austral summer of 1995. High phytoplankton biomass was associated with the MIZ in the study area. Vertical stability induced by meltwater appears to be the most important factor controlling phytoplankton biomass distribution. Nitrate concentrations are significantly depleted within the upper water column at the phytoplankton biomass maximum. The time required to attain the observed nutrient depletion was calculated from phytoplankton biomass and nitrate depletion, which ranges from 27 to 68 days in transect 4 and from 33 to 145 days in transect 3. Phytoplankton production was also calculated from nitrate depletion and time-scales of nitrate depletion, which varies from 272 to 1752 mg C m^{-2} day^{-1} in transect 4 and from 327 to 2648 mg C m^{-2} day^{-1} in transect 3. In the Southern Ocean where primary productivity shows large temporal and spatial variations, the productivity measurement from nutrient depletion can provide an average rate of primary production during phytoplankton bloom.

3-58 Lee, Kang-Hyun, **Kyung-Ho Chung**, and 2 others. 2003. "On the Distribution of Zooplankton in the Southeastern Barents Sea during July 2002". *Korean Journal of Environmental Biology*, 21(4): 392-399.

The spatial distribution and composition of the mesozooplankton community in the southeastern Barents Sea were observed at 17 stations, from 12 to 28 July 2002. Six taxa of zooplankton were found, including tintinnids, copepods, cumaceans, appendicularians, polychaetes, and barnacle larvae. Copepods were dominant, comprising 74% of the community. The copepod species *Limnoclanus grimaldii*, *Pseudocalanus acuspes, Calanus glacialis, Calanus finmarchicus*, and *Microsetella norvegica*, and the cumacean species *Diastylis rathkei* and *Campylaspis rubicunda* were identified. The

overall mean abundance of the zooplankton was 72 indiv.10 m^{-3} in the study area, ranging from 4 to 197 indiv.10 m^{-3}. Zooplankton was more abundant at the oceanic than the coastal stations. The highest biomass measured was 97.4 mg 10 m^{-3}, the mean biomass was 36.9 mg 10 m^{-3}, 93% of which was copepods. *Pseudocalanus acuspes*, *C. glacialis*, and *C. finmarchicus* predominated, accounting for 61% of abundance and 86% of biomass. Spatial distributions of the zooplankton community in the study area depended on the variations in water temperature and salinity, which were influenced by freshwater runoff from the continent.

3-59 Lee, Kyung Eun, **Jang Jun Bahk**, and Hisashi Narita. 2003. "Temporal variations in productivity and planktonic ecological structure in the East Sea (Japan Sea) since the last glaciation". *Geo-Marine Letters*, 23(2): 125-129.

We investigated the biogenic components (biogenic opal, calcium carbonate, and organic carbon) of the marine sediments in core TY99PC18 recovered from the southeastern part of the Ulleung Basin, East Sea (Japan Sea). Our results indicate that primary productivity by diatoms increased after the last glaciation (15,000 ^{14}C years B.P.) probably because of the onset of vertical mixing of seawater and nutrient supply from the deep water. Between 5,000 and 10,000 ^{14}C years B.P. a shift in the dominant primary producer, i.e. from diatoms to coccolithophores, coincides with decreased productivity, which could be related to the influx of warm, low-nutrient waters at that time. During the late Holocene (after 5,000 ^{14}C years B.P.) the productivity of diatoms increased once more probably due to renewed ventilation and vertical mixing.

3-60 **Lee, Mi-Young**, **Sung-Ho Kang**, **SangHoon Lee**, and 2 others. 1996. "Distribution and biomass of phytoplankton and bacterioplankton: relationships to environmental parameters during an Antarctic austral summer in the Bransfield Strait". *Korean Journal of Polar Research,* 6(1/2): 31-47.

As part of the 7th Korea Antarctic Research Program expedition, distributions of phytoplankton and bacterioplankton were compared in relation to environmental parameters and their biomass in the Bransfield Strait during the 93/94 austral summer. Phytoplankton biomass integrated in the upper 100 m ranged from 564 to 2330 mg C m^{-2}(avg. 1591 mg C m^{-2}). Phytoplankton assemblages consisted of autotrophic flagellates and diatoms. Autotrophic flagellates usually predominated in the phytoplankton assemblages. The biomass of autotrophic flagellates ranged from 458 to 2150 mg C m^{-2}(avg. 1266 mg C m^{-2}), diatom biomass from 83 to 1080 mg C m^{-2}(avg. 307 mg C m^{-2}), and bacterioplankton biomass from 207 to 1620 mg C m^{-2}(avg. 892 mg C m^{-2}). Bacterioplankton carbon biomass accounted for about 56 % of the total phytoplankton carbon biomass. Autotrophic flagellates such as *Cryptomonas* sp. and *Phaeocystis antarctica* (motile stage) were dominant in their carbon biomass, and *Phaeocystis antarctica* (motile stage) and autotrophic picoflagellates(~1 μm) were dominant in their cell number. *Fragilariopsis* "*nana*" was a dominant diatom species in both the biomass and the cell number. Concentration of inorganic N (NO_2^- + NO_3^-) ranged from 5.59 to 34.94 μM (avg. 22.88 μM), phosphate from 0.12 to 3.06 μM (avg. 1.82 μM), and silicate from 28.62 to 132.27 μM (avg. 97.62 μM). Distribution of phytoplankton reflects the physical conditions of the upper water column such as temperature, salinity and the subsequent stability of the water mass.

3-61 **Lee, Sang Hoon**, **Jang Jun Bahk**, and Sung Kwun Chough. 2003. "Origin of deep-water sediment waves in the Ulleung Interplain Gap, East Sea". *Geosicences Journal*, 7(1): 65-71.

A detailed analysis of Chirp (2–7 kHz) subbottom profiles and a long (ca. 10 m) piston core reveals origin of deep-water sediment waves in the Ulleung Interplain Gap (UIG). On the basis of acoustic and lithologic characters, the sediments are divided into two units: 1) upper transparent unit (UTU) and 2) lower wavy stratified unit (LWSU). The LWSU is characterized by a few regular wavy reflectors with upslope migration. Also, it gradually decreases downslope in wave height, wave asymmetry and thickness, and consists dominantly of fine-grained turbidites with subordinate pelagic and hemipelagic sediments. These sedimentary features indicate that the LWSU was most likely generated by turbidity currents, rather than bottom currents. The UTU, discordant to the reflectors of the underlying LWSU, mostly comprises muddy contourites and managniferous contourites with rare fine-grained turbidites, reflecting intensified bottom-current activity and infrequent input of turbidity currents from the slopes of the Oki Bank and Dok Island. Under these conditions, a thin (3–6 m thick), elongate mound of bottom-current deposits (UTU) formed on the fine-grained turbidity current waves (LWSU).

3-62 **Lee, Sang Hoon**, **Young Keun Jin**, **Kyu Jung Kim**, **Sang Heon Nam**, and **Yeadong Kim**. 2003. "High-Resolution (3.5 kHz) Echo Characters of the Northern South Shetland Continental Margin and the South Scotia Sea, Antarctica". *Ocean and Polar Research*, 25(4): 557-567.

High-resolution (3.5 kHz) subbottom profiles were analyzed in order to reveal sedimentation pattern of late Quaternary in the northern South Shetland continental margin and the South Scotia Sea, Antarctica. On the basis of clarity, continuity and geometry of surface and subbottom echoes together with seafloor topography, high-resolution echo characters are classified into eight echo types which represent rock basements (echo type III-1), coarse-grained subglacial till or moraine (echo type I-1), slides/slumps (echo type IV), debris-flow deposits (echo types II-3 and III-2), and bottom-current deposits (echo types I-2, II-1 and II-2). Subglacial till or moraine (echo type I-1) is mostly present in the lower continental shelf and upper continental slope of the northern South Shetland continental margin, which changes downslope to slides/slumps (echo type IV) and debris-flow deposits (echo types II-3 and III-2) in the middle to lower continental slope. This distribution suggests that the continental slopes of the northern South Shetland continental margin were mostly affected by downslope gravitational processes. Further downslope, bottom-current sediments (echo type I-2) deposited by the southwestward flowing Antarctic Deep Water (ADW) occur at the South Shetland Trench, reflecting an Interaction between mass flows and bottom currents in the area. In contrast to the northern South Shetland continental margin, the South Scotia Sea is dominated by bottom-current deposits (echo types II-1 and II-2), indicating that the sedimentation was mostly controlled by the westward flowing ADW. Flow intensity of the ADW has increased in the relative topographic highs, forming thin covers of coarse-grained contourites (echo type II-1), whereas it has decreased in the relative topographic lows, depositing thick, fine-grained contourites (echo type II-2). The poor development of wave geometry in the fine-grained bottom-current deposits (echo type II-2) is suggestive of the unsteady nature of the ADW flow.

3-63 Lee, Wonchoel, **Sung-Ho Kang**, and 2 others. 2003. "Temporal Dynamics and Patterning of Meiofauna Community by Self-Organizing Artificial Neural Networks". *Ocean and Polar Research,* 25(3): 237-247.

The temporal dynamics of the meiofauna community in Marian Cove, King George Island were observed from January 22 to October 29 1996. Generally, 14 taxa of metazoan meiofauna were found. Nematodes were dominant comprising 90.12% of the community, harpacticoid 6.55%, and Kinorhynchs 1.54%. Meiofauna abundance increased monthly from January to May 1996, while varying in abundance after August 1996. Overall mean abundance of metazoan meiofauna was 2634 ind./10 cm^2 during the study periods, which is about as high as that found in temperate regions. Nematodes were most abundant rep-resenting 2399 ind./10 cm^2. Mean abundance of harpacticoids, including copepodite and nauplius was 131 ind./10 cm^2 by kinorhynchs (26 ind./10 cm^2). The overall abundance of other identified organisms was 31 ind./10cm^2. Other organisms consisted of a total of 11 taxa including Ostracoda (6 ind./10 cm^2), Polycheata (7 ind./10 cm^2), Oligochaeta (8 ind./10 cm^2), and Bivalvia (6 ind./10 cm^2). Additionally, pro-tozoan Foraminifera occurred at the study area with a mean abundance of 263 ind./10 cm^2. Foraminiferans were second in dominance to nematodes. The dominant taxa such as nematodes, harpacticoids, kinorhynchs and the other taxa were trained and extensively scattered in the map through the Kohonen network. The temporal pattern of the community composition was most affected by the abundance dynamics of kinorhynchs and harpacticoids. The neural network model also allowed for simulation of data that was missing during two months of inclement weather. The lowest meiofauna abundance was found in August 1996 during winter. The seasonal changes were likely caused by temperature and salinity changes as a result of meltwater runoff, and the physical impact by passing icebergs.

3-64 **Lee, Youn-Ho**. 2001. "Genetic Studies on the Sea Urchin Embryogenesis and Skeletogenesis". 「*The Sea*」 *Journal of the Korean Society of Oceanography*, 6(4): 265-273.

The sea urchin has been used as sea food in many countries. This species has also been an important organism of embryological studies for more than a century. In recent years, sea urchin embryos are being used as testing materials for toxicity of pollutants and toxins. Usefulness of sea urchin embryos as experimental models comes from the easiness in obtaining sea urchin samples and a lot of gametes, in rearing embryos in the laboratory, in observing the cellular movement and organ formation during the embryogenesis and in manipulating blastomeres and genetic materials. The sea urchin in itself is a key organism for the understanding of deuterostome evolution from the protostomes and of indirect development of marine invertebrates which undergo the planktotrophic larval stage. A fertilized sea urchin egg goes through rapid cleavage and becomes a 60 cell embryo 7hr after fertilization. It then develops into a morula, a blastula, a gastrula and finally a pluteus larva approximately 70 hr after fertilization. At the 60 cell stage, the embryo comprises of five territories that express territory-specific genes and later form different organs. Micromeres at the vegetal po1e ingress into the blastoceol and become the primary mesenchyme cells(PMCs). PMCs express genes involved in skeletogenesis such as SM30, SM37, SM50, PM27, msp130. Among the genes, SM37 and SM50 are considered to be members of a gene family which is characterized by early blastula expression, Glycine-Proline-Glutamine rich repeat

structures and spicule matrix forming basic proteins. Genetic studies on the sea urchin embryos help understand the molecular basis of indirect development of marine invertebrates and also of the biomineralization common to the animal kingdom.

3-65 Norris, Richard D., **Dong Yup Kim**, **Byong-Kwon Park**, **Sung-Ho Kang**, and Boo-Keun Khim. 1998. "Stable isotope and ecological habitat of Planktonic foraminifera adjacent to the ice edge in the western Weddell Sea". *Geoscience Journal*, 2(2): 88-98.

Planktonic foraminifera collected from the entire 200 m water column in the western Weddell Sea using vertically-towed nets consisted largely of *Neogloboquadrina pachyderma* (s) and *Globigerina quinqueloba*. Peak abundance of planktonic foraminifera occurred in low-nutrient waters adjacent to the sea ice margin. Nearly all specimens of *N. pachyderma* (s) in the > 250 μm size class possessed a kummerform final chamber, but less than 20% added gametogenic calcite to the exterior of their shells. The frequent occurrence of δ18O values of *N. pachyderma* (s) lighter than the $\delta^{18}O_{calcite}$ in equilibrium with ambient surface waters presumably indicates that significant growth occurred either out of isotopic equilibrium or in water beneath the ice shelf containing ^{18}O-depleted snow melt. We suggest herein that the variation between $\delta^{18}O_{water}$ and $\delta^{18}O_{foranminifera}$ is most likely due to secretion of shell carbonate in water influenced by snow melt or glacier melt.

3-66 **Shim, JeongHee**, **Young Chul Kang**, Myung Woo Han, **Dongseon Kim**, **Hosung Chung**, and **SangHoon Lee**. 2002. "Seasonal Variations of Settling Particles and Metal Fluxes at a Nearshore Site of Marian Cove, King George Island, Antarctica". *Ocean and Polar Research*, 24(2): 123-134.

Seasonal variations of settling particles and metal fluxes were monitored at a nearshore site of Marian Cove, King Geroge Island, Antarctica from 28th February 1998 to 22nd January 2000. Near-bottom sediment traps were deployed at 30 m water depth of the cove, and sampling bottles were recovered every month by SCUBA divers. Total particulate flux and metal concentrations were determined from the samples. Total particulate flux showed a distinct seasonality, high in austral summer and low in austral winter: the highest flux (21.97 g $m^{-2}d^{-1}$) was found in February of 1999, and the lowest (2.47 g $m^{-2}d^{-1}$) in September of 1998, when sea surface was frozen completely. Lithogenic particle flux accounted for 90% of the total flux, and showed a significantly negative correlation with the thickness of snow accumulation around the study site. It was suggested that the most of the lithogenic particles trapped in the bottles was transported by melt water stream from the surrounding land. Fluxes of Al, Fe, Ti, Mn, Zn, Cu, Co, Ni, Cr, Cd, and Pb showed similar seasonal variations with the total flux, and their averaged fluxes were 34000, 9000, 960, 180, 13.8, 17.6, 3.0, 2.1, 5.4, 0.02, and 1.5 nmol $m^{-2}d^{-1}$, respectively. Among the metals, Cu and Cd showed the most noticeable seasonal patterns. The Cd flux correlated positively with the fluxes of biogenic components while the Cu flux correlated with both the lithogenic and biogenic particle fluxes. The Cu flux peak in the late summer is likely related to a substantial amount of inflow of ice melt water laden with Cu-enriched lithogenic particles. On the other hands, the Cd flux peak in the early spring may be associated with the unusually early occurred phytoplankton bloom.

3-67 **Shin, Hyoung-Chul** and Stephen Nicol. 2002. "Using the relationship between eye diameter and body length to detect the effects of long-term starvation on Antarctic krill *Euphausia superba*". *Marine Ecology Progress Series*, 239: 157-167.

Body shrinkage may be one of the strategies that Antarctic krill use to cope with food scarcity, particularly during winter. Despite their demonstrated ability to shrink, there are only very limited data to determine how commonly shrinkage occurs in the wild. It has been previously shown that laboratory-shrunk krill tend to conserve the size of the eye. This study examined whether the relationship between the eye diameter and body length could be used to detect whether krill had been shrinking. By tracking individuals over time and examining specimens sampled as groups, it was demonstrated that fed and starved krill are distinguishable by the relationship between the eye diameter and body length. The eye diameter of starved krill did not decrease, even when the animals had shrunk in overall body length. The eye diameter of well-fed krill continued to increase as overall length increased. This created a distinction between fed and starved krill, while no separation was detected in terms of the body length to weight relationship. Eye growth of krill re-commenced with re-growth of krill following shrinkage although there was some time lag. It would take approximately 2 moult cycles of shrinkage at modest rates to significantly change the eye diameter to body length relationship between normal and shrunk krill. If krill starve for a prolonged period in the wild, and hence shrink, the eye diameter to body length relationship should be able to indicate this. This would be particularly noticeable at the end of winter.

3-68 **Shin, Hyoung-Chul**, and 2 others. 2003. "NUCLEIC ACID CONTENT AS A POTENTIAL GROWTH RATE ESTIMATOR OF ANTARCTIC KRILL; RESULTS FROM FIELD-CAUGHT KRILL FROM THE INDIAN SECTOR OF THE SOUTHERN OCEAN". *Marine and Freshwater Behaviour and Physiology,* 36(4): 295-305.

Nucleic acid contents of tissue were determined from field-caught Antarctic krill to determine whether they could be used as an alternative estimator of individual growth rates which can currently only be obtained by labour intensive on-board incubations. Krill from contrasting growth regimes from early and late summer exhibited differences in RNA-based indices. There was a significant correlation between the independently measured individual growth rates and the RNA : DNA ratio and also the RNA concentration of krill tissue, although the strength of the relationship was only modest. DNA concentration, on average, was relatively constant, irrespective of the growth rates. The moult stage did not appear to have a significant effect on the nucleic acid contents of tissue. Overall, the amount of both nucleic acids varied considerably between individuals. Nucleic acid-based indicators may provide information concerning the recent growth and nutritional status of krill and further experimentation under controlled conditions is warranted. They are, however, reasonably costly and time-consuming measurements.

3-69 Yang, Sung Ryull, **Sung-Ho Kang**, and **SangHoon Lee**. 1998. "Carbon and Nitrogen Primary Productivities in the Weddell Sea and the Bransfield Strait, Antarctica". *Korean Journal of Polar Research*, 9(1): 55-62.

Carbon and nitrogen primary productivities using ^{14}C-bicarbonate and ^{15}N nitrate and ammonia were measured during the 7th KARP (Korea Antarctic Research Programme)

cruise in the Weddell Sea and the Bransfield Strait, Antarctica. Carbon primary productivity ranged between 55.11 and 155.78 mg C m^{-2} h^{-1}. The nitrogenous new productivity was between 1.105 and 4 .464 μmoles N m^{-2} h^{-1}, and regenerated productivity between 0.721 and 4.310 μmoles N m^{-2} h^{-1}. The f-ratio, the fraction of new production from primary production, was approximately 0.65, which is the characteristics of eutrophic areas. The C:N productivity ratio ranged between 0.76 and 5.83 (mean = 2.61), significantly lower than the traditional Redfield ratio of 6.7. The low values were observed in the ice margin area. This indicates the unbalanced growth of phytoplankton between carbon and nitrogen metabolism. This imbalance could have a significant implication in the vertical flux of carbon dioxide. Other factors (e.g., the stability of water column, light condition) are plausible candidates for this unusual phenomenon of low C:N productivity ratio.

3-70 Yoon, Cheolho, **Kyungho Chung**, and Jongki Hong. 2002. "Speciation of Arsenic and Selenium Compounds in the Environmental Field using HPLC Coupled to Specific Detectors". *Journal of the Korean Society for Environmental Analysis*, 5(1): 1-11.

This review deals with liquid phase separation of major arsenic and selenium species followed by element specific detection. The species-selective trace elements analysis is critically evaluated with particular emphasis on the use of techniques combining high performance liquid chromatography(HPLC) with an element specific detectors(e.g. AAS, ICP or ICP-MS). The potential and limitation of hyphenated techniques as a tool for speciations of arsenic and selenium compounds in environmental materials is discussed using a number of examples drawn from the latest research papers.

3-71 Yoon, Seok-Hoon, Jang-Jun Bahk, and Sang-Joon Han. 2003. "Late Quaternary Depositional Processes in the Korea Plateau and Ulleung Interplain Gap, East Sea". *Journal of the Korean Society of Oceanography*, 8(2): 187-198.

High-resolution (Chirp, 3-11 kHz) echo facies and sedimentary facies of piston-core sediments were analyzed to reveal the late Quaternary depositional processes in the Korea Plateau and Ulleung Interplain Gap. The Korea Plateau is an Isolated topographic high with a very restricted input of terrigenous sediments, and its slope is characterized by a thin sediment cover and various-scale submarine canyons and valleys. Echo and sedimentary facies suggest that the plateau has been moulded mainly by persistent (hemi) pelagic sedimentation and intermittent settling of volcanic ashes. Sediments on the plateau slope and steep margins of ridges and seamounts were reworked by earthquake-induced, large-scale slope failures accompanied by slides, slumps and debris flows. As major fraction of the reworked sediments consists of (hemi) pelagic clay particles, large amounts of sediments released from mass flows were easily suspended to form turbid nepheloid layers rather than bottom-hugging turbidity currents, which flowed further downslope through the submarine canyons and spreaded over the Ulleung Basin plain. In the Ulleung Interplain Gap, sediments were introduced mainly by (hemi) pelagic settling and subordinate episodic mass flows (turbidity currents and debris flows) along the submarine channels from the slopes of the Oki Bank and Dok Island. The sediments in the Ulleung Interplain Channel and its margin were actively eroded and reworked by the deep water flow from the Japan Basin.

PART 4

Life Sciences

4-1 Choi, Yoon-Sil, **Youn-Ho Lee**, and Deuk-Hee Jin. 2003. "Cloning and DNA Sequences Analysis of Mitochondrial NADH Dehydrogenase Subunit 3 from Korean Chum Salmon *Oncorhynchus keta*". *Journal of Korea Fisheries Society,* 36(2): 94-99.

Mitochondrial DNAs has been used frequently as genetic markers for the population genetic studies of salmonid fishes. Samples used in this experiment were chum salmons (*Oncorhynchus keta*) from Korea. We analyzed variation of mitochondrial NADH dehydrogenase subunit 3 gene (ND3) among 4 individuals of the Korea population. Genomic DNA was extracted from the liver of the chum salmon samples. Then, the ND3 gene was amplified by polymerase chain reaction (PCR) including the 3' region of cytochrome oxidase III gene (COIII) and the 5' region of NADH dehydrogenase subunit 4L gene (ND4L). The size of the PCR product was 752 Up and the sequences showed some genetic variation among those four individuals. Genetic variations were observed in 7 sites as single nucleotide polymorphism (SNP). Within the open reading frame of the ND3 gene which encodes 116 amino acids, 5 nucleotide substitutions were found. Both transitional and transversional changes occurred more frequently with transitional changes. Comparison of these sequences with the others of a Japanese chum salmon in GenBank showed 5 sites of SNPs. This study provided the basic information of SNP in ND3 gene among Korean chum salmons and demonstrated the possible use of the SNP data as a genetic marker.

4-2 **Chung, Hosung**, and 2 others. 1997. "Community Structure of Benthic Marine Algae in Maxwell Bay, Antarctica". *Korean Journal of Polar Research*, 8(1 ,2): 181.

To identify the characteristics of macroalgal assemblages, systematic fieldworks carried out in Maxwell Bay, Antarctica during 1988-1995. A total of 44 species, 7 green, 1 golden-brown, 16 brown and 20 red algae was identified. Estimating the important value calculated from coverage and biomass, *Desmarestia* spp. (mainly composed of *D. menziesii* and *D. anceps*) and *Himantothallus grandifolius* amounted to 45%, and they played a leading role for macroalgal assemblages in Maxwell Bay. The infralittoral zonation was represented by the mixed vegetation of thallic rhodophytes from surface to 5 m deep, *D.* spp. on 5~15 m, and *H. grandifolius* below 15 m. Mud deposition was considered as a major factor which determined the species diversity, abundance and community structure in this area, and it was depended on the geographical location. Thus, horizontally, they could be divided into the two types; exposed outward type and protected fjord type. the high number of species was found at exposed sites (23-38 species) than at protected sites (8-16 species). The mean of total biomass (fresh-weight) was low with 204.5 $g \cdot m^{-2}$ due to the formation of bare zone depending on mud deposition and ice abrasion, and the deviation was obviously from 28.7 $g\ m^{-2}$ to 364.8 $g\ m^{-2}$ with the mixing extent of substrate component. At infralittoral rocks, however, the highest biomass was observed with more than 1,500 $g\ m^{-2}$.

4-3 **Chung, Hosung**, **Jae Sam Yang**, and Chang Soo Chung. 1991. "Seawater Properties and Macroalgal Growth in Littoral Zone of Barton Peninsula, King George Island, Antarctica". *Korean Journal of Polar Research*, 2(2): 51-60.

Growth patterns of macroalgae were investigated with seawater properties (temperature, salinity, and nutrients) from

five littoral stations at Barton Peninsula, King George Island, Antarctica during January 1990. Seawater composition in tidepools was so varied that temperature in a station of which water circulation was not frequent increased to 10℃ (2℃ in open-sea), and that concentrations of nutrients in a station where freshwater soaked through the substrata were two times as high as those of the open sea. Between macroalgal communities of the tidepools, there was a wide difference of biomass (296.6~990.1 mg/m^2) and species composition. Also, populations of *Leptosomia simplex* (Rhodymeniaceae), a dominant species in Antarctic region, showed a morphological difference characteristically. comparing with a population of 2m depth in open-sea(control), one population influenced by high water temperature grew rapidly with elongated-form. Another population by fresh-water grew slowly with almostly oval-form.

4-4 **Chung, Hosung**, Yoon Sik Oh, In Kyu Lee, and **Dong-Yup Kim**. 1994. "Macroalgal Vegetation of Maxwell Bay in King George Island, Antarctica". *The Korean Journal of Phycology*, 9(1): 47-58.

The community structure of littoral and infralittoral marine algae was investigated in Maxwell Bay, King George Island during the austral summer 1988/1989. A total of 36 species, 5 green, 1 yellow-brown, 12 brown, and 18 red algae, was identified. Ephemeral or pseudoperennial algae grew up rapidly at the littoral and upper-infralittoral zones since the thawing season, whereas some perennial brown algae were dominant at the lower-infralittoral zone. The vertical zonation was represented by *Palmaria decipiens* from the surface to 5 m, *Desmarestia menziesii* and *Ascoseira mirabilis* at 5-15 m, and *Himantothallus grandifolius* below 15 m. Horizontally, the abundance and diversity of macroalgal vegetation were changed according to the exposed outward or protected embayment with mud deposit and freshwater inflows, and the rocky or pebble-bouldered substrata.

4-5 **Chung, Hosung**, Yoon Sik Oh, **Ji Hee Kim**, **Young-Chul Kang**, **Sung-Ho Kang**, and **SangHoon Lee**. 2000. "Species Composition and Biomass Distribution of Benthic Macroalgae in Maxwell Bay, King George Island, Antarctica". *Korean Journal of Polar Research*, 11(1): 1-12.

Species composition and biomass distribution of benthic macroalgae were investigated during 92/93 austral summer in Maxwell Bay, King George Island, Antarctica. Systematic fieldworks at eleven sites, combined with the previous works, provided us opportunities to analyze the macroalgal assemblages quantitatively and qualitatively. A total of 42 species was collected and identified; 7 green, 1 golden-brown, 14 brown, and 20 red algae. The macroalgal biomass of Maxwell Bay was generally low (204 .5 g wet w m^{-2} in average) due to discontinuity of the vegetation by mud deposition. It showed strong variation according to the substrate type; from 28 g wet w m^{-2} at muddy fjords to 364.8 g wet w m^{-2} at exposed rocky shores. The highest biomass (>8.7 kg wet w m^{-2} was recorded on a vertical rock of exposed site. The littoral zonation was dominated by *Ulothrix australis* and *Porphyra endiviifolium* at supralittoral zone. In the center of tidepools at eulittoral zone, ephemeral species presented mainly at sublittoral fringe were observed. The sublittoral zonation was dominated by perennial brown algae of Desmarestiales, *Desmarestia* spp. (40%) and *Himantothallus grandifolius* (27%), which accounted for 67% of the macroalgal weight in total. In view of the vertical profile at the upper sublittoral zone which was affected by winterly sea-ice cover and abrasion by floating ice with wave action, various ephemeral species were

observed. *Desmarestia* spp. were dominant from 5 to 15 m deep, and *H. grandifolius* was mainly distributed below 15 m. These zonations of the perennial brown algae assumed different aspects in relation to the inclination of substrate and the extent of mud deposition. More focus on *Desmarestia* spp. would be needed for the understanding of the nearshore ecosystem in the Antarctic Peninsula region.

4-6 **Chung, Hosung**, **Young Chul Kang**, and **Dong-Yup Kim**. 1990. "Notes on Algal Flora of Maxwell Bay, South Shetland Islands, Antarctica". *Korean Journal of Polar Research*, 1(1): 77-80.

As a part of the studies on natural environments around King Sejong Station in the South Shetland Island, the algal flora of Maxwell Bay was described briefly. A total of 36 species was found during 1988-1989 austral summer, 5 Chlorophyta, 1 Chrysophyta, 12 Phaeophyta, and 18 Rhodophyta While ephemeral algae grew up rapidly in summer at the littoral and upper-infralittoral, some perennial brown algae were dominant at the lower-infralittoral.

4-7 **Hyun, Jung-Ho**, **Hong Kum Lee**, and **Kae Kyoung Kwon**. 2003. "Sulfate Reduction in the Marine Environments: Its Controlling Factors and Relative Significance in Mineralization of Organic Matter". 「*The Sea*」 *Journal of the Korean Society of Oceanography,* 8(2): 210-224.

Sulfate reduction is a microbiological process which occurs ubiquitously in anaerobic marine environment. Sulfate reducing bacteria play a significant role in anaerobic decomposition of organic matter and regeneration of inorganic nutrients which supports the primary production in the water column (i.e., benthic-pelagic coupling) and, in special case, could be responsible for the harmful algal bloom in the coastal marine environment. Summary of the sulfate reduction rates reported in various marine sedimentary environments revealed that supply of organic substrates and presence of various electron acceptors (i.e., O_2, NO_3^-, Fe(III) and Mn(IV), etc.) for other aerobic and anaerobic respiration directly affect the sulfate reduction rate and relative significance of sulfate reduction in organic matter mineralization. Significance of temperature, macrophytes and bioturbation is discussed as factors controlling supply of organic substrates and distribution of electron acceptors. Finally, we suggest studies on the anaerobic microbiological processes associated with biogeochemical element cycles in the coastal environments of Korea where massive operation of organic enriched fish cage farm, frequent occurrence of toxic algal bloom and hypoxia and conservation of tidal flat are of major environmental issues.

4-8 Hyun, Jung-Ho, Kyung Hong Kim, **Kae Kyoung Kwon**, **Jung-Hyun Lee**, **Hong Kum Lee**, **Sang Jin Kim**, and Ki Hyun Kim. 2002. "Total microbial biomass measured by ATP in three marine sedimentary environments". *The Korean Journal of Microbiology*, 38(2): 119-126.

ATP concentrations far estimating total microbial biomass in the sediment were measured in three different marine sedimentary environments. ATP concentrations were highest in the surface sediment and decreased with increasing sediment depth and distance from the land. The results indicated that the benthic microbial biomass is primarily controlled by nutrient inputs from the overlying water column. Because of the longer residence time and adsorption to the sediment, the variations in organic carbon (OC) contents with sites and depths were not as distinct as

that of ATP, and the correlation between OC and ATP was not significant in the coastal sediments. No significant correlation between OC and ATP in the coastal sediments also suggested that microbial biomass in the labile organic-enriched coastal sediment is suppressed by the grazing of higher trophic level such as meiofauna. Overall regional and vertical distribution of ATP indicated that how can be a relevant tool for measuring total microbial biomass in various marine sedimentary environments.

4-9 Jin, EonSeon, Juergen E. W. Polle, **Hong Kum Lee**, and 2 others. 2003. "Xanthophylls in Microalgae: From Biosynthesis to Biotechnological Mass Production and Application". *Journal of Microbiology and Biotechnology*, 13(2): 165-174.

Xanthophylls are oxygenated carotenoids that serve a variety of functions in photosynthetic organisms and are essential for survival of the organism. Within the last decade, major nor advances have been made in the elucidation of the molecular genetics and biochemistry of the xanthophyll biosynthesis pathway. Microalgae, yeast, or other microorganisms produce some of the xanthophylls that are being commercially used due to their own color and antioxidant properties. Currently, only a few microalgae are being considered or already being exploitd for the production of high-value xanthophylls. However, new developments in molecular biology have important implications for the commercialization of microalgae, and make the genetic manipulation of the xanthophyll content of microalgae mure attractive for biotechnological purposes. Accordingly, the current review summarizes the general properties of xanthophylls in microalgae and the recent developments in the biotechnological production of xanthophylls.

4-10 Jo, Ki Woong, Ji-Heon Bang, Hye-Won Hong, Seung Il Park, and Yun Ho Lee. 2002. "Purification and Characterization of extracellular protease from psychrotrophic Antarctic bacteria". *The Korean Journal of Microbiology*, 38(4): 254-259.

4-11 **Jung, Woongsic**, **Youn-Ho Lee**, and 3 others. 2003. "Genetic identification of the North Pacific chum salmon (*Oncorhynchus keta*) stocks". *Journal of Korean Fisheries Society*, 36(6): 578-585.

The chum salmon (*Oncorhynchus keta*) is an anadromous fish distributed all around the North Pacific. Artificial production and release of the juveniles are being made by Korea, Japan, Russia, Canada and the United States. It is important to set up some criteria identifying each stock in order to clarify each nation's right of harvest for the chum salmon resource. As an attempt to build such criteria, we analyzed sequences of a microsatellite DNA Ogo5 and the COIII-ND3-ND4L region of the mitochondrial DNA from chum salmons of Korea, Japan, and the United States. Ogo5 has 4 different alleles: allele A, B-1, B-2, and B-3. Allele B-3 is found only in 3 individuals out of 12 Korea salmons. The Japan salmons have the other 3 alleles and the America salmons have only 2 allots, A and B-1. Heterozygosity index (Ho/He) distinguishes the Korea (1.61) and Japan salmons (1.63) from the America ones (1.09). Seventeen different haplotypes are found in the COIII-ND3-ND4L region from 60 individuals,20 from each stock. The gene genealogy of the haplotypes revealed by TCS program shows that the Korea and Japan salmons are genetically closely linked, but that they are clearly distinguished from the America ones. Ten and eleven individuals of the Korea and Japan salmons have an identical haplotype. Nine individuals of the Korea salmons (45%), however, are separable from the Japan salmons by their own specific nucleotides. This result presents

usefulness of the COIII-ND3-ND4L region as a genetic marker for identification of the chum salmon stocks.

4-12 **Kae Kyoung Kwon**, **Hyun Sang Lee**, Sung-Young Jung, **Joung-Han Yim**, **Jung-Hyun Lee**, and **Hong Kum Lee**. 2002. "Isolation and Identification of Biofilm-Forming Marine Bacteria on Glass Surfaces in Dae-Ho Dike, Korea". *Journal of Microbiology*, 40(4): 260-266.

Bacterial strains were isolated from biofilms formed on glass slides submerged in seawater in Dae-Ho Dike. Eight strains showing fast attaching ability were selected and identified. Their exopolysaccharide (EPS)-producing ability and EPS properties were characterized. Based on Microlog System, 4 among the 8 strains were identified as *Micrococcus luteus* and the rest were *Bacillus thuringiensis*, *Bacillus megaterium*, *Staphylococcus saprophyticus* and *Agrobacterium vitis*. *A. vitis* was reidentified as *Sulfitobacter pontiacus* based on 16S rDNA sequence data. The amount of water-soluble EPS produced by the 8 strains ranged from 0.114 to 1.329 $g \cdot l^{-1}$ and the productivity was negatively correlated with the cell biomass. The molecular weight of the produced EPS ranged from 0.38 to 25.19 × 10^4 Da. Glucose and galactose were ubiquitous sugar components. Mannose, ribose, and xylose were also major sugar components. The molecular weight and composition of the EPS showed strain-specific variation.

4-13 **Kang, Young-Chul**, **JeongHee Shim**, **Dongseon Kim**, **In-Ho Lee**, and **Hosung Chung**. 1998. "Organic Balance in Subtidal Benthic Community of the Marian Cove, King George Island, South Shetland Islands, Antarctica". *Korean Journal of Polar Research*, 9(1): 63-70.

Vertical flux of organic particles and benthic community respiration were directly measured at the Marian Cove, King George Island, Antarctica in an austral summer. For the direct mea-surement of the particle flux and the benthic respiration, near-bottom sediment traps and benthic chambers were deployed on the bottom at about 25 m below the surface of the cove from Dec. 26, 1994 to Jan. 15, 1995. Primary production in the surface waters and of benthic microalgae was also measured. The vertical flux of organic particles into the benthic community was low (55 to 166 mg Cm^{-2} d^{-1}). The benthic respiration rate directly measured at the benthic community, however, showed high oxygen consumption rate (400 to 800 mg O_2 m^{-2} d^{-1}), which is equivalent to organic demand of 127.5 to 255.0 mg C m^{-2} d^{-1}. Benthic microalgae, on the other hand, showed high primary production (ca. 180 mg C m^{-2} d^{-1}) even under 1% light condition. Organic particles supplied from the water-column alone could not sustain the organic demand of the benthic community of the Marian Cove. The benthic microalgal production might be responsible for balancing between the low organic supply from the surface and the high organic demand of the benthic community at least during the 94/95 austral summer.

4-14 **Kim, Ji Hee**, **Hosung Chung**, and 2 others. 2001. "Macroalgal flora of Maxwell Bay, King George Island, Antarctica: II. Rhodophyta". *Ocean and Polar Research*, 23(4): 347-360.

This study examined the taxonomic composition of marine benthic algal flora from Maxwell Bay, King George Island, Antarctica, collected between January 1988 and January 1995. The rhodophyte specimens collected and examined included a total of 20 genera and 20 species of red algae. Of these, 2 species, *Kallymenia antarctica* Hariot and *Pantoneura plocamioides* Kylin, were recorded in Maxwell Bay for the first time.

Taxonomic keys for the rhodophytes are also provided.

4-15 **Kim, Ji Hee**, **Hosung Chung**, **Han-Gu Choi**, and **Yeadong Kim**. 2003. "Macroalgal flora of Kongsfjorden in Svalbard Islands, the Arctic". *Ocean and Polar Research*, 25(4): 569-591.

Marine benthic flora was investigated in an Arctic bay. Specimens of chlorophyte, phaeophyte, and rhodophyte were collected and examined over the period from July to August 2003 from Kongsfjorden Spitsbergen in Svalbard Islands. A total of 28 genera and 32 species (5 chlorophytes, 18 phaeophytes, and 9 rhodophytes) was identified and described. A green alga *Enteromorpha linza* (Linnaeus) J. Agardh, a brown alga *Asperococcus compresus* Griffiths ex Hooker, and three red algae *Gracilaria gracilis* (Stackhouse) Steentoft et al., *Rhodymenia pacifica* Kylin and *Schizochlaenion rhodotrichum* Wynne et Norris were recorded in Svalbard Islands for the first time.

4-16 **Kim, Ji-Hee**, **HoSung Chung**, and 2 others. 2001. "Macroalgal Flora of Maxwell Bay, King George Island, Antarctica: I. Chlorophyta, Chrysophyta and Phaeophyta". *Ocean and Polar Research*, 23(3): 209-221.

Taxonomic composition of marine benthic algal flora was investigated in an Antarctic bay. Specimens of chlorophyte, chrysophyte and phaeophyte were collected and examined over the period from January 1988 to January 1995 from Maxwell Bay, King George Island. A total of 19 genera and 23 species (7 chlorophytes, 1 chrysophyte and 15 phaeophytes) were identified and described. A chlorophyte *Lambia antarctica* (Skottsberg) Delepine and a phaeophyte Alethocladus corymbosus (Dickie) Sauvageau were recorded in Maxwell Bay for the first time. Taxonomic keys for the chlorophytes and the phaeophytes were also provided.

4-17 Lee, Eun-Young, **Hong Kum Lee**, **Yoo Kyung Lee**, Chung Ja Sim, and **Jung-Hyun Lee**. 2003. "Diversity of symbiotic archaeal communities in marine sponges from Korea". *Biomolecular Engineering*, 20(4-6): 299-304.

A molecular analysis of archaeal communities in eight sponges collected along the coast of Cheju Island, Korea was conducted using terminal-restriction fragment length polymorphism (T-RFLP) in conjunction with sequencing analysis of 16S rDNA clones. The terminal-restriction fragment (T-RF) profiles showed that each sponge had a simple archaeal community represented by a single major peak of the same size except for one unidentified sponge (01CJ20). In order to identify the components of the community, 170 archaeal 16S rDNA clones were recovered from sponges and analyzed by RFLP typing. Sequences of 19 representative clones for all RFLP types found in each sponge were determined and phylogenetic analysis was carried out. Seventeen of these archaeal 16S rDNA clones showed a high similarity to marine group I, belonging to the crenarchaeotes. In the phylogenetic tree, 15 archaeal clones were grouped into five sponge-associated archaeal clusters. In the unidentified sponge sample (01CJ20), one major T-RF peak was represented by a single RFLP type (40 clones), which implied a specific relationship between the sponge and its symbiotic archaeal components.

4-18 **Lee, Hong Kum**, Jongsik Chun, Eun Young Moon, **Sung-Hwan Ko**, **Deuk-Soo Lee**, **Hyun Sang Lee**, and Kyung Sook Bae. 2001. "*Hahella chejuensis* gen. nov., sp. nov., an extracellular-polysaccharide-producing marine bacterium". *International Journal of Systematic and Evolutionary Microbiology*, 51(2): 661-666.

A bacterial strain, designated 96CJ10356^T, which produced abundant extracellular polysaccharides and red pigment was isolated from marine sediment collected from Marado, Cheju Island, Republic of Korea. The organism is Gram-negative, aerobic, rod-shaped and motile. Growth was not observed in the absence of NaCl, and was optimal at an NaCl concentration of 2%. The strain contained oxidase and catalase, and was able to hydrolyse aesculin and gelatin. The major cellular fatty acids were saturated or monounsaturated straight-chain fatty acids. An almost complete 16S rDNA sequence of the test strain was determined. Phylogenetic analysis based on the neighbour-joining and Fitch–Margoliash methods indicated that the organism formed a distinct phyletic line within the γ *Proteobacteria*. This relationship was also supported by sequence comparison, as no valid bacterial species showed more than 90% sequence homology with the isolate. It is clear from polyphasic evidence that the isolate merits the status of genus in the γ subclass of the *Proteobacteria*, and the name *Hahella chejuensis* gen. nov., sp. nov. is proposed for the marine isolate 96CJ10356^T (= KCTC 2396^T = IMSNU 11157^T).

4-19 **Lee, Hyun Sang**, **Shin Hye Park**, Jong Ho Lee, and **Hong Kum Lee**. 2001. "Effect of Aeration Rates on Production of Extracellular Polysaccharide, EPS-R, by Marine Bacterium *Hahella chejuensis*". *Biotechnology and Bioprocess Engineering*, 6: 359-362.

The production of an extracellular polysaccharide, EPS-R, from the marine bacterium *Hahella chejuensis* was investigated at various aeration rates in a batch culture. Higher aeration rate resulted in enhanced EPS production and increased the viscosity of the culture broth. At an aeration rate of 1.5 vvm, EPS-R (12.2 g/L) was obtained with a yield ($Y_{P/S}$) of 0.6 from the STN medium after 72 h of cultivation. The *H. chejuensis* cells changed their rod morphology to a short-rod form in the stationary growth phase.

4-20 **Lee, Y. K.**, **H. W. Kim**, C. L. Liu, and **H. K. Lee**. 2003. "A simple method for DNA extraction from marine bacteria that produce extracellular materials". *Journal of Microbiological Methods*, 52(2): 245-250.

We present a simple method for extracting DNA from the marine bacteria *Hahella chejuensis*, a *Streptomyces* sp., and a *Cytophaga* sp. Previously, DNA purification from these strains was hindered by the presence of extracellular materials. In our extraction method, the marine bacteria are lysed by freezing and grinding in liquid nitrogen, and treated with SDS. The extracted DNA is purified using a phenol/chloroform mixture, and precipitated in isopropanol. The extracted DNA is of high quality and suitable for molecular analyses, such as PCR, restriction enzyme digestion, genomic DNA blot hybridization, and genomic DNA library construction. We used this method to extract genomic DNA from several other marine bacteria. Our method is a reproducible, simple, and rapid technique for routine DNA extractions from marine bacteria. Furthermore, the low cost of this method makes it attractive for large-scale studies.

4-21 **Lee, Yoo Kyung** and **Hong Kum Lee**. 2001. "Eukaryotic Algal Genes and Progress in Molecular Biology of Eukaryotic Algae". *Algae*, 16(1): 1-19.

Molecular biology has provided new tools to explore and expose the genetic basis of taxonomy, biochemistry, physiology, cellular differentiation and developmental biology of eukaryotic algae. In this article we provide a list of previously published eukaryotic algal genes encoded in nuclear genome. The algal

groups highlighted are Rhodophyta, Chlorophyta, Chrysophyta, Haptophyta, Dinophyta, Cryptophyta and Euglenophyta. We also focus on five areas where molecular research has provided major insights: cell structure, metabolism, sexual differentiation, photosynthetic apparatus and expressed sequence tags (EST). This paper demonstrates the importance of molecular biological research in algal systems. We also suggest areas where molecular biology will lead to new understanding of algal biology and its applications.

4-22 **Lee, Yoo Kyung** and **Hong Kum Lee**. 2003. "A Simple Method for DNA Extraction from Red Algae". *Algae,* 18(1): 65-69.

A simple method is described for extracting DNA from marine red algae from which it has been difficult to isolate DNA because of their polysaccharides and phenolic compounds. In this DNA extraction method, the red algae were lysed mechanically by freezing and grinding in liquid nitrogen, and chemically by SDS. Then, the DNA was purified in phenol/chloroform, and precipitated in isopropanol. This method was applied to *Antithamnion sparsum*, *Campylaephora crassa*, *Gelidium amansii*, *Griffithsia japonica*, *Polysiphonia morrowii*, *Porphyra yezoensis*, and *Symphyocladia latiuscula*. The DNA extracted by this method is high yield and high quality for molecular analyses, such as PCR, sequencing, restriction enzyme digestion, and genomic DNA library construction. This method is reproducible, simple, and fast for routine DNA extraction from red algae.

4-23 **Lee, Yoo Kyung** and **Hong Kum Lee**. 2003. "Putative histone H2A genes from a red alga, *Griffithsia japonica". Algae*, 18(3): 191-197.

Histones are important proteins that interact with the DNA double helix to form nucleosome. Two putative his-tone genes, GjH2A-1 and GjH2A-2 were isolated from a red alga *Griffithsia japonica*. The putative open reading frame of GjH2A-1 and GjH2A-2 shared high similarity with the previously reported amino acid sequences of histone H2As. They have a motif consisting of seven amino acids A-G-L-Q-F-P-V, which matches the histone H2A motif [AC]-G-L-x-F-P-V. Phylogenetic trees were constructed from amino acid sequences of 38 histone H2As. The histone H2As were divided into two groups: major H2As and H2A.F/Z variants. The major histone H2A group consisted of animals, fungi, plants + green algae, and red algae H2A subgroups. The animal histone H2A subgroup was divided into vertebrates, echinoderms, nematodes, insects, and segmented worms H2As. The putative red algal histone genes, GjH2A-1 and GjH2A-2, constituted an independent lineage. This is the first report on red algal histone genes.

4-24 **Lee, Yoo Kyung**, **Jung-Hyun Lee**, and **Hong Kum Lee**. 2001. "Microbial Symbiosis in Marine Sponges". *Journal of Microbiology*, 39(4): 254-264.

Sponges are host organisms for various symbiotic microorganisms such as archaea, bacteria, cyano-bacteria and microalgae. Sponges are also sources of a wide variety of useful natural products like cytotoxins. antifouling agents, antibiotics, and anti-inflammatory and antiviral compounds, Symbiotic microorganisms is sponges can be sources of various natural products, because metabolites previously ascribed to sponges have recently been demonstrated to be biosynthesized by symbionts. If a symbiotic microorganisms from which some natural products are derived can be cultured, the microorganism could be used in a mass production of the bioactive compounds. We summarize recent research on isolation and

cultivation of sponge-symbiotic microorganisms and the symbiotic relationship.

4-25 **Lee, Yoo Kyung**, **Kae-Kyung Kwon**, **Kyeung Hee Cho**, **Hyo Won Kim**, **Jae Hyun Park**, and **Hong Kum Lee**. 2003. "Culture and Identification of Bacteria from Marine Biofilms". *Journal of Microbiology*, 41(3): 183-188.

We isolated and cultured bacteria that inhabited marine biofilms, and identified them by phylogenetic analysis using 16S rDNA sequences. In the marine environment, biofilms cover most subtidal and inter-tidal solid surfaces such as rocks, ships, loops, marine animals, and algae. The bacteria in most biofilms are embedded in extracellular polymeric substances that comprise mainly of exopolysaccharides. The exopolysaccharides are excreted from multiple bacterial species; therefore, biofilms are a good source for screening exopolysaccharide-producing bacteria. Thirty-one strains were cultured, and a total of 17 unique strains were identified. Phylogenetic analysis using 16S rDNA sequences indicated that the 17 strains belonged to α-Proteobacteria (*Ochrobactrum anthropi, Paracoccus carotinifaciens*); γ-Proteo-bacteria *(Pseudoalteromonas agarovorans*, *P. piscicida, Pseudomonas aeruginosa, Shewanella baltica, Vibrio parahaemolyticus, V. pomeroyi*); CFB group bacteria (*Cytophaga latercula, Tenacibaculum meso-philum*); high GC, Gram-positive bacteria (*Arthrobacter nicotianae, Brevibacterium casei, B. epidermi-dis, Tsukamurella inchonensis*); and low GC, Gram-positive bacteria (*Bacillus macroides, Staphylococcus haemolyticus, S. warneri*).

4-26 **Lee, Youn-Ho**. 2003. "Molecular Phylogenies and Divergence Times of Sea Urchin Species of Strongylocentrotidae, Echinoida". *Molecular Biology and Evolution*, 20(8): 1211-1221.

Sea urchins of the family Strongylocentrotidae have been important model systems in many fields of basic biology, yet knowledge of their evolutionary identities such as the phylogenetic relationships and divergence times remains limited. Here, I inferred molecular phylogenies of seven Strongylocentrotid species (*Strongylocentrotus franciscanus*, *S. nudus*, *S. purpuratus*, *S. intermedius*, *S. droebachiensis*, *S. pallidus*, and *Hemicentrotus pulcherrimus*) from the analyses of mitochondrial DNA sequences of 12SrDNA (349 nt), 12SrDNA-tRNA(gln) region (862 nt), and a combined sequence of cytochrome oxidase subunit I (COI, 1080 nt) and NADH dehydrogenase subunit I (NDI, 742 nt). The rate of sequence evolution and divergence times for each species were then estimated from the trees with reference to the time of separation between Strongylocentrotidae and Parechinidae, 35 to 50 MYA. The three trees agree well with each other, and the phylogeny is summarized by ((*S. franciscanus, S. nudus*), *(H. pulcherrimus (S. purpuratus, S. intermedius* (*S. droebachiensis, S. pallidus*)))). It is notable that the genus *Strongylocentrotus* consists of two distinct clades and that *H. pulcherrimus* branches off within *Strongylocentrotus*, implying assignment of a separate, monospecific genus to this species inappropriate. The rate of sequence evolution is calibrated to be 0.24%-0.34%/Myr in 12SrDNA, 0.25%-0.36%/Myr in 12SrDNA-tRNA(gln), and 0.65%-0.93%/Myr in COI-NDI combined sequences. *S. purpuratus*, in particular, shows the significantly higher rate of evolution in the 12SrDNA and 12SrDNA-tRNA(gln) regions compared to other species, suggesting careful use of its sequences in comparative studies. The two clades of Strongylocentrotidae seem to have split 13-19 MYA, and *H. pulcherrimus* branched off 7.2-14 MYA. In the former clade, *S. franciscanus* and *S. nudus* separated 5.7-8.1

MYA. In the latter clade, *S. purpuratus, S. intermedius*, and the clade of *S. droebachiensis* and *S. pallidus* diverged approximately 4.6-12 MYA, and the last two closest species separated 2.1-3.1 MYA.

4-27 Pak, K. -R., O. -Y. Lim, **H. -K. Lee**, and S. -C. Choi. 2002. "Aerobic reduction of manganese oxide by *Salmonella* sp. strain MR4". *Biotechnology Letters*, 24(14): 1181-1184.

A new isolate of *Salmonella*, strain MR4, reduced Mn(IV)O_2 at 2.3 mM under aerobic conditions by about 83% over 24 h. Direct contact of cells to MnO_2 was not necessary as the cell-free spent medium produced a similar amount of Mn(II). Pyruvate (1.6 mM) and oxalate (0.8 mM) were identified in the culture medium and presumed to have a role in Mn(II) production in this microorganism.

4-28 Pak, Kyung-Ran, Hyun-Jin Lee, **Hong Kum Lee**, and 3 others. 2003. "Involvement of Organic Acid During Corrosion of Iron Coupon by *Desulfovibrio desulfuricans*". *Journal of Microbiology and Biotechnology,* 13(6): 937-941.

Microbiologically influenced corrosion (MIC) is an electrochemical process where the participation of microorganisms initiates, facilitates, or accelerates the corrosion reaction. Sulfate-reducing bacteria (SRB) reduce sulfate to sulfide and are known to be the most destructive microorganisms in anaerobic MIC. Accordingly, the current study attempted to elucidate the mechanisms involved and the relative importance of the corrosive products in SRB-induced corrosion. The measured rate of anaerobic corrosion of iron coupons by *Desulfovibrio desulfuricans* was 89.9 μg cm^{-2} d^{-1}. Direct contact between the cells and the iron coupon did not seem to be necessary for corrosion to occur, since the corrosion rate was similar (100.8 μg cm^{-2} d^{-1}) when the coupon was enclosed in a dialysis bag. The participation of sulfide in the corrosion process was only marginal, as the specific corrosion rate was 2.5 times higher in a sulfate-free pyruvate medium than in an H_2S-producing lactate medium. Acetate (18.8-22.1 mM), the end-product of pyruvate and lactate metabolism, was identified in the culture medium and thus presumed to play a major role in the corrosion process involving *Desulfovibrio desulfuricans*.

4-29 **Park, Shin Hye** and **Hong Kum Lee**. 2001. "Hydrophobicity of Microbial Cell Surface and its Applications". *Korean Journal of Biotechnology and Bioengineering*, 16(3): 225-232.

The hydrophobicity of the microbial cell surface is responsible for the various interactions between microorganisms and different surface, and results in the flocculation of microbial cells, their adhesion to liquid or solid materials, and the floatation of microorganisms at the air-water interface. Accordingly, cell surface hydrophobicity is important not only in medicine but in other areas of biotechnology. This article reviews the role of cell surface hydrophobicity and its applications.

4-30 **Park, Shin Hye**, **Hyun Sang Lee**, and **Hong Kum Lee**. 2001. "Preservation of Marine Heterotrophic Bacteria by Using a Deep-freezing Method". *The Journal of Microbiology*, 39(3): 240-243.

The effect of cryoprotectants and suspending solutions on the preservation of marine heterotophic bacteria was investigated. Six halotolerant and four halophilic bacterial isolates suspended in either distilled water or artificial seawater were preserved in glycerol and dimethylsulfoxide at –70℃, respectively. After one year of preservation, the recovery

rates on the appropriate agar plates were estimated. The survival rate was found to be dependent on the strain tested, regardless of the preservation conditions tested.

4-31 **Park, Shin Hye**, **Kae Kyoung Kwon**, **Deuk-Soo Lee**, and **Hong Kum Lee**. 2002. "Morphological Diversity of Marine Microorganisms on Different Isolation Media". *Journal of Microbiology*, 40(2): 161-165.

Isolation frequency of microorganisms from marine sources was examined with different media and samples collected from the coastal area of Cheju Island. From sea water samples, about 1% of microorganisms from the total number of bacteria were recovered. Microorganisms were cultured at the much lower frequency of 10^{-4}-10^{-6} from other marine sources, such as sediment, sponges and corals. The frequency of duplicated isolation was examined with 140 morphologically different colonies isolated on different media. Fourteen percent of them exhibited the same morphology on two different media. The duplication frequency of the isolates among three different media was 33%.

4-32 Seo, Youngwan, Ki Woong Cho, **Hosung Chung**, and 2 others. 1998. "New Secosteroids from a Gorgonian of the Genus *Muricella*". *Journal of Natural Products,* 61(11): 1441-1443.

Calicoferols F–I (2–5), four new 9, 10-secosteroids, have been isolated from a gorgonian of the genus *Muricella* collected from Jaeju Island, Korea. The structures of these compounds have been determined by combined spectroscopic methods. Calicoferols exhibited significant cytotoxicity and inhibitory activity against PLA_2.

4-33 **Yim, Joung Han**, **Sung Jin Kim**, **Se Hoon Ahn**, and **Hong Kum Lee**. 2003. "Optimal conditions for the production of sulfated polysaccharide by marine microalgae *Gyrodinium impudicum* strain KG03". *Biomolecular Engineering*, 20(4): 273-280.

A marine microalga *Gyrodinium impudicum* strain KG03 produced sulfated exopolysaccharide designated as p-KG03, which showed a strong antiviral activity against encephalomyocarditis virus (EMCV). To optimize culture conditions for the production of p-KG03, mineral salts, vitamins, plant growth hormones, temperature, pH and light conditions were examined. From this study, M-KG03 medium for the maximum production of p-KG03 was suggested as follows; NH_4Cl 75 μM, NaH_3PO_4 200 μM, $NaHCO_3$ 50 μM, Na_2SO_4 10 μM, $FeCl_2 \cdot 6H_2O$ 10 μM, $MnCl_2 \cdot 4H_2O$ 0.1 μM, vitamin B_{12} 0.75 μg, naphthalene acetic acid (NAA) 7.5 μg and myo-inositol 200 mg per liter of aged sea water. The optimal temperature and pH were 22.5 ℃ and 8.0, respectively. The optimal light conditions of intensity and period were 150 E μE m^{-2} s^{-1} and 16:8 h light:dark cycle. Finally, the cell growth and p-KG03 production were measured in one liter of M-KG03 medium with 1% CO_2 and 50 ml min^{-1} of airflow using two liters airlift balloon type photobioreactor (ABTPR). At these optimal conditions, p-KG03 production and cell growth were 134.6±5.9 mg l^{-1} and 123,076 ± 1,597 cells ml^{-1}, respectively, representing a 7.7 and 5.1 times compared with f/2 medium with Erlenmeyer flask culture (p-KG03 production 17.5 ± 1.3 mg l^{-1} and cell growth 24,311 ± 1,291 cells ml^{-1}).

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