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Volume 2 (2004-2006)

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PART 1

Climate Change Sciences

- 1-1 Bak, Young-Suk, Jong-Deock Lee, **Ho-Il Yoon**, and Hyesu Yun. 2004. "Diatom assemblage from Maxwell Bay in Antarctica". *Journal of the Geological Society of Korea*, 40(4): 455-468.

A total of 60 species and varieties belonging to 33 genera is identified from the Core GC00-MX2 in the Maxwell Bay of the South Shetland Islands, Western Antarctica. The Holocene diatom assemblages from the core are characterized by predominance (about 50.3% of the total) of *Cocconeis costata*, *Fragilariopsis kerguelensis*, *Rhizosolenia styliformis*, *Thalassiosira antarctica*, *T. glacilis* and *T. rentiginosa*. The neritic benthic diatoms, such as *Acanthes* sp., *Cocconeis costata*, *Grammatophora* sp., *Licomphora* sp., *Navicula directa*, *Pseudogomphonema* sp., and *Trachyneis aspera*, which are introduced by glacier meltwater, indicate a warm event during the sedimentation periods. The lower horizons of the core (592 cm ~ 208 cm) are characterized by high abundance of *Chaetoceros* resting spore, indicating input of sea-ice meltwater. In contrast, the abundance of this resting spore in upper horizons is gradually decreased from 208 cm horizon upward. As a result, the lower horizons of the core were influenced by open marine conditions and ice conditions, and the upper horizons changed to ice conditions(cold) in core intervals of 176 cm to 96 cm.

- 1-2 Boer, G. J., B. Yu, **S.-J. Kim**, and G. M. Flato. 2004. "Is there observational support for an El Niño-like pattern of future global warming?". *Geophysical Research Letters*, 31(6): L06201(1-4). doi: 10.1029/2003GL018722

Three streams of evidence, namely

simulations with coupled models, feedback analysis in the tropical Pacific, and observation-based paleoclimate reconstructions, all support the expectation of a future mean El Niño-like temperature response to the positive radiative forcing resulting from a continued increase in atmospheric greenhouse gas concentrations.

- 1-3 Boutron, Claude, Kevin Rosman, Carlo Barbante, Michael Bolshov, Freddy Adams, **Sungmin Hong**, and Christophe Ferrari. 2004. "L'archivage des activités humaines par les neiges et glaces polaires : le cas du plomb". *Comptes Rendus Geoscience*, 336(10): 847-867. doi: 10.1016/j.crte.2004.01.008

The investigation of the occurrence of lead in dated snow and ice from Greenland and Antarctica has played a major role in our understanding of the history of the pollution of the atmosphere of our planet by this metal. Such studies have however proven to be very demanding, mainly because of the extremely purity of polar snow and ice. Reliable measurements can be obtained only if ultra-clean and highly sensitive procedures are used, as pioneered by Clair Patterson. The Greenland data show evidence of large-scale pollution of the atmosphere of the Northern Hemisphere for lead as early as two millennia ago during Greco-Roman times, especially because of mining and smelting activities in southern Spain. It peaked at the end of the 1960s, with lead concentrations in snow about 200 times higher than natural values, before declining during recent times because of the fall in the use of leaded gasoline. Lead pollution in Antarctica was already significant at the end of the 19th century as a consequence of whaling activities, the traffic of coal-powered ships crossing the Cape Horn, and mining activities in South America, South Africa and Australia. After declining because of the opening of the Panama Canal,

the great economic depression and World War II, it reached a maximum during the 1980s. with lead concentrations 20 times higher than natural values. Other studies focus on past natural variations of lead in ancient ice dated from the last climatic cycles.

- 1-4 Cho, Y. -M., G. G. Shepherd, **Y. -I. Won**, and 3 others. 2004. "MLT cooling during stratospheric warming events". *Geophysical Research Letters*, 31(10): L10104(1-4). doi: 10.1029/2004GL019552

MLT (Mesosphere and Lower Thermosphere) airglow emission rates and temperatures have been monitored with a Spectral Airglow Temperature Imager (SATI), operated at Resolute Bay (74.68°N, 94.90°W). The 2001/2002 winter season data exhibits a major cooling event for both the O₂ and OH emissions near the end of December, a mild event in mid February and a final cooling in early March. These temperature perturbations are compared with the UKMO stratospheric assimilated data for the Resolute Bay location and for zonally averaged data at 75°N, at two pressure levels, 3.16 hPa and 0.316 hPa. For the major event the 3.16 hPa zonally averaged temperature coincides in time with the MLT cooling. The O₂ temperatures increase slightly, prior to the stratospheric warming, but after onset both emissions exhibit cooling; this is consistent with the TIME-GCM/CCM3 predictions for the meridional circulation at high latitudes.

- 1-5 Choi, Taejin, **Bang Yong Lee**, and 2 others. 2004. "Surface Flux Measurements at King Sejong Station in West Antarctica: I. Turbulent Characteristics and Sensible Heat Flux". *Ocean and Polar Research*, 26(3): 453-463.

The Antarctic Peninsula is important in terms of global warming research due to pronounced increase of air temperature over

the last century. The first eddy covariance system was established at King Sejong Station located in the northern region of the Antarctic Peninsula in December of 2002 and has been operated over one year. Here, we analyze turbulent characteristics to determine quality control criteria for turbulent sensible heat flux data as well as to diagnose the possibility of long term eddy covariance measurement under extreme weather conditions of the Antarctic Peninsula. We also report the preliminary result on sensible heat flux. Based on the analyses on turbulent characteristics such as integral turbulence characteristics of vertical velocity (w) and heat (T), stationarity test and investigation of correlation coefficient, they follow the Monin-Obukhov similarity and eddy covariance flux data were reliable. ~47 % of total retrieved sensible heat flux data could be used for further analysis. Daytime averaged sensible heat flux showed a pronounced seasonal variation, with a maximum of up to 300 Wm⁻² in summer. In conclusion, continuous and long-term eddy covariance measurement may be possible at the study site and the land surface may influence the atmosphere significantly through heat transport in summer.

- 1-6 Chung, Chull Hwan, **Ho Il Yoon**, and Seung Hyoun Lee. 2004. "Paleoclimatic Implications of Palynoflora from the Quaternary Sediments at Seogwipo, Jeju Island, Korea". *Journal of the Korean Earth Science Society*, 25(5): 377-385.

Palynoflora from a core (BH-4) drilled on the Quaternary sediments in the vicinity of Seogwipo, Jeju Island, provide an unusual opportunity to reveal vegetational transition from the last glacial to the Holocene in Korea. It consists mainly of ferns, deciduous broad-leaved angiosperms, and herbs, and is represented by Polypodiaceae, Gramineae, *Castanea/Castanopsis*, *Quercus* and

Compositae. A distinct vegetational change is observed at a core depth of 200 cm. The interval of 30 to 190 cm in depth yields mainly arboreal pollen and warm temperate taxa such as Polypodiaceae, *Ceratopteris*, and Taxodiaceae-Cupressaceae-Taxaceae, whereas the interval of 200 to 800 cm is dominated by herbaceous pollen and a decrease of warm temperate taxa, reflecting the influence of cold climate. This palynofloral climatic signature closely corresponds to paleoclimate proxy records such as magnetic susceptibility.

more exposed to the sun, than at the northern part. Comparing sea-ice formation in winter with air temperature data shows a pattern starting to freeze below -5°C and to thaw over -3°C . It is conclusively estimated that the patterns and magnitudes of ice cliff retreat and sea-ice formation are consistent with fluctuations of the air temperature, and that the recent rapid retreat of ice cliff and less formation of sea-ice are caused especially by the warming trends in autumn accompanied with expansion of summer thawing period.

- 1-7 **Chung, Hosung, Bang Yong Lee, Soon-Keun Chang, Ji Hee Kim, and Yeadong Kim.** 2004. "Ice Cliff Retreat and Sea-ice Formation Observed around King Sejong Station in King George Island, West Antarctica". *Ocean and Polar Research*, 26(1): 1-10.

Ice cliff retreat and sea-ice formation around King Sejong Station in King George Island were analysed and compared with air temperature change. Analysis of 33-year (1969-2001) air temperature records at Bellingshausen Station has revealed regional atmospheric warming, and the increasing rate of air temperature is equivalent to a warming of 1°C for 27-year period. Here we present time-series of observations for the areal extent of the ice cliff and ice sheet, showing that they have retreated dramatically in the past 45 years (1956-2001). Retreat of 1,050 m in length of the ice cliff has changed the Marian Cove into a low rectangular form of 4 km in length and 1 to 1.3 km in width. The retreat rates have since increased from 6 m/yr of the Primary investigated Period to 54 and 81 m/yr in the recent years. Exceptionally, the ice cliff had been advanced of 21 m in length for a year between 1987 and 1988 of cold winters. Ice sheet in King George Island also shows a similar decrease, and the decreasing extent is much larger at the southern part of the Marian Cove, relatively

- 1-8 Gabrielli, Paolo, Anita Varga, Carlo Barbante, Claude Boutron, Giulio Cozzi, Vania Gaspari, Frédéric Planchon, Warren Cairns, **Sungmin Hong**, and 2 others. 2004. "Determination of Ir and Pt down to the sub-femtogram per gram level in polar ice by ICP-SFMS using preconcentration and a desolvation system". *Journal of Analytical Atomic Spectrometry*, 19(4): 831-837.

doi: 10.1039/b316283d

A new analytical methodology, based on inductively coupled plasma sector field mass spectrometry (ICP-SFMS) coupled with a micro-flow nebulizer and desolvation system, has been set up for the quantification of Ir and Pt down to the sub-ppq level ($1 \text{ ppq} = 1 \text{ fg g}^{-1} = 10^{-15} \text{ g g}^{-1}$) in polar ice samples. Ultra-clean procedures were adopted during the pre-treatment phases in our laboratories in order to avoid possible contamination problems and a preconcentration step by evaporation at sub-boiling temperatures was necessary. A procedural detection limit of 0.02 ppq and 0.08 ppq for Ir and Pt, respectively, was obtained. The reproducibility of the analytical procedures at the ppq level was about 50% for Ir and 30% for Pt and the recoveries were 75% and 93% for Ir and Pt, respectively. Spectral interferences, which affect the determination of Ir and Pt, were reduced by using a desolvation system for sample introduction.

The contribution of the interfering species was determined and subtracted. This new method allowed us to analyze Ir and Pt in remote uncontaminated ice samples from Antarctica and Greenland down to the sub-ppq level. The concentration ranges were from 0.1 up to 5 ppq for Ir and from 0.2 up to 7 ppq for Pt. These measurements represent the first data of Ir concentrations in unfiltered melted ice samples and the lowest concentrations ever recorded for Pt in environmental samples.

- 1-9 Gabrielli, Paolo, Carlo Barbante, John M. C. Plane, Anita Varga, **Sungmin Hong**, and 8 others. 2004. "Meteoric smoke fallout over the Holocene epoch revealed by iridium and platinum in Greenland ice". *Nature*, 432(7020): 1011-1014.
doi: 10.1038/nature03137

An iridium anomaly at the Cretaceous/Tertiary boundary layer has been attributed to an extraterrestrial body that struck the Earth some 65 million years ago. It has been suggested that, during this event, the carrier of iridium was probably a micrometre-sized silicate-enclosed aggregate or the nano-phase material of the vaporized impactor. But the fate of platinum-group elements (such as iridium) that regularly enter the atmosphere via ablating meteoroids remains largely unknown. Here we report a record of iridium and platinum fluxes on a climatic-cycle timescale, back to 128,000 years ago, from a Greenland ice core. We find that unexpectedly constant fallout of extraterrestrial matter to Greenland occurred during the Holocene, whereas a greatly enhanced input of terrestrial iridium and platinum masked the cosmic flux in the dust-laden atmosphere of the last glacial age. We suggest that nanometer-sized meteoric smoke particles, formed from the recondensation of ablated meteoroids in the atmosphere at altitudes >70 kilometers, are transported into the

winter polar vortices by the mesospheric meridional circulation and are preferentially deposited in the polar ice caps. This implies an average global fallout of 14 kilotons per year of meteoric smoke during the Holocene.

- 1-10 **Hong, Sungmin**, and 9 others. 2004. "Atmospheric heavy metals in tropical South America during the past 22000 years recorded in a high altitude ice core from Sajama, Bolivia". *Journal of Environmental Monitoring*, 6(4): 322-326.
doi: 10.1039/B314251e

V, Co, Cu, Zn, As, Rb, Sr, Ag, Cd, Ba, Pb, Bi and U have been analysed by inductively coupled plasma sector field mass spectrometry in various sections of a dated snow/ice core drilled at an altitude of 6542 m on the Sajama ice cap in Bolivia. The analysed sections were dated from the Last Glacial Stage (~22000 years ago), the Mid-Holocene and the last centuries. The observed variations of crustal enrichment factors (EF_c) for the various metals show contrasting situations. For V, Co, Rb, Sr and U, EF_c values close to unity are observed for all sections, then showing that these elements are mainly derived from rock and soil dust. For the other metals, clear time trends are observed, with a pronounced increase of EF_c values during the 19th and 20th centuries. This increase shows evidence of metal pollution associated with human activity in South America. For Pb an important contribution was from gasoline additives. For metals such as Cu, Zn, Ag and Cd an important contribution was from metal production activities, with a continuous increase of production during the 20th century in countries such as Peru, Chile and Bolivia.

- 1-11 **Hong, Sungmin**, Claude F. Boutron, Paolo Gabrielli, Carlo Barbante, Christophe P. Ferrari, Jean Robert Petit, **Khanghyun Lee**,

and Vladimir Y. Lipenkov. 2004. "Past natural changes in Cu, Zn and Cd in Vostok Antarctic ice dated back to the penultimate interglacial period". *Geophysical Research Letters*, 31: L20111(1-4).

doi: 10.1029/2004GL021075

Improved ice core decontamination procedures have allowed us to obtain the first reliable data on Cu, Zn and Cd in ancient Antarctic ice drilled in a fluid filled hole at Vostok Station, dated back to the beginning of the next to last ice age ~240,000 years ago. Cu, Zn and Cd concentrations and fallout fluxes display very large natural variations by up to a factor of 35, with high values obtained during the coldest climatic stages and much lower values during warm climatic stages. Crustal dust was an important source of Cu and Zn during the coldest climatic stages, and volcanic emissions were probably an important source of Cd both during warm and cold periods.

- 1-12 Hwang, Seung-Hyun, Soo-Jin Lee, Jun-Kyu Kim, Young-Soon Jang, Jeong-Joo Park, Gwang-Rae Cho, Jhoon Kim, Hi Ku Cho, Seung-Hoon Lee, and **Young In Won**. 2004. "Application of Rocket-Borne UV Radiometer Onboard KSR-III to O₃ Measurement". *Journal of the Korean Physical Society*, 44(2): 435-441. doi: 10.3938/jkps.44.435

KSR-III, the third Korean Sounding Rocket, was launched successfully at Anheung, Korea on Nov. 28, 2002. One of the scientific missions of KSR-III was to measure the stratospheric ozone density profile by using an onboard four-channel UV radiometer. The apogee of the rocket was 42.8 km, and the total flight time was 231 s. The UV radiometer onboard the KSR-III measured the attenuation of solar radiation during ascending phase to obtain a vertical profile of the ozone density. The detector has UV channels centered at 255, 290, and 310 nm

and a visible channel at 450 nm for attitude reference. Because the measurement of the solar radiation depends on the response function of the sensor, calibrations of interference filters and phototubes must be done. The optical calibration system consists of a monochromator, an optical power meter, light detectors, standard light sources, a control PC, and data acquisition software. The application of the rocket-borne UV radiometer onboard the KSR-III to the ozone measurement are presented together with the calibration results from the integrated calibration system at the Korea Aerospace Research Institute. Using the calibration results and the *in-situ* measurement data, we obtained the ozone number density profile, and compared with other measurements.

- 1-13 Jeong, Gi Young, **Ho Il Yoon**, and Seung Yeop Lee. 2004. "Chemistry and microstructures of clay particles in smectite-rich shelf sediments, South Shetland Islands, Antarctica". *Marine Geology*, 209(1-4): 19-30. doi: 10.1016/j.margeo.2004.05.027

The clay mineralogy of a Holocene sediment core from the shelf of Livingston Island, South Shetland Islands, Antarctica has been investigated by X-ray diffraction (XRD), lattice imaging, bulk chemical analysis of fine clay fractions and analytical transmission electron microscopy (ATEM). The clay minerals identified by XRD of < 2 μm fraction are smectite 63%, chlorite 25% and illite 12%, with little downcore variation. Lattice imaging of clay particles has confirmed the presence of interstratified illite-smectite and interstratified chlorite-smectite. ATEM of Ca-saturated samples showed that the smectitic clay particles are rich in K, Fe and Mg. K in the smectitic particles is mostly present as a fixed cation in the interlayer, confirming the presence of interstratified illite. A comparison of the mineralogy of the bedrock/soils in the probable source area and

the core sediment strongly supports the view that the clay minerals must have originated by glacial erosion, physical weathering and reworking of hydrothermally altered volcanic bedrock and tephra of the South Shetland Islands.

- 1-14 Khim, Boo-Keun, **Ho Il Yoon, Cheon Yun Kang,** and Junlin Zhao. 2004. "Holocene Variations of Organic Carbon Contents in Lake Langer of King George Island, South Shetland islands, West Antarctica". *Ocean and Polar Research*, 26(3): 507-514.

A sediment core drilled from Lake Langer on King George Island was analyzed for a variety of textural and geochemical properties along with ^{14}C age dates. This data was combined with published records of other cores to provide a detailed history of Holocene variation of total organic carbon (TOC) contents with respect to terrestrial paleoclimate change. The lithologic contrast of the lower diamicton and upper fine-grained sediments shows the glacier activity and subsequent lake formation. Low TOC contents fluctuated during the diamicton deposition whereas the increase of TOC started with the lake formation during the postglacial period that started about 5,000 yr B.P. More notable are the distinct TOC peaks that may imply enhanced primary productivity during the warm period. The uniform and low TOC may reflect the limited productivity during the evolution of the lake. However, the recent TOC readvance clearly indicates gradual warming on King George Island. However, the paleoclimatic signature in the terrestrial lake environment during the Holocene seems to be subtle and less distinct, compared to the marine environment.

- 1-15 **Kim, S. J.** 2004. "The effect of atmospheric CO_2 and ice sheet topography on LGM climate". *Climate Dynamics*, 22(6-7): 639-651.

doi: 10.1007/s00382-004-0412-2

The role of reduced atmospheric CO_2 concentration and ice sheet topography plus its associated land albedo on the LGM climate is investigated using a coupled atmosphere-ocean-sea ice climate system model. The surface cooling induced by the reduced CO_2 concentration is larger than that by the ice sheet topography plus other factors by about 30% for the surface air temperature and by about 100% for the sea surface temperature. A large inter-hemispheric asymmetry in surface cooling with a larger cooling in the NH is found for both cases. This asymmetric inter-hemispheric temperature response is consistent in the ice sheet topography case with earlier studies using an atmospheric model coupled with a mixed-layer ocean representation, but contrasts with these results in the reduced CO_2 case. The incorporation of ocean dynamics presumably leads to a larger snow and sea ice feedback as a result of the reduction in northward ocean heat transport, mainly as a consequence of the decrease in the North Atlantic overturning circulation by the substantial freshening of the North Atlantic convection regions. A reversed case is found in the Southern Ocean. Overall, the reduction in atmospheric CO_2 concentration accounts for about 60% of the total LGM climate change.

- 1-16 **Kim, Seong-Joong.** 2004. "A Coupled Model Simulation of Ocean Thermohaline Properties of the Last Glacial Maximum". *Atmosphere-Ocean*, 42(3): 213-220.
doi: 10.3137/ao.420305

The temperature and salinity of the ocean during the last glacial maximum (LGM) are simulated using a coupled ocean-atmosphere-sea ice climate model. The imposition of glacial boundary conditions leads to deep ocean heat loss to the

atmosphere at high latitude convection regions through an active vertical mixing and associated turbulent heat fluxes and deepwater temperature approaches to the freezing point. The LGM conditions also modify the fresh water distribution at the ocean surface and cause a marked change in the ocean convection, overturning circulation, and ocean salinity distribution. In the LGM, the ocean becomes substantially fresher in the Atlantic basin due to a freshening of northern North Atlantic and associated reduction in North Atlantic Deep Water formation, while the saltiest water mass is found in the Southern Ocean as a result of the increase in the formation of sea ice and drier climate around Antarctica. The LGM thermohaline properties simulated by the coupled model are in reasonable agreement with paleoclimate proxy evidence.

- 1-17 **Kim, Seong-Joong, Bang Yong Lee, Ho-Il Yoon, and Yeodong Kim.** 2004. "Implication of the Change in Overturning Circulation to the LGM CO₂ Budget". *Ocean and Polar Research*, 26(3): 501-506.

The observational proxy estimates suggest that the North Atlantic overturning stream function associated with the North Atlantic Deep Water (NADW) production and outflow was substantially weaker during the last glacial maximum (LGM) than that observed under present conditions. The impact of the changes in overturning circulation on the glacial carbon budget is investigated using a box model. The carbon box model reveals that the atmospheric CO₂ concentration is more sensitive to change in the overturning circulation of the North Atlantic than that of the Southern Ocean, especially when North Atlantic overturning becomes weaker. For example, when the strength of the North Atlantic overturning circulation is halved, the atmospheric CO₂ concentration is reduced by 50 ppm of that associated with the

accumulation of CO₂ in the deep ocean. This result implies that a weaker North Atlantic overturning circulation may play an important role in the lowering of LGM atmospheric CO₂ concentration.

- 1-18 **Kwak, Young-Sil, Byung-Ho Ahn, and Young-In Won.** 2004. "IONOSPHERE-THERMOSPHERE INTERACTIONS BASED ON NCAR-TIEGCM: THE INFLUENCE OF THE INTERPLANETARY MAGNETIC FIELD(IMF)-DEPENDENT IONOSPHERIC CONVECTION ON THE HIGH-LATITUDE LOWER THERMOSPHERIC WIND". *Journal of Astronomy & Space Sciences*, 21(1): 11-28.

To better understand how high-latitude electric fields influence thermospheric dynamics, winds in the high-latitude lower thermosphere are studied by using the Thermosphere-Ionosphere Electrodynamics General Circulation Model developed by the National Center for Atmospheric Research (NCAR-TIEGCM). The model is run for the conditions of 1992-1993 southern summer. The association of the model results with the interplanetary magnetic field(IMF) is also examined to determine the influences of the IMF-dependent ionospheric convection on the winds. The wind patterns show good agreement with the WINDII observations, although the model wind speeds are generally weaker than the observations. It is confirmed that the influences of high-latitude ionospheric convection on summertime thermospheric winds are seen down to 105 km. The difference wind, the difference between the winds for IMF≠0 and IMF=0, during negative IMF B_y shows a strong anticyclonic vortex while during positive IMF B_y a strong cyclonic vortex down to 105 km. For positive IMF B_z the difference winds are largely confined to the polar cap, while for negative IMF B_z they extend down to subauroral latitudes. The IMF B_z-dependent diurnal wind component is strongly

correlated with the corresponding component of ionospheric convection velocity down to 108 km and is largely rotational. The influence of IMF by on the lower thermospheric summertime zonal-mean zonal wind is substantial at high latitudes, with maximum wind speeds being 60 ms^{-1} at 130 km around 77° magnetic latitude.

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- 1-19 Lee, Hee Choon, **Bang Yong Lee**, and 2 others. 2004. "Tower-based Flux Measurement Using the Eddy Covariance Method at Ieodo Ocean Research Station". *Ocean and Polar Research*, 26(2): 145-154.

Surface energy and CO_2 fluxes have been measured over an ocean at Ieodo Ocean Research Station of KORDI since May 2003. Eddy covariance technique, which is a direct flux measurement, is used to quantitatively understand the interaction between the ocean surface and the atmospheric boundary layer. Although fluxes were continuously measured during the period from May 2003 to February 2004, the quality control of these data yielded $< 20\%$ of data retrieval. The atmospheric stability did not show any distinct diurnal patterns and remained near-neutral to stable from May to June but mostly unstable during fall and winter in 2003. Sensible heat flux showed a good correlation with the difference between the sea water temperature and the air temperature. The maximum fluxes of sensible heat and latent heat were 120 Wm^{-2} and 350 Wm^{-2} respectively, with an averaged Bowen ratio of 0.2. The ocean around the tower absorbed CO_2 from the atmosphere and the uptake rates showed seasonal variations. Based our preliminary results, the daytime CO_2 flux was steady with an average of $-0.1 \text{ mg CO}_2 \text{ m}^{-2} \text{ s}^{-1}$ in summer and increased in winter. The nighttime CO_2 uptake was greater and fluctuating, reaching up to $-1.0 \text{ mg CO}_2 \text{ m}^{-2} \text{ s}^{-1}$ but these data require further

examination due to weak turbulent mixing at nighttime. The magnitude of CO_2 flux was positively correlated with the half hourly changes in horizontal mean wind speed. Due to the paucity of quality data, further data collection is needed for more detailed analyses and interpretation.

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- 1-20 Lee, Kyu-Tae, **Bang Yong Lee**, **Young-In Won**, and 3 others. 2004. "The Variation of UV Radiation by Cloud Scattering at King Sejong Station in West Antarctica". *Ocean and Polar Research*, 26(2): 133-143.

For the purpose of understanding the cloud scattering effect of UV radiation at King Sejong station in West Antarctica, we analyzed the data measured by UV-Biometer at surface and compared its result with solar radiation model. The parameterization of UV radiation by cloud ice crystal was applied to solar radiation model and the sensitivity of this model for the variation of ice crystal was tested. The cloud optical thickness was calculated by using this solar radiation model. It was compared the result from calculation with CERES satellite data. In solar radiation model, the UV radiation was less scattered with increase of ice crystal size in cloud and this scattering effect was more important to UV-A radiation than Erythemal UV-B radiation. But scattering effects by altitude of cloud was not serious. The calculated cloud optical thicknesses in Erythemal UV-B and UV-A region were compared with CERES satellite data and the result by UV-A was more accurate than Erythemal UV-B region.

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- 1-21 Lee, Yong Il, Hyoun Soo Lim, and **Ho Il Yoon**. 2004. "Geochemistry of soils of King George Island, South Shetland Islands, West Antarctica: Implications for pedogenesis in cold polar regions". *Geochimica et Cosmochimica Acta*, 68(21): 4319-4333. doi: 10.1016/j.gca.2004.01.020

Fine fractions of soils on the Barton Peninsula, King George Island, West Antarctica have been forming during the last 6000 yr since the last deglaciation. Texturally, they are mostly composed of mineral and rock fragments with some volcanic ashes, which are also indicated by geochemical compositions representing for the nonclay silicate minerals and low values of chemical index of alteration. No significant changes are observed in major- and trace element abundances. Such geochemical characteristics suggest that chemical weathering of bedrocks on the Barton Peninsula seems insignificant and that the soils are composed of physically weathered mineral and rock fragments which are mixed with eolian additions of volcanic ashes and Patagonian dusts.

Chondrite-normalized rare earth element (REE) distribution patterns of the Barton Peninsula soils are slightly different from those of bedrocks, indicating that the REE abundances and characteristics were influenced by eolian additions. Mixing calculations, which mass-balance the REEs, suggest that volcanic ashes blown from Deception Island were the major eolian contributor, followed by atmospheric dusts sourced from Patagonia, South America. Even in the warmer and humid climatic conditions in the maritime Antarctic region, the chemical weathering of bedrocks appears to be insignificant, probably due to the relatively short duration of weathering since the last deglaciation.

- 1-22 Lee, Yun Gon, Jhoon Kim, **Bang Yong Lee**, and Hi Ku Cho. 2004. "Effects of Ozone, Cloud and Snow on Surface UV Irradiance". *Ocean and Polar Research*, 26(3): 439-451.

Total solar irradiance (TSO), total UV irradiance (TUV) and erythemal UV irradiance (EUV) measured at King Sejong station (62.22°S, 58.78°W) in west Antarctica have been used together with total ozone,

cloud amount and snow cover to examine the effects of ozone, cloud and snow surface on these surface solar irradiance over the period of 1998-2003. The data of three solar components for each scan were grouped by cloud amount, n in oktas ($0 \leq n < 3$, $3 \leq n < 4$, $4 \leq n < 5$, $5 \leq n < 6$, $6 \leq n < 7$ and $7 \leq n \leq 8$) and plotted against solar zenith angle (SZA) over the range of 45° to 75°. The radiation amplification factor (RAF) is used to quantify ozone effect on EUV. RAF of EUV decreases from 1.51 to 0.94 under clear skies but increases from 0.94 to 1.85 under cloudy skies as SZA increases, and decreases from 1.51 to 1.01 as cloud amount increases. The effects of cloud amount and snow surface on EUV are estimated as a function of SZA and cloud amount after normalization of the data to the reference total ozone of 300 DU. In order to analyse the transmission of solar radiation by cloud, regression analyses have been performed for the maximum values of solar irradiance on clear sky conditions ($0 \leq n < 3$) and the mean values on cloudy conditions, respectively. The maximum regression values for the clear sky cases were taken to represent minimum aerosol conditions for the site and thus appropriate for use as a normalization (reference) factor for the other regressions. The overall features for the transmission of the three solar components show a relatively high values around SZAs of 55° and 60° under all sky conditions and cloud amounts $4 \leq n < 5$ and $5 \leq n < 6$. The transmission is, in general, the largest in TUV and the smallest in EUV among the three components of the solar irradiance. If the ground is covered with snow on partly cloudy days ($6 \leq n < 7$), EUV increases by 20 to 26 % compared to snow-free surface around SZA 60°-65°, due to multiple reflections and scattering between the surface and the clouds. The relative difference between snow surface and snow-free surface slowly increases from 9% to 20% as total ozone increases from 100 DU to 400 DU under partly cloud conditions ($3 \leq n < 6$) at SZA 60°.

The snow effects on TUV and TSO are relatively high with 32% and 34%, respectively, under clear sky conditions, while the effects changes to 36% and 20% for TUV and TSO, respectively, as cloud amount increases.

- 1-23 Mishra, Vinit K., Ki-Hyun Kim, **Sungmin Hong**, and **Khanghyun Lee**. 2004. "Aerosol composition and its sources at the King Sejong Station, Antarctic peninsula". *Atmospheric Environment*, 38: 4069-4084. doi: 10.1016/j.atmosenv.2004.03.052

The annual cycles of major metals and ions in suspended particulate matters (SPM) have been investigated at a costal site of the Antarctic Peninsula in order to elucidate temporal variations as well as major source processes responsible for their formation. The measurements had been performed from January 2000 to December 2001 at the Korean Antarctic research station, 'King Sejong' (62° 13'S, 58° 47'W). The observed time series of important aerosol components showed clear seasonal variation patterns, while the mean elemental concentrations (e.g., 1875 (Al), 10.3 (Ba), 0.3 (Bi), 1.3 (Cd), 1.7 pgm⁻³ (Co)) were generally compatible with those reported previously. The presence of high EF values with respect to both mean crustal and seawater composition (such as Bi, Cd, Cr, Cu, Ni, V, and Zn), however, suggests a possibly important role of anthropogenic processes in this remote site. In contrast, the concentrations of ionic species were not clearly distinguishable from those of other Antarctic sites; but the consideration of ionic mass balance between cations and anions pointed out the uniqueness of their source/sink processes in the study area. The major source processes of those aerosol components were also investigated using a series of statistical analyses. The overall results of our study indicated the dominance of several processes (or sources) such as

sea-salt emission, secondary aerosol formation, and anthropogenic pollution from both local and distant sources.

- 1-24 **Won, Young-In, Bang-Yong Lee**, and Soon-Chul Kwon. 2004. "CHARACTERISTICS OF ATMOSPHERIC WAVES OBSERVED FROM AIRGLOW MEASUREMENTS IN THE NORTHERN LATITUDE". *Journal of Astronomy & Space Sciences*, 21(2): 101-108.

The terrestrial nightglow emission in near infrared region were obtained using a Fourier Transform Spectrometer (FTS) at Esrange, Sweden (67.90°N, 21.10°E) and the OH(4-2) bands were used to derive temperature and airglow emission rate of the upper mesosphere. For this study, we analyzed data taken during winter of 2001/2002 and performed spectral analysis to retrieve wave information. From the Lomb-Scargle spectral analysis to the measured temperatures, dominant oscillations at various periods near tidal frequency are found. Most commonly observed waves are 4, 6, and 8 hour oscillations. Because of periods and persistence, the observed oscillations are most likely of tidal origin, i.e. zonally symmetric tides which are known to have their maximum amplitudes at the pole.

- 1-25 Yi, Hana, **Ho Il Yoon**, and Jongsik Chun. 2004. "*Sejongia antarctica* gen. nov., sp. nov. and *Sejongia jeonii* sp. Nov., isolated from the Antarctic". *International Journal of Systematic and Evolutionary Microbiology*, 55: 409-416. doi: 10.1099/ijs.0.63273-0

Two yellow-pigmented, gram-negative and aerobic bacterial strains, designated AT1013^T and AT1047^T, were isolated from terrestrial samples of the Antarctic. On the basis of 16S rDNA sequence analyses, the two Antarctic strains shared 97.7 % sequence similarity and showed moderate relationships to the genera

Chryseobacterium (92.5-95.3 %), *Riemerella* (92.3-93.5 %), *Bergeyella* (92.5-92.6 %) and *Kaistella* (92.5-93.3 %). In phylogenetic analysis, the two isolates formed a robust monophyletic clade and represented a distinct phyletic line equated to a novel generic status. Cells were non-motile, non-gliding and psychrotolerant with optimum growth temperature of about 20 °C. Flexirubins were absent. The major isoprenoid quinone was MK-6. The predominant cellular fatty acids were 15 : 0 iso, 15 : 0 anteiso and 17 : 1 iso ω9c. DNA G+C contents were 34-36 mol%. The two isolates shared low genomic relatedness (27 %) and were differentiated from each other by several phenotypic characteristics. The polyphasic data presented in this study indicated that our isolates should be recognized as two separate novel species in a novel genus within the family *Flavobacteriaceae*. The name *Sejongia* gen. nov. is therefore proposed for the Antarctic isolates, with two species, *Sejongia antarctica* sp. nov. (type strain AT1013^T = IMSNU 14040^T = KCTC 12225^T = JCM 12381^T) and *Sejongia jeonii* sp. nov. (type strain, AT1047^T = IMSNU 14049^T = KCTC 12226^T = JCM 12382^T).

- 1-26 **Yoon, Ho Il, Kyu-Cheul Yoo, Byong-Kwon Park, Yeodong Kim, and 2 others.** 2004. "The origin of massive diamicton in Marian and Potter coves, King George Island, West Antarctica". *Geosciences Journal*, 8(1): 1-10.
doi: 10.1007/BF02910274

Marine sediment cores were obtained from in front of the tidewater glaciers in Marian and Potter coves in the South Shetland Islands in the austral summer of 1998-1999. Sedimentological and geochemical data from these cores document an advance of ice tongue for the deposition of clast-supported, massive diamicton, interpreted as having been produced by ice rafting in front of glacier margin and/or releasing of clasts from basal

debris zones in the sub-ice tongue setting. A C-14 chronology for a core indicates that glacial advance took place ca. 1450-1700 yrs B.P., coincident with warm, humid phase in the study area. During this period, the glacier margin was likely to advance and release diamicton clasts, inferred from a reduction in the total organic carbon content, and an increase in sand and clasts within the diamicton facies. The glacial advance probably caused enhanced ice-edge blooms near the core sites, resulting in increased abundance of sea-ice related diatoms i.e., *Fragilariopsis curta* and *Fragilariopsis cylindrus* in the diamicton. The warm and humid conditions between 1450-1700 yrs B.P. might allow the intrusion of warm circumpolar deep water within the fjords, bringing about increased abundance of warm water form, i.e., *Fragilariopsis kerguelensis*. On the other hands, this warming condition probably prohibited the intrusion of Weddell Ice shelf water from the fjord, as evidenced by lack of cold water form, *Thalassiosira antarctica*, in the diamicton. Clearly, the response of the outlet glacier system along the periphery of the South Shetland Islands Ice Sheet during the late Holocene warm, humid period (1450-1700 yrs B.P.) was expansion. Thus the process of clast-supported massive diamicton formation is likely to be applicable to a number of areas of the modern and Quaternary Antarctic Peninsula.

- 1-27 **Yoon, Seok Hoon, Ho Il Yoon, and Cheon Yun Kang.** 2004. "Late Quaternary Sedimentary Processes in the Northern Continental Margin of the South Shetland Islands, Antarctica". 『The Sea』 *Journal of the Korean Society of Oceanography*, 9(1): 1-12.

Sedimentary facies and high-resolution echo facies were analyzed to elucidate sedimentation pattern of the late Quaternary glacial-marine deposits in the northern

continental margin of the South Shetland Islands. Six sedimentary facies are classified, based on grain texture and sedimentary structures in gravity cores. The high-resolution (3.5 kHz) 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. Distribution of the echo and sedimentary facies suggest that there was a significant change in sedimentation pattern between the Last Glacial Maximum (LGM) and subsequent glacier-retreating period. When the grounded glaciers extended to the present shelfbreak during LGM, coarse-grained subglacial tills were widespread in the shelf area, and deep troughs in the shelf were carved beneath the fast-flowing ice stream. As the glacial margin retreated landward after LGM, dense meltwater plumes released from the retreating ice-front were funneled along the glacier-carved troughs, and accumulated channel- or canyon-fill deposits in the shelf and the upper to mid slope. At that time, slope sediments seem to have been reworked by slope failures and unsteady contour currents, and further transported by fine-grained turbidity currents along the South Shetland Trench. After the glacial retreat, sediments in the shelf and slope areas have been mainly introduced by persistent (hemi) pelagic settling, and fine-grained turbidity currents frequently occur along the axis of the South Shetland Trench.

PART 2

Earth-System Sciences

- 2-1 **Cho, Hyun-Moo, Han-Joon Kim, Hyeong-Tae Jou, Jong-Kuk Hong,** and Chang-Eob Baag. 2004. "Transition from rifted continental to oceanic crust at the southeastern Korean margin in the East Sea (Japan Sea)". *Geophysical Research Letters*, 31:

L07606(1-4).

doi: 10.1029/2003GL019107

The southeastern Korean margin documents the processes of continental rifting and seafloor spreading that eventually led to the opening of the southern part of the East Sea (Japan Sea). Two-dimensional crustal structure of the southeastern Korean margin was computed from ocean bottom seismometer data by tomographic inversion and iterative forward modeling. The crustal structure shows the emplacement of high-velocity (>7 km/s) lower crust under the continental shelf and slope area associated with a rapid transition from rifted continental to oceanic crust. The high-velocity lower crust is interpreted as magmatic underplating formed by voluminous igneous activity during rifting. Magnetic modeling confirms its primary correlation with a prominent magnetic anomaly along the edge of the Korean Peninsula. We suggest that the rifting and subsequent seafloor spreading at the Korean margin was significantly controlled by the supply of magma in a region of hotter than normal mantle temperature.

- 2-2 **Choe, Moon Young, Hyung Rae Jo, Young Kwan Sohn, and Yeadong Kim.** 2004. "Architecture and Depositional Style of Gravelly, Deep-Sea Channels: Lago Sofia Conglomerate, Southern Chile". *Korean Journal of Petroleum Geology*, 10(1,2): 23-33.

The Lago Sofia conglomerate in southern Chile is a lenticular unit encased within mudstone-dominated, deep-sea successions (Cerro Toro Formation, upper Cretaceous), extending from north to south for more than 120 km. The Lago Sofia conglomerate is a unique example of long, gravelly deep-sea channels, which are rare in the modern environments. In the northern part (areas of Lago Pehoe and Laguna Goic), the conglomerate unit consists of 3-5

conglomerate bodies intervened by mudstone sequences. Paleocurrent data from these bodies indicate sediment transport to the east, south, and southeast. The conglomerate bodies in the northern Part are interpreted as the tributary channels that drained down the paleoslope and converged to form N-S-trending trunk channels. In the southern part (Lago Sofia section), the conglomerate unit comprises a thick (> 300 m) conglomerate body, which probably formed in axial trunk channels of the N-S-trending foredeep trough. The well-exposed Lago Sofia section allowed for detailed investigation of sedimentary facies and large-scale architecture of the deep-sea channel conglomerate. The conglomerate in Lago Sofia section comprises stratified conglomerate, massive-to-graded conglomerate, and diamictite, which represent bedload deposition under turbidity currents, deposition by high-density turbidity currents, and muddy debris flows, respectively. Paleocurrent data suggest that the debris flows originated from the failure of nearby channel banks or slopes flanking the channel system, whereas the turbidity currents flowed parallel to the orientation of the overall channel system. Architectural elements produced by turbidity currents represent vertical stacking of gravel sheets, lateral accretion of gravel bars, migration of gravel dunes, and filling of channel thalwegs and scoured hollows, similar to those in terrestrial gravel-bed braided rivers. Observations of large-scale stratal pattern reveal that the channel bodies are offset stacked toward the east, suggestive of an eastward migration of the axial trunk channel. The eastward channel migration is probably due to tectonic tilting related to the uplift of the Andean protocordillera just west of the Lago Sofia deep-sea channel system.

- 2-3 **Choe, Moon Young**, Young Kwan Sohn, Hyung Rae Jo, and **Yeadong Kim**. 2004. "Sedimentary Facies and Evolution of the Cretaceous Deep-Sea Channel System in Magallanes Basin, Southern Chile". *Ocean And Polar Research*, 26(3): 385-400.

The Lago Sofia Conglomerate encased in the 2km thick hemipelagic mudstones and thin-bedded turbidites of the Cretaceous Cerro Toro Formation, southern Chile, is a deposit of a gigantic submarine channel developed along a foredeep trough. It is hundreds of meters thick kilometers wide, and extends for more than 120km from north to south, representing one of the largest ancient submarine channels in the world. The channel deposits consist of four major facies, including stratified conglomerates (Facies A), massive or graded conglomerates (Facies B), normally graded conglomerates with intraformational megaclasts (Facies C), and thick-bedded massive sandstones (Facies D). Conglomerates of Facies A and B show laterally inclined stratification, foreset stratification, and hollow-fill structures, reminiscent of terrestrial fluvial deposits and are suggestive of highly competent gravelly turbidity currents. Facies C conglomerates are interpreted as deposits of composite or multiphase debris flows associated with preceding hyperconcentrated flows. Facies D sandstones indicate rapidly dissipating, sand-rich turbidity currents. The Lago Sofia Conglomerate occurs as isolated channel-fill bodies in the northern part of the study area, generally less than 100m thick, composed mainly of Facies C conglomerates and intercalated between much thicker fine-grained deposits. Paleocurrent data indicate sediment transport to the east and southeast. They are interpreted to represent tributaries of a larger submarine channel system, which joined to form a trunk channel to the south. The conglomerate in the southern part is more than 300 m thick, composed of subequal proportions of Facies

A, B, and C conglomerates, and overlain by hundreds of m-thick turbidite sandstones (Facies D) with scarce intervening fine-grained deposits. It is interpreted as vertically stacked and interconnected channel bodies formed by a trunk channel confined along the axis of the foredeep trough. The channel bodies in the southern part are classified into 5 architectural elements on the basis of large-scale bed geometry and sedimentary facies: (1) stacked sheets, indicative of bedload deposition by turbidity currents and typical of broad gravel bars in terrestrial gravelly braided rivers, (2) laterally-inclined strata, suggestive of lateral accretion with respect to paleocurrent direction and related to spiral flows in curved channel segments around bars, (3) foreset strata, interpreted as the deposits of large gravel dunes that have migrated downstream under quasi-steady turbidity currents, (4) hollow fills, which are filling thalwegs, minor channels, and local scours, and (5) mass-flow deposits of Facies C. The stacked sheets, laterally inclined strata, and hollow fills are laterally transitional to one another, reflecting juxtaposed geomorphic units of deep-sea channel systems. It is noticeable that the channel bodies in the southern part are of feet stacked toward the east, indicating eastward migration of the channel thalwegs. The laterally inclined strata also dip dominantly to the east. These features suggest that the trunk channel of the Lago Sofia submarine channel system gradually migrated eastward. The eastward channel migration is interpreted to be due to tectonic forcing imposed by the subduction of an oceanic plate beneath the Andean Cordillera just to the west of the Lago Sofia submarine channel.

2-4 Fang, Aimin, Xiaohan Liu, **Jong Ik Lee**, and 2 others. 2004. "Sedimentary environments of the Cenozoic sedimentary debris found in the moraines of the Grove Mountains, east

Antarctic and its climatic implications". *Progress in Natural Science*, 14(3): 223-234. doi: 10.1080/10020070412331343391

During the field work of the 1998~1999's and 1999~2000's Chinese National Antarctic Research Expedition (CHNARE) in the Grove Mountains, east Antarctica, some Cenozoic sedimentary debris are found in two terminal moraine banks over the blue ice near Harding Mount in the center of this region. All the debris are of characteristics of glaciogenic diamicton and belong to the products of the glacial movements of the East Antarctic Ice Sheet. In this paper, the authors make detailed study on the sedimentary environments of the sedimentary debris through petrologic, sedimentological, mineralogical, and geochemical methods. Characteristics of their sedimentary textures and structures, grain size distributions, quartz grains' surface textures and features, together with their geochemical compositions all show that these sedimentary rocks are kind of subglacial lodgement tills which are deposited in the ice sheet frontal are by reactions of glacial movements and glaciogenic melt water. Their palaeoenvironmental implications in revealing the retreat history of East Antarctic Ice Sheet are discussed. The authors draw the conclusion from current study that the glacial frontal of the East Antarctic Ice Sheet might have been retreated to this area during the Pliocene Epoch, which represents warm climate event accompanied by large-scale ice sheet retreat in Antarctic at that time.

2-5 Huh, Sik, Dong-Lim Choi, Hai-Soo Yoo, Dong-Ju Min, **Jong-Kuk Hong**, and Kwang-Ja Lee. 2004. "Preliminary Interpretation of Depositional Environment and Geological Structure of the Jeju Basin in the South Sea of Korea". *Journal of the Korean Geophysical Society*, 7(3): 225-232.

To investigate the depositional environment and the geological structure of the Jeju Basin in the South Sea of Korea, we acquired 54-channel seismic data of about 1,980 line-km. The study area lies at the northeastern part of the East China Sea Trough, a Tertiary back-arc basin. The sedimentary basin formed by rifted activities resulted in the formation of graben and/or half-graben structures. The basin is composed of pre-rift, syn-rift and post-rift sediments bounded by regional unconformity. The pre-rift and syn-rift sediments consist of Oligocene, Early and Middle Miocene sequence, whereas the post-rift sediments consist of Late Miocene and Plio-Pleistocene sequences. Seismic and well data from the Jeju Basin indicate that Oligocene-Miocene sediments were deposited under fluvial and lacustrine depositional conditions. Following compressional tectonic movements in the Late Miocene time and a subsequent period of erosion, regional subsidence during the Pliocene time brought the Jeju Basin under marine conditions, resulting in the deposition of dominantly marine sediments.

2-6 Hur, Soon Do. 2004. "Mineral Resources Potential of Antarctica". *Journal of Mineral Society of Korea (Mineral & Industry)*, 17(2): 1-8.

2-7 Hwang, Jeong, Soon Do Hur, and Young Bae Seo. 2004. "Mineralogical and Chemical Changes in Pyrite after Traditional Processing for Use in Medicine". *The American Journal of Chinese Medicine*, 32(6): 907-919.

Pyrite has been the most commonly used medicinal mineral, and its toxicity was reduced by traditional processing operations including heating and quenching in vinegar. To verify the scientific effects of this process, pyrite was processed at temperatures up to 850°C and through as many as 5 processing

cycles. Metal extraction test was carried out from the processed pyrites on the assumption that pyrite medicines with the lowest toxic metal content would be most desirable. Increasing temperature and the number of processing cycles promoted phase change of pyrite to hematite, reduction of toxic metals in pyrite and their concentrations in the extraction solutions. However, the relationships between variations in extracted elements and the number of processing cycles at the same processing temperature were not clearly defined. Heating temperature is more important than the number of processing cycles for effective processing, and pyrite should be processed at the highest possible temperature in order to diminish highly toxic metals such as As and Pb.

2-8 Jin, Young Keun, Kyu Jung Kim, Sang Heon Nam, Yeodong Kim, and Joochan Lee. 2004. "Interpretation of Gravity, Magnetic and High-resolution (3.5 kHz) Seismic Data in the Powell Basin, Antarctica". *Journal of the Korean Geophysical Society*, 7(1): 1-10.

Gravity, magnetic and high-resolution seismic surveys were carried out in the Powell Basin to examine tectonic structure and recent sedimentation on Dec. 2002. The trend of negative gravity anomalies along the spreading axis of the Powell Basin changes from northwest to east-west toward south. Both boundaries of the basin with the Antarctic Peninsula and the South Orkey micro-continent show negative magnetic anomalies, which indicates that the boundaries were continental rift areas in the initial stage of spreading. Magnitude of the magnetic anomalies corresponding to the axis of the basin is rather small compared to those of normal spreading axes in other regions. Such small anomalies would be caused by reduction of magnetic strength of oceanic crust below thick sediments due to thermal alternation. High-resolution (3.5 kHz) seismic

profiles reveal that top of the South Scotia Ridge is a flat terrain covered with thin coarse sediments by glacial erosion. Thick oceanic sediments are deposited in the central part of the basin. Little deformation in the oceanic sediments indicates that the Powell Basin has been in stable tectonic environment after spreading of the basin stopped.

- 2-9 Jin, Young Keun, Kyung Ho Chung, and Yeadong Kim.** 2004. "Geophysical Investigation of Gas Hydrate-Bearing Sediments in the Sea of Okhotsk". *Journal of the Korean Geophysical Society*, 7(3): 207-215.

As the sea connecting with the East Sea, the Sea of Okhotsk is the most potential area of gas hydrates in the world. In order to examine geophysical structures of gas hydrate-bearing sediments in the Sea of Okhotsk, the CHAOS (hydro-Carbon Hydrate Accumulation in the Okhotsk) international research expedition was carried out in August 2003. In the expedition, high-resolution seismic and geochemical survey was also conducted. Sparker seismic profiles show only diffusive high-amplitude reflections without BSRs at BSR depth. It means that BSR appears to be completely different images on seismic profiles obtained using different frequencies. Many gas chimneys rise up from BSR depth to seafloor. The chimneys can be divided into two groups with different seismic characteristics; wipe-out (WO) and enhanced reflection (ER) chimneys. Different seismic responses in the chimneys would be caused by amount of gas and gas hydrates filling in the chimneys. In hydroacoustic data, a lot of gas flares rise up several hundreds meters from seafloor to the water column. All flares took place at the depths within gas hydrate stability zone. It is interpreted that gas hydrate-bearing sediments with low porosity and permeability due to gas hydrate filling in the pore space make good pipe around gas chimneys in which gas is migrating up

without loss of amount. Therefore, large-scale gas flare at the site on gas chimney releases into the water column.

- 2-10 Jin, Young Keun, Sang Heon Nam, Yeadong Kim, and Joohan Lee.** 2004. "Seismic Structures of the Eastern Bransfield Basin, Antarctic Peninsula". *Journal of the Korean Geophysical Society*, 7(2): 99-111.

The Basin, a marginal basin located between the Antarctic Peninsula and the South Shetland Islands, is consist of three small basins, the Central, Eastern, Western Basins. Seismic data obtained on December 1995 show well-defined spreading ridges, basement highs, faults, morphology of the basin, distribution of sediments, crustal and sedimentary deformation, diapirs, and contourites. The main spreading axis of the Central Bransfield Basin connecting Deception and Bridgeman Islands continues up to the central part of the Eastern Basin, whereas deep basin covered by thick sediments without any spreading structures develops in the northeastern part. This indicates that back-arc spreading along the axis of the Bransfield Basin has been taken place in the southwestern part of the Eastern Basin, not in the northeastern part. Many NW-SE trending faults perpendicular to the axis of the basin would be related with strike-slip movement of the Shackleton Fracture Zone. Extensional structures like deep basin without any spreading structures in the northeastern part, normal faults and diapirs on both continental slopes of the Eastern Basin would be formed by extension as a consequence of the sinistral movement between Antarctic and the Scotia plates.

- 2-11 Kim, Dong Il, Young Keun Jin, Sang Heon Nam, and Joohan Lee.** 2004. "Geomagnetic Field Monitoring at King Sejong Station, Antarctica". *Journal of the Korean Geophysical*

Society, 7(1): 11-21.

The variation of geomagnetic field and absolute magnetic field at the geomagnetic observatory of King Sejong Station has been measured with 3-component ring core fluxgate magnetometer, proton magnetometer and D-I magnetometer. With data obtained from King Sejong Station during 2003, the diurnal and annual variations of geomagnetic field were researched and compared with those at other observatories. The deviation of daily variation of magnetic field in antarctica decreased gradually during winter season due to sun effect. The rates of componental annual variation of magnetic field at King Sejong Station were calculated using the least-square method under the assumption that the annual variation of magnetic field is linear. The rates are -55.93 nT/year in horizontal intensity, -0.87 min./year in declination, 58.30 nT/year in vertical intensity, and -69.85 nT/year in total intensity of magnetic field. A remarkable variation was caused by the magnetic storms occurred on 29~30 October, which were so powerful that the variation was observed in mid latitudes as well as high latitudes. The values of variation are generally 1500~2000 nT in Antarctica including King Sejong Station, 350~500 nT in East Asia. The measurement of absolute magnetic field shows that ring core fluxgate magnetometer has relatively large error range under cold temperature.

- 2-12 Yeo, Jeong Pil, **Jong Ik Lee**, **Soon Do Hur**, and Byeon-Gak Choi. 2004. "Geochemistry of volcanic rocks in Barton and Weaver peninsulas, King George Island, Antarctica: Implications for arc maturity and correlation with fossilized volcanic centers". *Geosciences Journal*, 8(1): 11-25.
doi: 10.1007/BF02910275

We investigated geochemical characteristics of

the Paleocene-Eocene volcanic rocks in Barton and Weaver peninsulas, King George Island, Antarctica. Volcanic rocks are predominantly tholeiitic, and show geochemical properties typical for island arc volcanism. The volcanic rocks can be subdivided into three groups based on the differences of geochemistry and regional distribution. The group 1 rocks are distributed in Weaver Peninsula and in the central part of Barton Peninsula. They show relatively mafic compositions (basalts to basaltic andesites) with the lowest level of total REEs. The group 2 rocks are widely distributed in Barton Peninsula, and show intermediate compositions (basaltic andesites to andesites) with the highest LILE/HFSE and LREE/HREE ratios. The group 3 rocks occur as intermediate dikes or plugs along the southern coast of Barton Peninsula. They generally show similar compositions to those of the group 2, but have smaller LREE/HREE ratios. The parental magma of the group 1 seems to be most depleted among three groups, whereas that of the group 2 rocks enriched in LILEs and LREEs. Predominance of tholeiite series rocks, general absence of the basement complex, and difficulty of identifying dual volcanic chains suggest that the Early Tertiary volcanism in King George Island occurred in an immature island arc without thickened continental-type crust. Geochemical correlations between volcanic rocks and fossilized volcanic vents suggest that volcanic groups can be linked with vents: the group 1 with Weaver Nunatak, and the group 2 with Three Brothers Hill, Florence Nunatak and/or Czajkowski Needle. However, the group 3 seems to be correlative with the Chottaebawi plug (the Narebski Point), or represent distinct dike swarms.

PART 3

Ocean Environment Sciences

- 3-1 **Ahn, In-Young, Heeseon J. Choi, Jungyoun Ji, Hosung Chung, and Ji Hee Kim.** 2004. "Metal Concentrations in Some Brown Seaweeds from Kongsfjorden on Spitsbergen, Svalbard Islands". *Ocean and Polar Research*, 26(2): 121-132.

Concentrations of Al, As, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Zn were determined in four arctic brown algae (*Laminaria saccharina*, *L. digitata*, *Alaria esculenta*, *Desmarestia aculeata*) in an attempt to examine for their metal accumulation capacity and also to assess their contamination levels. Macroalgae were collected from shallow subtidal waters (<20 m) of Kongsfjorden (Kings Bay) on Spitsbergen during the period of the late July to early August 2003. Metal concentrations highly varied between sampling sites, species and tissue parts. Input of melt-water laden with terrigenous sediment particles seemed to have a large influence on baseline accumulations of some metals (Al, Fe, Mn, Pb etc.) in the macroalgae, causing a significant spatial variation. There were also significant concentration differences between the young and old tissue parts in *L. saccharina*, *L. digitata* and *A. esculenta*. While Al, Fe, Mn, Pb were higher in the perennial parts below meristematic region (excluding holdfast), Cd and As concentrations were significantly higher in the young blades above the meristematic region. Zn and Cr, on the other hand, showed little differences between the tissue parts. The highest metal concentrations were found in *D. aculeata*, which seems to be due to its filamentous fine branches leading to high surface/volume ratios. The lowest concentrations were found in the two *Laminaria* spp., the blades of which are thicker than *D. aculeata* and *A. esculenta*. No distinct signs of contamination were detected in the brown algal species analyzed. Added to

this, the results of the present studies suggest the potential utility of *L. saccharina*, *L. digitata* and *A. esculenta* as biomonitors for metal pollution monitoring in this area.

- 3-2 **Ahn, In-Young, Kyung Ho Chung, and Heeseon J. Choi.** 2004. "Influence of glacial runoff on baseline metal accumulation in the Antarctic limpet *Nacella concinna* from King George Island". *Marine Pollution Bulletin*, 49(1-2): 119-141.
doi: 10.1016/j.marpolbul.2004.03.008.

- 3-3 **Han, Taejun, Jeong-Ae Kong, Young-Seok Han, Sung-Ho Kang, and Donat-Peter Häder.** 2004. "UV-A/BLUE LIGHT-INDUCED REACTIVATION OF SPORE GERMINATION IN UV-B IRRADIATED *ULVA PERTUSA* (CHLOROPHYTA)". *Journal of Phycology*, 40(2): 315-322.
doi: 10.1111/j.1529-8817.2004.03069.x

Recent reduction in the ozone shield due to manufactured chlorofluorocarbons raised considerable interest in the ecological and physiological consequences of UV-B radiation ($\lambda = 280-315$ nm) in macroalgae. However, early life stages of macroalgae have received little attention in regard to their UV-B sensitivity and UV-B defensive mechanisms. Germination of UV-B irradiated spores of the intertidal green alga *Ulva pertusa* Kjellman was significantly lower than in unexposed controls, and the degree of reduction correlated with the UV doses. After exposure to moderate levels of UV-B irradiation, subsequent exposure to visible light caused differential germination in an irradiance- and wavelength-dependent manner. Significantly higher germination was found at higher photon irradiances and in blue light compared with white and red light. The action spectrum for photoreactivation of germination in UV-B irradiated *U. pertusa* spores shows a major peak at 435 nm with a

smaller but significant peak at 385 nm. When exposed to December sunlight, the germination percentage of *U. pertusa* spores exposed to 1 h of solar radiation reached 100% regardless of the irradiation treatment conditions. After a 2-h exposure to sunlight, however, there was complete inhibition of germination in PAR+UV-A+UV-B in contrast to 100% germination in PAR or PAR+UV-A. In addition to mat-forming characteristics that would act as a selective UV-B filter for settled spores under the parental canopy, light-driven repair of germination after UV-B exposure could explain successful continuation of *U. pertusa* spore germination in intertidal settings possibly affected by intense solar UV-B radiation.

- 3-4 He, Jianfeng, Bo Chen, **Sung-Ho Kang, Kyung Ho Chung**, and 2 others. 2004. "Biomass of Bacterioplankton and Protists and Their Ecological Importance in the Bering Sea". *Ocean and Polar Research*, 26(2): 113-120.

The abundance, biomass and distribution of phytoplankton, bacterioplankton and heterotrophic protists in the Bering Sea were investigated from July to August 1999. Chlorophyll a concentrations in the surface waters ranged from 0.16 to 3.79 $\mu\text{g l}^{-1}$. Nano-phytoplankton were found to constitute from 63 to 98% of the total phytoplankton biomass, and were clearly the dominant primary producers. The biomass of bacterioplankton in the surface layers varied from 1.46 to 20.2 $\mu\text{g C l}^{-1}$ and accounted for 30% of the total phytoplankton biomass. The biomass of bacterioplankton integrated over a depth of 0 to 100 m averaged 65.4% of the total phytoplankton biomass. The surface biomass of heterotrophic protists ranged from 1.2 to 27.4 $\mu\text{g C l}^{-1}$, and was within the same order of magnitude as that of bacterioplankton. Of the total biomass of heterotrophic protists in the upper 100 m of the water column, 65% was attributed to

protists in the nano-size class. The results of this study suggest that bacteria and nano-protists are important components of the planktonic community in the Bering Sea during the summer season. The abundance of bacterioplankton and planktonic protists decreased from the western to northeastern and eastern regions of the Bering Sea. The abundance of these organism also decreased with depth. The available evidence suggests that variation in the abundance and distribution of these organisms may be affected by water currents and vertical temperature variation in the Bering Sea.

- 3-5 Hewitta, R. P., S. Kim, M. Naganobu, M. Gutierrez, D. Kange, Y. Takao, J. Quinones, **Y.-H. Lee, H. -C. Shin**, and 4 others. 2004. "Variation in the biomass density and demography of Antarctic krill in the vicinity of the South Shetland Islands during the 1999/2000 austral summer". *Deep-Sea Research II*, 51(12-13): 1411-1419. doi: 10.1016/j.dsr2.2004.06.018

Vessels from Japan, Peru, and the USA conducted four sequential surveys designed to estimate the biomass density and demography of Antarctic krill in the vicinity of the South Shetland Islands between late December 1999 and early March 2000. The surveys were conducted during the same austral summer as the CCAMLR 2000 Survey in the Scotia Sea (Watkins et al., *Deep-Sea Research, II*, this issue [doi: 10.1016/j.dsr2.2004.06.010]), and the data were analyzed in a similar manner. Biomass densities were not significantly different between the surveys and averaged 49 g m^{-2} . Maps of krill biomass indicate three areas of consistently high density: one near the eastern end of Elephant Island, one mid-way between Elephant Island and King George Island, and one near Cape Shirreff on the north side of Livingston Island. The areas of highest krill density appeared to move closer

to the shelf break as the season progressed. This apparent movement was accompanied by a change in the demographic structure of the population, with smaller krill absent and a larger proportion of sexually mature animals present in late summer.

- 3-6 Ju, Se-Jong, H. R. Harvey, **Hyoung-Chul Shin**, **Yeadong Kim**, and **Sung-Ho Kang**. 2004. "Does Antarctic Krill Employ Body Shrinkage as an Overwintering Strategy?". *Ocean and Polar Research*, 26(4): 679-684.

To determine if Antarctic krill employ body shrinkage as one of its overwintering mechanisms in the field, *Euphausia superba* and *Euphausia crystallorophias* were collected during fall and winter in and around Marguerite Bay through US Southern Ocean GLOBEC field programs during fall and winter 2001 and 2002. The relationships between the body length and weight of both krill species were exponentially correlated with no significant differences between the two species ($p > 0.05$). The ratio between eye diameter and body length of individual krill was examined in an expectation that it could be used as an indicator of the body shrinkage as previously suggested by Shin and Nicol (2002). These ratios were significantly different between the two krill species. Especially, *E. crystallorophias* had bigger eyes than *E. superba*. In both krill species, eye diameters were highly correlated with body lengths (regression coefficients ≥ 0.70). For *E. crystallorophias*, no significant differences of the ratio of eye diameter/body length were detected between fall and winter. Even though the ratios for *E. superba* were seasonally varied, it was not clear whether body shrinkage was an actual and critical overwintering mechanism for the krill population found in this study area. These results suggest that some individuals of *E. superba* might experience the body shrinkage during a part of their life, but this

morphological index alone (eye diameter/body length) may be insufficient to unambiguously separate the shrunk krill from the non-shrunk ones in the field-collected animals.

- 3-7 **Kim, DongSeon**, **Dong-Yup Kim**, Young-June Kim, **Young-Chul Kang**, and **JeongHee Shim**. 2004. "Downward fluxes of biogenic material in Bransfield Strait, Antarctica". *Antarctic Science*, 16(3): 227-237.
doi: 10.1017/S0954102004 002032

Time-series sediment traps were deployed to investigate the temporal evolution of particle fluxes in eastern and central Bransfield Strait, from December 1999 to December 2000. Particle fluxes showed large seasonal variation at both trap sites. In eastern Bransfield Strait, summer mass fluxes were two orders of magnitude higher than winter mass fluxes, while in central Bransfield Strait, almost 99 % of the annual mass flux (33 g m^{-2}) was collected in a 40-day period from December to January. Export flux also exhibited a high regional variability. This regional variability is probably due to central Bransfield Strait's strong surface current, which carries most settling particles produced in the surface waters away from the mooring site during the low summer flux period. The relatively low biogenic silica to organic carbon ratios (a range of 0.29-1.4) and high lithogenic fluxes (41 % of total mass flux) indicate that the growth of phytoplankton is not limited by the micronutrient iron in eastern Bransfield Strait. The annual flux of organic carbon in eastern Bransfield Strait was 6.8 g C m^{-2} , which is three times higher than the flux measured in central Bransfield Strait (2.2 g C m^{-2}). Organic carbon flux in eastern Bransfield Strait is relatively high for the Southern Ocean, possibly due to fast-sinking fecal pellets that lead to less decomposition of organic material in the water column.

Approximately 7.2 % of the organic carbon produced at the surface in eastern Bransfield Strait is exported to a depth of 678 m. This exceeds the maximum export of primary production to a depth of 1,000 m in the Atlantic and Southern Oceans.

- 3-8** Kim, Dongseon, JeongHee Shim, Kyung Tae Kim, and **Young-Chul Kang**. 2004. "Distribution of Total CO₂, Nutrients, Chlorophyll-a in the Scotia Sea During Austral Summer". *Ocean and Polar Research*, 26(3): 401-414.

Temperature, salinity, alkalinity, pH, nutrients, chlorophyll, and iron were measured within the upper 250 m water column around Antarctic Polar Front in the Scotia Sea from late November to early December 2001. Temperature and salinity showed a rapid change across the Polar Front, and the temperature minimum layer exist only in the southern area of the Polar Front. Total CO₂ and nutrient concentrations were relatively high and increased rapidly with water depth in the southern area of the Polar Front, which was resulted from upwelling of the Antarctic deep water containing high concentrations of total CO₂ and nutrients. $\Delta C:\Delta N:\Delta P$ ratios measured in the northern and southern areas of the Polar Front were 75:11.4:1 and 84:12.5:1, respectively, which were lower than the Redfield ratio. $\Delta Si:\Delta N:\Delta P$ ratio (3.65) measured in the southern area of the Polar Front was two times higher than that (1.95) in the northern area. These two ratios were higher than the ratio (1.0) measured in the temperate and tropical oceans. Chlorophyll concentrations were extremely high in the area of 59°~60°S, which was attributed to favorable environmental conditions for phytoplankton growth in this area, such as sufficient iron, high water column stability, and high silicate concentration.

- 3-9** Kim, Gi Beum, Sung Yong Ha, **In-Young Ahn**, and **Heeseon Choi**. 2004. "Distribution of Polycyclic Aromatic Hydrocarbon at Kongsfjorden in Spitsbergen, Svalbard Islands". *Journal of the Environmental Sciences*, 13(9): 819-826.

In order to elucidate the polycyclic aromatic hydrocarbon concentration and its origin in arctic area, four arctic brown algae (*Laminaria saccharina*, *L. digita*, *Alaria esculenta*, *Desmarestia aculeata*), one marine invertebrate (*Echinoidea*) and sediments were collected from Kongsfjorden in Spitsbergen from the late July to early August, 2003. In case of macroalgae, the young blade part above growth point and the old stipes and blades beneath growth point were separated and analyzed for polycyclic aromatic hydrocarbons (PAHs) in an attempt to check the mechanism of uptake in macroalgae to accumulate PAH. There was no difference in PAH concentrations between sampling sites (Stations B and C), species, and blades beneath and above growth point. PAH concentrations in all samples collected in this study were relatively higher than those reported in other areas of arctic. Especially, station C, which is known as an unpolluted area, showed 10 times higher PAH concentration (8,765 ng/g) in sediment than station A (694 ng/g) around harbor. In addition high PAH concentration, station C had very higher proportion of methylated PAH to parent PAH in sediment than station A. Source analysis using PAH isomer pair ratios as indicators showed that Kongsfjorden area seemed to be relatively contaminated with PAH derived from direct petroleum input.

- 3-10** Lee, Wonchoel, Suam Kim, **Sung Ho Kang**, and 3 others. 2004. "Distribution and Abundance of Zooplankton in Bransfield Strait and the Western Weddell Sea during Austral Summer". *Ocean and Polar Research*, 26(4): 607-618.

Zooplankton community was surveyed during the Seventh Korea Antarctic Research Program, from 28 December 1993 to 11 January 1994. Zooplankton samples were collected at 40 stations from the waters around the South Shetland Islands with a Bongo net and a MOCNESS. A total of 14 taxa of zooplankton were identified. Zooplankton abundances varied at each station as well as with the sampling gears. Zooplankton abundances were higher in the Western Weddell Sea than those in the Bransfield strait. Zooplankton collected with MOCNESS showed a different vertical distribution depending on its depths at selected stations. Copepods were the major components of zooplankton contributing 72.84% (mesh size 333 μm) and 68.36% (mesh size 505 μm) of total zooplankton abundance from the Bongo samples. Salps were the second most abundant group comprising 7.92% (333 μm) and 11.99% (505 μm) of total zooplankton abundance. Euphausiids, chaetognaths, polychaetes, pteropods and ostracods occurred more than 1% of total zooplankton. Copepods were not abundant at stations salps and euphausiids were dominant. *Salpa thompsoni*, *Euphausia superba*, *Calanoides acutus*, *Metridia gerlachei* and *Calanus propinquus* were dominant depending on the stations. The hierarchical UPGMA cluster analysis of dissimilarities between sampling stations is displayed with clusters identified similar habitats. Copepods rarely appeared in the clusters 4 and 5, and they appeared a few in the cluster 3 (or salps were numerous), while copepods were abundant in the clusters 1 and 2. As in the results of cluster analysis, the distributions of dominant taxa have a well identified correspondence to the geological positions included physical factors.

- 3-11 Lee, Yoo Kyung, Hyo Won Kim, Kyeung Hee Cho, **Sung-Ho Kang**, Hong Kum Lee, and **Yeadong Kim**. 2004. "Phylogenetic Analysis of Culturable Arctic Bacteria". *Ocean and Polar*

Research, 26(1): 51-58.

We isolated and identified culturable Arctic bacteria that had inhabited soils around the Korean Arctic Research Station *Dasan* located at Ny-Ålesund, Svalbard, Norway (79°N, 12°E). The collected soils were diluted in distilled water; the diluted soil-water was spread on 3M petri-films at *Dasan* Station. The petri-films were transported to the laboratory at KORDI, and cultured at 4°C. Colonies grown on the petri-films were subsequently cultured on nutrient agar plates at 4°C every 7 days. The pure colonies were inoculated into nutrient liquid media, genomic DNA was extracted, and phylogenetic analysis was performed on the basis of 16S rDNA sequences. A total of 227 strains of bacteria were isolated. Among them, 16S rDNA sequences of 185 strains were identical with those of known strains isolated in this study, and 42 strains were finally identified. Phylogenetic analysis using 16S rDNA indicated that the 30 strains belonged to *Pseudomonas*, 7 strains to *Arthrobacter*, two strains to *Flavobacterium*, and the remaining to *Achromobacter*, *Pedobacter*, and *Psychrobacter*. Among the 42 strains, 14 bacteria produced protease: they were 6 strains of *Pseudomonas*, 4 strains of *Arthrobacter*, an *Achromobacter* strain, 2 strains of *Flavobacterium*, and a *Pedobacter* strain. We expect these Arctic bacteria can be used for screening to develop new industrial enzymes that are active at low temperatures.

- 3-12 Lee, **Youn-Ho**, **Miwha Song**, **Sanghoon Lee**, and 3 others. 2004. "Molecular phylogeny and divergence time of the Antarctic sea urchin (*Sterechinus neumayeri*) in relation to the South American sea urchins". *Antarctic Science*, 16(1): 29-36.
doi: 10.1017/S0954102004001786

Sterechinus neumayeri is an abundant regular sea urchin that lives in the shallow Antarctic

waters. This organism has been used as a model system in many fields of the Antarctic biology. Yet, understanding of the evolutionary identity of the species, such as its phylogenetic relationships and divergence time, remains limited. Here, we reconstructed the molecular phylogenies of the species together with two sea urchin species in southernmost South America (*Loxechinus albus* and *Pseudechinus magellanicus*), a parechinid species (*Paracentrotus lividus*) and three strongylocentrotid species (*Strongylocentrotus purpuratus*, *S. intermedius*, and *Hemicentrotus pulcherrimus*) using mitochondrial DNA sequences of 12S rDNA-tRNA(gln) region (877 nt) and cytochrome oxidase subunit I (COI, 1079 nt). The rate of sequence evolution and the divergence time of the species were then estimated from the trees. The phylogenetic trees reveal that *S. neumayeri* is a sister group to the lineage of *L. albus* and *P. lividus*, and separated from the lineage 24–35 million years ago (m.y.a.). The divergence between *S. neumayeri* and *L. albus* coincides with the separation of Antarctica from South America, suggesting that the tectonic event must have provoked the cladogenesis of the species through vicariance.

- 3-13 Yang, Eun Jin, Joong Ki Choi, Sun Young Kim, **Kyung Ho Chung**, **Hyoung-Chul Shin**, and **Yeadong Kim**. 2004. "Spatial Distribution and Community Structure of Heterotrophic Protists in the Central Barents Sea of Arctic Ocean During Summer". *Ocean and Polar Research*, 26(4): 567-579.

To investigate the spatial distribution and community structure of heterotrophic protists, we collected water samples at 23 stations of central Barents Sea in August, 2003. This study area was divided into three area with physico-chemical and chl-a distribution characteristics: Area I of warm Atlantic water mass, Area III of cold Arctic

water mass and Area II of mixed water mass. Chl-a concentration ranged from 0.18 to 1.04 $\mu\text{g l}^{-1}$ and was highest in Area I. The nano-sized chl-a accounted for more than 80% of the total chl-a biomass in this study area. The contribution of nano-sized chl-a to total chl-a was higher in Area I than in Area II. Communities of heterotrophic protists were classified into three groups such as heterotrophic nanoflagellates (HNF), ciliates and heterotrophic dinoflagellates (HDF). During the study periods, carbon biomass of heterotrophic protists range from 11.3 to 38.7 $\mu\text{g C l}^{-1}$ (average 21.0 $\mu\text{g C l}^{-1}$), and were highest in Area I and were lowest in Area III. The biomass of ciliates ranged from 4.2 to 19.3 $\mu\text{g C l}^{-1}$ and contributed 31.5-66.9% (average 48.1%) to the biomass of heterotrophic protists. Ciliates to heterotrophic protists biomass accounted for more than 50% in Area I. Heterotrophic dinoflagellates biomass ranged from 5.7 to 18.4 $\mu\text{g C l}^{-1}$ and contributed 27.1 to 56.3% (average 42.8%) of heterotrophic protists. Heterotrophic dinoflagellates to heterotrophic protists biomass accounted for about 50% in Area III. Heterotrophic nanoflagellate biomass ranged from 0.5 to 3.4 $\mu\text{g C l}^{-1}$ and contributed 3.2 to 19.6% (average 9.2%) of heterotrophic protists. Heterotrophic nanoflagellates to heterotrophic protists biomass accounted for more than 10% in Area III. These results indicate that the relative importance and structure of heterotrophic protists may vary according to water mass. Heterotrophic protists and phytoplankton biomass showed strong positive correlation in the study area. The results suggest that heterotrophic protists are important consumers of phytoplankton, and protists might play a pivotal role in organic carbon cycling in the pelagic ecosystem of this study area during the study period.

PART 4

Life Sciences

- 4-1 **Kim, Ji Hee and Hosung Chung.** 2004. "Distribution Pattern of *Deschampsia antarctica*, a Flowering Plant Newly Colonized around King Sejong Station in Antarctica". *Ocean and Polar Research*, 26(1): 23-32.

As a baseline survey for long-term monitoring on environmental change around the Antarctic King Sejong Station, distribution pattern of *Deschampsia antarctica* Desv., a flowering plant newly colonized were investigated qualitatively and quantitatively in both austral summer 2002 and 2003.

Dispersal of the seeds and vegetative leaves by skuas might lead to the colonization into this area from neighbors in Maxwell Bay. The pioneer populations were observed around ponds and a stream of the Sejong Point in January 2002, and the maximum dispersal area was four times expanded after a year.

Most of the populations were formed on the stable and well-drained substrate, which consisted of moss carpet of *Sanionia georgico-uncinata* (65%) and pebbles (25%), while only a few young individuals were observed on the unstable and watertight silt-sandy area. Especially, *S.*

georgico-uncinata was being effectively utilized as their primary substrate with the soft, coarse and water-contained leaves. Also the perennial mature plants of *D. antarctica* were mainly formed on the moss carpet rather than pebbles. A few individuals were grown on other mosses of *Polytrichastrum alpinum*, *Bryum pseudotriquetrum*, *Pohlia cruda*, and *Conostomum magellanicum* and on a liverwort of *Cephaloziella varians*. We expect that dispersal of *D. antarctica* and the following succession to grass field will be continuously and dynamically proceeded in this area, with the characteristics of ecological niche against the initial moss populations, on the similar continuity of environmental

conditions. The continuous observations are needed with establishment of database on environmental change of micro-habitats, e.g. the water content and nutrients of soil and the underground temperature and permafrost.

- 4-2 **Kim, Ji Hee, Hosung Chung, and 2 others.** 2004. "A new melobesoid alga *Synarthrophyton chejuensis* sp. nov. (Corallinales, Rhodophyta), including comparison with *Mesophyllum cystocarpideum*". *Phycologia*, 43(5): 501-520.

Synarthrophyton chejuensis (Corallinales, Rhodophyta) is newly described from Korea and represents the first northern hemisphere species of the genus. It differs from other known species of *Synarthrophyton* in having the following combination of features: it has thalli that are thin, foliose, discoid, more or less proliferously lobate, and lamellate with numerous horizontally to vertically oriented layers of branches. The thalli are partially attached to the substrate. Mature tetra- or bisporangial conceptacles have flat or moundlike pore plates, and usually two or more conceptacles are joined. The pore plates are composed of filaments of four or five cells along with an epithallial cell. The pore canal is lined by filaments with cells similar in size and shape to the cells of other filaments making up the pore plate. Korean plants belonging to *S. chejuensis* previously had been misidentified as *Lithothamnion cystocarpideum* or *Mesophyllum cystocarpideum*, but a reexamination of the type of *M. cystocarpideum* has shown that it is specifically distinct from *S. chejuensis*. A detailed morphological and anatomical account of *S. chejuensis* is provided, and the value of several characters used to distinguish species within *Synarthrophyton* is discussed.

- 4-3 Lee, Hyi-Seung, Jong-Woong Ahn, **Youn-Ho Lee**, and 2 others. 2004. "New Sesterterpenes from the Antarctic Sponge *Suberites* sp.". *Journal of Natural Products*, 67(4): 672-674. doi: 10.1021/np030342t

Suberitenones C and D and suberiphenol, three new sesterterpenes of the suberitane class, were isolated from the sponge *Suberites* sp. collected from Antarctica. The structures of these compounds were determined on the basis of combined spectral and chemical analyses.

- 4-4 **Yim, Jong Han** and **Hong Kum Lee**. 2004. "Axenic Culture of *Gyrodinium impudicum* Strain KG03, a Marine Red-tide Microalga that Produces Exopolysaccharide". *Journal of Microbiology*, 42(4): 305-314.

An exopolysaccharide-producing microalgal dinoflagellate was isolated from a red-tide bloom and designated strain KG03. A bacteria-free culture of strain KG03 was achieved using a modified wash with phototaxis and antibiotic treatment. Combined treatment with neomycin and cephalosporin was the most effective for eliminating the bacteria associated with the microalgae. Strain KG03 was identified as *Gyrodinium impudicum* by analyzing the ITS regions of 5.8S rDNA, the 18S rDNA, morphological phenotype, and fatty acid composition. Exopolysaccharide production and cell growth in a 300-ml photobioreactor increased 2.7- and 2.4-fold, respectively, compared with that in flask culture at the first isolation step.

- 4-5 **Yim, Jong Han, Sung Jin Kim, Se Hoon Aan**, and **Hong Kum Lee**. 2004. "Physicochemical and Rheological Properties of a Novel Emulsifier, EPS-R, Produced by the Marine Bacterium *Hahella chejuensis*". *Biotechnology and Bioprocess Engineering*, 9(5): 405-413.

doi: 10.1007/BF02933066

The rheological properties of an exopolysaccharide, EPS-R, produced by the marine bacterium *Hahella chejuensis* strain 96CJ10356 were investigated. The E_{24} of 0.5% EPS-R was 89.2%, which was higher than that observed in commercial polysaccharides such as xanthan gum (67.8%), gellan gum (2.01%) or sodium alginate (1.02%). Glucose and galactose are the main sugars in EPS-R, with a molar ratio of ~1:6.8, xylose and ribose are minor sugar components. The average molecular mass, as determined by gel filtration chromatography, was 2.2×10^3 KDa. The intrinsic viscosities of EPS-R were calculated to be 16.5 and 15.9 dl/g using the Huggins and Kraemer equations, respectively, with a 2.3 dl/g overlap. In terms of rigidity, the conformation of EPS-R was similar to that of carboxymethyl cellulose (5.0×10^{-2}). The rheological behavior of EPS-R dispersion indicated that the formation of a structure intermediate between that of a random-coil polysaccharide and a weak gel. The aqueous dispersion of EPS-R at concentrations ranging from 0.25% to 1.0% (w/w) showed a marked shear-thinning property in accordance with Power-law behavior. In aqueous dispersions of 1.0% EPS-R, the consistency index (K) and flow behavior index (n) were 1,410 and 0.73, respectively. EPS-R was stable to pH and salts.

- 4-6 **Yim, Jong Han, Sung Jin Kim, Se Hun Ahn, Chong Kyo Lee, Ki Tae Rhie, and Hong Kum Lee**. 2004. "Antiviral Effects of Sulfated Exopolysaccharide from the Marine Microalga *Gyrodinium impudicum* Strain KG03". *Marine Biotechnology*, 6: 17-25. doi: 10.1007/s10126-003-0002-z

The sulfated exopolysaccharide p-KG03, which is produced by the marine microalga *Gyrodinium impudicum* strain KG03, exhibited impressive antiviral activity in vitro ($EC_{50} = 26.9 \mu\text{g/ml}$) against the

encephalomyocarditis virus (EMCV). Depending on the p-KG03 concentration, the development of cytopathic effects in EMCV-infected HeLa cells was either inhibited completely or slowed. Moreover, p-KG03 did not show any cytotoxic effects on HeLa cells, even at concentrations up to 1000 µg/ml. The polysaccharide was purified by repeated precipitation in ethanol, followed by gel filtration. The p-KG03 polysaccharide had a molecular weight of 1.87×10^7 , and was characterized as a homopolysaccharide of galactose with uronic acid (2.96% wt/wt) and sulfate groups (10.32% wt/wt). The biological activities of p-KG03 suggest that sulfated metabolites from marine organisms are a rich source of antiviral agents. This is the first reported marine source of antiviral sulfated polysaccharides against EMCV. The p-KG03 polysaccharide may be useful in the development of marine bioactive polysaccharide for biotechnological and pharmaceutical products.



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PART 1

Climate Change Sciences

- 1-1 Birkenmajer, Krzysztof, Andrzej Gaździcki, Krzysztof P. Krajewski, Andrzej Przybycin, Andrzej Solecki, Andrzej Tatur, and **Ho Il Yoon**. 2005. "First Cenozoic glaciers in West Antarctica". *Polish Polar Research*, 26(1): 3-12.

One of the most significant global climatic events in the Cenozoic was the transition from greenhouse to icehouse conditions in Antarctica. Tectonic evolution of the region and gradual cooling at the end of Eocene led to the first appearance of ice sheets at the Eocene/Oligocene boundary (ca. 34 Ma). Here we report geological record of mountain glaciers that preceded major ice sheet formation in Antarctica. A terrestrial, valley-type tillite up to 65 metres thick was revealed between two basaltic lava sequences in the Eocene-Oligocene Point Thomas Formation at Hervé Cove - Breccia Crag in Admiralty Bay, King George Island, South Shetland Islands. K-Ar dating of the lavas suggests the age of the glaciation at 45-41 Ma (Middle Eocene). It is the oldest Cenozoic record of alpine glaciers in West Antarctica, providing insight into the onset of glaciation of the Antarctic Peninsula and South Shetland Islands.

- 1-2 **Choi, Taejin, Bang Yong Lee, Hee-Choon Lee, Seong-Joong Kim, and Sungmin Hong**. 2005. "Surface Flux Measurements at King Sejong Station in West Antarctica: II. Turbulent exchanges of sensible heat and latent heat in the austral summer of 2002-2003". *Journal of the Korean Geophysical Society*, 8(3): 159-167.

Turbulent fluxes of sensible heat and latent heat were analyzed at King Sejong station in the austral summer of 2002 (December) and 2003 (January and February). Monthly mean

air temperatures of January and February (2.2 °C) were similar to those averaged over 1988 to 2001. Precipitation was less in January and greater in February than those averaged over last 14 years. In December of 2002 and January, there was precipitation primarily when easterly wind blew usually. The frequency of snowfall was equal to or larger than that of rainfall. In the mean while, precipitation primarily in forms of rainfall occurred with westerly wind in February. In addition, while for easterly wind, temperature and humidity was low, temperature and humidity were high in case of westerly wind. Based on flux footprint, measured flux mainly came from within 300 m with maximum of 40 m upwind, indicating the insignificant role of the sea around the study site. Half-hourly downward short wave radiation amounted up to ~1000 Wm⁻² and net radiation ranged from -50 to 600 Wm⁻². Half-hourly sensible heat flux was positive at daytime with maximum of ~400 Wm⁻², except the 27th and 28th in February of 2003 when it was negative all day despite of positive net radiation at short daytime. Latent heat flux was positive with maximum of ~130 Wm⁻². Depending on wind direction, the partitioning of net radiation into the sum of sensible heat flux and latent heat flux was larger than 0.8, indicating the strong source of the land surface for the atmospheric heating. The daytime averaged Bowen ratio (=sensible heat flux /latent heat flux) was significantly greater than 1, indicating that sensible heat flux was the main source to heat the atmosphere over the site.

- 1-3 Gabrielli, Paolo, Frédéric A.M. Planchon, **Sungmin Hong, Khang Hyun Lee, Soon Do Hur**, and 6 others. 2005. "Trace elements in Vostok Antarctic ice during the last four climatic cycles". *Earth and Planetary Science Letters*, 234(1-2): 249-259. doi: 10.1016/j.epsl.2005.03.001

Li, V, Cr, Mn, Co, As, Rb, Sr, Ba, Bi and U were determined by inductively coupled plasma sector field mass spectrometry (ICP-SFMS) in various sections of the 3623 m Vostok deep Antarctic ice core dated from 4600 to 410,000 years BP, which corresponds to the last four climatic cycles back to isotopic stage 11.3. Concentrations of all elements were found to be highly variable with low values during interglacial periods and warm interstadials and much higher values during the coldest periods of the last four ice ages. Crustal enrichment factors suggest various sources for the different elements. Rock and soil dust is the dominant source of V, Mn, Rb, Ba and U whatever the period, and of Li, Cr, Co, Sr and As during cold periods. Sea salt aerosol, together with aeolian dust, also contributes significantly to Sr whereas volcanic emissions could provide a significant input for As and Bi especially during warm periods.

- 1-4 **Hong, Sungmin**, Claude F. Boutron, Carlo Barbante, **Soon Do Hur**, **Khangyun Lee**, and 6 others. 2005. "Glacial-interglacial changes in the occurrence of Pb, Cd, Cu and Zn in Vostok Antarctic ice from 240 000 to 410 000 years BP". *Journal of Environmental Monitoring*, 7(12): 1326-1331.
doi: 10.1039/b507331f

Lead (Pb), cadmium (Cd), copper (Cu) and zinc (Zn) have been measured by Electrothermal Atomic Absorption Spectrometry in various sections of the 3623 m deep ice core drilled at Vostok, in central East Antarctica. The sections were dated from 240 to 410 kyr BP (Marine Isotopic Stages (MIS) 7.5 to 11.3), which corresponds to the 3rd and 4th glacial-interglacial cycles before present. Concentrations are found to have varied greatly during this 170 kyr time period, with high concentration values during the coldest climatic stages such as MIS 8.4 and 10.2 and much lower concentration values during warmer periods, such as the

interglacials MIS 7.5, 9.3 and 11.3. Rock and soil dust were the dominant sources for Pb, whatever the period, and for Zn and Cu and possibly Cd during cold climatic stages. The contribution from volcanic emissions was important for Cd during all periods and might have been significant for Cu and Zn during warm periods.

- 1-5 **Hyun, Sangmin**, Naokaze Ahagon, and **Ho-II Yoon**. 2005. "Milankovitch cycles and paleoceanographic evolution within sediments from ODP Sites 980 and 983 of the North Atlantic Ocean". *Geosciences Journal*, 9(3): 235-242.
doi: 10.1007/BF02910583

Sediments from Ocean Drilling Program (ODP) Sites 980 and 983 in the North Atlantic Ocean were analyzed to obtain evidence of long-range Milankovitch cycles and to examine the cycles' effect on the paleoceanographic evolution of the North Atlantic Ocean. Wide cyclic variations in total organic carbon and biogenic carbonate occur throughout the columns at both sites and provide distinctive characteristics of both sediment groups. Spectral modeling of these variations shows typical 100-ka cyclic variations in both the total organic carbon (TOC) and carbonate records at Site 980, although this 100-ka Milankovitch frequency occurs only in the upper, ~472.5 ka, section of the core. In Site 983, only 400-ka cycle in carbonate is observed but the 100-ka cycle in TOC and carbonate is absent. The terrigenous content, expressed in terms of K, Al, Ti, and Th, also shows strong 100-ka and 400-ka cyclic variations at Site 983. The earth's eccentricity as expressed 100-ka and 400-ka cycles, and no appearance of obliquity (41-ka) and precession (23-ka) are important characteristics of North Atlantic Ocean sediments. Milankovitch pulse differences in carbonate, TOC at the two sites likely arise from the evolution of paleoceanography. The

dilution of carbonate fractions by terrigenous materials (indicated by the cyclical behavior of trace elements) at Site 983 is one of plausible explanation. Climatic warming over the last 600ka probably caused the differences in the sedimentary cycles at the two sites; induced meltwater discharge is recorded in the terrigenous record, and changes in the oceanic circulation system are related to major glacial-interglacial climatic episodes that probably underlie the differences in the cyclical records.

anomalies are caused mostly by the decrease of surface air temperature. So it can be explained that cold-coastal type precipitation is closely related with the air mass modification due to cold air advection over warm ocean surface. But in warm type precipitation, the anomalies which are negative rather than positive are found in the sensible heat and latent heat distribution. It may be postulated that warm type precipitation is effected by internal process of atmosphere rather than atmosphere-ocean interaction.

- 1-6 Kim, Ji-Eon, Tae-Yong Kwon, and **Bang Yong Lee**. 2005. "Characteristics of Sensible Heat and Latent Heat Fluxes over the East Sea Related with Yeongdong Heavy Snowfall Events". *Ocean and Polar Research*, 27(3): 237-250.

To investigate the air mass modification related with Yeongdong heavy snowfall events, we examined sensible heat and latent heat fluxes on the East Sea, the energy exchange between atmosphere and ocean in this study. Sensible heat and latent heat were calculated by bulk aerodynamic method, in which NCEP/NCAR reanalysis data, and high resolution NOAA/AVHRR weekly SST data were used. Among winter precipitation events in the Yeongdong region, 19 heavy precipitation events (1995~2001) were selected and classified into three types (mountain, cold-coastal, and warm types). Mountain type precipitation shows highly positive anomalies of sensible and latent heats over the southwestern part of the East-Sea. When separating these into the two components due to variability of wind and temperature/specific humidity, it is shown that the wind components are dominant. Cold-coastal type precipitation shows strong positive anomalies of sensible and latent heats over the northern part and over the central-southern part of the East-Sea, respectively. It is shown that the sensible heat

- 1-7 Kim, Ki-Hyun, Min-Young Kim, **S. M. Hong**, and 2 others. 2005. "The effects of wind speed on the relative relationships between different sized-fractions of airborne particles". *Chemosphere*, 59(7): 929-937. doi: 10.1016/j.chemosphere.2004.11.042

The concentrations of three different size fractions of particular matter (PM) including PM_{2.5}, PM₁₀, and TSP were determined continuously at hourly intervals from four different sites in Seoul, Korea during the spring of 2001. To learn the effects of wind speed change on PM fractionation, the entire data sets were initially sorted into three particle fractions such as: fine (F: PM_{2.5}), coarse (C: PM₁₀-PM_{2.5}), and giant (G: TSP-PM_{2.5}). The inter-fraction relationships of PM were then explored by linear regression analysis of the data divided into four wind speed regimes. The results of this analysis, when examined in terms of either relative dominance between different PM fractions (i.e., in terms of their slope values) or strength of correlations, indicate the existence of diverse inter-fraction patterns. Most of importantly, the physical influence of wind speed is seen to be reflected most efficiently between fine and coarse particle fractions, as the relative contribution of coarse fraction to the mass concentration of total particles (e.g., PM₁₀) changes proportionally with changes

in wind speed. However, such systematic patterns decrease noticeably between fine and giant fractions, as they can be affected more sensitively by such factors as the nature of their sources or the surrounding environmental conditions. The results of our comparative analysis thus confirm that wind speed is a useful barometer to distinguish and predict the behavior of different particle fractions in relation to each other.

- 1-8 Kim, Ki-Hyun, R. Ebinghaus, W. H. Schroeder, P. Blanchard, H. H. Kock, A. Steffen, F. A. Froude, Min-Young Kim, **SungMin Hong**, and Jae-Hwan Kim. 2005. "Atmospheric Mercury Concentrations from Several Observatory Sites in the Northern Hemisphere". *Journal of Atmospheric Chemistry*, 50(1): 1-24. doi: 10.1007/s10874-005-9222-0

In an effort to investigate both large-scale (spatial) and short/long-term (temporal) distribution characteristics of atmospheric mercury, we have combined and analyzed the Hg concentration data sets collected continuously by four different scientific groups for the areas and periods covering (1) America (three sites near the Canadian Great Lakes (CGL): 1997–2000), (2) Asia (Seoul, Korea (SEL): 1997–2002), (3) Arctic (Alert, Canada (ALT): 1995–2001), and (4) Europe (Mace Head, Ireland (MH): 1996–2002). The mean concentrations of Hg data from those widely dispersed monitoring stations were computed to be (1) 1.58 ± 0.23 , 1.69 ± 0.32 , and 1.93 ± 0.44 (three sites in CGL), (2) 5.06 ± 2.46 ng m⁻³ (SEL), (3) 1.55 ± 0.41 (ALT), and (4) 1.76 ± 0.31 (MH). Intersite relationships were investigated among all different stations using the data groups divided into different temporal intervals. The analysis of diurnal variation patterns of Hg indicated differences in regional source/sink characteristics, with increasing amplitudes of variability toward areas under the strong influence of anthropogenic sources. When the analysis

was made over different seasons, the patterns contrasted greatly between the Arctic and the other areas. It was found that the relative enhancement of Hg concentrations was dominant during winter/spring in most areas due to direct or indirect influences of anthropogenic emissions. However, the pattern for the Arctic area was distinguished pronouncedly from others with the spring minimum and summer maximum both of which reflect the potent effects of mercury depletion phenomenon (MDP). By contrast, no long-term trend, either being an increase or decrease, was evident from any of the stations during each respective study period. Although our initial attempts to examine the distribution characteristics of Hg analyzed by different scientific groups were successful, we feel that these efforts should be continued further to extend the compatibility of the global database of Hg.

- 1-9 **Kim, Seong-Joong** and **Bang Yong Lee**. 2005. "Distribution and Vertical Structures of Water Masses around the Antarctic Continental Margin". *Ocean and Polar Research*, 27(3): 277-288.

Spatial distribution and vertical structures of water masses around the Antarctic continental margin are described using synthesized hydrographic data. Antarctic Surface Water (AASW) over the shelf regime is distinguished from underlying other water masses by the cut-off salinity, varying from approximately 34.35 to 34.45 around Antarctica. Shelf Water, characterized by salinity greater than the cut-off salinity and potential temperature less than -1.7°C , is observed on the Ross Sea, off George V Land, off Wilkes Land, the Amery Basin, and the Weddell Sea, but in some shelves AASW occupies the entire shelf. Lower Circumpolar Deep Water is present everywhere around the Antarctic oceanic regime and in some places it mixes with Shelf Water, producing

Antarctic Slope Front Water (ASFW). ASFW, characterized by potential temperature less than about 0°C and greater than -1.7°C, and salinity greater than the cut-off salinity, is found everywhere around Antarctica except in the Bellingshausen-Amundsen sector. The presence of different water masses over the Antarctic shelves and shelf edges produces mainly three types of water mass stratifications: no significant meridional property gradient in the Bellingshausen and Amundsen Seas, single property gradient where ASFW presents, and a V-shaped front where Shelf Water exists.

- 1-10 Kim, Seong-Joong, Bang Yong Lee, Yoo-Min Park, and Bong-Chool Suk.** 2005. "Numerical Simulation of the Asian Monsoon for the Mid-Holocene Using a Numerical Model". *Ocean and Polar Research*, 27(3): 289-297.

The change in global climate and the Asian monsoon during the mid-Holocene, 6000 years before present (6 ka), is simulated by a climate model at spectral truncations of T170 with 18 vertical layers, corresponding to grid-cell sizes of roughly 75 km. The present simulation is forced with the observed monthly data of sea surface temperatures, and the specified concentration of atmospheric carbon dioxide while in the mid-Holocene experiment, orbital parameters such as obliquity, precession, and eccentricity are changed to the 6 ka conditions. Under such conditions, the precipitation associated with the summer monsoon is enhanced over wider zonal band from the Middle East to Southeast Asia, while no significant alteration takes place in winter. The monsoonal wind also increases over the Arabian Sea, showing the enhanced southwesterly wind during the summer and the northeasterly wind during the winter. Overall, the strength of the Asian monsoon is enhanced during the mid-Holocene, especially in summer, which is consistent

with the proxy estimates and other previous model simulations.

- 1-11 Lee, Bang Yong, Taejin Choi, Hee-Choon Lee, and Young-Jun Yoon.** 2005. "Flux Footprint Climatology and Data Quality at Dasan Station in the Arctic". *Journal of the Korean Geophysical Society*, 8(4): 201-205.

Turbulent fluxes of heat, water vapor, and CO₂ have been measured since August, 2003 at Dasan Station (78° 55'N, 11°50'E) in the Arctic. These data can allow us to better understand the interactions between the Polar ecosystems and the atmosphere together with those at King Sejong Station in the Antarctic. Due to the buildings and measurement platforms around the flux tower, it is required to evaluate how they influence measured flux data. By using one-year turbulence statistics data and footprint model, flux footprint climatology was analyzed together with data availability. The upwind distance of source area ranged from 150 to 300 m, where the buildings and measurement platforms existed. However, flow distortion due to them may be not a major factor to reduce the data availability significantly. Based on, the dominant wind direction of SW and footprint climatology, the location of flux tower is considered suitable for flux measurement.

- 1-12 Lee, Bang Yong, Tae-Yong Kwon, Jeong-Soon Lee, Ho-Il Yoon, and Young-Jun Yoon.** 2005. "Climatic Characteristics Related with Sedimentary Process in Bransfield Strait, Antarctica". *Journal of the Korean Geophysical Society*, 8(4): 173-185.

This study examines the relationships among sea ice concentration, surface air temperature, surface wind, and SST (Sea Surface Temperature) in Bransfield Strait to understand the climatic characteristics and

its related sedimentary process there. In analyses of the monthly data, during the austral autumn (Mar., Apr., and May), the frequency of southeasterlies is correlated positively with the sea ice concentration and negatively with the surface air temperature, whereas that of northwesterlies is reverse. These relationships are explained by the process that the southeasterlies of the cold air from the Antarctic Continent affect the ocean current around Bransfield Strait. And then the ocean current makes the sea ice generated in the Weddell Sea drift into the strait. During the spring (Sep., Oct., and Nov.), sea ice concentration and surface air temperature are closely correlated with the frequency of northwesterlies with warm air mass. In the some parts of the northern boundary region, the sea ice concentration in Bransfield Strait is positively correlated with the SST during the autumn and spring. Such relationship may rather propel the sea ice melting in proportion to the sea ice concentration during the autumn.

- 1-13 Lee, Kyu-Tae, **Bang Yong Lee**, and 3 others. 2005. "The Vertical Distribution of Radiative Flux and Heating Rate at King Sejong Station in West Antarctica". *Ocean and Polar Research*, 27(1): 87-95.

The vertical profiles of radiative flux and heating rate at King Sejong Station in West Antarctica were calculated with radiative transfer model by Chou and Suarez (1999) and Chou *et al.* (2001). To run this model, the profiles of temperature, mixing ratios of water vapor and ozone at King Sejong Station were derived from ECMWF Reanalysis data. The surface temperature and albedo were also derived from NCEP/NCAR Reanalysis and CERES data. The radiative flux strongly depends on the cloud optical path length that was calculated using the measured W-h data and model by Chou and Lee(1996). During the period of 2000~2001 (12 and 18 UTC), the

correlation coefficient between calculated and measured downward solar fluxes at surface was 0.90 and the coefficient for downward longwave flux was 0.61. The calculated net heating rates of surface layer decreased during the same period, the trend of which was in accordance with the decrease of measured temperature.

- 1-14 Pirjola, L., C. D. O'Dowd, **Y. J. Yoon**, and K. Sellegri. 2005. "Modelling Iodine Particle Formation and Growth from Seaweed in a Chamber". *Environmental Chemistry*, 2(4): 271-281.
doi: 10.1071/EN05075

A sectional atmospheric chemistry and aerosol dynamics box model AEROFOR was further developed to be able to simulate ultra-fine particle formation and growth from seaweed in the chamber conditions. Thermodynamically stable clusters were formed by dimer nucleation of OIO vapour, whose precursor was assumed to be molecular I₂ emitted by seaweed. Fractal geometry of particles was taken into account. For the I₂ fluxes of (0.5-1.5)×10⁹ cm⁻³ s⁻¹ the model predicted strong particle bursts, the steady state concentrations of I₂ vapour and particles larger than 3 nm were as high as 4×10⁹-1.2×10¹⁰ cm⁻³ and 5.0×10⁶ - 9.2×10⁶ cm⁻³, respectively. The steady state was reached in less than 150 s and the predicted growth rates of 3-6 nm particles varied in the range of 1.2 - 3.6 nm min⁻¹. Sensitivity of the size distribution against I₂O₃ cluster formation, an extra condensable vapour, the photolysis rate of the OIO vapour as well as against the density of OIO_n-clusters was discussed. The modelled results were in good agreement with the chamber measurements performed during the BIOFLUX campaign in September, 2003, in Mace Head, Ireland, confirming that I₂ emissions and nucleation of iodine oxides can largely explain the coastal nucleation phenomenon.

- 1-15** Pupek, M., S. S. Assonov, J. Mühle, **T. S. Rhee**, and 4 others. 2005. "Isotope analysis of hydrocarbons: trapping, recovering and archiving hydrocarbons and halocarbons separated from ambient air". *Rapid Communications in Mass Spectrometry*, 19(4): 455-460.
doi: 10.1002/rcm.1812

It is argued that isotope analysis of atmospheric non-methane hydrocarbons (NMHCs) and, in particular, the analysis of the deuterium/hydrogen (D/H) ratio is valuable because the dominant self-cleansing property of the troposphere is based on the OH radical which removes, e.g., CH₄ and other alkanes by H-atom abstraction, which induces large kinetic isotope effects. The major obstacle in applying D/H isotope analysis to atmospheric NMHCs is not only the low abundance of D itself but, in particular, the low concentrations of NMHCs in the parts per trillion range. We show how a selection of NMHCs can be quantitatively separated from 300 L air samples together with CO₂ as carrier gas matrix, by using high efficiency cryogenic traps. After diluting the extracted NMHC mixtures with hydrocarbon free air, and determining the mixing ratios, good agreement with original whole air sample analysis exists for alkanes and several halocarbons. For unsaturated hydrocarbons and some other halocarbons the extraction and recovery yield under the given conditions fell considerably, as a function of boiling point. Furthermore, the mixture of NMHCs in the CO₂ matrix is proven to remain unchanged over several years when conveniently stored in glass ampoules. The 'extracts' or 'concentrates' of condensables extracted from larger air samples will enable the D/H isotope analysis of ultra trace gases in the atmosphere.

- 1-16** **Rhee, T. S.**, and 10 others. 2005. "A case study of rapid mixing across the extratropical tropopause based on Civil Aircraft for the Regular Investigation of the Atmosphere Based on an Instrumented Container (CARIBIC) observations". *Journal of Geophysical Research*, 110: D22301(1-12).
doi: 10.1029/2005JD005890

Using the CARIBIC Boeing 767 aircraft, a suite of trace gases and aerosols was measured between Germany and the Maldives in June 2000 at altitudes between 9.4 and 10 km. In the extratropics, the flight track was located in the tropopause region. A large variability of trace gases and ultrafine aerosol concentrations was observed while the aircraft intercepted air masses from the upper troposphere and the lowermost stratosphere, as well as outflow of deep convection. The correlations of alkanes (C₂-C₅) observed in the nonconvective areas point to relatively rapid mixing across the tropopause within about a day. Unusually high mixing ratios of short-lived alkanes (C₄-C₆) in the convective areas indicate rapid transport of boundary layer air masses to cruising altitude. Using the ratios of the mixing ratios of alkanes (C₃-C₅) observed in the convective and nonconvective areas, we estimate the age of air masses in the tropopause region to be 24(±6) days for this event. This timescale is similar to that of vertical transport within the troposphere. Altogether our observations provide further evidence that the extratropical tropopause is often not a very effective mixing barrier.

- 1-17** Sellegri, K., **Y. J. Yoon**, and 6 others. 2005. "Quantification of Coastal New Ultra-Fine Particles Formation from *In-situ* and Chamber Measurements during the BIOFLUX Campaign". *Environmental Chemistry*, 2(4): 260-270.
doi: 10.1071/EN05072

New particle formation processes were studied during the BIOFLUX campaign in September 2003 and June 2004. The goals were to bring new information on the role of I_2 in the new particle formation from seaweeds and to quantify the amount of I_2 emitted and new particles formed by a given amount of seaweed. These two goals were achieved by using a simulation chamber filled with selected species of seaweeds from the Mace Head area and flushed with particle-free atmospheric air. It was found that total particle concentrations and particles in the 3-3.4 nm size range produced in the chamber are positively correlated with gaseous I_2 concentrations emitted by the seaweeds, with a typical source rate of $2,800 \text{ particles cm}^{-3} \text{ ppt}_{(I_2)}^{-1}$ in the 3-3.4 nm size range. In fact, I_2 and particle concentrations are also both directly positively correlated with the seaweeds mass ($64,300 \text{ particles cm}^{-3}$ formed per kg of seaweed, and 24 ppt of I_2 per kg of seaweeds) until saturation was reached for a seaweed biomass of 7.5 kg m^{-2} . From the chamber experiments, the flux of 3-3.4 nm particles was calculated to be $2.5 \times 10^{10} \text{ m}^{-2} \text{ s}^{-1}$ for a seaweed loading of 2.5 kg m^{-2} (representative of a typical seaweed field density), decreasing to $1 \times 10^{10} \text{ m}^{-2} \text{ s}^{-1}$ for a seaweed loading of 1 kg m^{-2} . At a seaweed loading of 2.5 kg m^{-2} the growth rate of particles produced in the chamber was calculated to be 1.2 nm min^{-1} . The source rates and growth rates determined from the chamber experiments were used in conjunction with seaweed coverage in and around Mace Head to produce local emission inventories for a meso-scale dispersion model. Comparison of the resulting aerosol size distributions from the model simulations and those observed exhibited good agreement suggesting that the chamber fluxes and growth rates are consistent with those associated with the tidal emission areas in and around Mace Head.

1-18 Yoon, Ho Il, Sang Heon Nam, Kyu-Cheul Yoo, Byong-Kwon Park, Yeadong Kim, and Jae-Kyung Oh. 2005. "Late Quaternary paleoceanographic change in the South Scotia Sea, northern Antarctic Peninsula". *Journal of the Geological Society of Korea*, 41(2): 211-226.

It is getting urgent to obtain an increased knowledge of regional paleoclimatic trends in order to understand the recent warming observed on the Antarctic Peninsula and to predict the resultant environmental changes. High-resolution sedimentologic and geochemical analyses, aided by AMS ^{14}C chronology of two gravity core sediments (core SS01 and SS02) obtained in the South Scotia Sea, represent the detailed record of late Pleistocene to Holocene climate change in Antarctic Peninsula region. The South Scotia Sea seems to have experienced occasionally open-water environment during MIS 3 (Marine Isotope Stage 3) (prior to 22,500 yr B.P.) with increased TOC (total organic carbon) content. During LGM (Last Glacial Maximum) the South Scotia Sea was considered to have been covered by prolonged sea-ice coverage, with reduced biological productivity in the surface ocean and strengthened bottom currents which originated from the Weddell Sea. At this time there must be intermittent formations of polynya which might cause enhanced biological production and bottom water production as well. Major deglaciation of the South Scotia Sea is believed to have occurred at about 12,500 yr B.P. At this time there was an gradual increase in TOC content and a decrease in terrigenous sediment due to the decrease in sea-ice coverage. During this deglaciation the South Scotia Sea might have experienced short-term cold events around 10,400~9,500 yr B.P., accompanied by TOC decrease and increase in sand content. The deglaciation was followed by a period (mid-Holocene climatic optimum) of open marine conditions with variable extent of sea

ice (variable TOC content) between 8,300 and 2,400 yr B.P. Around 2,400 yr B.P. the decrease in TOC content and increase in sand content reflects the formation of more extensive and seasonally persistent sea (fast) ice. The ice shelf in the Weddell Sea, now retreating from the shelf, advanced approximately towards the shelf edge with the bottom water production, transporting large amounts of terrigenous sediments into the South Scotia Sea.

PART 2

Earth-System Sciences

- 2-1 **Choe, Won Hie, Jong Ik Lee, Mi Jung Lee, Soon Do Hur, and Young Keun Jin.** 2005. "New Approach on the Extinction of Spreading at the Phoenix Ridge, Antarctica". *Journal of Petroleum Society of Korea*, 14(1): 73-81.

K-Ar ages have been determined for the submarine basalts dredged from the P2 and P3 segments of the Phoenix Ridge, Drake Passage, Antarctica, for better understanding on the extinction of seafloor spreading. At the P3 segment, the K-Ar ages of the rifted ridge basalts are 3.5-6.4 Ma, and those for the axial seamount basalts are 1.5-3.1 Ma. The K-Ar ages for the basalts at the rifted ridge and axial central high in the P2 segment are 2.1 and 1.4-1.9 Ma, respectively. We suggest that the extinction of seafloor spreading at the P3 and P2 segments occurred at 3.3 and 2.0 Ma, respectively, on the basis of ridge structure and formation time of basalts. This result favors a stepwise extinction model rather than a simultaneous one on the extinction of the Phoenix Ridge.

- 2-2 **Dziak, R. P., M. Park, H. Matsumoto, and S. -K. Byun.** 2005. "Hydroacoustic records and a numerical model of the source mechanism

from the first historical eruption of Anatahan Volcano, Mariana Islands". *Journal of Volcanology and Geothermal Research*, 146(1-3): 86-101.

doi: 10.1016/j.jvolgeores.2004.12.009

Anatahan Volcano in the Commonwealth of the Northern Mariana Islands (CNMI) erupted for the first time in recorded history on 10 May 2003. The underwater acoustic records (*T*-waves) of earthquakes, explosions, and tremor produced during the eruption were recorded on a sound channel hydrophone deployed in February 2003. Acoustic propagation models show that the seismic to acoustic conversion at Anatahan is particularly efficient, aided by the upward slope of the seamount toward the hydrophone. The hydrophone records confirm the onset of earthquake activity between 0100 and 0200Z on 10 May, with a substantial increase in seismicity beginning at ~0620Z. In addition, the onset of continuous, low-frequency (3-40 Hz) acoustic energy that is likely volcanic tremor related to magma intrusion was also observed at 0620Z. The hydrophone recorded 1401 earthquakes during the first 3 days of the eruption. A histogram of seismicity indicates two main periods of explosion/eruption activity, the first beginning at ~0620Z on 10 May and the second at ~0000Z on 11 May. Relative earthquake depth estimates indicate that both eruption periods were accompanied by earthquake activity from deep within the Anatahan volcanic edifice. A numerical representation of the Anatahan volcano-seismic source was developed to examine the character of acoustic signals generated from the eruption governed by the geometry of the source and the physical properties of the magma. A magma pipe source mechanism is used to compute the seismo-acoustic wavefield on the flank of the Anatahan volcanic edifice (on the seafloor and in the water column) due to mode conversion by roughness scattering. A fluid-filled pipe

model was chosen because it allows for a more straightforward relation between volcano geometry and spectral features of harmonic tremor as well as its morphologic similarity to a submerged volcanic edifice.

- 2-3 Han, Uk, Choon-Ki Lee, **Sang Heon Nam, Bang Yong Lee, and Yeadong Kim**. 2005. "Thermal dynamics of active layer at the Dasan station, Svalbard". *Journal of the Geological Society of Korea*, 41(1): 91-100.

Borehole temperature measurements at the Dasan station were made by Baroo-Diver geothermal datalogger. During September 28, 2002 - August 12, 2003 three temperature data (at the depth of 0.25 m, 0.5 m, and 0.75 m) were obtained by Environ Mon every thirty minutes. The thermal dynamics of active layer at the Dasan Korea Arctic Research Station, Svalbard (78°55.5'N, 11°56.0'E) is represented in the soil temperature which can be measured with high accuracy and high temporal resolution. Using the continuous data over a period of 318 days at the Dasan site, Svalbard, we deduce and quantify the processes which constitute the thermal dynamics. Conductive heat flow, migration of water vapor, and heat generation from phase transition are analyzed. Average thermal diffusivity indicates the range of thermal diffusivity $4 \times 10^{-7} \sim 6 \times 10^{-7} \text{ m}^2 \text{ s}^{-1}$. The Dasan experiment is a good test of the geothermal method of climate reconstruction because the permafrost is a valuable recorder of climate change.

- 2-4 **Hong, Jong Kuk, Young Keun Jin, Joochan Lee, Sang Heon Nam, and Minkyu Park**. 2005. "Tectonic Features along the South Scotia Ridge, Antarctica". *Journal of the Korean Geophysical Society*, 8(4): 215-219.

Multichannel seismic survey has conducted

along the South Scotia Ridge which is located in the northern part of Weddell sea, Antarctic sea. The South Scotia Ridge is part of continental crust extended from Antarctic Peninsula. It borders on Oceanic plates, the Scotia sea plate and Powell basin. Transtensional tectonics along the sinistral transform fault plate boundary led to the creation of the present tectonic geomorphology of the South Scotia Ridge. The fan-shaped deposits with angular unconformities in the central depression is interpreted as a divergent tectonic movement along the ridge.

- 2-5 **Jin, Young Keun, Kyung Ho Chung, Yeadong Kim, and Joochan Lee**. 2005. "Side-scan sonar survey in the Pechora Sea, Russian Arctic". *Journal of the Korean Geophysical Society*, 8(4): 187-194.

As a study of Arctic marine survey project, Side-scan sonar survey was carried out in the Pechora Sea belonging to the southeaster part of Barents Sea. The study area is a shallow sea 11 m-16 m deep with recent sediments of rich organic carbon. Side-scan sonar profiles show large-scale marine plant communities 2-3 m wide covering the southeastern area. A lot of lineaments are traced on the seafloor in the central and northern area. The major trends of the lineaments are 220° and 290° (WSW-ENE and WNW-ESE). This trends is thought to be a main path of icebergs. Pockmarks on the seafloor are locally distributed in the area, which are formed by fluid and/or gas discharge. These would be related with petroleum/gas system well developed around the study area. Dut to weak appearances and limited distribution of the pockmarks, more detailed studies are necessary to examine their nature and structure.

- 2-6 Kil, Young-Woo, Seok-Hoon Lee, **Jong-Il Lee**, and **Young-Keun Jin**. 2005. "The origin of serpentinite from Fero Fracture Zone in Drake Passage, Antarctic". *Journal of the Geological Society of Korea*, 41(2): 157-173.

Serpentinites from Hero Fracture zone in Antarctic contain serpentine, amphibole, talc, chlorite, and magnetite as well as olivine, pyroxene, and spinel as relict minerals. Fosterite compositions of olivines in serpentinites are 89 - 90. Cr-numbers and Mg-numbers of spinels in serpentinites are similar to those of spinels in abyssal peridotite. Serpentinites from Hero Fracture zone in Drake Passage have undergone two serpentinitization events by oceanic water; first serpentinitization event and second serpentinitization event. First serpentinitization part includes lizardite and antigorite, but second serpentinitization part includes only lizardite. First serpentinitization event occurred at deeper part (150 - 450°C) than second serpentinitization event. During serpentinitization, MgO and FeO in olivine are decreased, and those in orthopyroxene and clinopyroxene are increased. The protholith of serpentinites is upper mantle spinel peridotite because of mineral assemblage, Fo₈₉₋₉₀ composition in olivines, and Cr-number and Mg-number in spinels. Moreover, the values of (HREE)_n (0.3 - 1.6) and no Eu anomaly in serpentinites from Hero Fracture zone indicate that the protholith of serpentinites is upper mantle spinel peridotite.

- 2-7 **Lee, Jae Il, Byong-Kwon Park**, Yong-Joo Jwa, **Ho Il Yoon, Kyu Chul Yoo**, and **Yeadong Kim**. 2005. "Geochemical characteristics and the provenance of sediments in the Bransfield Strait, West Antarctica". *Marine Geology*, 219(2-3): 81-98.
doi: 10.1016/j.margeo.2005.06.002

The Bransfield Basin is a Quaternary marginal

basin separating the South Shetland Islands from the Antarctic Peninsula. We analyzed major, trace, and rare earth element chemistries, and the Nd, Sr, and Pb isotopic compositions for six piston core sediments from the western and eastern Bransfield basins to determine the sediment provenance and factors controlling the composition of the sediments. The Bransfield sediments have chemical characteristics similar to sediments deposited in a tectonically active setting where the source rocks are predominated by igneous rocks of intermediate to mafic composition: low K and high CN in the A-CN-K diagram, low La/Sc, low Th/Sc, and lower LREE/HREE than average shale. The low chemical alteration index of the sediments, about 45 on average, suggests the effect of weathering on the sediment composition was minimal. The source rocks of the Bransfield sediments are mostly composed of Mesozoic to Tertiary arc volcanic and plutonic rocks in the Antarctic Peninsula and the South Shetland Islands. Meanwhile, contributions from other rock types in the northern Antarctic Peninsula region, such as the Trinity Peninsula Group or Scotia Metamorphic Complex, seem to be negligible. The Bransfield sediments can be divided into three distinct compositional groups. Group I sediments have a lower La/Yb and a less prominent negative Eu anomaly than Group II sediments. They are also characterized by negative Ce anomalies. Group I sediments have been derived mainly from the South Shetland Islands, whereas Group II sediments, which are more widespread than Group I sediments in the Bransfield Strait, have been derived mainly from the Antarctic Peninsula. Group III sediments, which are very low in La/Yb with the lowest ⁸⁷Sr / ⁸⁶Sr and the highest ¹⁴³Nd / ¹⁴⁴Nd values, have been derived from Deception Island. The composition of the Bransfield sediments is largely controlled by the composition of nearby source rocks; the distribution of sediments is further modified

by the current and topography of the basin.

- 2-8 **Lee, Joohan, Young Keun Jin, Jong Kuk Hong, Sungmin Hong, and Yeadong Kim.** 2005. "GPR Investigation of Glacier on Livingstone Island, Antarctica". *Journal of the Korean Geophysical Society*, 8(2): 63-66.

With the aim of global environmental monitoring we carried out GPR (Ground Penetrating Radar) surveys at the Livingstone Island in Antarctica. Research area is near the Mt. Charra (340m) in Livingstone Island which is located 80 km to the southwest of the King Sejong Station. We have collected 5 lines of GPR data. Two kinds of survey, CMP (Common Midpoint) surveys and common offset profiles, were performed. We classified the glacier into the three layers using electromagnetic velocity of the ice and reflection characteristic. The depth of glacier reached about 80~110m. Some reflectors showed the evidence of the water filled glacial drainage and volcanic ash-layers.

- 2-9 **Lee, Mi Jung, Jong Ik Lee, and Jaques Moutte.** 2005. "Compositional variation of Fe-Ti oxides from the Sokli complex, northeastern Finland". *Geosciences Journal*, 9(1): 1-13. doi: 10.1007/BF02910549

The phoscorite-carbonatite complex at Sokli, northeastern Finland, is composed of five stages of intrusions of phoscorites and carbonatites (P1-C1, P2-C2, P3-C3 phoscorites and calcite carbonatites, D4 and D5 dolomite carbonatites) which are cut by numerous lamprophyric dikes. Magnetite is ubiquitous in all constituent rock units of the complex and frequently associates with ilmenite. Most ilmenite intergrowths from the Sokli phoscorite-carbonatite complex occur as internal and/or external granules (composite type exsolutions) or sandwich type exsolution lamellae in the host

magnetites. Discrete ilmenite crystals are found only in P3 and C3. On the other hand, ilmenites in the ultramafic lamprophyres occur as discrete crystals as well as trellis and sandwich type exsolution lamellae or composite type exsolutions in magnetite. Electron microprobe analyses reveal that magnetite of the Sokli complex belongs essentially to the magnetite-ulvöspinel solid solution series with a small proportion of magnesioferrite. The compositions of magnetite from the Sokli phoscorite-carbonatite complex vary systematically from stage to stage with increasing $Fe^{2+}/(Fe^{2+}+Mg)$ ratio, and decreasing Al, Mn and Ti contents. Magnetite from the ultramafic lamprophyre is characterized by large compositional ranges owing to the large amount of mantle-derived xenocrysts. Some grains are particularly high in Cr (up to 21.0 wt.% Cr_2O_3). Aluminous magnesian titanomagnetites are also found, but most magnetites in the ultramafic lamprophyres are pure magnetite. The compositional variation of ilmenite from the Sokli complex is mainly caused by the substitution of Fe^{2+} into Mg and Mn, and partly Ti into Nb. Mg- and Mn-rich ilmenites in the early stage P1-C1 rocks evolve towards pure $FeTiO_3$ composition in the latest D5 dolomite carbonatite. Ilmenites from the ultramafic lamprophyres are relatively poor in Mn compared to those from the phoscorite-carbonatite complex. In the coexisting magnetite and ilmenite, Mg and Mn cations preferentially partition into ilmenite rather than magnetite. In spite of the mineralogical and geochemical contrasts between the phoscorites and associated carbonatites, compositions of Fe-Ti oxide minerals from the two paired rocks at a given stage are basically the same, and evolve systematically from stage to stage. This supports the hypothesis that the phoscorites and conjugate carbonatites are derived from common parental melts. Furthermore, the intrusions of the Sokli phoscorite-carbonatite

complex are considered to have either crystallized from successive batches representing a continuum in time and magmatic evolution, or that the P1-C1 parental magma has simply differentiated to form the later stage rocks.

- 2-10 **Park, Minkyu**, and Robert I. Odom. 2005. "Propagators and Feynman diagrams for laterally heterogeneous elastic media". *Geophysical Journal International*, 160: 289-301.
doi: 10.1111/j.1365-246X.2004.02469.x

The propagator for coupled-mode elastic waves can be cast into a number of different representations, which emphasize particular aspects of the wave propagation in a laterally heterogeneous medium. One representation has the form of a generalized scattering operator and contains a quantity that can be interpreted as the lateral impedance. Another representation reduces naturally to the JWKB approximation for smoothly varying media with no mode coupling. The propagator solution for the fields in a laterally heterogeneous elastic medium with weak random boundary fluctuations leads naturally to the application of Feynman diagram techniques for the derivation of Dyson's equation and the Bethe-Salpeter equation for the propagator mean and covariance, respectively. The diagram techniques are reviewed and their utility for solution of random media elastic wave problems is demonstrated.

Cove, King George Island, Antarctica". *Korean Journal of Environmental Biology*, 23(2): 191-199.

The community structure, vertical distribution and harpacticoids composition of the meiofauna community were observed from five stations in Marian Cove, King George Island and one station on the northeastern side of Nelson Island. Sample was taken by a free-fall corer in December 2002. Generally, 11 taxa of meiofauna were found, and meiofauna abundance ranged from 322 to 1575 indiv. 10cm⁻² (mean 781 indiv. 10cm⁻²). Nematodes were the most dominant group, making up 89% of total meiofauna, followed by harpacticoids (6.8%). Benthic harpacticoids appeared 19 species of nine families at all the stations, and most various taxa appeared at station B (13 species of seven families). For vertical distribution, more than 70% of meiofauna was concentrated in the upper 0~2cm sediment layers, and the density abruptly decreased with depth in all the stations. Total biomass of meiofauna varied between 41 and 360 µgC 10cm⁻², and overall mean biomass was 205 µgC 10cm⁻². Also nematodes had the highest percentage of total meiofauna biomass (62.4%). The analysis results of Canonical Correspondence Analysis between meiofauna community and sediment grain size showed that polychaets, oligochaets and cumaceans were influenced by silt&cray, and sand, granule and pebble had a influence on harpacticoids, kinorhynchans and ostracods respectively. But nematodes were not affected by sediment grain size.

PART 3

Ocean Environment Sciences

- 3-1 Bang, Hyun Woo, **Sung-Ho Kang**, and Wonchoel Lee. 2005. "Study on the Community Structure of Meiofauna in Marian

- 3-2 **Joo, Hyoung Min**, Jin Hwan Lee, **Kyung Ho Chung**, **Jae Shin Kang**, and **Sung-Ho Kang**. 2005. "Phytoplankton and Environmental Factors in the Southeastern Barents Sea during August 2003". *Ocean and Polar Research*, 27(3): 265-276.

In order to grasp the structure and dynamics of phytoplankton communities, chlorophyll-*a* (Chl-*a*) and cell abundance were measured at 20 stations during the period from August 9 to August 21, 2003 in the southeastern Barents Sea on surface and subsurface chlorophyll maximum depth (SCM). Surface temperatures were varied from minimum -0.7°C (st. 18) to maximum 10.4°C (st. 1). Salinities were varied from minimum 29.9 psu(st. 18) to maximum 35.8 psu(st. 2). The maximum nutrient(phosphate, nitrate, silicate) concentrations were $0.12\ \mu\text{M}$, $0.11\ \mu\text{M}$, $7.53\ \mu\text{M}$ and minimum concentrations were $0.01\ \mu\text{M}$, $0.03\ \mu\text{M}$, $1.43\ \mu\text{M}$, respectively. On SCM physical environmental factor were almost similar. Chl-*a* concentrations ranged from 0.23 to $2.13\ \mu\text{g chl-}a\ l^{-1}$ at SCM. Nano- and pico phytoplankton were the important contributors for increase of the Chl-*a*. It was about seven times difference between highest concentration to lowest. Phytoplankton communities were composed of diatoms, dinoflagellates, cryptophyceae, silicoflagellate, and prymnesiophyceae showing 37 taxa at surface and 38 taxa at SCM. Picophytoplankton was the most dominant in all stations and all layers, but the second groups were 2 and/ or 3 taxa. Phytoplankton abundance ranged from minimum $4.3 \times 10^5\ \text{cells}\ l^{-1}$ (st. 20) to maximum $2.4 \times 10^6\ \text{cells}\ l^{-1}$ (st. 17) at surface water. As a result, phytoplankton might be controlled by physical factors such as North Atlantic ocean currents and northern melt water among environmental factors in Barents Sea. In addition the dominant species were nano- and pico phytoplankton such as *Phaeocystis*, *Cryptomonas* and *Dinobryon* in the study area.

A time-series sediment trap was deployed at 1,034m water depth in the eastern Bransfield Strait for a complete year from December 25, 1998 to December 24, 1999. About 99% of total mass flux was trapped during an austral summer, showing distinct seasonal variation. Biogenic particles (biogenicopal, particulate organic carbon, and calcium carbonate) account for about two thirds of annual total mass flux ($49.2\ \text{g}\ \text{m}^{-2}$), among which biogenic opal flux is the most dominant (42% of the total flux). A positive relationship (except January) between biogenic opal and total organic carbon fluxes suggests that these two variables were coupled, due to the surface-water production (mainly diatoms). The relatively low $\delta^{13}\text{C}$ values of settling particles result from effects on C-fixation processes at low temperature and the high CO_2 availability to phytoplankton. The correspondingly low $\delta^{15}\text{N}$ values are due to intense and steady input of nitrates into surface waters, reflecting an unlikely nitrate isotope fractionation by degree of surface-water production. The $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ values of sinking particles increased from the beginning to the end of a presumed phytoplankton bloom, except for anomalous $\delta^{15}\text{N}$ values. Krill and the zooplankton fecal pellets, the most important carriers of sinking particles, may have contributed gradually to the increasing $\delta^{13}\text{C}$ values towards the unproductive period through the biomodification of the $\delta^{13}\text{C}$ values in the food web, respiring preferentially and selectively ^{12}C atoms. Correspondingly, the increasing $\delta^{15}\text{N}$ values in the intermediate-water trap are likely associated with a switch in source from diatom aggregates to some remains of zooplankton, because organic matter dominated by diatom may be more liable and prone to remineralization, leading to greater isotopic alteration. In particular, the tendency for abnormally high $\delta^{15}\text{N}$ values in February seems to be enigmatic. A specific species dominancy during the production may be suggested as a possible and speculative

- 3-3 Khim, Boo-Keun, Dongseon Kim, **Hyoung Chul Shin**, and **Dong Yup Kim**. 2005. "Stable Carbon and Nitrogen Isotopes of Sinking Particles in the Eastern Bransfield Strait (Antarctica)". *Ocean Science Journal*, 40(3): 167-176.

reason.

- 3-4 Kim, Dae-Oak, Kitack Lee, and Sung-Deuk Choi, Hee-Seok Chang, Jia-Zhong Zhang, and Yoon-Seok Chang. 2005. "Determination of diapycnal diffusion rates in the upper thermocline in the North Atlantic Ocean using sulfur hexafluoride". *Journal of Geophysical Research*, 110: C10010(1-9). doi: 10.1029/2004JC002835

The apparent diapycnal diffusivity below the wind-driven surface mixed layer of the ocean was determined in an anticyclonic eddy in the eastern North Atlantic using sulfur hexafluoride (SF₆) tracer data collected in June 1998. In this tracer experiment the downward penetration of SF₆ was measured for 3 weeks following the deliberate injection of SF₆ in the surface mixed layer. The resulting data were used to constrain the one-dimensional Fickian diffusion model to estimate the diapycnal diffusivity. The model also includes the lateral diffusion component so that it can more accurately represent the time evolution of the SF₆ concentrations along the isopycnal surface. This affects the estimation of the diapycnal diffusivity. For the upper thermocline immediately below the surface mixed layer we estimated the diapycnal diffusivity for the 3 week period as $0.3 \pm 0.2 \text{ cm}^2 \text{ s}^{-1}$ at a buoyancy frequency of 8.2 cph.

- 3-5 Kim, Dongseon, JeongHee Shim, Jeong-Ah Lee, and **Young-Chul Kang**. 2005. "The Distribution of Nutrients and Chlorophyll in the Northern East China Sea during the Spring and Summer". *Ocean and Polar Research*, 27(3): 251-263.

In order to study changes in the marine ecosystem of the East China Sea derived by the global warming and construction of the Three Gorges Dam in the middle of the

Changjiang, temperature, salinity, nutrients, and chlorophyll-a were studied intensively in the northern part of the East China Sea during the summer of 2003 and spring of 2004. According to the previous studies, the upwelling of the Kuroshio Current and the Changjiang resulted in a major inputs of nutrients in the East China Sea, but these two inputs may not contribute gently to a build up of nutrients in the northern East China Sea. In spring, relatively high concentrations of nitrates and phosphates were observed in the western part of the study area, which resulted from the supply of high concentrations of nutrients showing up in the surface waters as a result of vertical mixing from the ocean bottom. The concentrations of nitrates and phosphates observed in summer were lower than those in spring, since the surface waters were well stratified by the larger discharge of fresh water from the Changjiang in summer. The surface nitrate/phosphate ratios ranged from 1.3 to 16 in spring and from 1.1 to 15 in summer and were lower than the Redfield ratio of 16, indicating that the growth of phytoplankton is limited by nitrogen. This results are contrary to the previous results, in which the growth of phytoplankton was limited by phosphate in the East China Sea. The reason for this contrary result is that most nutrients in the surface waters are supplied by vertical mixing from the bottom waters with low nitrate/phosphate ratios, not directly influenced by the Changjiang with high nitrate/phosphate ratios. The depth-integrated chlorophyll observed in summer was similar to the previous results, but those measured in spring were almost twice as high as those found in previous results. The depth-integrated chlorophyll in spring was higher than that of summer, which results from high concentrations of nitrates and phosphates in the surface waters in spring due to active vertical mixing.

- 3-6 Kim, Hyun-Cheol, Kitack Lee, and Wonyong Choi. 2005. "Contribution of phytoplankton and bacterial cells to the measured alkalinity of seawater". *Limnology and Oceanography*, 51(1): 331-338.

We report the first direct measurements of the contribution of phytoplankton and bacterial cells to the measured alkalinity of unfiltered seawater. Phytoplankton and bacterial cells suspended in seawater make a significant contribution to the measured alkalinity of unfiltered seawater; their contribution is probably next to that of borate ion in most seawater samples. This nonnegligible contribution of particulate organic matter to the measured alkalinity is due largely to the presence of negatively charged surface groups on the phytoplankton and bacterial cells that react with protons during titration with hydrochloric acid. The contribution of organic particles to the measured alkalinity of unfiltered seawater could potentially be an important factor when evaluating the accuracy of presently available carbonate thermodynamic models using at-sea carbon system parameters that include measured alkalinity.

- 3-7 Lee, Kang Hyun, **Kyung-Ho Chung, Sung-Ho Kang**, and Wonchoel Lee. 2005. "Study on the Community Structure of Sublittoral Meiofauna in the Barents Sea in Summer 2002, Arctic Ocean". *Korean Journal of Environmental Biology*, 23(3): 257-268.

Meiofauna community was surveyed in the Arctic Ocean. Sediment samples were collected from six stations in the east Barents Sea and from five stations in Kongsfjorden, Svalbard during summer 2002. Eight taxa of meiofauna were identified in the Barents Sea. Meiofauna abundance ranged from 245 to 906 indiv.10 cm⁻² (mean 580 indiv.10 cm⁻²) and total biomass varied from 23 and 404 μg C10 cm⁻² (mean 184 μg C 10 cm⁻²) in the

Barent Sea. Nematode predominated in meiofauna comprising 95.2% of total abundance and 66.4% of biomass. Copepods, polychaets and sarcomastigophonans were also dominant in the study area. Nine taxa of meiofauna were identified in Kongsfiorden. Meiofauna abundance ranged from 103 to 513 indiv.10 cm⁻² (mean 292 indiv.10 cm⁻²) and biomass varied from 13 and 196 μg C10 cm⁻² (mean 94 μg C 10 cm⁻²) in the Kongsfiorden. Nematodes predominated in meiofauna, comprising 64.1% of abundance and 64.3% biomass. Copepods, polychaets, and kinorhyncha were also dominant in the study area. The meiofauna abundances from both the study areas well match with the previous reports from the various regions including the temperate areas. However the occurred taxa in the present study are only a half comparing with the reports from temperate zone. Meiofauna abundance, biomass, diversity index and species richness were much higher than in the coastal which were strongly affected by fresh water run off in the Barents Sea. The stations affected by chlorophyll had high abundance and biomass, but low diversity index and species richness in Kongsfiorden.

- 3-8 **Lee, SangHoon**, and 3 others. 2005. "Genomic DNA Extracted from Ancient Antarctic Glacier Ice for Molecular Analyses on the Indigenous Microbial Communities". *Ocean and Polar Research*, 27(2): 205-214.

From ancient Antarctic glacier ice, we extracted total genomic DNA that was suitable for prokaryotic 16S rDNA gene cloning and sequencing, and bacterial artificial chromosome (BAC) library and end-sequencing. The ice samples were from the Dry Valley region. Age dating by ⁴⁰Ar/³⁹Ar analysis on the volcanic ashes deposited *in situ* indicated the ice samples are minimum 100,000-300,000 yr (sample DLE) and 8 million years (sample EME) old. Further assay

proved the ice survived freeze-thaw cycles or other re-working processes. EME, which was from a small lobe of the basal Taylor glacier, is the oldest known ice on Earth.

Microorganisms, preserved frozen in glacier ice and isolated from the rest of the world over a geological time scale, can provide valuable data or insight for the diversity, distribution, survival strategy, and evolutionary relationships to the extant relatives. From the 16S gene cloning study, we detected no PCR amplicons with *Archaea*-specific primers, however we found many phylotypes belonging to *Bacteria* divisions, such as *Actinobacteria*, *Acidobacteria*, *Proteobacteria* (α , β , and γ), *Firmicutes*, and *Cytophaga-Flavobacterium-Bacteroid*. BAC cloning and sequencing revealed protein codings highly identical to phenylacetic acid degradation protein paaA, chromosome segregation ATPases, or cold shock protein B of present day bacteria. Throughput sequencing of the BAC clones is underway. Viable and culturable cells were recovered from the DLE sample, and characterized by their 16S rDNA sequences. Further investigation on the survivorship and functional genes from the past should help unveil the evolution of life on Earth, or elsewhere, if any.

- 3-9 Lee, Soon-Youl, **Sung-Ho Kang**, and EonSeon Jin. 2005. "Characterization of the Gene for the Light-Harvesting Peridinin-Chlorophyll-Protein of *Alexandrium tamarense*". *Journal of Microbiology and Biotechnology*, 15(5): 1094-1099.

Photosynthetic dinoflagellates contain a water-soluble, light-harvesting antenna called the peridinin-chlorophyll-protein(PCP) complex, which has an apoprotein with no sequence similarity to other known proteins. There are two forms of PCP apoproteins; the 15-kDa short form and the 32- to 35-kDa long form. The present study describes the PCP

protein and its cDNA from *Alexandrium tamarense*. A cDNA library was constructed from mRNA isolated from *A. tamarense*. The complete PCP cDNA was generated by reverse-transcription coupled to polymerase chain reaction (RT-PCR), together with rapid-amplification of cDNA ends (RACE). The *A. tamarense* PCP cDNA encoded a 55-amino acid signal peptide and a 313-amino acid mature protein with a calculated mass of 32 kDa, which corresponded to that of the long form of PCP. Phylogenetic analysis indicated that the sequence of *A. tamarense* PCP did not cluster with the short-form PCPs, to which it was only about 55% identical, but which were 79-83% identical to other long-form PCPs. The deduced amino acid sequence of *A. tamarense* PCP contains an internal duplication, which suggests the possibility that long-form PCPs arose by gene duplication or by the fusion of genes encoding the short form. The abundance of PCP mRNA changed substantially in response to different light conditions, indicating the possible existence of a photo-acclimation response in *A. tamarense*.

- 3-10 **Shim, JeongHee**, Myung Woo Han, **Young Chul Kang**, and **DongSeon Kim**. 2005.

"Biogeochemical cycle of organic matter in a subtidal benthic environment in Marian Cove, King George Island, Antarctica". *Antarctic Science*, 17(2): 193-204.

doi: 10.1017/S0954102005002592

The flux and composition of settling particles were measured in a subtidal benthic environment of Marian Cove, King George Island, from February 1998-January 2000. The total mass flux ranged between 2.47 g m⁻² d⁻¹ (August and September 1998) and 21.97 g m⁻² d⁻¹ (February 1999), and showed distinct seasonal variation: high in the summer and low in winter. Lithogenic particles constituted 70-95% of the total particles, while biogenic particles represented only 10%, except in

spring when biogenic particles made up more than 30%. The fluxes of organic carbon, biogenic silica, nitrogen, and organic phosphorus all peaked in spring rather than in summer, with ranges of 4.4–34.0, 1.2–23.5, 0.48–5.56, and 0.01–0.15 mmol m⁻² d⁻¹, respectively. Fluxes of metals (Al, Ti, Cu, Cd, and Pb) showed temporal variability, similar to that of the total mass flux, but each metal had different enrichment factor (EF) values. The EF value of Cu correlated positively with fluxes in lithogenic components, while the EF value of Cd correlated with biogenic particle fluxes. The Cu flux is mainly related to substantial inflows of melt water laden with Cu-enriched lithogenic particles. The Cd flux is probably associated with organic matter deposition following phytoplankton blooms in the water column.

PART 4

Life Sciences

- 4-1 Cho, Eun Kyung, **Yoo Kyung Lee**, and Choo Bong Hong. 2005. "A Cyclophilin from *Griffithsia japonica* Has Thermoprotective Activity and Is Affected by CsA". *Molecules and Cells*, 20(1): 142-150.

Members of the multifunctional Cyp family have been isolated from a wide range of organisms. However, few functional studies have been performed on the role of these proteins as chaperones in red alga. For studying the function of cDNA *GjCyp-1* isolated from the red alga (*Griffithsia japonica*), we expressed and purified a recombinant *GjCyp-1* containing a hexahistidine tag at the amino-terminus in *Escherichia coli*. An expressed fusion protein, H₆GjCyp-1 maintained the stability of *E. coli* proteins up to 50 °C. For a functional bioassay for recombinant H₆GjCyp-1, the viability of *E. coli* cells overexpressing H₆GjCyp-1 was

compared with that of cells not expressing H₆GjCyp-1 at 50 °C. After high temperature treatment for 1 h, *E. coli* overexpressing H₆GjCyp-1 survived about three times longer than *E. coli* lacking H₆GjCyp-1. Measurement of the light scattering of luciferase (*luc*) showed that *GjCyp-1* prevents the aggregation of *luc* during mild heat stress and that the thermoprotective activity of *GjCyp-1* is blocked by cyclosporin A (CsA), an inhibitor of Cyps. Furthermore, the Cyp-CsA complex inhibited the growth of *E. coli* under normal conditions. The results of the *GjCyp-1* bioassays as well as *in vitro* studies strongly suggest that Cyp confers thermotolerance to *E. coli*.

- 4-2 Gabrielli, Paolo, Carlo Barbante, Claude Boutron, Giulio Cozzi, Vania Gaspari, Frédéric Planchon, Christophe Ferrari, Clara Turetta, **Sungmin Hong**, and Paolo Cescon. 2005. "Variations in atmospheric trace elements in Dome C (East Antarctica) ice over the last two climatic cycles". *Atmospheric Environment*, 39(34): 6420-6429.
doi: 10.1016/j.atmosenv.2005.07.025

Concentrations of Li, Mg, Cr, Mn, Co, Cu, As, Rb, Cd, Ba and Bi have been determined by inductively coupled plasma sector field mass spectrometry (ICP-SFMS) in various sections of the new Dome C EPICA Antarctic ice core, down to the depth of 2193 m, covering a time period of two climatic cycles. The time resolution of these records is at least twice as good as previously published ultra trace elements profiles obtained from the Vostok ice core. During the ~217 kyr period spanned by this record, a high variability in concentrations is observed for most elements, with low values during warm periods and high values during cold periods. The highest concentrations are recorded at the times of the last two glacial maxima (~20 and ~140 kyr BP). The timing and the amplitude of the main concentration peaks match remarkably

well the insoluble dust concentration profile. It confirms that dust was the main carrier of atmospheric trace elements to East Antarctica during the cold periods. For Ba, Co, Cu and Rb the crustal contribution was also dominant during warm periods. For other elements the situation is more complex during interglacial periods, when other sources such as volcanic quiescent emissions, became probably significant for several trace elements such as Cd and Bi. Peculiarly high concentration values are observed for Cd and Bi for a short depth interval dated at ~18 kyr BP. It is the same depth interval in which elevated F-values were previously observed. These very high concentrations are attributed to fallout from major local volcanic emissions at that time.

contained a large number of genes involved in regulation or transport as well as with characteristics as a marine heterotroph. Sequence analysis also revealed a multitude of genes of functional equivalence or of possible foreign origin. Functions encoded in the genomic islands include biosynthesis of exopolysaccharides, toxins, polyketides or non-ribosomal peptides, iron utilization, motility, type III protein secretion and pigmentation. Molecular structure of the algicidal pigment, which was determined through LC-ESI-MS/MS and NMR analyses, indicated that it is prodigiosin. In conclusion, our work provides new insights into mitigating algal blooms in addition to genetic make-up, physiology, biotic interactions and biological roles in the community of a marine bacterium.

- 4-3 Jeong, Haeyoung, **Joung Han Yim**, Choonghwan Lee, Sang-Haeng Choi, Yon Kyoung Park, Sung Ho Yoon, Cheol-Goo Hur, Ho-Young Kang, Dockyu Kim, Hyun Hee Lee, Kyun Hyang Park, Seung-Hwan Park, Hong-Seog Park, **Hong Kum Lee**, and 2 others. 2005. "Genomic blueprint of *Hahella chejuensis*, a marine microbe producing an algicidal agent". *Nucleic Acids Research*, 33(22): 7066-7073.
doi: 10.1093/nar/gki1016

Harmful algal blooms, caused by rapid growth and accumulation of certain microalgae in the ocean, pose considerable impacts on marine environments, aquatic industries and even public health. Here, we present the 7.2-megabase genome of the marine bacterium *Hahella chejuensis* including genes responsible for the biosynthesis of a pigment which has the lytic activity against a red-tide dinoflagellate. *H.chejuensis* is the first sequenced species in the *Oceanospiralles* clade, and sequence analysis revealed its distant relationship to the *Pseudomonas* group. The genome was well equipped with genes for basic metabolic capabilities and

- 4-4 Jung, Sang-Oun, Jung Soo Seo, Young-Mi Lee, Tae Jin Park, **Il-Chan Kim**, and 2 others. 2005. "Cloning of Acetate Kinase Gene from the Copepod *Paracyclopina nana* and its Expression in *Escherichia coli*". *The Korean Journal of Microbiology*, 41(3): 157-163.

The acetate kinase gene from the copepod *Paracyclopina nana* was cloned. The open reading frame (ORF) was 1,200 bp, and poly(A) signal sequence was located in the end of the ORF. After the molecular phylogenetic analysis of *P. nana* acetate kinase gene, it was revealed that it formed the same branch with that of *Aspergillus*. Also *P. nana* acetate kinase showed the difference with those of other prokaryotic microorganisms but showed the same clade with those of fungi. We also confirmed that the recombinant protein of *P. nana* acetate kinase made approximately 50 kDa after expression of recombinant gene construct in *E. coli*.

- 4-5 **Kim, Il-Chan**, and 5 others. 2005. "The complete mitochondrial genome of the rayfish *Raja porosa* (Chondrichthyes, Rajidae)". *DNA Sequence*, 16(3): 187-194. doi: 10.1080/10425170500087975

We isolated mitochondrial DNA from the rayfish *Raja porosa* by long-polymerase chain reaction (Long-PCR) with conserved primers, and sequenced it by primer walking method using flanking sequences as sequencing primers. *R. porosa* mitochondrial DNA consists of 16,972 bp and its structural organization is conserved in comparison with other fishes and mammals. Based on the mitochondrial cytochrome b (cyt b) sequence, the phylogenetic position of *R. porosa* among cartilaginous fishes was inferred using different phylogenetic methods (ML-based quartet puzzling, Neighbor-joining (NJ) and Bayesian approaches). In this paper, we report the characteristics of the *R. porosa* mitochondrial genome including structural organization, base composition of rRNAs, tRNAs and protein-encoding genes and characteristics of mitochondrial tRNAs. These findings are applicable to comparative mitogenomics of *R. porosa* with other related taxa.

- 4-6 Kim, Jeong-Hoon, **Hosung Chung**, **Ji Hee Kim**, Jeong-Chil Yoo, and **In-Young Ahn**. 2005. "Nest Distribution of Skuas on Barton and Weaver Peninsulas of the King George Island, the Antarctic". *Ocean and Polar Research*, 27(4): 443-450.

The ratio of breeding pairs of brown skuas (*Catharacta lonnbergi*), south polar skuas (*C. maccormicki*) and mixed species pairs between Barton and Weaver peninsulas were not different (χ^2 -test, $\chi^2=0.503$, $df=2$, $p=0.778$). The nests of skuas were clustered on Barton, whereas distributed randomly on Weaver peninsula. The distance of between brown skua nests, and that of mixed species

pair nests were longer than that of south polar skua nests. Brown skua nests were distributed along the coast. Whereas, the nests of mixed species pairs and south polar skuas were found more frequently inland (Kruskal-Wallis, $\chi^2=11.631$, $df=2$, $p<0.005$). There was no interspecific difference in the distances between skua nests and Penguin rookery in Barton (Kruskal-Wallis, $\chi^2=2.153$, $df=2$, $p=0.341$) and in King Sejong Station (ANOVA, $F=1.483$, $df=2$, $p=0.229$). In general, skuas prefer lower site (<125 m above sea level) as their nest building sites. Brown skua nests were distributed mainly on the beach, whereas south polar skua ones were distributed on the predominant periglacial landforms and till areas (χ^2 -test, $\chi^2=24.988$, $df=8$, $p<0.005$).

- 4-7 Kim, Min-Sun, **Il-Chan Kim**, and 5 others. 2005. "cDNA cloning and expression of ferritin heavy chain 1, ferritin heavy chain 2 and hemoglobin genes from the fire-bellied frog *Bombina orientalis*". *DNA Sequence*, 16(5): 340-351. doi: 10.1080/10425170500153645

We cloned two *Bombina orientalis* ferritin heavy chains (ferritin heavy chains 1 and 2) and one hemoglobin beta-chain gene from a *B. orientalis* oviduct cDNA library, and the length of transcripts was 882, 858 and 611 bp encoding 177, 177 and 148 aa, respectively. *B. orientalis* ferritin heavy chain genes showed high similarity to those of amphibia (88-93%), mammals (70-71%), and fishes (70-72%), and the hemoglobin beta-chain gene showed moderate similarity to amphibian (65-68%) and mammalian (54-57%) hemoglobin β -chain genes, respectively. Based on phylogenetic analysis, the genes were clustered to the same clade in amphibia. The two *B. orientalis* ferritin heavy chain genes showed different tissue-specific gene expression patterns. Thus, ferritin heavy chain 1 gene was highly expressed in intestine

and oviduct but ferritin heavy chain 2 gene was ubiquitously expressed in most of the examined tissues. The hemoglobin β -chain gene was more highly expressed in liver than in oviduct. These findings indicate that the genes may play different roles in different tissues. In this paper, we discuss the basic characteristics of *B. orientalis* ferritin heavy chain genes and hemoglobin β -chain gene.

- 4-8 **Lee, Yoo Kyung, Kae Kyoung Kwon, Kyeong Hee Cho, Jae Hyun Park, and Hong Kum Lee.** 2005. "Isolation and Identification of Bacteria from Marine Biofilms". *Key Engineering Materials*, 277-279: 612-617.
doi: 10.4028/www.scientific.net/KEM.277-279.612

In the marine environment, biofilms cover most of the subtidal and intertidal solid surfaces. Culturable bacteria forming marine biofilms were isolated on artificial substrate called acrylic coupons. The bacterial isolates were identified through a comparison of 16S rDNA sequences. A total of 115 strains were cultured and identified, 45 of which showed the same sequences with other strains. Therefore, 70 strains were finally identified. The bacterial isolates belonged to α -Proteobacteria (32 isolates), γ -Proteobacteria (12 isolates), CFB group bacteria (4 isolates), high GC Gram-positive bacteria (9 isolates), and low GC Gram-positive bacteria (13 isolates). The bacterial isolates may be used as standard bacteria to test new antifouling agent. They may also be utilized as useful bacteria to enhance the settlement of commercial algae and invertebrate larvae for aquaculture.

- 4-9 **Lee, Yoo Kyung, Ki Cheol Sung, Jung Han Yim, Kyu Jin Park, Hosung Chung, and Hong Kum Lee.** 2005. "Isolation of Protease-Producing Arctic Marine Bacteria". *Ocean Polar Research*, 27(2): 215-219.

We isolated and identified three protease-producing bacteria that had inhabited the region around the Korean Arctic Research Station Dasan located at Ny-Alesund, Svalbard, Norway (79°N, 12°E). Biofilms were collected from the surface of a floating pier and from dead brown algae in a tide pool near the seashore. The biofilm samples were transported to the Korea Polar Research Institute (KOPRI) under frozen conditions, diluted in sterilized seawater, and cultured on marine agar plates with 1% skim milk at 10°C. Three clear zone forming colonies were selected as protease-producing bacteria. Phylogenetic analysis based on 16S rDNA sequences showed that these three strains shared high sequence similarities with *Pseudoalteromonas elyakovii*, *Exiguobacterium oxidotolerum* and *Pseudomonas jessenii*, respectively. We expect these Arctic bacteria may be good source to develop new varieties of protease that are active at low temperatures.

- 4-10 **Lee, Young-Mi, Il-Chan Kim, and 2 others.** 2005. "Analysis of 686 expressed sequence tags (ESTs) from the intertidal harpacticoid copepod *Tigriopus japonicus* (Crustacea, Copepoda)". *Marine Pollution Bulletin*, 51(8-12): 757-768.
doi: 10.1016/j.marpolbul.2005.02.014

The intertidal harpacticoid copepod *Tigriopus japonicus* is an important species in the study of marine pollution. To facilitate molecular biomonitoring using *T. japonicus*, we constructed a *T. japonicus* unidirectional cDNA library using λ ZAP expression vector, excised to pBluescript vector with the aid of helper phage, and analyzed 686 randomly picked expressed sequence tags (ESTs) from this species. From the 686 ESTs sequenced, we found several functional genes such as vitellin, kinases and potential detoxification-related genes. We are now preparing a *T. japonicus* cDNA chip for

molecular ecotoxicological studies. In this paper, we discuss the potential use of *T. japonicus* ESTs and their importance in ecotoxicology.

- 4-11 Park, Hyun,** and 2 others. 2005. "Effects of pressure on deuterium isotope effects of yeast alcohol dehydrogenase using alternative substrates". *Archives of Biochemistry and Biophysics*, 433: 335-340. doi: 10.1016/j.abb.2004.09.033

Hydrostatic pressure causes biphasic effects on the oxidation of alcohols by yeast alcohol dehydrogenase as expressed on the kinetic parameter V/K which measures substrate capture. Moderate pressure increases capture by activating hydride transfer, whose transition-state must therefore have a smaller volume than the free alcohol plus the capturing form of enzyme, with $\Delta V^\ddagger = -30 \text{ mL mol}^{-1}$ for isopropanol. A comparison of these effects with those on the oxidation of deuterio-isopropanol generates a monophasic decrease in the intrinsic isotope effect; therefore, the volume of activation for the transition-state of deuteride transfer must be even more negative, by 7.6 mL mol^{-1} . The pressure data extrapolate and factor the kinetic isotope effect into a semi-classical reactant-state component, with a null value of $k_H/k_D=1$, and a transition-state component of $Q_H/Q_D=4$, suggestive of hydrogen tunneling. Pressures above 1.5 kbar decrease capture by favoring a minor conformation of enzyme which binds nicotinamide adenine dinucleotide (NAD^+) less tightly. This inactive conformation has a smaller volume than active E- NAD^+ , with a difference of 74 mL mol^{-1} and an equilibrium constant of 93 between them, at one atmosphere of pressure. These results are virtually identical to those obtained with benzyl alcohol and give credence to this method of analysis. Moreover, qualitatively similar results with greater pressure sensitivity but less precision

are obtained using ethanol as a substrate, only with pressure driving the value of the isotope effect to a value less than $^Dk=1.03$ directly, without extrapolation. The ethanol data verify the most surprising finding of these studies, namely that the entire kinetic isotope effect arises from a transition-state phenomenon.

- 4-12 Park, Hyun,** and 2 others. 2005. "Effects of Trehalose on Pressure-Induced Inactivation of Yeast Alcohol Dehydrogenases". *Protein and Peptide Letters*, 12(6): 597-599.

Isozymes of yeast alcohol dehydrogenase are slowly denatured at moderate hydrostatic pressures ($<3 \text{ kbar}$). The time courses for inactivation are biphasic and both phases of both isozymes are protected by trehalose. ADH-I is slightly more barostable than ADH-II which is opposite to their thermostabilities. Trehalose at 1M extends their halflives about 6-fold at 2 kbar, pH 7.5 and 25°C . In contrast, 1M sucrose provides only 4.4-fold protection under identical conditions, a finding consistent with the superior protein stabilization of trehalose to other denaturants.

- 4-13 Park, Hyun,** and 3 others. 2005. "Effects of Methanol on the Catalytic Properties of Porcine Pancreatic Lipase". *Journal of Microbiology and Biotechnology*, 15(2): 296-301.

The effect of aqueous methanol on the catalytic properties of porcine pancreatic lipase has been investigated. The k_{cat} values for the hydrolysis of N^α -benzyloxycarbonyl-L-lysine *p*-nitrophenyl ester at 0°C increased in a linear manner with increasing methanol concentration. However, the K_M values were not influenced at methanol concentrations lower than 30% and then began to increase at higher concentrations in an exponential

fashion. Based on product analysis, the increase in k_{cat} with increasing methanol concentration can be accounted for by nucleophilic competition of methanol for the acyl enzyme intermediate, indicating that the rate-limiting step of the porcine pancreatic lipase-catalyzed reaction is deacylation under current experimental conditions. The exponential increase in K_M at methanol concentrations higher than 30% is attributed to the hydrophobic partitioning effect on substrate binding. There was no loss of lipase activity over a 4h period in 60% methanol concentration at pH5.5 and 0°C. By monitoring the intrinsic fluorescence and absorbance, no evidence for structural changes by methanol was observed.

- 4-14 **Park, Hyun,** and 5 others. 2005. "Relationship Between Enhancement of Electrostriction and Decrease of Activation Energy in Porcine Pancreatic Lipase Catalysis". *Journal of Microbiology and Biotechnology*, 15(3): 587-594.

The contribution of electrostriction of water molecules to the stabilization of negatively charged tetrahedral transition state of a lipase-catalyzed reaction was examined by means of kinetic studies involving high-pressure and solvent dielectric constant. A good correlation was observed between the increased catalytic efficiency of lipase and the decreased solvent dielectric constant. When the dielectric constant of solvents was lowered by 5.00 units, the losses of activation energy and free energy of activation were 7.92 kJ/mol and 11.24 kJ/mol, respectively. The activation volume for k_{cat} decreased significantly as the dielectric constant of solvent decreased, indicating that the degree of electrostriction of water molecules around the charged tetrahedral transition state has been enhanced. These observations demonstrate that the increase in the catalytic efficiency of the lipase reaction with

decreasing dielectric constant resulted from the stabilization of electrostatic energy for the formation of an oxyanion hole, and that this stabilization was caused by the increase of electrostricted water around the charged tetrahedral transition state. Therefore, we conclude that the control of solvent dielectric constant can stabilize the tetrahedral transition state, thus lowering the activation energy.

- 4-15 **Yim, Joung Han,** Eunwha Son, Suhkneung Pyo, and **Hong Kum Lee.** 2005. "Novel Sulfated Polysaccharide Derived from Red-Tide Microalga *Gyrodinium impudicum* strain KG03 with Immunostimulating Activity in vivo". *Marine Biotechnology*, 7(4): 331-338. doi: 10.1007/s10126-004-0404-6

The high-sulfate-containing exopolysaccharide p-KG03 is produced by the red-tide microalga *Gyrodinium impudicum* strain KG03. The immunostimulatory effects of this sulfated exopolysaccharide were investigated by isolating peritoneal macrophages from mice 10 or 20 days after they had received a single dose of p-KG03 (100 or 200 mg/kg body weight). The cytotoxicity of the isolated macrophages for B16 tumor cells was tested, as B16 tumor cells are sensitive to tumor necrosis factor α (TNF- α) and nitric oxide. The activities of natural killer cells from the p-KG03-treated mice against YAC-1 mouse lymphoma cells were also tested. The nonspecific immune functions mediated by natural killer cells and macrophages were increased by treatment with p-KG03 in vivo. These results suggest that p-KG03 has immunostimulatory effects and enhances the tumoricidal activities of macrophages and NK cells in vivo. In addition, p-KG03 treatment increased the plaque-forming cell response to sheep red blood cells, as well as the levels of IgM and IgG. Exposure to p-KG03 also increased the production by macrophages of cytokines,

such as interleukins -1 β and -6, and TNF- α . This is the first report of a marine microalgal sulfated polysaccharide having immunostimulatory activities. The p-KG03 polysaccharide may be useful for the development of biotechnological and pharmaceutical products that incorporate bioactive marine exopolysaccharides.

- 4-16 Yim, Joung Han, Se Hun Ahn, Sung Jin Kim, Yoo Kyung Lee, Kyu Jin Park, and Hong Kym Lee.** 2005. "Production of Novel Exopolysaccharide with Emulsifying Ability from Marine Microorganism, *Alteromonas* sp. Strain 00SS11568". *Key Engineering Materials*, 277-279: 155-161.
doi: 10.4028/www.scientific.net/KEM.277-279.155

To find a novel exopolysaccharide, marine bacterial strains were isolated from coastal regions of Korea. Strain 00SS11568 was then selected as it produced a mucous exopolysaccharide during the stationary phase in a batch culture. The isolate was identified as *Alteromonas* sp. based on its 16S rDNA sequence, morphological, and biochemical properties. The exopolysaccharide, designated as p-11568, exhibited an emulsifying ability. The Emulsification Index (E_{24}) of 0.1% p-11568 was 77.4% with an emulsified kerosene content, and was higher than those of commercial polysaccharides, such as xanthan gum (26.1%), gellan gum (1.3%), and sodium alginate (2.0%). p-11568 was found to be composed of glucose and galactose as the main natural sugars in a molar ratio of 1.3:1, along with uronic acid (18.9%, w/w) and sulfate groups (1.2% w/w). The average molecular mass was 4.4×10^5 daltons by gel filtration chromatography. The effects of pH, temperature, inorganic compounds, and C and N sources were tested to obtain the optimal medium composition for the production of p-11568. Under optimal growth

conditions with the M-11568 medium, 14.9 g of crude p-11568 per liter was obtained.

- 4-17 You, Dae-Eun, Misun Kang, Eun-Jung Park, IL-Chan Kim, and 2 others.** 2005. "Molecular Biomarkers of Octachlorostyrene Exposure in Medaka, *Oryzias latipes*, using Microarray Technique". *Journal of Environmental Toxicology*, 20(2): 187-194.

Octachlorostyrene (OCS) is a primarily concerning chemical in many countries because of its persistent and bioaccumulative properties in the environment. OCS is not commercially manufactured or used but it may be produced during incineration or chemical synthetic processes involving chlorinated compounds. There are several reports that OCS was found in the waters, sediments, fish, mussels, and also in human tissues. However, systematic studies on the OCS toxicities are scarce in literature. In this study, we tried to get the gene expression data using medaka DNA chip to identify biomarkers of OCS exposure. Medaka (*Oryzias latipes*) was exposed to OCS 1 ppm for 2 days and 10 days, respectively. Total RNA was extracted and purified by guanidine thiocyanate method and the Cy3- and Cy5-labelled cDNAs produced by reverse transcription of the RNA were hybridized to medaka microarray. As results, eighty five genes were found to be down- or up-regulated by OCS. Some of the genes were listed and confirmed by real-time PCR.

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PART 1

Climate Change Sciences

- 1-1 **Choi, Taejin, Bang-Yong Lee, Seong-Joong Kim, Yoo-Min Park, and Young Jun Yoon.** 2006. "The Characteristics of Radiation, Temperature and Wind Direction around King Sejong Station, Antarctica". *Journal of the Korean Geophysical Society*, 9(4): 397-408.

Due to the temporal and spatial variability of the warming at and near the Antarctic Peninsular, it is required to better understand local climate at the issued region. The purpose of the study are to characterize surface radiation, air temperature and wind direction and investigate their relations at the King Sejong Station near the Antarctic Peninsular during last three and half years. While the study site was a weak radiative energy sink (positive net radiation) with annual mean of $15-20 \text{ Wm}^{-2}$, it played a role as a strong sink in summer (December to January) with mean of 85 Wm^{-2} , a magnitude that was significantly larger than those at other surface covered with snow or ice in Antarctica. Monthly averaged air temperature ranged from $-7.7-2.8^{\circ}\text{C}$ and the variations of monthly averaged air temperature showed the distinct differences with year. Northwesterly, westerly and easterly were dominant and the variability of air temperature could be explained by the variability of the frequency of wind direction with cold easterly and warm northwesterly/northerly to some degree, which in turn influenced radiation budget through albedo in summer.

- 1-2 **Chung, Chull-Hwan, Hyoun Soo Lim, and Ho Il Yoon.** 2006. "Vegetation and climate changes during the Late Pleistocene to Holocene inferred from pollen record in Jinju area, South Korea". *Geosciences Journal*, 10(4): 423-431.

doi: 10.1007/BF02910436

The pollen record from paleo-swamp deposits spanning the last ca. 26,000 yr reveals a detailed history of vegetation and climate changes of the Jinju area, South Korea. From ca. 26.2 to 23.9 cal. kyr BP, xerophytic *Artemisia*-dominated grassland and mixed subalpine coniferous and deciduous broadleaved forests occupied the study area, indicating a cool and dry condition during interstadial stage of the last glacial period. The period between ca. 23.9 and 14.7 cal. yr BP exhibits the expansion of grassland and subalpine coniferous forest and the retreat of deciduous broadleaved forest, reflecting a cold and dry condition during the Last Glacial Maximum (LGM). During the period of ca. 14.7–11.2 cal. yr BP, climatic amelioration comparable to the Boelling-Alleroed Event induced an enlargement of temperate deciduous broadleaved forest and a shrink of subalpine coniferous forest and grassland. Vegetation changes controlled by human impact occurred from ca. 4.7 to 0.7 cal. kyr BP, as indicated by an increase in *Pinus* and Gramineae pollen.

- 1-3 **Kim, Jhoon, Hi Ku Cho, Yeon Jin Jung, Yun Gon Lee, and Bang Yong Lee.** 2006. "Surface Energy Balance at Sejong Station, King George Island, Antarctica". *Atmosphere*, 16(2): 111-124.

This study examines seasonal variability of the surface energy balance at the King Sejong Station, Antarctica, using measurements and estimates of the components related to the balance for the period of 1996 to 2004. Annual average of downward shortwave radiation at the surface is 81 Wm^{-2} which is 37% of the extraterrestrial value, with the monthly maximum of 188 Wm^{-2} in December and the minimum of 8 Wm^{-2} in June. These values are relatively smaller than those at other stations in Antarctica, which can be

attributed to higher cloudy weather conditions in Antarctic front zone. Surface albedo varies between ~ 0.3 in the austral summer season and ~ 0.6 in the winter season. As a result, the net shortwave radiation ranges from 117 Wm^{-2} down to 3 Wm^{-2} with annual averages of 43 Wm^{-2} . Annual average of the downward longwave radiation shows 278 Wm^{-2} , ranging from 263 Wm^{-2} in August to 298 Wm^{-2} in January. The downward longwave radiation is verified to be dependent strongly on the air temperature and specific humidity, accounting for 74% and 79% of the total variance in the longwave radiation, respectively. The net longwave radiation varies between 25 Wm^{-2} and 40 Wm^{-2} with the annual averages of 30 Wm^{-2} . Accordingly, the annual average energy balance is dominated by radiative warming of a positive net all-wave radiation from September to next March and radiative cooling of a negative net all-wave radiation from April to August. The net all-wave radiative energy gain and loss at the surface is mostly balanced by turbulent flux of sensible and latent heat. The soil heat flux is of negligible importance in the surface energy balance.

- 1-4 Kim, Ki-Hyun, Chang-Hee Kang, Jin-Hong Lee, Kum-Chan Choi, Yong-Hoon Youn, and **Sungmin Hong**. 2006. "Investigation of airborne lead concentrations in relation to Asian Dust events and air mass transport pathways". *Aerosol Science*, 37(12): 1809-1825.
doi: 10.1016/j.jaerosci.2006.08.009

In order to explain the influence of Asian Dust (AD) on metal concentration levels in different sized particles, the analysis of Pb in both particulate matters with an aerodynamic diameter less than 2.5 (PM_{2.5}) and 10 (PM₁₀) fractions was made consecutively for every spring season during a four-year study period between 2001 and 2004. To explore the

impact of AD, a comparative analysis was made to compile Pb measurement data in two different categories: (1) between the AD and non-AD (NAD) periods and (2) between fine and coarse fractions. The results of our analysis indicated that the concentrations of coarse PM fraction increased significantly during the AD period, whereas an increase in the fine PM fraction was of moderate degree. However, when Pb concentrations were concerned, the patterns tended to change quite considerably in both the time-period (AD and NAD) and the particle fractions group. The distribution of atmospheric Pb in the AD period can be explained in two contrasting manners: either preferential enrichment of Pb due to the intrusion of Pb-polluted fine particles or relative depletion of Pb due to the dominance of coarse particles with poor Pb contents. Comparison of the Pb data based on the back trajectory analysis indicates that the effect of AD can be quite selective between pollutant species. If Pb data collected during the entire study period are divided by transport pathways, the patterns derived for each individual route suggest that air masses retained in the local area are more effective to build up Pb concentration levels than those affected by long range transport process.

- 1-5 Kim, Ki-Hyun, Vinit K. Mishra, and **Sungmin Hong**. 2006. "The rapid and continuous monitoring of gaseous elemental mercury (GEM) behavior in ambient air". *Atmospheric Environment*, 40(18): 3281-3293.
doi: 10.1016/j.atmosenv.2006.01.046

In order to examine the environmental behavior of elemental mercury (GEM or Hg⁰) at varying time scales, Hg concentrations data were obtained at 1-s intervals using a rapid Hg monitoring system (Lumex Hg analyzer). The Hg data sets obtained from a total of 24 experiments were analyzed in two different manners-either as raw data (collected at 1-s

intervals) or after modification into two arbitrarily extended intervals (i.e., 10s and 1 min). To meaningfully interpret those rapidly monitored Hg data, we evaluated both the raw and modified data sets in varying respects. The environmental behavior of Hg, while exhibiting clear distinctions over diurnal and/or seasonal scales, was found to experience sharp changes for a very short time period, usually less than a few tens of seconds to a minute. During such a short duration, a five- to ten-fold increase in Hg concentration was commonly found. As a mean to evaluate the temporal factors associated with Hg behavior, the correlation analysis was made using both the original and modified data sets between the various statistical parameters (mean, median, min, and max). The overall results of this study confirm that the temporal variability of Hg, while maintaining highly stable and systematic patterns (e.g., over diurnal or seasonal scale), can be dramatically dynamic over very short time intervals such as a few tens of seconds or minutes.

- 1-6 **Kim, Seong-Joong and Bang-Yong Lee.** 2006. "The Impact of Southern Ocean Thermohaline Circulation on the Antarctic Circumpolar Current Transport". *Journal of the Korean Geophysical Society*, 9(4): 291-299.

The observed ocean barotropic circulation is not completely explained by the classical wind-driven circulation theory. Although it is believed that the thermohaline forcing plays a role in the ocean barotropic circulation to some degree, how much the thermohaline forcing contributes to the barotropic circulation is not well known. The role of thermohaline circulation driven by changes in temperature and salinity in the Southern Ocean (SO) water masses on the Antarctic Circumpolar Current (ACC) transport is investigated using a coupled ocean - atmosphere - sea ice - land surface climate

system model in a Last Glacial Maximum (LGM) context. With the implementation of glacial boundary conditions in a coupled model, a substantial increase in the ACC transport by about 75% in 80 years of integration and 25% in the near LGM equilibrium is obtained despite of the decreases in the magnitude of wind stresses over the SO by 33% in the transient time and 20% in the near-equilibrium. This result suggests that the increase in the barotropic ACC transport is due to factors other than the wind forcing. The change in ocean thermohaline circulation in the SO seems to play a significant role in enhancing the ACC transport in association with the change in the bottom pressure torque.

- 1-7 **Kim, Seong-Joong, Bang Yong Lee, and Ho-II Yoon.** 2006. "Numerical Model Study of Surface Temperature and Hydrological Budget Change for the Last Glacial Maximum". *Journal of the Korean Geophysical Society*, 9(2): 135-145.

The surface temperature and hydrological budget for the last glacial maximum (LGM) is simulated with an atmospheric general circulation model of NCAR CCM3 at spectral truncation of T170, corresponding to a grid cell size of roughly 75 km. LGM simulations were forced with the reconstructed CLIMAP sea surface temperatures, sea ice distribution, ice sheet topography, reduced CO₂, and orbital parameters. Under LGM conditions, global-mean surface temperature is reduced by 6.1 °C in winter, 5.6 °C in summer, and 6 °C annual-mean. The decrease of surface temperature leads to a weakening of the hydrological cycle. Global-mean precipitation decreases by about 14% in winter, 17% in summer, and 13% annually. However, some regions such as the U.S., southern Europe, northern and eastern Africa, and the South America appear to be wetter in the LGM winter and Canada and the Middle East are

wetter in summer. These results are in a broad agreement with paleoclimate proxy records. Overall, the high-resolution model captures detailed climate features over land.

- 1-8 **Kim, Seong-Joong, Yoo-Min Park, Bang-Yong Lee, Tae-jin Choi, Young-Jun Yoon,** and Bong-Chool Suk. 2006. "Study of East Asia Climate Change for the Last Glacial Maximum Using Numerical Model". *The Korean Journal of Quaternary Research*, 20(1): 51-66.

The climate of the last glacial maximum (LGM) in northeast Asia is simulated with an atmospheric general circulation model of NCAR CCM3 at spectral truncation of T170, corresponding to a grid cell size of roughly 75 km. Modern climate is simulated by a prescribed sea surface temperature and sea ice provided from NCAR, and contemporary atmospheric CO₂, topography, and orbital parameters, while LGM simulation was forced with the reconstructed CLIMAP sea surface temperatures, sea ice distribution, ice sheet topography, reduced CO₂, and orbital parameters. Under LGM conditions, surface temperature is markedly reduced in winter by more than 18°C in the Korean west sea and continental margin of the Korean east sea, where the ocean exposed to land in the LGM, whereas in these areas surface temperature is warmer than present in summer by up to 2°C. This is due to the difference in heat capacity between ocean and land. Overall, in the LGM surface is cooled by 4~6°C in northeast Asia land and by 7.1°C in the entire area. An analysis of surface heat fluxes show that the surface cooling is due to the increase in outgoing longwave radiation associated with the reduced CO₂ concentration. The reduction in surface temperature leads to a weakening of the hydrological cycle. In winter, precipitation decreases largely in the southeastern part of Asia by about 1~4 mm/day, while in summer a larger reduction is found over China. Overall, annual-mean

precipitation decreases by about 50% in the LGM. In northeast Asia, evaporation is also overall reduced in the LGM, but the reduction of precipitation is larger, eventually leading to a drier climate. The drier LGM climate simulated in this study is consistent with proxy evidence compiled in other areas. Overall, the high-resolution model captures the climate features reasonably well under global domain.

- 1-9 **Lee, Bang Yong,** and 4 others. 2006. "Recent Changes in Solar Irradiance, Air Temperature and Cloudiness at King Sejong Station, Antarctica". *Atmosphere*, 16(4): 333-342.

The long-term trends of global solar irradiance, air temperature, specific humidity and cloudiness measured at King Sejong station, Antarctica, during the period of 1988-2004, have been investigated. A statistically insignificant decrease, $-0.21 \text{ Wm}^{-2} \text{ yr}^{-1}$ ($-0.26 \% \text{ yr}^{-1}$, $P < 0.5$) in global solar irradiance was found in an analysis from the time series of the monthly mean values, except for the increasing trends only in two months of January and June. The trends in irradiance are directly and inversely associated with the cloudiness trends in annual and monthly means. The trends in surface air temperature show a slight warming, $0.03 \text{ }^\circ\text{C yr}^{-1}$ ($1.88 \% \text{ yr}^{-1}$, $P < 0.5$) on the annual average, with cooling trend in the summer months and the warming in the winter. The exact relationship, if any, between the irradiance and temperature trends is not known. No significant tendency was found in specific humidity for the same periods. Recent (1996-2004) erythermal ultraviolet irradiance shows decreasing trend in annual mean, $-0.15 \text{ mWm}^{-2} \text{ yr}^{-1}$ ($-1.18 \% \text{ yr}^{-1}$, $P < 0.1$) which is about five times the trends of global solar irradiance. The ratio of erythermal ultraviolet to global solar irradiance shows remarkable seasonal variations with annual mean value of 0.01 %

and a peak in October and November, showing the increase of ultraviolet irradiance resulting from the Antarctic ozone hole. The sensitivity of global solar irradiance to the change in cloudiness is roughly 13 \% oktas^{-1} which is about twice of the value at the South Pole due to the difference in the average surface reflectance between the two stations. Much more sensitive values of 59 \% oktas^{-1} was found for erythermal UV irradiance than for the global solar irradiance.

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- 1-10** Lee, Jong-Cheol, Young-Jun Cho, Tae-Yong Kwon, **Bang-Yong Lee**, and Ki-Song Ban. 2006. "Regional Variations of SWT and its Relationship with ENSO in the Coast of the Korean Peninsula". *Journal of Basic and Life Research Science*, 6(2): 33-46.

This study investigates the spatial distribution of warming trends and the relationship between sea water temperature and El Niño/South Oscillation (ENSO) in the coast of the Korean peninsula using monthly mean sea water temperature (SWT). The monthly mean data are calculated from the daily sea water temperature at 24 fixed coastal stations for 33 years (1967-1999). The annual variation of SWT is the greatest in the coast of the Yellow Sea where the impact of the coastal water was relatively large. The variability of SWT is in general larger in Summer than any other seasons, while the largest variability is found during winter especially in the central east coast which the warm and cold ocean currents encounter each other. The analysis of trend indicates that the warming trend is the strongest in winter of 4 seasons and in the coast of Yellow sea among the three coasts surrounding the Korean peninsula, and it shows locally the highest warming ($1.2 \text{ }^\circ\text{C/decade}$) at the central East Coast in winter. The relation between SWT and ENSO, based on the correlation analysis between SWT and SST anomalies in the eastern equatorial Pacific,

shows in general negative correlations in the entire coasts during summer. The stronger negative correlations are found in the southeastern coast for a longer time period (3-4 months) with larger slope (approximately $-0.7 \text{ }^\circ\text{C}/^\circ\text{C}$). Furthermore, the anomaly analysis also supports on the relationship between SWT and ENSO in the southeastern coast of the Korean peninsula.

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- 1-11** Lee, Kyu-Tae, **Bang Yong Lee**, Won-Hak Lee, Joon-Bum Jee, and **Young Jun Yoon**. 2006. "Radiative Properties of King Sejong Station in West Antarctica with the Radiative Transfer Model: Climate Change Using Radiative Convective Equilibrium Model". *Journal of the Korean Geophysical Society*, 9(1): 27-36.

The radiative convective equilibrium (RCE) temperature was calculated for the climate change study at King Sejong Station in West Antarctica. As a result of RCE model sensitivity test, the increases of surface albedo, solar zenith angle, and cloud optical thickness decrease surface warming due to the greenhouse effect. According to the model calculation result, annual mean surface temperature shows a upward trend of $0.012 \text{ }^\circ\text{C/year}$ during the period of 1958-2001. During the period of 1989~2001, the trend of monthly mean surface temperature by model calculation is $0.01 \text{ }^\circ\text{C/month}$ and the observation trend is $0.005 \text{ }^\circ\text{C/month}$.

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- 1-12** **Lim, Hyoun Soo**, Yeon Jeong Nam, Yong Il Lee, Cheong-Bin Kim, Seonbok Yi, Chull-Hwan Chung, Heon-Jong Lee, and **Ho Il Yoon**. 2006. "Principles and applications of tephrochronology: widespread AT (Aira-Tanzawa) tephra found in the Korean Peninsula". *Journal of the Korean Geophysical Society*, 42(4): 645-656.

Tephrochronology is the study of volcanic ash

(tephra) beds for the purpose of correlating and dating volcanic and other geologic events. Tephra beds can be identified based on refractive indices and geochemical composition of volcanic glasses because of their unique chemical and physical characteristics, reflecting magma compositions and eruption types. The age of tephra bed can be estimated by historical documents, radiocarbon, fission-track, and Ar-Ar dating methods. In Korea, several tephra layers have been reported from marine sediments and terrestrial paleosols. Most prominent ash layer found in Pleistocene paleosols is the Aira-Tanzawa (AT) tephra, which was erupted from the Kyushu Island of Japan about 25 ka. This rhyolitic tephra occurs extensively on land and in marine sediments around Korea and Japan, and is the marker-tephra of the Late Pleistocene. Further studies on widespread tephra layers in Pleistocene paleosols can provide valuable information about the Quaternary research, including paleoclimate and paleoenvironment changes, and Paleolithic archaeology.

- 1-13 Paolo Gabrielli, John M.C. Plane, Claude F. Boutron, **Sungmin Hong**, and 7 others. 2006. "A climatic control on the accretion of meteoric and super-chondritic iridium-platinum to the Antarctic ice cap". *Earth and Planetary Science Letters*, 250(3-4): 459-469.
doi: 10.1016/j.epsl.2006.08.015

Meteoritic smoke particles (MSPs) form through the vaporization of meteoroids and the subsequent re-condensation of metallic species in the mesosphere. Recently, iridium and platinum enrichments have been identified in Greenland ice layers and attributed to the fallout of MSPs supplying polar latitudes with cosmic matter during the Holocene. However, the MSP fallout to Antarctica during the Earth's climatic history

remains essentially unknown. We have determined iridium and platinum in deep Antarctic ice from Dome C and Vostok dated back to 240 kyrs BP. We find high super-chondritic fluxes during warm periods and low meteoric accretion during glacial times, a pattern that is opposite to any known climatic variation in dust fallout to polar regions. The proposed explanation of this accretion regime is a weaker polar vortex during warm periods, allowing peripheral air masses enriched in volcanic iridium and platinum to penetrate inland to Antarctica. The MSP signal emerges only during cold phases and is four times lower than in the Greenland ice cap where more snow accumulates. This suggests that wet deposition is an important route of cosmic material to the Earth's surface.

- 1-14 **Rhee, T. S.**, and 2 others. 2006. "The overwhelming role of soils in the global atmospheric hydrogen cycle". *Atmospheric Chemistry and Physics Discussions*, 6(6): 1611-1625.
doi: 10.5194/acp-6-1611-2006

The removal of molecular hydrogen (H₂) from the atmosphere is dominated by the uptake in soils. Notwithstanding, estimates of the magnitude of this important process on a global scale are highly uncertain. The CARIBIC aircraft observations of the seasonal variations of H₂ and its D/H isotopic ratio in the northern hemisphere allow an independent, better constrained estimate. We derive that 82% of the annual turnover of tropospheric H₂ is due to soil uptake, equaling 88 (±11) Tg a⁻¹, of which the northern hemisphere alone accounts for 62 (±10) Tg a⁻¹. Our calculations further show that tropospheric H₂ has a lifetime of only 1.4 (±0.2) years – significantly shorter than the recent estimate of ~2 years – which is expected to decrease in the future. In addition, our independent top-down

approach, confined by the global and hemispheric sinks of H_2 , indicates $64 (\pm 12) \text{ Tg a}^{-1}$ emissions from various sources of volatile organic compounds by photochemical oxidation in the atmosphere. This estimate is as much as up to 60% larger than the previous estimates. This large airborne production of H_2 helps to explain the fairly homogeneous distribution of H_2 in the troposphere.

- 1-15 Rhee, Tae Siek**, and 3 others. 2006. "Isotopic composition of H_2 from CH_4 oxidation in the stratosphere and the troposphere". *Journal of Geophysical Research*, 111: D23303(1-14). doi: 10.1029/2005JD006760

Enrichment in deuterium (D) of stratospheric H_2 is investigated using new and published data. Applying a Rayleigh model to account for the isotopic fractionations in the photochemical chain reactions from CH_4 to the final product H_2O via H_2 reveals a strong enrichment of photochemically produced H_2 . This is consistent with previous studies, but the degree of enrichment obtained in this study appears to be 100 ~ 120 ‰ larger than the previous estimates on average. The discrepancy primarily stems from the former use of either an isotopic fractionation factor of H_2 that does not take into account the effect of stratospheric transport, or an H_2 yield from CH_2O photolysis that is not applicable to stratospheric conditions. We further investigate the same isotopic fractionation process under tropospheric conditions by considering the differences in both the species and amounts of oxidizing agents, and the wavelengths that are effective in the photolysis of CH_2O . These were not considered in the former studies when they derived the δD value under the tropospheric conditions. We thereby anticipate the δD value of H_2 from photochemical oxidation of CH_4 in the troposphere to be $190 (\pm 50) \text{ ‰}$

- 1-16 Sellegri, K., C. D. O'Dowd, Y. J. Yoon**, and 2 others. 2006. "Surfactants and submicron sea spray generation". *Journal of Geophysical Research*, 111: D22215(1-12). doi: 10.1029/2005JD006658

Laboratory experiments have been carried out to elucidate the role of surfactants on the primary marine aerosol production of submicron marine aerosols. A synthetic surfactant SDS was used in conjunction with artificially generated seawater, and the resultant bubble-mediated aerosol produced was observed. At 23°C , the aerosol distribution resulting from the use of surfactant-free seawater comprised three modes: (1) a dominant accumulation mode at 110 nm; (2) an Aitken mode at 45 nm; and (3) a third mode, at 300 nm, resulting from forced bursting of bubbles. The forced bursting occurs when bubbles fail to burst upon reaching the surface and are later shattered by splashing associated with breaking waves and/or wind pressure at the surface. At 4°C , the accumulation mode diameter was reduced to 85 nm, the Aitken mode diameter was reduced to <30 nm and the 300 nm mode diameter was reduced to 200 nm. With the addition of SDS, the relative importance of the mode resulting from forced bursting increased dramatically. The laboratory results were compared to the observed seasonality of North Atlantic marine aerosol where a progression from mode radii minima in winter to maxima in summer is seen. The bimodality and the seasonality in modal diameter can be mostly explained by a combination of the three modes observed in the laboratory and their variation as a function of sea-surface temperature and seawater surfactant concentration. These results indicate that submicron primary aerosol modes would on a first approximation result from bubble bursting processes, although evidences of additional secondary processes leading, during summer, to a higher amplitude of the Aitken mode and mode 2

smoothed into mode 3 still need to be investigated.

- 1-17 Seong, Yeong Bae, **Hyoun Soo Lim**, **Ho Il Yoon**, Yong Il Lee, **Yeadong Kim**, and Lewis A. Owen. 2006. "A Preliminary Geomorphic Overview of Late Quaternary Glacier Fluctuations in the South Shetland Islands, West Antarctica". *Journal of the Korean Geophysical Society*, 41(5): 513-526.

The timing and extent of glaciations during the Late Quaternary in the South Shetland Islands, West Antarctica were defined using field mapping, geomorphic analysis and radiocarbon dating. Landforms of glacial erosion and deposition, in particular subglacial meltwater channel erosion, suggest that at least three glaciations occurred during the late Quaternary within the study region. During the global LGM, glacial troughs (such as Maxwell Bay and Admiralty Bay) were overdeepened by an ice stream moving south from an ~1000 m-thick ice cap centered on the present-day continental shelf to the north. This ice was responsible for the subglacial meltwater channel erosion, and glacial polished and striated bedrock on the Fildes Peninsula. The recent local glaciations occurred about 2,000 years ago and during Little Ice Age (LIA). During these glaciations, glaciers were less extensive than the previous one and less erosive as a cold-based ice.

- 1-18 Vaattovaara, P., P. E. Huttunen, **Y. J. Yoon**, and 4 others. 2006. "The composition of nucleation and Aitken modes particles during coastal nucleation events: evidence for marine secondary organic contribution". *Atmospheric Chemistry and Physics*, 6(1): 4601-4616. doi: 10.5194/acp-6-4601-2006

Newly-formed nanometer-sized particles have been observed at coastal and marine environments world wide. Organic species

have so far not been detected in those newly-formed nucleation mode particles. In this study, we applied the ultrafine organic tandem differential mobility analyzer method to study the possible existence of an organic fraction in recently formed coastal nucleation mode particles ($d < 20$ nm) at the Mace Head research station. Furthermore, effects of those nucleation events on potential cloud condensation nuclei were studied. The coastal events were typical for the Mace Head region and they occurred at low tide conditions during efficient solar radiation and enhanced biological activity in spring 2002. Additionally, a pulse height analyzer ultrafine condensation particle counter technique was used to study the composition of newly-formed particles formed in low tide conditions during a lower biological activity in October 2002. The overall results of the ultrafine organic tandem differential mobility analyzer and the pulse height analyzer ultrafine condensation particle counter measurements indicate that those coastally/marinely formed nucleation mode particles include a remarkable fraction of secondary organic products, beside iodine oxides, which are likely to be responsible for the nucleation. During clean marine air mass conditions, the origin of those secondary organic oxidation compounds can be related to marine coast and open ocean biota and thus a major fraction of the organics may originate from biosynthetic production of alkenes such as isoprene and their oxidation driven by iodine radicals, hydroxyl radicals, acid catalysis, and ozone during efficient solar radiation. During modified marine conditions, also anthropogenic secondary organic compounds may contribute to the nucleation mode organic mass, in addition to biogenic secondary organic compounds. Thus, the ultrafine organic tandem differential mobility analyzer results suggest that the secondary organic compounds may, in addition to being significant contributors to the nucleation mode processes, accelerate the growth of

freshly nucleated particles and increase their survival probability to cloud condensation nuclei and even larger radiatively active particle sizes. The results give new insights to the marine/coastal particle formation, growth, and properties. The marine biota driven secondary organic contributions to marine/coastal particle formation and composition can be anticipated in other species specific biologically active oceans and fresh-waters areas around the world and thus, they may be significant also to the global radiative budget, atmosphere-biosphere feedbacks, and climate change.

- 1-19 Yoon, Ho Il, Yeadong Kim, Kyu-Cheul Yoo, Jae Il Lee, and Seung-Il Nam.** 2006. "Holocene Glaciomarine Sedimentation and Its Paleoclimatic Implication on the Svalbard Fjord in the Arctic Sea". *Ocean and Polar Research*, 28(1): 1-12.

Analyses of sedimentological and geochemical parameters from two radiocarbon-dated sediment cores (JM98-845-PC and JM98-818-PC) retrieved from the central part of Isfjorden, Svalbard, in the Arctic Sea, reveal detailed paleoclimatic and paleoceanographic histories over the last 15,000 radiocarbon years. The verconsolidated diamicton at the base of core JM98-845-PC is supposed to be a basal till deposited beneath grounding glacier that had advanced during the LGM (Last Glacial Maximum). Deglaciation of the fjord commenced after the glacial maximum, marked by the deposition of interlaminated sand and mud in the ice-proximal zone by subglacial meltwater discharge, and prevailed between 13,700 and 10,800 yr B.P. with enriched-terrigenous organic materials. A return to colder conditions occurred at around 10,800 yr B.P. with a drop in TOC content, which is probably coincident with the Younger Dryas event in the North Atlantic region. At this time, an abrupt decrease of

TOC content as well as an increase in C/N ratio suggests enhanced terrigenous input due to the glacial readvance. A climatic optimum is recognized between 8,395 and 2,442 yr B.P., coinciding with 'a mid-Holocene climatic optimum' in Northern Hemisphere sites (e.g., the Laurentide Ice sheet). During this time, as the sea ice receded from the fjord, enhanced primary productivity occurred in open marine conditions, resulting in the deposition of organic-enriched pebbly mud with evidence of TOC maxima and C/N ratio minima in sediments. Fast ice also disappeared from the coast, providing the maximum of IRD (ice-rafted debris) input. Around 2,442 yr B.P. (the onset of Neoglacial), pebbly mud, characterized by a decrease in TOC content, reflects the formation of more extensive sea ice and fast ice, which might cause decreased primary productivity in the surface water, as evidenced by a decrease in TOC content. Our results provide evidence of climatic change on the Svalbard fjords that helps to refine the existence and timing of late Pleistocene and Holocene millennial-scale climatic events in the Northern Hemisphere.

- 1-20 Yoon, Y. J., and 3 others.** 2006. "Statistical characteristics and predictability of particle formation events at Mace Head". *Journal of Geophysical Research*, 111: D13204(1-9). doi: 10.1029/2005JD006284

The seasonal characteristics of coastal nucleation events at the Mace Head Atmospheric Research Station, resulting from exposure of macroalgae to the atmosphere, were analyzed for a 2-year period from August 2002 to July 2004. Nucleation events occurred on 58% of the days over the period. The seasonal variation of the number of event days and event duration show a clear cycle, with maximum values in spring and autumn and the minimum values in the winter season. The nucleation events typically start ~75 min prior to the occurrence of the low-tide mark

and the event start time is correlated ($r = 0.75$) to the low-tide height. The intensity of the events, as determined by the peak particle concentrations achieved, is also positively correlated with the amount of tidal areas exposed to ambient air, as determined by the tidal height, and solar radiation. A nucleation potential index (NPI) was developed as a tool to provide a predictive capability for event prediction at Mace Head. The index was derived from normalized tidal height, solar radiation intensity, and wind direction and was compared with the occurrence of nucleation events from the database. The result shows that Mace Head particle formation events can be quite well predicted with a threshold probability of 50%.

PART 2

Earth-System Sciences

- 2-1 Goo, Kyoung Mo, **Jong Kuk Hong, Young Keun Jin, Minkyu Park, Sang Heon Nam,** and Jung Mo Lee. 2006. "AVO Analysis on Gas Hydrates in the Continental Margin off the South Shetland Islands, Antarctica". *Journal of the Korean Geophysical Society*, 9(4): 417-426.

Geophysical survey has been conducted on the continental margin off the South Shetland Islands aboard R/V Onnuri of KORDI in 1992/1993. About 800-line km of 96-channel reflection data have been acquired. On the seismic section, BSR with strong reflectivity and negative polarity has been found at 700 ms below the sea bottom. BSR is considered as the base of gas hydrates and AVO analysis was performed to study physical properties along BSR. True amplitude recovery and surface consistence amplitude were applied to seismic data and angle gathers were obtained. AVO gradient and AVO intercept are calculated on every CDP gather. Section of AVO intercept show strong reflectivity and

negative polarity on BSRs and stronger continuity of BSR than stacked section. Cross plot of P-G indicates that the lower below BSR is filled with free gas.

- 2-2 **Hong, Jong Kuk, Young Keun Jin, Minkyu Park, Joohan Lee, Sang Heon Nam,** and **Jong Ik Lee.** 2006. "Tectonic Structures of the South Scotia Ridge Adjacent to the Northern Part of the Powell basin, Antarctica". *Journal of the Korean Geophysical Society*, 9(4): 409-416.

Reflection seismic survey has been conducted using R/V Yuzmogeologia of Russia on the area of between northern part of Powell basin and South Scotia Ridge. 48-channel seismic data have been processed using Promax system. Hesperides and Eastern Deep located in the central part of the South Scotia Ridge show similar geological structure comprising two distinct sedimentary layers. The lower layer filled with fault breccia is considered to be formed with the expansion of the deeps. The upper layer is filled with pelagic sediments which implies this layer is formed after the spreading of the deeps has stopped. The south branch of the South Scotia Ridge is characterized by bigger width than the north branch. Topographical depression shown in the south branch is formed by many faults accompanied with the seafloor expansion of Powell basin.

- 2-3 **Jin, Young Keun, Sang Heon Nam, Joohan Lee, Jong Kuk Hong,** Duk Kee Lee, and **Jong Ik Lee.** 2006. "Seismic Structures of the Continental Margin around Smith Island, Antarctic Peninsula". *Journal of the Korean Geophysical Society*, 9(4): 443-453.

Using seismic profiles obtained in the Antarctic Peninsula continental margin around Smith Island located at the southwestern end of the South Shetland Islands, we investigated sediments

distribution, sedimentation, continental shelf formation, and tectonic evolution history. The study area is a very unique area that has two tectonic provinces with a tectonic boundary near Smith Island just the landward projection of the Hero Fracture Zone (HFZ). To the southwest of the Island, the margin became inactive margin after the collision of the ridge crest of the Antarctic-Phoenix ridge and trench, whereas to the northeast the margin is still apparently active margin with the spreading center and trench morphology in the sea. Generally the northeastern margin has the shelf sedimentary basins with thick sedimentary layers, well-developed forearc basin, broad continental slope and distinct trench morphology, and the southwestern margin is characterized by steep and narrow continental slope and localized shelf basins. The mid-shelf basement high structures are distinct in the southwestern margin, which are thought to be formed by thermal effect caused by the subducted spreading centers. The high is observed in the area just northeast of the Island, implying that the tectonic boundary along the landward projection of the HFZ is not sharply defined.

- 2-4 **Kim, Keehoon, Minkyu Park, Jong-Kuk Hong, and JooHan Lee.** 2006. "Shallow Crustal Structure of the Bransfield Basin Using an Autonomous Underwater Hydrophone". *Journal of the Korean Geophysical Society*, 9(4): 351-359.

We investigated subsurface structures of the Bransfield Basin, the Antarctic with AUH which was designed to record abyssal T-waves generated from submarine earthquakes. The data obtained from a multi-channel seismic survey and an AUH were used for this study. A seismic reflection method was applied to the multi-channel seismic survey data in order to identify bathymetry and sedimentary structures, and the signals recorded in the AUH were used to

obtain deep structures as we applied a seismic refraction method. Even though we couldn't investigate deeper and detailed structure in study area because of lack of Airgun's capacity, the AUH showed possibilities for being used for a marine seismic survey. From this experiment, we decided the upper and lower sediment layer velocities, detected irregular basement topography caused by submarine volcanic/magmatic activities, and retrieved the velocity of the basement and the depth of the sediment layer/basement boundary.

- 2-5 **Kim, Ki Young, Myung Ho Hong, Howoong Shon, and JooHan Lee.** 2006. "Enhancement of Vertical Resolution of GPR data through Singature Deconvolution". *Journal of the Korean Geophysical Society*, 9(1): 1-6.

To remove ringing and increase vertical resolution of GRP data, signature deconvolution was applied to GPR data obtained using a 100 MHz antenna in the Soyang Lake. The signature was extracted through stacking reflection signals from the lake bottom. Results of this deterministic deconvolution was compared with those from the conventional Wiener method. Due to increased vertical resolution, both deconvolution methods are able to resolve three or more layers in an apparent single layer on the input data. However, identification of reflection boundaries from ringing is not easy due to poor definition in the output data of the Wiener filter. On the contrary, the signature deconvolution greatly enhances both vertical resolution and definition of reflection boundaries, showing detailed internal stratigraphic features of the three sedimentary layers. Since extraction of signature at various depths is possible, this deconvolution method can be applied effectively to unstationary GPR data.

- 2-6 Kim, Ki Young, Myung Ho Hong, Howoong Shon, and **JooHan Lee**. 2006. "Experimental Ground Penetrating Radar survey on teh frozen Soyang Lake". *Journal of the Geological Society of Korea*, 42(2): 273-282.

To understand characteristics of Ground Penetrating Radar antenna for studying lacustrine sediments, experimental data were recorded on the frozen Soyang Lake using three antennas with center frequencies of 50, 100, and 250 MHz. For the three center frequencies, the vertical resolution of reflected signals is 0.17, 0.08, and 0.03 m at the lake bottom and 0.30, 0.15, and 0.06 m in the bottom sediments, respectively. The corresponding radii of the first Fresnel zone are computed to be 1.30, 0.91, and 0.58 m at the lake bottom. The attenuation factors and bulk conductivity for the water are obtained as 1.04, 1.17, and 1.19 dB/m and 0.049, 0.056, and 0.057 S/m, respectively. Such low conductivities indicate that the water is fresh and clean. The penetration depths into the bottom sediments are approximately 5.11 and 3.36 m for 50 and 100 MHz antennas, respectively.

- 2-7 Lee, Mi Jung, **Jong Ik Lee**, Daniel Garcia, Jaques Moutte, C. Terry Williams, Frances Wall, and **YeaDong Kim**. 2006. "Pyrochlore chemistry from the Sokli phoscorite-carbonatite complex, Finland: Implications for the genesis of phoscorite and carbonatite association". *Geochemical Journal*, 40(1): 1-13.

The phoscorite-carbonatite complex in the Sokli alkaline-carbonatite massif, northern Finland, comprises five stages of intrusions of phoscorites and carbonatites (P1-C1, P2-C2 and P3-C3 for phoscorites and calcite carbonatites; D4 and D5 for dolomite carbonatites). The phoscorites and calcite carbonatites at Sokli usually occur as pairs with the same mineral assemblages. Pyrochlore is found in the majority of rock

types in the Sokli phoscorite-carbonatite complex, shows wide compositional variation and seems to preserve evolution trends of host rocks. Crystallization of pyrochlore begins from the P2-C2 phoscorite and calcite carbonatite and continues up to the latest D5 dolomite carbonatite. Pyrochlore in the early stage P2-C2 rocks has high U and Ta contents. These elements suddenly decrease from the P3-C3 rocks, on the other hand, Th and Ce contents increase. The compositions of the late generations from the D4 and D5 rocks are close to that of an ideal end-member pyrochlore with formula $(Ca,Na)_2Nb_2O_6F$. The Nb/Ta ratio and F content of pyrochlore increase from P2-C2 to the latest D5 dolomite carbonatite. The composition and evolutionary history of pyrochlore from the phoscorites are distinguished from those of the associated calcite carbonatites.

Pyrochlore from the calcite carbonatites shows larger A-cation deficiencies compared to those from the paired phoscorites. Ta and Zr contents are slightly higher in pyrochlore from the calcite carbonatites, whereas Ti is generally higher in pyrochlore from the associated phoscorites. Moreover, pyrochlore from the phoscorites always shows a longer and more complex crystallization history compared to that of the same stage carbonatites. This indicates that the chemical condition was clearly different in the two systems during the crystallization of pyrochlore. Based on these results, together with the previous mineralogical and geochemical studies on the Sokli phoscorite-carbonatite complex, we propose a liquid immiscibility process as the most possible seg-regation mechanism of the two associated rocks. The composition of pyrochlore in the late dolomite carbonatites is distinct and always lies on the evolutionary trend of the earlier varieties. This implies that the dolomite carbonatites are the final magmatic products of the Sokli phoscorite-carbonatite system.

- 2-8 Lee, Mi Jung, **Jong Ik Lee, Soon Do Hur, Yeadong Kim**, Jacques Moutte, and Elena Balaganskaya. 2006. "Sr-Nd-Pb isotopic compositions of the Kovdor phoscorite-carbonatite complex, Kolar Peninsula, NW Russia". *Lithos*, 91(1-4): 250-261.
doi: 10.1016/j.lithos.2006.03.020

The Sr, Nd and Pb isotopic compositions for the Kovdor phoscorite-carbonatite complex (PCC), Kola Peninsula, NW Russia, have been determined to characterize the mantle sources involved and to evaluate the relative contributions of a plume and subcontinental lithospheric mantle in the formation of the complex. The Kovdor PCC is a part of the Kovdor ultramafic-alkaline-carbonatite massif, and consists of six intrusions. The initial isotopic ratios of the analyzed samples, calculated at 380 Ma, display limited variations: ϵ_{Nd} , +2.0 to +4.7; $^{87}Sr/^{86}Sr$, 0.70319 to 0.70361 (ϵ_{Sr} , -12.2 to -6.2); $^{206}Pb/^{204}Pb$, 18.38 to 18.74; $^{207}Pb/^{204}Pb$, 15.45 to 15.50; $^{208}Pb/^{204}Pb$, 37.98 to 39.28. The Nd and Sr isotope data of the Kovdor PCC generally fit the patterns of the other phoscorites and carbonatites from the Kola Alkaline Province (KAP), but some data are slightly shifted from the mixing line defined as the Kola Carbonatite Line, having more radiogenic $^{87}Sr/^{86}Sr$ ratios. However, the less radiogenic Nd isotopic compositions and negative $\Delta 7/4$ values of Pb isotopes of the analyzed samples exclude crustal contamination, but imply the involvement of a metasomatized lithospheric mantle source. Isotopic variations indicate mixing of at least three distinct mantle components: FOZO-like primitive plume component, EMI-like enriched component and DMM-like depleted component. The isotopic nature of the EMI- and DMM-like mantle component observed in the Kovdor samples is considered to be inherited from metasomatized subcontinental lithospheric mantle. This supports the previous models invoking plume-lithosphere interaction to

explain the origin of the Devonian alkaline carbonatite magmatism in the KAP.

PART 3

Ocean Environment Sciences

- 3-1 **Ahn, In-Young, Jungyoun Ji**, Heeseon J. Choi, **Sei-Hong Pyo, Hyun Park**, and Jin-Woo Choi. 2006. "Spatial Variations of Heavy Metal Accumulation in Manila clam *Ruditapes philippinarum* from Some Selected Intertidal Flats of Korea". *Ocean and Polar Research*, 28(3): 215-224.

Spatial variation of heavy metal accumulation was investigated in Manila clam *Ruditapes philippinarum* collected from several tidal flats. Sediment metal levels varied highly among the sites, which was attributed primarily to differences in Fe and organic carbon contents and in part to grain size. Significant differences in metal concentrations also were found in the clam tissue among the different sampling sites. However, except a few metals (Mn, Zn, Pb), which showed some elevation, the variations in the clam tissue were not related to the variations in the sediment. This is likely because most metals in filter-feeding herbivores such as *R. philippinarum* accumulated as a result of feeding on suspended particles such as phytoplankton and organic detritus in water column, not in bottom sediment. In addition, tissue weight for a specific shell size varied significantly among the sites, and increased tissue mass indicating a good nutritive condition likely caused a subsequent dilution of body metals leading to reduced weight-specific concentrations of some metals (Cd, Zn, Cu, Co).

- 3-2 Alverson, Andrew J., **Sung-Ho Kang**, and Edward C. Theriot. 2006. "CELL WALL MORPHOLOGY AND SYSTEMATIC IMPORTANCE OF *THALASSIOSIRA RITSCHERI* (HUSTEDT) HASLE, WITH A DESCRIPTION OF *SHIONODISCUS* GEN. NOV.". *Diatom Research*, 21(2): 251-262.

doi: 10.1080/0269249X.2006.9705667

The centric diatom order Thalassiosirales includes all diatoms with a fulcra (strutted process), a feature now recognized as a synapomorphy for the lineage. Within Thalassiosirales, *Thalassiosira* is perhaps the most taxonomically and morphologically diverse genus, and at least two distinct morphological groups have been recognized within it. Group "A" *Thalassiosira* species, which include the type species, *T. nordenskiöldii*, have short inward and long outward extensions of the strutted processes and a labiate process on the valve mantle. Group "B" species have exceptionally long inward and reduced outward extensions of the strutted processes, and a labiate process on the valve face. We collected and cultured *Thalassiosira ritscheri*, which has a combination of group A and B characters. It has a labiate process on the valve face and reduced outward extensions of the strutted processes. We show for the first time that *T. ritscheri* has short inward, A-type extensions of the strutted processes. A phylogenetic interpretation of these conditions suggests a close relationship between *T. ritscheri* and the traditionally held group "B" species. Species diagnosed by autapomorphic condition of a labiate process away from the valve mantle, including many group "B" *Thalassiosira* species, are transferred into *Shionodiscus* gen. nov.

- 3-3 Gye, Myung Chan and **Sung-Ho Kang**. 2006. "Reproductive Biology of the Seals in Polar Regions: Spermatogenesis". *Korean Journal of Environmental Biology*, 24(1): 1-6.

Global decline in wildlife mammals has been accelerated during past decades. Especially the conservation of the wild life mammals in polar areas, is urgent. In an effort to understand the reproduction of the seals dwelling in the polar area, spermatogenesis in the seals was reviewed. Seals breed seasonally and in most of the seal species, delayed implantation is frequently observed. To date, histological and endocrinological evaluation revealed highly cyclic nature in spermatogenesis and steroidogenesis in testis. Seasonal changes in blood testosterone level together with melatonin is closely related with changes in light cycle between summer and winter. In adult testis at breeding seasons, spermatogenesis is manifested by consecutive 18 stages of germ cell development. Three kinds of Leydig cells different in steroidogenic activity as well as cellular morphology appear during the testis development. During non-breeding season, spermatogenic arrest and Leydig cell hypoplasia are frequently found.

Interestingly, blood circulation through the anastomoses of pelvic veins cooled the testes and thus guarantees spermatogenesis within the body trunk. Endocrine disruptors and heavy metals have been found in the body tissues of several seals species and alter steroidogenesis in seals, suggesting environmental pollutants together with decrease in habitats are potentially threatening the reproductive success in seal species.

- 3-4 Ha, Tae-Youl, **Sung-Ho Kang**, and 4 others. 2006. "Antioxidant Activity and Contents of Bioactive Components in Polar Microalgae". *Ocean and Polar Research*, 28(1): 37-43.

In this study, bioactive components such as polyphenols, flavonoids and tocopherols were determined in cultured polar microalgae (*Fragilariopsis pseudonana*, *Chaetoceros neogracile*, *Stellarima microtrias*,

Porosira pseudodenticular). Antioxidant activity of methanol extracts of polar microalgae was also investigated. α -Tocopherol contents of *Fragilariopsis pseudonana* were almost two times higher than those of *Chaetoceros neogracile*. The antioxidant activity of methanol extracts of *Fragilariopsis pseudonana* determined by ABTS assay was higher than other algae. Total polyphenol contents of methanol extracts also showed a similar trend as antioxidant activity. The protective activity against oxidative damages induced by glutamate in PC 12 cells was shown in only *Chaetoceros neogracile*.

- 3-5 Hyo-Won Seo, Jung-Yoon Yi, Young-Eun Park, **Sung-Ho Kang, Ho-Sung Chung, and Ji-Hee Kim**. 2006. "Multiple Shoot Induction from Radicle-derived Callus and *in Vitro* propagation of *Silene Acaulis* Subsp. *Arctica*". *Korean Journal of Plant Biotechnology*, 33(4): 303-307.

We describe here an efficient *in vitro* propagation method of *Silene acaulis* subsp. *arctica* (Caryophyllaceae), one of the higher arctic angiosperms, through the multiple shoot regeneration after callus induction from the radicle. The seeds of *S. acaulis* subsp. *arctica* collected from Svalbard, the Norwegian Arctic, were germinated and calli were induced from the radicle on solid MS media supplemented with 0.25 mg/L 2,4-D and 1 mg/L GA₃ at both 10±1°C and 23±1°C. Two weeks after callus induction, the multiple shoots were efficiently regenerated on the MS media supplemented with 0.25 g/L BA and 0.05 mg/L HPh. The total biomass increment of regenerated shoots increased most efficiently of *S. acaulis* subsp. *arctica* was showed the maximum efficiency in at 23±1°C on 1/2 MS salt strength. The multiple regenerated plantlets of *S. acaulis* subsp. *arctica* were grown to normal plants on soil.

- 3-6 Iriarte, José L., Rodrigo R. González, Renato A. Quiñones, **Sung-Ho Kang, Jae H. Shim**, Cynthia P. Valenzuela. 2006. "Enzyme activities of phytoplankton in the South Shetland Islands (Antarctica) in relation to nutrients and primary production". *Revista Chilena de Historia Natural*, 79(1): 505-516.
doi: 10.4067/S0716-078X2006000400009

Given the potential significance of enzyme activities as a link between internal metabolic pathways and environmental nutrients, we investigated the relationships of nitrate reductase (NR) and alkaline phosphatase (AP) with primary production and inorganic nutrients in South Shetland Islands, Antarctica. Enzymatic activities of the phytoplankton (0.7-210 µm), primary productivity, autotrophic biomass and inorganic nutrients were studied in the upper 100 m depth at nine stations during a cruise in the northwestern area of South Shetland Islands (Antarctica), during late austral spring (December 2000). NR activities fluctuated between 0 and 42.8 nmol L⁻¹ h⁻¹ (mean = 10.08 nmol L⁻¹ h⁻¹, SD = 10.42 nmol L⁻¹ h⁻¹), AP activities between 0.81 and 5.67 nmol L⁻¹ h⁻¹ (mean = 2.68 nmol L⁻¹ h⁻¹, SD = 0.95 nmol L⁻¹ h⁻¹). Stations with primary productivity (PP) and chlorophyll a greater than 2 mg C m⁻³ h⁻¹ and 0.75 µg chlorophyll a L⁻¹, respectively, presented higher enzymatic activities of nitrate reductase, alkaline phosphatase than those stations characterized by primary productivity and chlorophyll a less than 2 mg C m⁻³ h⁻¹ and 0.17 µg chlorophyll a L⁻¹, respectively. The AP specific activity was negatively correlated with orthophosphate concentrations lower than 2.0 µM, which indicates that the microplankton were under phosphate deficient environment condition. Our results indicated that NR specific activity was positively associated with autotrophic biomass and primary productivity estimates, giving evidence of the use of nitrate by phytoplankton as external nitrogen source in

surface waters. In addition, high NR activities were positively correlated with NO_3^- , suggesting the occurrence of nitrate respiration in the well oxygenated surface waters of Antarctica.

- 3-7 Ji, Jungyoum, Heeseon J. Choi, and In-Young Ahn.** 2006. "Evaluation of Manila clam *Ruditapes philippinarum* as a sentinel species for metal pollution monitoring in estuarine tidal flats of Korea: effects of size, sex, and spawning on baseline accumulation". *Marine Pollution Bulletin*, 52(4): 447-468. doi: 10.1016/j.marpolbul.2005.12.012

- 3-8 Jung, Woongsic, Hyoung Min Joo, Sung Soo Hong, Jae-Shin Kang, Han-gu Choi, and Sung-Ho Kang.** 2006. "Morphology and Molecular Data for Antarctic Cryophilic Microalga, *Porosira pseudodenticulata*". *Algae*, 21(2): 169-174. doi: 10.4490/algae.2006.21.2.169

We have cultured more than 100 Arctic and Antarctic cryophilic microalgal strains in KOPRI culture collections of polar microorganisms (KCCPM). Among them, we tried to identify an Antarctic strain, KOPRI AnM0008 by morphological and molecular analysis. Nuclear SSU rDNA and plastid rbcL sequences were used to identify the strain. It was identified as *Porosira pseudodenticulata* based on SSU sequence data showing 99% identity with GenBank X85398. This result was supported by morphological features like solitary labiate process, external foramina and internal cribra by optical and scanning electron microscope. Morphological identification and molecular analysis on polar cryophilic microalgae will be accomplished to construct the databases for KCCPM.

- 3-9 Ki, Jang-Seu, Sung-Ho Kang, and 3 others.** 2006. "A Study on the Freshwater Algal Flora Occurring in Temporary Ponds around the Dasan Arctic Station, Ny-Alesund (Norway), and the Molecular Characteristics of *Chlamydomonas* 18S rDNA". *Ocean and Polar Research*, 28(2): 107-117.

Freshwater algal studies in North polar environments are relatively few. This study presented the algal-flora, -biomass and genetic features of dominant cells collected from temporary ponds around the Polar Research Station (PRS), Norway. Water samples were collected from 4 stations around PRS, and analyzed for their environmental and biological variables. Water temperature, salinity and conductivity ranged from 5 to 10 °C, 0.1 to 0.3‰ and 0.21 to 0.36 μS/cm, respectively. Chlorophyll a concentration ranged from 1.8 to 11.1 μg/l, and that of the size-fractionated cells was recorded from 0.7 to 1.1 μg/l in picoplankton 0.3 to 6.5 μg/l in nanoplankton, and 0.4 to 3.9 μg/l in microplankton respectively. Algal flora in the present study was recorded as 10 genera, in which *Chlamydomonas*, particularly, was dominant in all studied sites. By comparison of *Chlamydomonas* 18S rDNA sequences, including two isolates from PRS, they formed a distinct clade against others: sequence similarity was significantly low (<97.2%) with *C. noctigama*, being the highest score by BLAST search in GenBank. This study was valuable for basic knowledge regarding the freshwater algae around PRS and their genetic information.

- 3-10 Kim, Jeong-Hoon, and 3 others.** 2006. "Egg Retrieval as a Source of Nests with Supernormal and Mixed Egg Clutch in Little Terns *Sterna albifrons*". *Journal of Ecology and Field Biology*, 29(6): 545-550.

Ten supernormal clutches of little terns *Sterna albifrons* and seven clutches having

mixed eggs by little terns and kentish plovers *Charadrius alexandrinus* were recorded during the breeding seasons of 2003~2005 at Ganwol lake, Hongsung-gun, Chungcheongnam-do, Korea. The frequency of egg retrieval by Little Terns was higher after the second egg laying regardless of the clutch size and incubation stage. The frequency of egg retrieval was high at all incubation stage. When experimental eggs were placed within 15 cm from the nests, the percentage of egg retrieval was highest (almost 100%). However the percentage dropped rapidly over 35~55 cm range and finally to zero at 60 cm distance. Little terns retrieved all kinds of eggs set near their nests regardless of its kind or size. This study suggests that egg retrieval by little terns may be a source of the nest with supernormal and mixed egg clutch observed in this species.

- 3-11 Klochkova, Tatyana A., **Sung-Ho Kang**, and 4 others. 2006. "Biology of a terrestrial green alga, *Chlorococcum* sp.(Clorococcales, Chlorophyta), collected from the Mirusaji stupa in Korea". *Phycologia*, 45(3): 349-358. doi: 10.2216/04-58.1

A terrestrial chlorophyte, *Chlorococcum* sp., was isolated from the stone walls of Miruksaji stupa, which is a national treasure of Korea. The alga was one of the dominant organisms contributing to biodeterioration of the monument and it grew extensively on the walls of the inner room of the stupa, which had been sealed for more than 5 yr before we started this experiment. *Chlorococcum* survived in darkness during that time as dormant, warty, thick-walled spores. The resting spores revived in freshwater medium and released numerous unicellular progeny, which were isolated into a unialgal culture. The isolate was subjected to 18S rDNA phylogenetic analysis as well as ultrastructure and life cycle studies. In addition, the effect of salinity stress was

investigated using sterile enriched seawater as a medium. *Chlorococcum* sp. grew in seawater culture medium for more than 5 mo and reproduced by aplanospores.

- 3-12 Lee, Se-Jin, Ji-Hun Kim, Yoon-Seok Chang, and Myeong Hee Moon. 2006. "Characterization of polychlorinated dibenzo-*p*-dioxins and dibenzofurans in different particle size fractions of marine sediments". *Environmental Pollution*, 144(2): 554-561. doi: 10.1016/j.envpol.2006.01.040

The distribution of polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/Fs) 4 was examined according to particle size in marine sediments, with a particular focus on 5 fine particulates. Samples from different coasts of Korea were fractionated into five size 6 groups (<2, 2-5, 5-10, 10-20, and 20-63 μm diameter) by gravitational split-flow thin 7 fractionation. Despite the different size profiles and PCDD/F contents of the sediments 8 according to their surrounding environments, the concentrations of PCDD/Fs in 9 fractionated sediments tended to increase as the particle size decreased; the PCDD/F 10 levels in the finest particles were up to 16 times higher than in the coarsest particles, 11 which was associated with their organic carbon content. Log normalization showed high 12 levels of PCDD/Fs in the fine silt particles (2-10 μm), which can be consumed by aquatic 13 biota. Because of the different toxicity and bioavailability of PCDD/Fs in different 14 sediment particle sizes, it is important to study particle actions to understand their effects 15 on the aquatic ecosystem.

- 3-13 Lee, Yong Seok, Yong Hun Jo, In Sun Byun, Se Won Kang, Eun Mi Cho, Yeon Soo Han, Sang-Haeng Choi, Hong-Seog Park, Weon-Gyu Kho, **In-Young Ahn**, and Kye-Heon Jeong. 2006. "Bioaccumulation of Heavy Metals in

Ruditapes philippinarum". *Korean Journal of Malacology*, 22(2): 157-165.

The present study was conducted to confirm that a bivalve *Ruditapes philippinarum* can be used as a biomarker for the monitoring of the heavy metal pollution in the silt of the marine environment. The clams were collected from the silt of Cheonsu-bay, Buheung-ri, and Tan-island of the West Sea, Korea. To observe the normal structures of the target organs (hepatopancreas and gill), they were dissected out for the immunohistochemical study and the electron microscopy with TEM, SEM, and SEM-EDS. The immunohistochemical study showed that the interdiverticular connective tissues of the hepatopancreas, and the outer epithelium of the gill lamellae was strongly reacted to anti-metallothionein (MT), indicating the presence of MT, a metal-binding protein, involved in metal detoxifying process. According to the examinations under the TEM, the epithelial cells of the hepatopancreas of the clams collected from polluted area (Tan-island) showed certain changes such as swollen rER, swollen nuclear envelope and inclusion bodies in the nuclei. In the SEM-EDS analysis, tissue of the hepatopancreas showed relatively higher concentration of S, Zn, and Cd. These elements are supposed to be concerning with the MT-reaction in the hepatopancreas. Considering that the coastal bivalve *R. philippinarum* showed immediate subcellular responses to heavy metal pollution in the overall experiments conducted, this species might act as one of efficient biomarkers for the heavy metal contamination in the marine environment.

- 3-14 Lee, Yong-Seok, Yong-Hun Jo, Yeon-Soo Han, Weon-Gyu Kho, **In-Young Ahn**, and Kye-Heon Jeong. 2006. "Bioaccumulation of Heavy Metals in Intestine of *Nacella concinna*". *Korean Journal of Malacology*, 22(1): 83-91.

Immunohistochemical and ultrastructural experiments were conducted to find out heavy metal accumulation in the intestine of an Antarctic gastropod *Nacella concinna*. According to the immunohistochemical experiment in the apical cytoplasm of the intestinal epithelium showed positive reactions to anti-MT (metallothionein), indicating the presence of MT, a metal-binding protein involved in metal detoxifying process. In the transmission electron microscopic observations, the epithelial cells of the intestine exposed to Cd for over three hours showed irregular nuclear membranes, secretory granules, and probable metal granules. According to the SEM_EDS experiments on the intestine, concentration of Pb in the apical epithelium was in inverse proportion to that in the intestinal lumen. After exposing to Cd for over three days, S was rapidly reduced. Cd and Zn were rapidly increased after exposure to Cd. These elements are supposed to be concerned with the MT-reaction in the intestine. Taken together, these data suggest that *N. concinna* could be as a potential biomarker species.

- 3-15 Seo, Jung Soo, Kyun-Woo Lee, Jae-Sung Rhee, Dae-Sik Hwang, Young-Mi Lee, Heum Gi Park, **In-Young Ahn**, and Jae-Seong Lee. 2006. "Environmental stressors (salinity, heavy metals, H₂O₂) modulate expression of glutathione reductase (GR) gene from the intertidal copepod *Tigriopus japonicus*". *Aquatic Toxicology*, 80(3): 281-289. doi: 10.1016/j.aquatox.2006.09.005

Glutathione reductase (GR) plays an essential role in cell defense against reactive oxygen metabolites by sustaining the reduced status of an important antioxidant, glutathione. To address the effect of oxidative stresses on the intertidal copepod *Tigriopus japonicus*, we exposed specimens to hydrogen peroxide, heavy metals and different salinity levels, cloned and sequenced the oxidative

stress-related GR gene. *T. japonicus* GR gene (*Tigriopus* GR) cDNA contained 1526 bp including an open reading frame (ORF) encoding 458 amino acids with a theoretical pI of 6.58 and a calculated molecular weight of 49.6 kDa. *Tigriopus* GR showed a high similarity to frog *Xenopus laevis* GR (identity 57%) and the filarial parasite, *Onchocerca volvulus* GR (identity 57%). Specific motifs such as flavin adenine dinucleotide-binding site (LVLGGGSGGIASARRAAEF), pyridine nucleotide-disulphide oxidoreductases class-I active site (GGTCVNVGCVP), and NADPH binding motif (GxGYIAx18Rx5R) were highly conserved in the deduced amino acid sequence of *Tigriopus* GR. Interestingly, its expression and enzyme characteristics were different from GR homologue of filarial parasite *O. volvulus*. To investigate the biochemical and enzymatic characteristics of *Tigriopus* GR protein, we constructed the expression vector, pCRT7/TOPO NT containing *Tigriopus* GR. *Tigriopus* pCRT7/TOPO NT/GR was expressed in *Escherichia coli*, and the soluble protein was purified by 6x His-tag chromatography. The recombinant *Tigriopus* GR enzyme was found to make homodimer complexes of approximately 108 kDa on 12% native gel electrophoresis and showed enzymatic activity with NADPH and oxidized glutathione (GSSG) as substrates. To analyze the gene expression of *Tigriopus* GR against different environmental stresses (hydrogen peroxide, salinity, and heavy metals), we performed real-time reverse transcriptase-polymerase chain reaction (real-time RT-PCR). Slight down-regulation in the expression of *Tigriopus* GR at the initial stage was observed upon exposure to hydrogen peroxide. The expression recovered in 2h, while there were significant changes upon heavy metal (Cu and Mn) exposures in a time-dependent manner. Also, *Tigriopus* GR expression was significantly increased with moderately high salt stress (24 and 40 ppt). In the case of low salt stress (0 and 12 ppt) the expression was

found to be down-regulated. These findings provide a better understanding of cellular protection mechanisms in the intertidal copepod *T. japonicus* against the environmental stressors caused by non-optimal salt levels.

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- 3-16** Seo, Youngwan, **Sung-Ho Kang**, Hee-Jung Lee, You Ah Kim, Hyun Joo Youn, Burm-Jong Lee, and **Hosung Chung**. 2006. "In vitro Screening of Seaweed Extract on the Proliferation of Mouse Spleen and Thymus Cell". *Biotechnology and Bioprocess Engineering*, 11(2): 160-163.

A total number of 31 types of seaweed were assessed with regard to their effects on the proliferation of mouse spleen and thymus cells in a culture, using an MTT reduction assay. Acetone:dichloromethane (1:1) extracts of three seaweed plants: *Derbesia marina*, *Sargassum* sp., and *Hisikia fuziformis*, exhibited significantly positive effects on the survival of mouse spleen and thymus cells *in vitro*. The acetone:dichloromethane (1:1) extracts of *Sargassum* sp., in particular, much more potent effects on thymus cell activation than did any of the other types of seaweed. However, the methanol extracts of *Sargassum ringgoldianum* and *Chondrus crispus* exerted a stimulatory influence only on the proliferation of mouse spleen cells, whereas the methanol extracts of *Grateloupia lanceolata* exhibited significant cell proliferation properties in both spleen and thymus cells.

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- 3-17** Shim, JeongHee, **Young Chul Kang**, and 2 others. 2006. "Distribution of net community production and surface pCO₂ in the Scotia Sea, Antarctica, during austral spring 2001". *Marine Chemistry*, 101(1-2): 68-84. doi: 10.1016/j.marchem.2005.12.007

Surface and water column measurements of pCO₂, alkalinity, and nutrients were made in

the Scotia Sea in December 2001. From 54°S to 60°S along 52°W, $p\text{CO}_2$, TCO_2 , and nutrients in surface seawater increased southward. The $p\text{CO}_2$ concentration ranged from 370 μatm in the north to 420 μatm in the south and increased abruptly across the Polar and Scotia fronts by about 10–20 μatm . Net community production values from the preceding winter to the observation time were calculated at stations south of the Polar Front; values ranged from 1.0–1.2 mol m^{-2} and were comparable to other Southern Ocean measurements in summer, in or during an algal bloom. Processes affecting the surface $p\text{CO}_2$ distribution (e.g., thermodynamical change, air–sea exchange, biological production, and physical mixing) were evaluated from the preceding winter to the observation time at the stations. Seasonal warming increased surface $p\text{CO}_2$ at rates of 0.08 to 0.27 $\mu\text{atm d}^{-1}$; the highest values were observed at the station closest to the Polar Front. The air–sea exchange decreased surface $p\text{CO}_2$ at rates of -0.08 to -0.23 $\mu\text{atm day}^{-1}$, suggesting that the area around the study stations acted as a weak CO_2 source during the study period. The surface $p\text{CO}_2$ variation caused by biological production was -0.24 to -0.30 $\mu\text{atm day}^{-1}$ and was high south of the Scotia Front, where concentrations of chlorophyll a, biomass, and particulate Fe were relatively high. Physical mixing promoted an increase of 0.16 to 0.47 $\mu\text{atm day}^{-1}$ in surface $p\text{CO}_2$, a substantial contribution to total variation in $p\text{CO}_2$. This result contrasts with patterns in other Southern Ocean regions, where physical mixing was considered to be minimal or was ignored in previous studies. At station WS 8 in the Weddell-Scotia Confluence region, mixing was the dominant process of surface $p\text{CO}_2$ change during the study period, suggesting lateral and vertical transport of CO_2 -rich water masses from the Weddell Sea and the deep ocean.

PART 4

Life Sciences

- 4-1 Bae, Sung-Yun, **Joung Han Yim, Hong Kum Lee**, and Suhkneung Pyo. 2006. "Activation of murine peritoneal macrophages by sulfated exopolysaccharide from marine microalga *Gyrodinium impudicum* (strain KG03): Involvement of the NF- κ B and JNK pathway". *International Immunopharmacology*, 6(3): 473-484.
doi: 10.1016/j.intimp.2005.09.009

This study examined the ability of microalgal sulfated exopolysaccharide (MSE) from marine microalga *Gyrodinium impudicum* (strain KG03) to induce secretory and cellular responses in murine peritoneal macrophages. The cytotoxicity induced by preincubating tumor cells with MSE was demonstrated to be concentration-dependent. The MSE-induced tumoricidal activity was partially abrogated by a NO inhibitor, whereas the anti-TNF- α and anti-IFN- α/β antibodies as well as the scavengers of reactive oxygen intermediates had no effect. In addition, supernatants from murine peritoneal macrophages treated with MSE contained nitrite and their iNOS enzymatic activity was significantly increased. Therefore, the tumoricidal activity induced by MSE appeared to be mediated by the production of NO. Treating the macrophages with a JNK inhibitor (SP600125) partially blocked the tumoricidal activation and NO production induced by MSE, whereas inhibitors of the other kinases did not have an inhibitory effect. These results suggest that MSE induces NO production via the JNK dependent pathway. Furthermore, electrophoretic mobility shift assay analyses revealed that the MSE treatment induced the activation of the NF- κ B transcription factor. Overall, these results indicate that the tumoricidal activity induced by MSE is mainly due to NO production, and the activation of macrophage by MSE is

mediated probably via the NF- κ B and JNK pathway.

- 4-2 Bhattarai, Hari Datta, Viswanadh Sarma Ganti, Babita Paudel, **Yoo Kyung Lee, Hong Kum Lee**, and 2 others. 2006. "Isolation of antifouling compounds from the marine bacterium, *Shewanella oneidensis* SCH0402". *World Journal of Microbiology and Biotechnology*, 23(2): 243-249.

doi: 10.1007/s11274-006-9220-7

Two compounds, 2-hydroxymyristic acid (HMA) and cis-9-oleic acid (COA), were isolated from a chloroform extract of the marine bacterium, *Shewanella oneidensis* SCH0402. In a spectrophotometer based chemotaxis assay, HMA completely eliminated the optical density (OD) of *Alteromonas marina* SCH0401 and *Bacillus atrophaeus* SCH0408, motile, fouling bacteria, at 100 and 1000 $\mu\text{g ml}^{-1}$, respectively. COA similarly decreased the OD of *A. marina* and *B. atrophaeus* by 100% at 1000 $\mu\text{g ml}^{-1}$. The commercially available, highly toxic anti-fouling compound, tributyltin oxide (TBTO) never reduced the OD of the target bacteria by 100% even at higher concentration. Instead, all the test bacterial cells were killed at higher than 1000 $\mu\text{g ml}^{-1}$ of concentration. Both HMA and COA inhibited germination of *Ulva pertusa* spores completely at 10 and 100 $\mu\text{g ml}^{-1}$, respectively, while TBTO inhibited germination at 0.01 $\mu\text{g ml}^{-1}$. However, in field assays, both HMA and COA showed antifouling activities as potent as TBTO against a wide range of fouling organisms, including micro- and macro-algae, barnacles, and mussels. The average fouling coverage on the surface of the control panel was $93 \pm 6\%$ after 1.5 years but no fouling was observed on the surface of the test panel onto which each compound was applied separately. Thus, bacterial repellent compounds can be used as substitutes for potent toxic anti-fouling

compounds, resulting in higher standards of environmental safety without loss of antifouling performance.

- 4-3 Bhattarai, Hari Datta, **Yoo Kyung Lee, Kyeung Hee Cho, Hong Kum Lee**, and Hyun Woung Shin. 2006. "The study of antagonistic interactions among pelagic bacteria: a promising way to coin environmental friendly antifouling compounds". *Hydrobiologia*, 568: 417-423.

doi: 10.1007/s10750-006-0220-2

Ten strains of marine bacteria (SCH0401–SCH0410) were isolated from Ayajin, the east coast of South Korea. In spectrophotometer based chemotaxis assay the ethyl acetate extract (300 μg) of SCH0402 decreased the optical density (OD) of the motile target strains SCH0401, SCH0402, SCH0407 and SCH0408 by two to six times when compared to control. Tributyltin oxide (TBTO) decreased the OD of all target strains by only two times. The most active strain SCH0402 was identified as *Shewanella oneidensis* by using 16S rDNA gene sequence analysis. Similarly, the target motile strains SCH0401, SCH0402, SCH0407 and SCH0408 were identified as *Alteromonas marina*, *Shewanella oneidensis*, *Roseobacter gallaeciensis* and *Bacillus atrophaeus*, respectively. The growth inhibition zone produced by the test bacterial extracts against the target strains were three to eight times smaller when compared to that of TBTO. Even though, SCH0402 showed six times weaker antibacterial activity, the repellent activity was three times stronger than TBTO. Therefore, the higher negative chemotactic activity would be better to select eco-friendly antifouling compounds than the other antibacterial activities.

- 4-4 Haitao Ahang, **Yoo Kyung Lee**, Wei Zhang, and **Hong Kum Lee**. 2006. "Culturable actinobacteria from the marine sponge *Hymeniacidon perleve*: isolation and phylogenetic diversity by 16S rRNA gene-RFLP analysis". *Antonie van Leeuwenhoek*, 90(2): 159-169.
doi: 10.1007/s10482-006-9070-1

A total of 106 actinobacteria associated with the marine sponge *Hymeniacidon perleve* collected from the Yellow Sea, China were isolated using eight different media. The number of species and genera of actinobacteria recovered from the different media varied significantly, underlining the importance of optimizing the isolation conditions. The phylogenetic diversity of the actinobacteria isolates was assessed using 16S rRNA gene amplification-restriction fragment length polymorphism (RFLP) analysis of the 106 strains with different morphologies. The RFLP fingerprinting of selected strains by *HhaI*-digestion of the 16S rRNA genes resulted in 11 different patterns. The *HhaI*-RFLP analysis gave good resolution for the identification of the actinobacteria isolates at the genus level. A phylogenetic analysis using 16S rRNA gene sequences revealed that the isolates belonged to seven genera of culturable actinobacteria including *Actinoalloteichus*, *Micromonospora*, *Nocardia*, *Nocardioopsis*, *Pseudonocardia*, *Rhodococcus*, and *Streptomyces*. The dominant genus was *Streptomyces*, which represented 74% of the isolates. Three of the strains identified are candidates for new species.

- 4-5 **Hong, Soon Gyu**. 2006. "Effective Family Shuffling Method Using Complementary DNA Fragments Produced by S1 Nuclease". *Journal of Microbiology and Biotechnology*, 16(12): 2004-2007.

An efficient method for the in vitro reassembly of homologous DNA sequences is

presented. The proposed method involves obtaining single strands of homologous genes and hybridizing them to obtain partially hybridized heteroduplex DNA; cleaving the single-stranded regions of the heteroduplex DNA using S1 nuclease to generate double-strand DNA fragments; denaturing the double-strand DNA fragments to generate single-strand DNA fragments; conducting a series of polymerase chain reactions (PCR) using the single-strand DNA fragments as internal primers and a mixture of homologous DNA as templates to obtain elongated reassembled DNA; and finally, amplifying the reassembled DNA by a PCR using terminal primers. As a result, DNA reassembly could be achieved between homologous genes with a sequence similarity as low as 78%.

- 4-6 **Hong, Soon Gyu**, and 3 others. 2006.

"Diversity of Yeasts Associated with *Panax ginseng*". *Journal of Microbiology*, 44(6): 674-679.

Biodiversity of yeasts was investigated in the ginseng cultivation field. Among 34 isolates tested in this study, 26 isolates belonged to the hymenomycetous yeast group. These 26 strains were classified into 12 species including four new-species candidates that did not have clear affiliation to any established species. Seven isolates among the remaining strains were classified into three ascomycetous yeast species, and one isolate was identified as a urediniomycetous yeast species.

- 4-7 **Hong, Soon Gyu**, and 4 others. 2006.

"Polyphasic classification of *Alternaria* isolated from hazelnut and walnut fruit in Europe". *Mycological Research*, 110(11): 1290-1300.

doi: 10.1016/j.mycres.2006.08.005

Brown apical necrosis of English walnut and

grey necrosis of hazelnut are destructive fruit diseases caused by a complex of opportunistic fungi including several small-spored catenulate *Alternaria* taxa. Thirty *Alternaria* isolates recovered from walnut and hazelnut fruit that were pathogenic on their respective host were compared along with type or representative isolates of *A. alternata*, *A. tenuissima*, *A. arborescens*, and *A. infectoria* using morphological and molecular criteria. Morphological examination using standardized procedures separated the walnut and hazelnut isolates into three morphological groups: the *A. alternata* group, the *A. tenuissima* group, and the *A. arborescens* group based upon common characteristics of the conidium and the sporulation apparatus. To evaluate genetic relationships among these groups, AFLP markers, inter simple sequence repeat (ISSR) markers, and histone gene sequence data were compared. Based upon AFLP data, the *A. alternata* and *A. tenuissima* groups comprised a single lineage, and the *A. arborescens* group comprised a separate lineage. ISSR data supported the grouping by AFLP data except for three isolates of the *A. alternata* group that clustered with the *A. arborescens* group. Base substitution of the H4 gene supported the discrimination of the *A. arborescens* group from the *A. alternata* and *A. tenuissima* groups. Tests of hypotheses based upon groupings derived from the various data sets supported the discrimination of the *A. arborescens* group but did not support the discrimination of the *A. alternata* group from the *A. tenuissima* group.

- 4-8 Janech, Michael G., Andreas Krell, Thomas Mock, **Jae-Shin Kang**, and James A. Raymond. 2006. "ICE-BINDING PROTEINS FROM SEA ICE DIATOMS (BACILLARIOPHYCEAE)". *Journal of Phycology*, 42(2): 410-416. doi: 10.1111/j.1529-8817.2006.00208.x

Sea ice diatoms thrive under conditions of low

temperature and high salinity, and as a result are responsible for a significant fraction of polar photosynthesis. Their success may be owing in part to secretion of macromolecules that have previously been shown to interfere with the growth of ice and to have the ability to act as cryoprotectants. Here we show that one of these molecules, produced by the sea ice diatom *Navicula glaciei* Vanheurk, is a ~25 kDa ice-binding protein (IBP). A cDNA obtained from another sea ice diatom, *Fragilariopsis cylindrus* Grunow, was found to encode a protein that closely matched the partially sequenced *N. glaciei* IBP, and enabled the amplification and sequencing of an *N. glaciei* IBP cDNA. Similar proteins are not present in the genome of the mesophilic diatom *Thalassiosira pseudonana*. Both proteins closely resemble antifreeze proteins from psychrophilic snow molds, and as a group represent a new class of IBPs that is distinct from other IBPs found in fish, insects and plants, and bacteria. The diatom IBPs also have striking similarities to three prokaryotic hypothetical proteins. Relatives of both snow molds and two of the prokaryotes have been found in sea ice, raising the possibility of a fungal or bacterial origin of diatom IBPs.

- 4-9 Jeong, Haeyoung, Sung Ho Yoon, **Hong Kum Lee**, and 2 others. 2006. "Lessons from the sea: Genome Sequene of an Algicidal Marine Bacterium *Hahella chejuensis*". *Korean Journal of Microbiology and Biotechnology*, 34(1): 1-6.

Harmful algal blooms (HABs or red tides), caused by uncontrolled proliferation of marine phytoplankton, impose a severe environmental problem and occasionally threaten even public health. We sequenced the genome of an EPS-producing marine bacterium *Hahella chejuensis* that produces a red pigment with the lytic activity against red tide dinoflagellates at parts per billion level. *H. chejuensis* is the first sequenced species among algicidal bacteria as well as in the

order *Oceanospirillales*. Sequence analysis indicated a distant relationship to the *Pseudomonas* group. Its 7.2-megabase genome encodes basic metabolic functions and a large number of proteins involved in regulation or transport. One of the prominent features of the *H. chejuensis* genome is a multitude of genes of functional equivalence or of possible foreign origin. A significant proportion (~23%) of the genome appears to be of foreign origin, i.e. genomic islands, which encode genes for biosynthesis of exopolysaccharides, toxins, polyketides or non-ribosomal peptides, iron utilization, motility, type III protein secretion and pigment production. Molecular structure of the algicidal pigment was determined to be prodigiosin by LC-ESI-MS/MS and NMR analyses. The genomics-based research on *H. chejuensis* opens a new possibility for controlling algal blooms by exploiting biotic interactions in the natural environment and provides a model in marine bioprospecting through genome research.

- 4-10 Kim, Il-Chan**, and 7 others. 2006. "Expression profiles of 4-nonylphenol-exposed medaka (*Oryzias latipes*) analyzed with a 3.4 K microarray". *Marine Environmental Research*, 62: S141-S146.
doi: 10.1016/j.marenvres.2006.04.051

Changes in gene expression in liver of medaka in response to 4-nonylphenol (4-NP) were investigated with a microarray consisting of 3.4 K medaka-specific cDNA probes. Upon exposure to 4-NP at two different concentrations (20 and 100 µg/L) for 24 h, we found 44 different genes that were up- or downregulated with statistically significant changes. Digestive enzyme genes were downregulated but vitellogenin, choriogenin and novel biomarker genes were upregulated. Additionally an analysis of the changes of gene expression with respect to time was conducted at 100 µg/L of 4-NP with samples

at 0, 24, 48 and 96 h. The expression of 75 genes was altered and these were categorized into four different clusters. The validity of the results was checked by semi-quantitative PCR with 12 representative genes and this confirmed the microarray data. Therefore, we suggest that this medaka 3.4 K chip would be useful in generating gene expression profiles for studies of ecotoxicogenomics in medaka.

- 4-11 Kim, Ji Hee, In-Young Ahn, Soon Gyu Hong**, and 5 others. 2006. "Lichen Flora around the Korean Antarctic Scientific Station, King George Island, Antarctic". *Journal of Microbiology*, 44(5): 480-491.

As part of the long-term monitoring projects on Antarctic terrestrial vegetation in relation to global climate change, a lichen floristical survey was conducted around the Korean Antarctic Station (King Sejong Station), which is located on Barton Peninsula, King George Island, in January and February of 2006. Two hundred and twenty-five lichen specimens were collected and sixty-two lichen species in 38 genera were identified by morphological characteristics, chemical constituents, TLC analysis and ITS nucleotide sequence analysis.

- 4-12 Kwon, Kae Kyoung, Soon Jae Lee, Jae Hyun Park, Tae-Young Ahn, and Hong Kum Lee**. 2006. "*Psychroserpens mesophilus* sp. nov., a mesophilic marine bacterium belonging to the family *Falvobacteriaceae* isolated from a young biofilm". *International Journal of Systematic and Evolutionary Microbiology*, 56(5): 1055-1058.
doi: 10.1099/ijs.0.64171-0

A number of marine bacteria isolated from young biofilms were characterized as belonging to the family *Flavobacteriaceae*. The taxonomic characterization of strain KOPRI 13649^T, which was isolated from an

acrylic surface at the seashore at Gangeung, Korea, is reported here. The nearly complete 16S rRNA gene sequence of strain KOPRI 13649 was determined and was found to have a high level of similarity with that of *Psychroserpens burtonensi* (95.0-95.6%). In addition, phylogenetic analysis and comparison with closely related strains confirmed that the strain represented a novel member of the genus *Psychroserpens*. The major respiratory quinone of strain KOPRI 13649 was MK-6 and the DNA G+C content was 29.8 mol%. The dominant fatty acid methyl esters were i-15 : 0, a-15 : 0, i-16 : 0, i-15 : 1 ω 10, 16 : 1 ω 7 and 15 : 0. Growth was observed at 10-34°C (optimum 30°C), at pH 6-9 (optimum 6.5-8.0) and with 0.5-4% NaCl (optimum 1%). On the basis of the polyphasic taxonomic evidence presented, strain KOPRI 13649^T (=KCCM 42261^T =JCM 13413^T) should be classified as the type strain of a novel species in the genus *Psychroserpens*, for which the name *Psychroserpens mesophilus* sp. nov. is proposed.

revealed that the isolate formed a phyletic lineage with members of the genus *Muricauda*. Cells were aerobic, motile, Gram-negative rods and they produced non-diffusible carotenoid pigments. Optimal growth was observed at pH 7.5-8.0 and 26-32°C degrees C and required the presence of 3% (w/v) sea salt. The strain required Ca²⁺ and K⁺ ions in addition to NaCl for growth. The dominant fatty acids were i-15 : 0, i-15 : 1 ω 10, 15 : 0 and 16 : 1 ω 9. The major respiratory quinone was MK-6. The DNA G+C content was 35.8 mol%. On the basis of this polyphasic taxonomic evidence, strain KOPRI 13342^T should be classified as a representative of a novel species in a new genus in the family *Flavobacteriaceae*; the name *Costertonia aggregata* gen. nov., sp. nov. is proposed. The type strain of *Costertonia aggregata* is KOPRI 13342^T (=KCCM 42265^T = JCM 13411^T).

- 4-13 Kwon, Kae Kyoung, **Yoo Kyung Lee**, and **Hong Kum Lee**. 2006. "*Costertonia aggregata* gen. nov., sp. nov., a mesophilic marine bacterium of the family *Flavobacteriaceae*, isolated from a mature biofilm". *International Journal of Systematic and Evolutionary Microbiology*, 56(6): 1349-1353.
doi: 10.1099/ijs.0.64168-0

A marine bacterium, strain KOPRI 13342, was isolated from a mature marine biofilm, including various marine algae, covering a rock-bed of the East Sea, Korea (also known as the Sea of Japan). Colonies of the isolate were orange-coloured on marine agar 2216. The isolate showed relatively high 16S rRNA gene sequence similarities to members of the genera *Maribacter* (91.2-92.4% similarity), *Zobellia* (90.7-91.5%) and *Muricauda* (90.7-91.4%). Phylogenetic analysis based on the nearly complete 16S rRNA gene sequence

- 4-14 **Lee, Yoo Kyung**, and 3 others. 2006. "Variation in Fucoic Acid Contents and Monosaccharide Compositions of Korean *Undaria pinnatifida* (Harvey) Suringar (Phaeophyta)". *Algae*, 21(1): 157-160.
doi: 10.4490/algae.2006.21.1.157

Three different forms of *Undaria pinnatifida*, the southern form (*U. pinnatifida* f. *typica*), the northern form (*U. pinnatifida* f. *distans*), and Samcheok form (recently cultivated strain), were examined for the contents and compositions of fucoidans. Fucoidans were extracted from the dried edible portions of three forms of *U. pinnatifida* in low pH condition, mainly by ethanol precipitation and CaCl₂ treatment. It was shown that Samcheok form contains 1.8 and 3.5 times more fucoidans than the northern and the southern forms, respectively. The monosaccharide compositions of individual fucoidans were also varied. The fucoidans from the southern and the northern forms were shown to be composed of mainly fucose

and galactose with the molar percentage ratios of 83.5%:16.5% and 87.4%:12.6%, respectively, indicating that these are F-type fucoidans. The fucoidan from Samcheok form, however, consisted of fucose (62.7%), galactose (32.9%), and small amount of glucose (4.4%). The results of this study showed that both amount and monosaccharide compositions of fucoidans are variable depending on *U. pinnatifida* forms.

- 4-15 **Lee, Yoo Kyung, Hyun Jung Jung, and Hong Kum Lee.** 2006. "Marine Bacteria Associated with Korean Brown Alga, *Undaria pinnatifida*". *Journal of Microbiology*, 44(6): 694-698.

Several marine bacterial strains were isolated from *Undaria pinnatifida* (Miyok in Korean). Sixty-six strains were isolated on R2A agar media at 10°C and identified by phylogenetic analysis of 16S rRNA gene sequences. From the initial sequence analysis of 5' domain of the gene (approximately 500 bp), they were grouped into 10 different sequence types. Full sequences of 16S rRNA gene were obtained from one strain in each sequence type and species-affiliation was determined by phylogenetic and sequence similarity analyses. As a result, they were found to be closely related to *Psychrobacter aquimaris*, *P. celer*, *P. nivimaris*, *P. pulmonis*, *Psychromonas arctica* or *Bacillus psychrodurans*. These bacteria are marine or psychrotrophic bacteria. Because sporophytes of *U. pinnatifida* are cultured on the costal area during winter time, the *U. pinnatifida* associated bacteria seemed to grow at low temperature. *U. pinnatifida* sporophytes can be a good source to isolate psychrotrophic bacteria.

- 4-16 **Lee, Young-Mi, Jung Soo Seo, Il-Chan Kim, and 2 others.** 2006. "Endocrine disrupting chemicals (bisphenol A, 4-nonylphenol,

4-tert-octylphenol) modulate expression of two distinct cytochrome P450 aromatase genes differently in gender types of the hermaphroditic fish *Rivulus marmoratus*". *Biochemical and Biophysical Research Communications*, 345(2): 894-903. doi: 10.1016/j.bbrc.2006.04.137

To understand the effect of endocrine-disrupting chemicals (EDCs) on cytochrome P450 aromatase (*rm-cyp19*) gene expression between gender types in the hermaphroditic fish *Rivulus marmoratus*, we cloned two distinct *rm-cyp19* genes using RT-PCR with degenerative primers, obtained full-length cDNAs using 5'- and 3'-RACE-PCR methods, and completely sequenced them. The brain aromatase (*rm-cyp19b*) cDNA consisted of 2,124 bp including the open reading frame (ORF), which encoded a putative protein of 505 amino acids. The ovarian aromatase (*rm-cyp19a*) cDNA consisted of 2,075 bp, including the ORF encoding a putative protein of 516 amino acids. Expression patterns of *rm-cyp19b* and *rm-cyp19a* mRNAs were investigated in embryos of different developmental stages and in seven different tissues of adult fish. The *rm-cyp19b* gene in hermaphrodite and secondary male *R. marmoratus* was predominantly expressed in the brain, while the *rm-cyp19a* gene was expressed gender-specifically in the gonad. The expression of *rm-cyp19b* mRNA increased from stage 1 (2 d post fertilization) to stage 4 (12 d post fertilization) in a developmental stage-dependent manner but steeply decreased in the hatching stage. Compared to the *rm-cyp19b* gene, the abundance of ovarian aromatase *rm-cyp19a* transcripts was very low, and its expression was first detected at stage 3 and then decreased gradually to the hatching stage. Alteration of *rm-cyp19b* and *rm-cyp19a* gene expression was further analyzed in the brain and gonad by real-time RT-PCR 96 h after EDC exposure in hermaphrodites and secondary males. The brain aromatase *rm-cyp19b* gene was up-regulated in the brain

after 4-nonylphenol (4-NP)-exposure, while the ovarian aromatase *rm-cyp19a* gene was significantly down-regulated in the gonad. In 300 µg/L 4-tert octylphenol (4-tert-OP), or 600 µg/L bisphenol A-exposed brain and gonad, both *rm-cyp19b* and *rm-cyp19a* genes were up-regulated. In the case of secondary males, the *rm-cyp19b* gene was highly expressed in the 4-NP-exposed brain, while expression of the *rm-cyp19a* gene was not detected in the gonad. These results indicate that the expression of *rm-cyp19a* and *rm-cyp19b* genes is differently modulated according to estrogenic compounds and gender type of *R. marmoratus*.

- 4-17** Lee, Young-Mi, Jung Soo Seo, Sang-Oun Jung, **Il-Chan Kim**, and Jae-Seong Lee. 2006. "Molecular cloning and characterization of θ -class glutathione *S*-transferase (GST-T) from the hermaphroditic fish *Rivulus marmoratus* and biochemical comparisons with α -class glutathione *S*-transferase (GST-A)". *Biochemical and Biophysical Research Communications*, 346(3): 1053-1061.
doi: 10.1016/j.bbrc.2006.06.014

We cloned and sequenced full-length cDNA of a θ -class-like glutathione *S*-transferase (GST-T) from liver tissue of the self-fertilizing fish *Rivulus marmoratus*. The full-length cDNA of rm-GST-T was 907 bp in length containing an open reading frame of 666 bp that encoded a 221-amino acid putative protein. Its derived amino acid sequence was clustered with other vertebrate θ -class GSTs in a phylogenetic tree. The deduced amino acid sequence of θ -like rm-GST (rm-GST-T) was compared with both classes (α and θ) of GST and α -class rm-GST (rm-GST-A). Tissue-specific expression of two rm-GST mRNAs was investigated using real-time RT-PCR. To further characterize the catalytic properties of this enzyme along with rm-GST-A, we constructed the recombinant θ -like rm-GST plasmid with a 6xHis-Tag at the N-terminal of rm-GST-T cDNA. Recombinant

rm-GST-T was highly expressed in transformed *Escherichia coli*, and its soluble fraction was purified by His-Tag affinity column chromatography. The kinetic properties and effects of pH and temperature on rm-GST-T were further studied, along with enzyme activity and inhibition effects, and compared with recombinant rm-GST-A. These results suggest that recombinant rm-GSTs such as rm-GST-A and rm-GST-T play a conserved functional role in *R. marmoratus*.

- 4-18** Park, Hyun, and 2 others. 2006. "Effect of Pressure on a Heavy-Atom Isotope Effect of Yeast Alcohol Dehydrogenase". *Journal of the American Chemical Society*, 128(6): 1868-1872.
doi: 10.1021/ja056525e

Hydrostatic pressure causes a monophasic decrease in the ^{13}C primary isotope effect expressed on the oxidation of benzyl alcohol by yeast alcohol dehydrogenase. The primary isotope effect was measured by the competitive method, using whole-molecule mass spectrometry. The effect is, therefore, an expression of isotopic discrimination on the kinetic parameter V/K , which measures substrate capture. Moderate pressure increases capture by activating hydride transfer, the transition state of which must therefore have a smaller volume than the free alcohol plus the capturing form of enzyme [Cho, Y.-K.; Northrop, D. B. *Biochemistry* 1999, 38, 7470-7475]. The decrease in the ^{13}C isotope effect with increasing pressure means that the transition state for hydride transfer from the heavy atom must have an even smaller volume, measured here to be $13 \text{ mL}\cdot\text{mol}^{-1}$. The pressure data factor the kinetic isotope effect into a semiclassical reactant-state component, with a null value of $k_{12}/k_{13} = 1$, and a transition-state component of $Q_{12}/Q_{13} = 1.028$ (borrowing Bell's nomenclature for hydrogen tunneling corrections). A similar experiment involving a deuterium isotope effect previously returned

the same volume and null value, plus a pressure-sensitive isotope effect [Northrop, D. B.; Cho, Y.-K. *Biochemistry* 2000, 39, 2406-2412]. Consistent with precedence in the chemical literature, the latter suggested a possibility of hydrogen tunneling; however, it is unlikely that carbon can engage in significant tunneling at ambient temperature. The fact that the decrease in activation volumes for hydride transfer is equivalent when one mass unit is added to the carbon end of a scissile C-H bond and when one mass unit is added to the hydrogen end is significant and suggests a common origin.

- 4-19 Park, Hyun, In-Young Ahn, Heeseon J. Choi, Sei Hong Pyo, and Hye Eun Lee.** 2006. "Cloning, expression and characterization of metallothionein from the Antarctic clam *Laternula elliptica*". *Protein Expression and Purification*, 52(1): 82-88. doi: 10.1016/j.pep.2006.08.008

The genes for two apparent subtypes of metallothionein (MT) isoform were isolated from the Antarctic clam *Laternula elliptica*. Determination of the nucleotide sequence showed that the gene consists of 222 bp that code a 73-amino acid protein. The comparison between MT cDNA sequences of *L. elliptica* and other bivalves showed strong homologies on positions of cysteine residues, which are important for their metal binding abilities. The gene for the MT was inserted into a pET vector and overexpressed as a carboxyl terminal extension of glutathionein-S-transferase (GST) in *Escherichia coli*. After the GST fusion proteins had been purified by glutathione-Sepharose aYnity chromatography column and digested with enterokinase, the MT was purified with gel filtration and analyzed for its biochemical properties. Recombinant MTs were reconstituted with Cd, Cu, and Zn, and kinetic studies of the reactions with electrophilic disulphide, DTNB, were investigated to explore their metal binding ability. It is revealed that the

Cd-MT and Zn-MT react with DTNB biphasically, and that Zn-MT reacts with DTNB more rapidly, and with a significantly greater pseudo-first-order rate constant. Cu-MT reacts monophasically and releases metal slowly from MT.

- 4-20 Seo, Jung Soo, Young-Mi Lee, Sang-Oun Jung, Il-Chan Kim, and 2 others.** 2006. "Nonylphenol modulates expression of androgen receptor and estrogen receptor genes differently in gender types of the hermaphroditic fish *Rivulus marmoratus*". *Biochemical and Biophysical Research Communications*, 346: 213-223. doi: 10.1016/j.bbrc.2006.05.123

To uncover the effect of estrogenic chemicals [4-nonylphenol (NP) and bisphenol A (BisA)] on the expression of androgen receptor (AR) and estrogen receptors (ER α and ER β) in the hermaphroditic fish *Rivulus marmoratus*, we cloned the full length of the cDNAs encoding AR, ER α , and ER β from gonadal tissue of *R. marmoratus* and analyzed the modulation of expression of these genes following exposure to estrogenic chemicals using real-time RT-PCR. *R. marmoratus* AR, ER α , and ER β genes showed a high similarity to the relevant fish species on amino acid residues, respectively. Rm-ER α and Rm-ER β cDNAs included a serine-rich region when compared to other teleost fish ER genes. Tissue-specific expression of Rm-AR and Rm-ER β mRNAs in adult hermaphrodite *R. marmoratus* was high in the gonad, while Rm-ER α mRNA was high in the liver based on real-time RT-PCR. In addition, Rm-AR and Rm-ER α mRNAs increased along with developmental stage from stage 3 (5 dpf) to hatching, while Rm-ER β mRNA increased from stage 2 (2 dpf). To uncover the effect of estrogenic chemicals on *R. marmoratus*, we exposed the fish to NP (300 $\mu\text{g}/\ell$) and BisA (600 $\mu\text{g}/\ell$) for 96 h. Significant down-regulation of Rm-AR, Rm-ER α , and Rm-ER β mRNA was observed in gonadal tissue

ABSTRACTS

after exposure to NP but not BisA. In the liver, there were gender differences in gene expression after EDC exposure. These results demonstrate that expression patterns of the Rm-AR, Rm-ER α , and Rm-ER β genes in the hermaphroditic fish, *R. marmoratus*, vary according to tissue and developmental stage as well as the specificity of environmental estrogenic chemicals. These genes can be useful as molecular biomarkers in assessing the potential impact of estrogenic compounds using this species as a model system.



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