Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

APE33-01 Room:103 Time:May 23 15:30-15:51

High resolution records in the Japanese coastal and slope regions for the last 3000 years

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Very recently, PAGES programme 2K network, to collect the best time series and spatial reconstructions of important state variables of the climate system, is ongoing. Behind the scenes is the awareness of an importance of the reconstructed maps and timeseries during the last 2 kyrs to be analyzed in combination with the best ensemble runs of existing Earth system models. In many parts of the globe high-resolution (spatially and temporally) paleorecords for comparison with model simulations are very sparse. This is particularly true for adequate paleoceanographic records because of the uncertainty of age and the limitation of resolution. Severe lack of paleoceanographic records for the last 2K could no longer be ignored to understand regional climate dynamics and the predictions. Here we present the work of high-resolution paleoceanographic reconstructions for the last 3K and discuss possibility of reconstruction of PDO-like climate patterns using TEX86 and alkenon thermometry and fossil scales of Japanese sardine in sediments of Beppu Bay, southwest Japan.

Keywords: ASIA 2K, Coastal and shelf/slope paleoceanography, TEX86, alkenon thermometry, Japanese sardine scale, PDO

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APE33-02 Room:103 Time:May 23 16:15-16:30

Temporal distribution in diatom assemblages from coastal area in Western Japan: The usability of diatom assemblages as a

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Diatom assemblage in sediment core is a useful proxy for dynamics of aquatic environment. However, more information about taxonomy, habitat, and taphonomy are required for coastal diatoms. Therefore,we investigated the relationship between temporal change of diatom assemblage and anthropogenic impacts (e.g., polution, environmental protection) recorded in sediment cores from Western Japan, and discuss the usavility of diatoms as a proxy of human-induced environmental changes. In Osaka Bay, diatom assemblages in three drilling core samples are classified into two indicator species-groups, i.e., assemblage 1 showing positive correlation, and assemblage 2 showing negative correlation between their valve abundance and human induced eutrophication, respectively. In our presentation, we will disscuss if these indicator species-groups are useful as proxies for human-induced eutrophication in broader area of Japan including Harima-Nada, Suo-Nada, and Lake Nakaumi, as well as Osaka Bay.

Keywords: diatom assemblage, coastal area, proxy, anthropogenic impact, eutrophication, Western Japan

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APE33-03 Room:103 Time:May 23 16:30-16:45

The feature of aquatic environment and surface sediment in the Lake Ogawara, Aomori Prefecture, north Japan.

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To analyze paleoenvironment and paleoclimate, we must understand the feature of sediments as recorder and recent environment. In particular, the coastal lagoon is necessary to investigate before performing the paleoenvironmental study because of shows each characteristic lake environment. In this study, we performed a field study in the Lake Ogawara from August 31to September 9, 2011, to clarify a characteristic of aquatic environments and surface sediments.

The Lake Ogawara, is located in east part of Aomori Prefecture, have a halocline around 20m for water depth throughout the year. The thermocline is formed around 10m for water depth in the summer season. Therefore, dissolved oxygen is not supplied in the intermediate water, and anoxic water mass thickens. In this study, we investigated in this timing. The investigation is made up of 110 detailed sampling localities in grid and 100 water quality measurement sites in a traverse line through the lake system.

In Lake Ogawara, the water temperature shows 24-25 degrees Celsius in surface water, and shows low with 9 degrees Celsius in bottom water. The thermocline was observed at 8-18m for water depth. The salinity in surface water is less than 2 psu, and is less than 1 psu around the delta of Hichinohe River. Salinity show high value with 12psu in bottom water, and halocline was observed at 8-18m for water depth. The water column of Lake Ogawara divided into 3 water masses, as an epilimnion (0-8m), a metalimnion (8-18m), and a hypolimnion (deeper than 18m).

The environments in metalimnion and hypolimnion show the anoxic to euxinic condition. The upper part of the metalimnion shows pycnocline dependent on water temperature and salinity, and the lower part shows pycnocline dependent on mainly salinity. The chlorophyll-a concentration is high in metalimnion and hypolimnion.

Surface sediments are observed well-sorted sand shallower than 6m, and black mud deeper than it depth. As a result of grain size analysis, the frequency distribution of muddy sediment have a mode at 3.5, 5.5, and 7.5 phi. It is considered that fraction of 3.5 phi was supplied from the seaside by density current flow because of the mode of 3.5 phi decreases southward. However, coarse fraction might be supplied by a tsunami because it was recognized over the lake basin.

As a result of CNS element anaysis of surface sediments, the total organic carbon (TOC) contens increase toward deep, and show very high value (around 8%) in metalimnion and hypolimnion. This value is high in comparison with the other coastal lagoon as a Nakaumi Lagoon, Lake Shinji, Lake Abashiri, and Lake Mokoto. This high values were caused by high productivity, low velosity of decomposition by the anoxic to euxinic condition, and low sedimentation rate. TOC contents show high value near the delta of river. This is suggested that terrestrial higher plant add to organic matter of in lake production because of high C/N ratio.

Total sulfur (TS) content shows 1-2% of values deeper than metalimnion. In spite of euxinic condition, TOC/TS ratio is high in comparison with the normal marine. This suggests the exhaustion of metal ions such as iron or undersupply of sulfate ion.

Keywords: Coastal Lagoon, Lake Ogawara, TOC content, C/N ratio, TS content, anoxic condition

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APE33-04 Room:103 Time:May 24 09:00-09:15

Glacial climate and thermohaline circulation: an ocean biogeochemical modeling toward direct comparison with proxy data

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The deep ocean circulation in the present climate is characterized by the existence of the Atlantic meridional overturning circulation (AMOC) accompanied with deep water formations in the Labrador and Greenland Seas. This circulation consists of sinking part in the northern North Atlantic Ocean and upwelling part in the Southern and Pacific Oceans. Although the flow in the deep ocean is very slow, it carries huge amount of water in the deep ocean and the heat transport associated with this circulation has a great influence on the climate. In addition, because the ocean stores large amount of carbon (60 times larger than that of the atmosphere), the deep ocean circulation significantly affects the carbon cycle in the climate system. From both physical and biogeochemical aspects, the deep ocean circulation is one of key factors controlling the climate system.

During glacial climate, abrupt climate changes known as Dansgaard-Oeshger events are considered to be caused by changes in the AMOC. The thermohaline circulation is also believed to have an important role in the changes in atmospheric CO2 concentration from glacial to interglacial periods. Simulation of the Last Glacial maximum has been a target of the Paleoclimate Model Intercomparision Project (PMIP), and various coupled climate models have challenged the LGM simulation by following the protocol proposed by PMIP. Therein, substantial differences in the glacial AMOC among models have been observed, with half of models simulating a weakening of the AMOC while the other half simulate a strengthening. Because paleo proxy data such as d13C and 231Pa/230Th ratio suggest that the AMOC became shallower and reduced by up to 30 % during the LGM compared with the present climate, it is widely believed that the AMOC during the LGM is weaker than that at the present climate. However, a couple of studies using another paleo proxy data, Nd isotope ratio, imply that the AMOC during the LGM may be almost the same or even slightly stronger than the present one. This means that there is also discrepancy among paleo proxy data themselves or their interpretation.

In order to validate climate model simulations directly with paleo proxy data, explicit simulation of these proxy data with ocean biogeochemical model is getting important recently. Such simulations are also very helpful for interpretation of proxy data because they can quantitatively evaluate which processes are important for controlling the distribution of paleo proxy. In this talk, recent attempts for simulation of paleo proxy with biogeochemical model are introduced.

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APE33-05 Room:103 Time:May 24 09:15-09:30

Reconstruction of the sedimentary environment using sea sediments in the northwest Australia

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The reconstruction of sea-level changes is the key not only to understand the Earth climate changes but also to predict the mantle viscosity. The Bonaparte Gulf in the northwestern Australia is located in a broad and well-developed shallow continental shelf. During times of sea-level lowstand, much of the shelf was exposed (Yokoyama et al., 2000; 2001). The Bonaparte Gulf has the Bonaparte Depression, which is the deepest part of the Gulf and has Ven Diemen Rise, Londonderry Rise and Sahul Rise. Sahul Rise is the shallowest Rise in them. The region is tectonically stable and far from the former ice-covered regions. The glacio-isostatic adjustment of the coast is therefore relatively small. So this region is suitable for the reconstruction of the sea level and evaluating the solid earth property using differential heights of the rsl at given times in the past using the restoration of the relative sea levels.

Yokoyama et al. (2000; 2001), which got sea-level information from the Bonaparte Gulf using radiocarbon dating and sediment core facies, reached the conclusion as

1) the LGM (Last Glacial Maximum) sea levels were locally at 125+-4 m;

2) the LGM terminated abruptly at 19 000 cal yr BP with a rapid rise in sea levels of about 15 m over the next 500 years

3) the onset of the minimum sea levels occurred before 22 000 cal yr BP.

In the cruise of KH11-1, a total of 1 piston core, 22 gravity cores and 6 multiple cores are collected. The number of cores is enough to reconstruct the tilting in this region. This study analyzed three cores, PC1, GC6 and GC9. We used the proxies of TOC, CN ratio and radiocarbon dating to reconstruct sea-level change and the tilting.

In this study, paleoenvironmental information is obtained using the habitat of shell samples found in the cores. We used AMS radiocarbon dating to determine the age of samples in MALT. Calendar ages were obtained using 14C curve marine09 (Reminer et al., 2009). We constructed age-model in PC1, GC6 and GC9.

The dried sediments of PC1, GC6 and GC9 were used for total organic carbon (TOC) and total nitrogen (TN) analyses. We obtained these data using EA-IRMS in Kochi Core Center.

Using dry bulk density (DBD: g/cm3) of the sediments and the liner sedimentation rate (LSR: cm/yr), we calculated the mass accumulation rate (MAR: g/cm2 yr) .

We constructed age-model for each core using the well-preserved shell samples. In PC1, GC6 and GC9, we plotted calendar age vs. TOC and CN ratio. PC1 does not have the hiatus and the water depth of PC1 (St. 1) site is 140 m below the present, so the lowest sea level was above -140m.

From 28 cal kyr BP, in PC1, TOC, CN ratio is gradually increased. This indicated that the catchment was spread in the Bonaparte Gulf by the cause of Sahul Rise exposed. MAR is reduced at the same timing, because the rise of the velocity of the current in the Gulf due to the post glacial transgression that the channel to the open (Timor Sea) became narrower as Sahul Rise being exposed. The depth of the water at Sahul Rise is about 60 m, so sea level at 28 cal kyr BP was about 60 m below.

In this study, we proved that at about 28 cal kyr BP Sahul Rise was exposed and the sea level is about -60 m.

We will reconstruct sea-level change and tilting at the broader area in the Bonaparte Gulf and predict the mantle viscosity from the estimation of the crustal tilting in future work.

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APE33-06 Room:103 Time:May 24 09:30-09:45

Origin of magnetic mineral concentration variation in the Southern Ocean

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In the Southern Ocean, magnetic mineral concentration increases in glacial periods. The variation pattern closely resembles eolian dust flux records from Antarctic ice cores, but the cause of the linkage remains unclear, as the dust flux is too small for the source of terrigenous materials in the Southern Ocean. We have conducted an environmental magnetic study of late Pleistocene sediments from the south Indian Ocean to investigate the origin of the magnetic concentration changes. Biogenic magnetites can be detected using the characteristics of almost no magnetostatic interactions and narrow coercivity distribution, reflecting occurrence of single-domain magnetites in a chain. We interpret that a non-interacting component on first-order reversal curve diagrams and low-coercivity components with small dispersion from isothermal remanent magnetization (IRM) component analyses represent biogenic magnetites, and that the interacting and middle-coercivity components represent terrigenous maghemites. The ratio of anhysteretic remanent magnetization susceptibility to saturation IRM reflects relative abundance of the biogenic and terrigenous components. It was revealed that biogenic magnetites are a dominant constituent of the magnetic minerals. In glacials, the abundance of both biogenic and terrigenous components increased with increased proportions of the latter. Increased ocean productivity in glacials is suggested from increased proportions of biogenic magnetites with elongated morphologies, indicative of less-oxic conditions, and increased sedimentation rates. These observations suggest that the increased magnetic concentration in glacials in the Southern Ocean may be explained by iron fertilization; the production of biogenic magnetites was enhanced associated with increased ocean productivity, which was fueled by increased eolian dust flux.

Keywords: rock magnetism, environmental magnetism, magnetic susceptibility, biogenic magnetite, southern ocean, paleoceanography

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APE33-07 Room:103 Time:May 24 09:45-10:00

230Th-normalized fluxes of biogenic components from the central-southernmost Chilean margin over the past 22,000 years.

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During the last glacial maximum, the atmospheric partial pressure of CO2 ($_pCO_{2atm}$) was quite low, 180-190 ppm and rapidly increased to 280 ppm during the last deglacation (Monnin et al., 2001). The combination of the biogeochemical (e.g. export flux, nutrient utilization) and physical processes (e.g. upwelling, stratification) has been considered to control $_pCO_{2atm}$. Considering the response of $_pCO_{2atm}$ on global climate changes, the polar ocean such as Southern Ocean is one of the most important area linking between atmosphere and ocean, because the deepest water mass can directly connects to the atmosphere and the largest carbon reservoir in the world oceans. During glacial periods, strengthened productivity and an efficient biological pump in the North Pacific, equatorial Pacific, and Southern Oceans may have contributed to low $_pCO_{2atm}$. However, there is still some controversy as to whether marine productivity was high everywhere during glacial periods. Resolving this controversy requires more data from many regions regarding temporal changes in past export fluxes of biogenic materials, especially in the eastern South Pacific Ocean including the Chilean marginal region, where active biological production is observed at present.

The aim of this study was to identify changes in the ^{230}Th-normalized export flux of biogenic components commonly used as proxies for paleoproductivity-namely total organic carbon (TOC), total nitrogen (TN) and biogenic opal (Si_{opal})-from two sediment cores collected at 36 ^{o} S off central-south Chilean covering the past 22 kilo years (kyr) (PC-1) and at 52 ^{o} S near the mouth of Strait of Magellan, Pacific side over the past 13 kyr (PC-3). In 13-8 Calendar kyr before present (cal kyr BP), the ^{230}Th-normalized TOC flux at the PC-1 site were relatively high pointing to increased productivity, and a marked decrease characterized the time around 13 cal kyr BP and 8-5 cal kyr BP. At the PC-3 site, the ^{230}Th-normalized TOC flux was low during the last deglaciation until 6 cal kyr BP. Our ^{230}Th-normalized fluxes suggested that biological pump would not have fully worked throughout 22-14 kyr BP and the early Holocene in the central-south Chilean and 13-6 kyr BP at southern most Patagonia. The entire trend of ^{230}Th-normalized biological components looks a latitudinal symmetrical change at PC-1 and PC-3 during the deglaciation-6 cal kyr BP. This trend in biological pump changes at both sites corresponded to changes on wind direction associated with latitudinal shift of Southern Westerly Winds (SWW) core, which might be affected by insolation, supporting the notion of orbital influence. The indirect connection between biological productivity and insolation might be explained by as a following hypothesis: during 22-15 cal kyr BP (or 13-10 cal kyr BP) at PC-1 site, when austral summer insolation became strong (or weak), it would make zonal wind inhibit (or strengthen) and would enhance the northerly (or southerly) wind associated with equatorward (or poleward) shift of SWW in the central-south Chile, and then the upwelling would have been suppressed (or active) resulting low (or high) productivity there. After 5 cal kyr BP, the ^{230}Th-normalized TOC fluxes at both sites were relatively high and an apparent zonal symmetry disappeared suggesting that the breakdown of zonal symmetry might reflect the onset of permanent El Nino-Southern Oscillation variability.

Monnin, E. et al. (2001) Science, 291, doi: 10.1126/science.291.5501.112.

Keywords: off Chile, Thorium 230, biogenic components, biological pump, Southern Westerly Wind

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APE33-08 Room:103 Time:May 24 10:00-10:15

Paloenvironment changes in the surface sediments of the Indian sector of the Southern Ocean

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Paloenvironment changes in the surface sediments of the Indian sector of the Southern Ocean (65 S)

Keywords: Antarctic Ocean, Indian sector, surface sediment, stable isotope, organic carbon, 14C

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APE33-09 Room:103 Time:May 24 10:15-10:30

Plio-Pleistocene reconstruction of East Antarctic Ice Sheet fluctuations

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Several major climatic transitions have occurred throughout the Plio-Pleistocene. The Pliocene climate optimum was a warm period, and is thought as very similar condition to the end of 21 century according to IPCC AR4. This warmth was ended by the late Pliocene transition that lead the climate to a colder and more glaciations in the Northern Hemisphere. The mid-Pleistocene transition marks the time when the periodicity of glacial-interglacial cycles varied from 41,000 years cycles to large-amplitude 100,000 years cycles. Since the above described climatic events are recorded in the benthic foraminifera oxygen isotopes, as is the measure of global ice volume primarily, strong link between cryosphere and global climate has been suggested. However little is known for the relationships in particular for the Antarctic ice sheet. The aim of this study is to reconstruct East Antarctic ice sheet (EAIS) fluctuation during the Plio-Pleistocne using exposure ages in various parts of East Antarctica, and to discuss the relationship between ice sheet fluctuations and global climate changes.

The concentration of *in situ* produced cosmogenic radionuclides (e.g. ^{10}Be, ^{14}C, ^{26}Al, ^{36}Cl) in quartz reflects the cumulative exposure time of the rock and provides the timing of final retreat of ice in the area. In the meantime, combinations of the nuclides can deduce further information in terms of nature of exposure histories, namely simple or complex exposure history for the sites. Isotopic ratios of two cosmogenic nuclides (e.g. ^{26}Al/^{10}Be ratio) can be used for these purposes and since this ratio indicates the erosional ability of ice sheet, we can reconstruct basal conditions of ice sheet in the past. For the case of warm-based ice sheets, the ice sheet basal temperature is above the pressure melting point and hence the bedrock surface is subjected to continuous erosion and resulted cosmogenic nuclides measurement exhibits a simple exposure history. In contrast, cold-based ice sheet cannot erode bedrock sufficiently enough to reset the exposure age ”clock” therefore inheritance of nuclides can be seen because of previous exposure ”memory”. The inheritance of nuclides as described above results in deviation of nuclide content from that predicted by both half-life and present day production rates. Compilations of the cosmogenic exposure ages from five ice-free areas of East Antarctica was conducted and re-calculated using new site specific production rates taken into account of realistic atmospheric pressure model in Antarctica since it deviates from standard atmospheric thickness significantly. I also added newly obtained ^{10}Be and ^{26}Al data for samples collected from Sor-Rondane Mountains, Droning Maud Land. The results indicate that the EAIS was thicker more than 600 m compare to the present, at least once prior to the 3 Ma. The EAIS had then become at least 400 m thinner from 3 to 1 Ma. Growth and decay of EAIS has repeatedly occurred with glacial-interglacial cycles during the Pleistocene epoch.

We successfully draw the picture of past fluctuations of EAIS throughout the Plio-Pleistocene. The EAIS was initially larger and more dynamic until 3 Ma and then it has become smaller as global climate cooled. Our direct evidence in terms of timing of ice sheet fluctuations together with previously published paleoclimate records suggest that inception of colder climate since 3 Ma inhibits active moisture transport to Antarctica that reduce the size of ice sheet. The relatively stable EAIS has become sensitive to changes in sea level namely EAIS has been dictated by variations in Northern Hemisphere Ice Sheets that is induced by Northern hemisphere high latitude insolation. Therefore global ice volume started to have 100,000 years cyclicities with larger amplitude between glacial and interglacial time since then due to relatively significant contributions from Antarctic ice sheet cased by sea-level changes.

Keywords: East Antarctica, ice sheet fluctuations, cosmogenic radionuclide dating, Pliocene climate optimum, Late Pliocene transition, Mid-Pleistocene transition

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APE33-10 Room:103 Time:May 24 10:45-11:00

Summer monsoon intensity as a recording mechanism of the astronomical rhythm in bedded chert

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The astronomical cyclicity recorded as sedimentary rhythms provide a clue to understanding the dynamics of Earth surface system. Bedded chert consists of rhythmical alternations of chert and shale beds whose rhythms are paced by astronomical cycles (Ikeda et al., 2010). However, the recording mechanisms of the sedimentary rhythms of bedded chert were still debated. To reveal their recording mechanisms, I attempted to extract paleoceanographic and paleoclimatologic information recorded in sedimentary rhythms of bedded chert on timescales of astronomical cycles based on the biogenic silica and terrigenous burial rates estimated for the bedded chert. To accomplish this objective, I conducted the major elements chemical analysis of individual chert and shale beds on the continuous sequence with bed-by-bed resolution. The biogenic silica and terrigenous contents were estimated, assuming the terrigenous material in the bedded chert as constant at the composition of the shale sample with the lowest SiO2 content among the samples analyzed, which is consistent with composition of the modern terrigenous material accumulated in the pelagic ocean. I calculated weights of biogenic silica and terrigenous material accumulated as a chert-shale couplet per unit area, which are well correlated with the chert bed thickness (r = 0.96) and shale bed thickness (r = 0.90), respectively. Based on these clear correlations, I regarded the chert bed thickness and shale bed thickness as approximate measures of biogenic silica and terrigenous burial rates, respectively, during one precession cycle, and reconstructed the variation in the biogenic silica and terrigenous burial rates during the Early Triassic to Early Jurassic for the bedded chert sequence in the Inuyama area. Together with paleogeographic distribution of bedded chert compiled from previous studies, the biogenic silica burial rate in the low latitude Panthalassa ocean in the form of bedded chert was a half to several times higher than the biogenic silica burial rate in the modern ocean (DeMaster, 2002). This result suggests that bedded chert was the major sink of dissolved silica in the ocean at least during the Early Triassic to Early Jurassic. Therefore, the variations in the biogenic silica burial rate in the bedded chert should be proportional to the variations in the dissolved silica input to the ocean, mainly through river input, in time-scales longer than the residence time of the dissolved silica in the ocean, 15 kyr (e.g. Treguer et al., 1995; Gaillardet et al., 1999). According to the geochemical modeling studies, the orbitally controlled summer monsoon intensity could have been a possible major controlling factor of the global silicate weathering intensity (Kutzubach, 1981). Therefore, variations in the orbitally-controlled summer monsoon intensity in Pangea should have had close association with variations in the biogenic silica burial rate in the form of bedded chert during the Early Triassic to Early Jurassic.

Keywords: chert, weathering, silica, Milankovitch, monsoon, eccentricity

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APE33-11 Room:103 Time:May 24 11:00-11:15

Trace element behaviors during the end Permian mass extinction at the deep sea floor.

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We describes the variations of trace-elemental compositions that took place in the paleo-super-ocean Panthalassa during the end-Permian mass extinction, based on the sedimentary rock samples from one of the most continuous Permian-Triassic boundary section of pelagic deep-sea, exposed in the northeastern Japan area. Our measurement shows high concentrations of redox-sensitive elements such as Molybdenum (Mo), Vanadium (V), and Chromium (Cr) are present in the Upper Permian to end-Permian strata in the study section.

Vanadium concentration shows two peaks in the section. First one is in the Changhsingian chert beds without any co-increase of another trace elements. Second one is recognized in the uppermost part of siliceous claystone and the basal black claystone bed which accords the end-Permian mass extinction. Mo shows high concentrations at the upper part of Changsingian siliceous claystone bed and overlying the base of the black claystone. These Mo concentrations are followed by high Chromium concentrations. The final peaks of Mo coincide with that of V. Above the horizon characterized by high concentrations of V, Mo, and Cr, any significant increase dose not detected from the Changhsingian to Induan black claystone. Rapid uptakes of V, Mo, Cr into the sediment require reduction in their valences. The single peak of V from Upper Permian chert beds suggest moderately reduced bottom water condition, because first step of reduction of V require relatively weak reduced condition. While second-step reduction of V and Mo reduction require strong reduced condition. Additionally, reduction of Cr requires moderately reduced condition which is corresponded between first-step and second step reduction of V. Hence, the co-occurrence of high concentrations in Mo and V at the basal black claystone which accords the end-Permian mass extinction suggest maximum reduced condition at least the sediment-water interface at that time. Therefore, this line of variations in trace element concentrations indicates a progressive reduced deep-water condition in the central Panthalassa, and the onset of the end-Permian black claystone is characterized by euxinic maxima at the Panthalassic sea floor. Such expanded euxinic deep waters might represent an important causal factor in the end-Permian mass extinction in central Panthalassa.

Keywords: mass extinction, trace element, euxinia, pelagic deep-sea, Panthalassa

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APE33-12 Room:103 Time:May 24 11:15-11:30

Compositional changes of organic matter and carbon isotope stratigraphy through the mid-Cretaceous lacustrine deposits

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Cretaceous oceanic anoxic events (OAEs) are well known perturbation events of carbon circulation over the earth surface. Oceanic environments during the events are well documented from marine sequences based on paleontological and geochemical characterization. On the other hand, lack of tools for precise inter-regional correlation between marine and non-marine sequences prevents us from discussion of dynamic environmental changes involving causal relationship between terrestrial and oceanic phenomena.

This study focuses on mid-Cretaceous Aptian-Albian terrestrial sequences from southeastern Mongolia that have been located deep inside of the Eurasian continent since Cretaceous and presumably record the climatic responses on the continent to OAE1a and OAE1b. The Shinekhudag Fm., and formations below (Tsagantsav Fm.) and above (Khuhuteg Fm.) exposed in the Shine Khudag location, Shaazangiin Gobi area are studied to cover majority of the sequence to construct a composite section. The Shinekhudag Fm., the main part of the studied section, is composed of alternating beds of dark greyish paper shale, greyish calcareous shale, light greyish dolomitic marl, and whitish to yellowish dolomite. Total range examined here is 490 m in thickness including sampling gap derived from bad outcrop conditions.

Carbon isotope value (d13C) of total organic matter trough the composite section exhibits general trend of gradual drop between 200 m and 330m (lower half of the Shinekhudag Fm.). However, some adjacent samples shows considerable difference as large as 6 permil suggesting that the d13C fluctuation does not only reflect secular variation of 13C/12C of ocean-atmospheric carbon reservoir but also changes in mixing rate of organic matter derived from different primary producers. It is also suggested from scattered stratigraphic distribution of C/N ratio ranging 3 to 38. Rock-Eval pyrolysis on selected 15 samples including that with C/N ratio over 20 shows high hydrogen index values over 400 mgHC/gTOC for all samples. This fact indicates contribution of terrestrial plant fragments in the sediments is not significant in the Shinekhudag Fm.

Cross-plot diagram of d13C and C/N ratio exhibits clear negative correlation for all sample sets from the Tsagantsav and Shinekhudag formations. It indicates that both parameters are controlled by a same factor in these formations. It is mixing rate of two types of organic matter produced by contrasting organisms. One of them is represented by normal lacustrine algae that has C/N ratio around 6 and the other is by unknown producer that has hydrogen index as high as algae, C/N ratio around 30 and d13C values 3 permil more negative relative to algae. The regression lines of the sample sets show parallel distribution and 4 permil of gradual negative sliding within the Shinekhudag Fm. Carbon isotopic shifts of two end components with same magnitude reflecting change in 13C/12C ratio of atmospheric CO2 is the most plausible explanation for this gradual sliding of the regression line. Applying this d13C fluctuation to chronostratigraphy, it is correlated to the long-term negative shift through the early Aptian after OAE1a.

Although carbon isotope stratigraphy is a powerful tool for international chronostratigraphic correlation (Ogg et al., 2008), its application to terrestrial sequences has been limited because of the difficulty of source evaluation of organic matter. Evaluation using C/N-d13C regression line in a cross-plot diagram can give clue to application of d13C chronostratigraphy to lacustrine sedimentary rocks.

Keywords: Cretaceous, lacustrine, carbon isotope, organic carbon, oceanic anoxic event

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APE33-13 Room:103 Time:May 24 11:30-11:45

Orbital-scale lake-level and productivity changes in the mid-Cretaceous lacustrine deposits in southeast Mongolia

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The mid-Cretaceous period is characterized by an extremely warm greenhouse climate with elevated atmospheric CO2 levels, and repeated occurrences of Ocean Anoxic Events (OAEs). However, detailed processes and causal mechanisms of these marked events, particularly the response of the terrestrial climate system, are only poorly understood. To evaluate interactions between the land and the ocean during an OAE interval, we examined the terrestrial climatic record from Aptian lacustrine deposits (Shinekhudag Formation) in southeast Mongolia.

The Shinekhudag Formation is widely distributed in southeastern Mongolia, and is well exposed in the Shine Khudag locality. The formation is composed of alternating beds of dark greyish paper shale, greyish calcareous shale, light greyish dolomitic marl, and whitish to yellowish dolomite. Strata are continuously exposed up to 250 m in thickness. The shale and dolomite successions are rhythmically alternated (decimeter-, meter-, tens of meter-scale), probably controlled by orbital-cycles. Shales and dolomitic marls show micrometer-scale lamination (alternation of organic- and detritus-rich layers), most likely reflecting seasonal cyclicity. The sedimentation rate is estimated as ca. 4-8 cm/kyr based on varve-counting of thin-sections.

In order to clarify the depositional environments and the controlling factors for the rhythmically alternating lithofacies change in the Shinekhudag lacustrine deposits, we conducted X-ray diffraction analysis to reconstruct changes in the sediment mineralogy, and we also performed elemental analysis (C, N, S), Rock-Eval pyrolysis, and a quantitative study of palynofacies to evaluate the organic matter composition in the shale and dolomite couplets. Both, the sediment mineralogy and organic matter composition of lacustrine deposits are controlled largely by hydrological factors that are highly dependent upon climatic fluctuations. The results revealed that the cyclic alternations (ca. 1-1.5 m cycles) of the dolomite abundant layer and detritus minerals and calcite rich layer, corresponding to the rhythmically alternating dolomite and shale layers of field observation. C/N values were significantly low (4-10) in the dolomite layers, while higher values (15-30) occur in the shale samples. Rock-Eval pyrolysis revealed that all the samples are composed of Type I-II organic matter. Palynofacies analysis further indicated dominance of Botryococcus colonies in the dolomite layers, whereas the shale layers show abundant amorphous organic matters, algal cysts, and terrestrial palynomorphs.

These lines of evidences indicate that the rhythmically alternating lithofacies changes recorded in the Shinekhudag lacustrine deposits were mainly controlled by orbital-scale lake-level changes as well as by lake productivity changes. Namely, the dolomite layers were formed during low lake level by microbially mediated precipitation in highly alkaline lake waters. Botryococcus colonies were abundant under such oligotrophic and euryhaline conditions. On the other hand, the shale layers were deposited during high lake levels, which were characterized by higher algal productivity and increased inputs of detrital minerals. Spectral analysis of the lithofacies change in the Shinekhudag Formation shows the cycles involving approximately 1.28 m, 2.27 m, 5.88 m, and 22.4-25.6 m cycles, corresponding to periodicities of approximately 21 kyr, 38 kyr, 98 kyr, and 373-427 kyr, respectively, based on a varve-tuned average sedimentation rate of 6 cm/kyr. These values are in accordance with orbital precession, obliquity, and eccentricity cycles, respectively. Therefore, the Aptian lacustrine deposits in southeast Mongolia are interpreted to record the orbital-scale paleo-hydrologic changes during the OAE1a-1b interval.

Keywords: lake-level change, Cretaceous, orbital-cycle, paleo-hydrology, land-ocean linkage, Ocean Anoxic Events

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APE33-14 Room:103 Time:May 24 11:45-12:00

Climate modeling for the mid-Pliocene warm period and model-model intercomparison

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The mid-Pliocene warm period (mPWP; 3.3~3.0 Ma) is the most recent interval when global climate was substantially warmer than the present-day for a sustained time with the modern geographical distribution of continent and ocean. The effort for simulating the climate in this interval would advance validations of climate models predicting future climate change and to the estimation of ”Earth system sensitivity”.

As a part of the United State Geological Survey (USGS) Global Changes Research effort, the Pliocene Research Interpretation and Synoptic Mapping (PRISM) Project has documented the characteristics of climate in mPWP on a global scale by use of various types of proxy records. The PRISM datasets have been used to drive numerical simulations designed to explore the impact of climate forcing and feedback during the Pliocene and assess the reproducibility of climate simulations derived by general circulation models (GCMs) in this period. The Paleoclimate Modeling Intercomparison Project (PMIP), a worldwide framework for studying on the paleoclimate reconstructions and simulations, has focuses on mPWP as one of new target intervals in its latest phase (PMIP3). By applying the latest version of the PRISM dataset (PRISM3D, Dowsett et al. 2010) for prescribed boundary forcings, Pliocene modeling intercomparison project (PlioMIP) was proposed to access the reproducibility of global climate models for mPWP climate simulations (Haywood et al. 2010, 2011). PRISM3D dataset contains all surface boundary conditions, topography, vegetation, land ice, and also deep ocean temperature for initial condition in air-sea coupled climate simulations. Under the experimental protocols, several results derived by climate models had already been reported.

We conducted the PlioMIP Experiments 1 (with atmospheric general circulation model, AGCM) and 2 (with atmosphere-ocean coupled general circulation model, AOGCM) using with MRI-CGCM2.3 (Yukimoto et al. 2001, 2006), which was also used in the third phase of the Coupled Model Intercomparison Project (CMIP3) and the second phase of the PMIP [1, 3, 4]. We also represent Pliocene biome prediction over the land using with equilibrium biogeography model, BIOME4, under the climate state simulated by the AGCM and AOGCMs [2, 4]. The biome simulations could help to compare general characteristics of surface climate patterns among the simulations by a single index translated from some elemental climate parameters and facilitate quantitative model-model or data-model comparisons.

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Keywords: paleoclimate, mid-Pliocene, climate model, PRISM, PlioMIP, biome

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APE33-15 Room:103 Time:May 24 12:00-12:15

Reconstruction of the tectonic activity in the southwestern Tarim Basin and its relationship with desertification

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Tectonics and climate linkage is one of the most important problems in Earth Science. Uplift of Tibetan Plateau is one of the most remarkable tectonic activities in the Cenozoic. Although climatic simulation studies suggest the possibility that uplift of Tibetan Plateau triggered the desertification of Tarim basin (e.g. Kitoh, 2005), the linkage between the two has not yet been proved. The major reasons that hamper proving the linkage are the difficulty in constraining the timing of the tectonic activity relative to the timing of desertification, and uncertainty in defining the onset of desertification. In this study, we tried to overcome these problems by extracting the climatic and tectonic information from the same sedimentary record using newly developed method to specify the onset of desertification.

We conducted a field research at the Yecheng section in the southwestern Tarim Basin. Fulvial to alluvial deposits with occasional intercalations of eolian sediments deposited between 7.6Ma to 1.8 Ma are continuously explosed along the Yecheng section (Zheng et al.,2010; Tada et al., 2010). We identified eolian sediment and river sediment in the field, and measured Electron Spin Resonance (ESR) signal intensity and crystallinity index (CI) of quartz in two size fractions of the sediments.

ESR signal intensity of quartz reflects the age of mother rock (Toyoda and Naruse, 2002), whereas CI of quartz reflects physical condition of its formation such as temperature and rate of crystallization (Murata and Norman, 1976). We used these two parameters to identify the provenance of quartz. In her study of river sediments in the Tarim basin, Isozaki (2009MS) suggested that quartz in coarse fraction (>64um) of river sediments reflects bedrock geology of the catchment area based on ESR signal intensity and CI of quartz. So, if tectonic uplift or lateral movement by faults occur in the catchment area, the assemblage of rock exposed in the catchment area should change, and we can detect the onset of tectonic activity by examining ESR signal intensity and CI of quartz in the coarse fraction. On the other hand, fine fraction (<16um) in river sediments may reflect geology of the river catchment area and eolian dust. So we can evaluate contamination of eolian dust by comparing ESR signal intensity and CI of quartz between fine and coarse fractions.

In this study, we applied these methods to the fluvial and alluvial sequence at Yecheng section to examine the relationship between tectonic activity in northwestern Tibet and desertification of the Tarim basin. The result will be presented at the meeting.

Keywords: Tarim Basin, Desertification, Tectonics, Fault, Provenance study, Eolian dust

Japan Geoscience Union Meeting 2012
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APE33-16 Room:103 Time:May 24 13:45-14:00

Palaeogeographic reconstruction of the 1.55 Ma synchronous isolation of the Ryukyu Islands, Japan, and Taiwan and inflow

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Below is abstract shown in Osozawa et al., 2011, International Geology Review. The Ryukyu islands evolved from a continental margin arc to their present configuration as an island arc, accompanied by subsidence and isolation of islands, by back-arc spreading of the Okinawa trough that continued to the present. The time of island isolation is recorded by trough-parallel half grabens filled by marine siltstone, as well as such sediments filling orthogonal fault-controlled and other non-fault-controlled valleys surrounding each island. New Quaternary nannofossil biostratigraphic data shows deposition marine siltstone noted above at 1.55 Ma. At that time, the entire 1000-km-long island chain comprising the Ryukyu islands separated from Asian continent by rifting extending from the Okinawa trough to the Tsushima strait. The Tokara, Kerama, and Yonaguni gaps, branched or transverse rifts of the Okinawa trough, separate the island chain into subgroups of the Osumi, Amami, Okinawa, and Yaeyama islands, and Taiwan. The shallow Taiwan strait separated Taiwan from the Chinese mainland. The Kuroshio warm current that previously ran off shore of the continental margin arc, began to flow into the opening backarc basin through the Yonaguni gap and flow out the Tokara gap, flowing along the axis of the Okinawa trough. Under influence of the warm current and because of entrapment of the Yellow and Yangtze rivers detrital sediments by the Okinawa trough, coral reefs formed around each isolated island. These reefs make up a unit called the Ryukyu limestone. Subsidence continued through the deposition of this limestone, resulting in further isolation of each island. Some islands did not separate from the mainland but emerged later from the sea as a result of volcanic edifice construction or forearc uplift. Following initial isolation the Japanese islands and Taiwan may have been connected to the mainland by land bridges during some sea level lowstands related to glacial periods, whereas the other islands remained isolated. Based on ages of isolation of each island, a Quaternary paleo-geographic map and phylogenetic tree of the islands can be drawn showing the separation time of the each island from the mainland and each other. This information should be useful for phylogenetic molecular biologists studying evolution of the Ryukyu endemic species and vicariant speciation, and facilitate analysis of DNA substitution rate.

Keywords: Ryukyu island arc, Okinawa Trough, island-encircling 1.55 Ma marine sediments, .55 Ma island separation, Kuroshio current, coral sea

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(May 20-25 2012 at Makuhari, Chiba, Japan)

APE33-17 Room:103 Time:May 24 14:00-14:15

Polycystine radiolarian fauna and paleoceanographical changes in the Shimokita Peninsula through the last 750 ky.

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The Northwestern Japanese Pacific Ocean margin is a region presenting high water masses mixing caused by the influences of three distinct currents (the Kuroshio Current, the Tsugaru Current, and the Oyashio Current). Our Studied Site, the Shimokita region located in front of the Tsugaru Strait, is a region directly influenced by the Tsugaru Warm Current, and the Oyashio Subarctic Current. Many studies of this region concerning the last 50 ky have been conducted for understand this region oceanographic changes through the late Pleistocene. At this time there are no long term palecoceanographical studies of this region for period older than the last 150 ky. In this context the core hole C9001C drilled at the 1,180 m water depths of the sea-bottom in the D/V Chikyu 2006 Mission, is an excellent example of a stratigraphic succession off Japan. This core has a high sedimentation rate and provides a nearly continuous record from MIS 18 (750 ka) to present, covering the Brunhes normal polarity epoch. Polycystine radiolarians due to their water masses vertical distribution, and their ecological properties is the most efficient micropaleontological proxy for establish paleoceanographical study of this region. The purpose of this study is to establish the first long term polycystine radiolarian assemblages faunal evolution of this region, and discuss the polycystine radiolarian faunal evolution through the last 750 ky. In this context we will focus our study on the unusual climatic change event as the Matsuyama/Bruhnes magnetic susceptibility reversal period, the Mid Bruhnes event (400-300 ky after Jansen et al., 1986), the MIS 9, the MIS 8 and the MIS 6.5 (Martinson et al., 1987).

Keywords: Polycystine Radiolarian, Paleoceanography, Fauna evolution, Mid Bruhnes Event, MIS 9, MIS 8

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APE33-18 Room:103 Time:May 24 14:15-14:30

Dynamics of millennial-scale variation in East Asian Summer Monsoon intensity and its relation to the Westerly jet

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Recently, increasing evidence demonstrated the occurrence of multicentennial to millennial-scale climate changes during the Holocene (e.g., Bond et al., 2001; Mayewski et al., 2004). Although some of these climate changes were inferred to be global-scale, the spatial extent and physical mechanisms of these changes are still controversial. In the East Asia, millennial-scale variations of the East Asian summer monsoon (hereafter call EASM) intensity have been examined using the best-dated records of stalagmite-derived oxygen isotope from caves in central China (e.g., Wang et al., 2005; Hu et al., 2008). However, due to the spatial heterogeneity of the EASM precipitation changes (e.g., An et al., 2000; Dayem et al., 2010), stalagmite-derived oxygen isotope records seem to represent local or regional variations of the EASM precipitation, not to represent dynamic changes of the EASM. Therefore, we need additional records to examine the nature and spatial extent of the EASM variations during the Holocene.

To date, many additional records representing the EASM precipitation changes were reported from lacustrine, loess-paleosol, and peat bog sediments in China, and marine sediments of the surrounding oceans. Among them, we selected the records with high sensitivity and chronological precision, and examine the multicentennial- to millennial-scale spatial changes of the EASM precipitation during the Holocene. Furthermore, here we focused on the role of the westerly jet (hereafter call WJ) on the spatial precipitation pattern of EASM (e.g., Liang and Wang, 1998; Sampe and Xie, 2010). Sampe and Xie (2010) demonstrated that eastward advection of warm air from the eastern flank of the Tibetan Plateau along the WJ axis triggers the convection that forms the rainband and further that the WJ anchors the rainband by guiding transient weather disturbances, which promote convection by intensifying moisture advection with upward motion. Therefore, the WJ is necessary to develop a rainband at middle to high latitude of East Asia. In our previous study, we presented provenance changes of the aeolian dust in Japan Sea sediments reflect the earlier/later jump of the WJ to the north of the Tibetan Plateau (Nagashima et al., 2011). Then here we reconstructed provenance changes of the aeolian dust in Japan Sea sediments during the Holocene, and compared the results with spatial precipitation changes in China.

Examination of the paleo-precipitation records in China and provenance of dust in Japan Sea sediments reveals large events around 9.5, 8.3, 5.5, 2.2, and 0.4 kyr BP, with large contribution of aeolian dust from the Taklimakan Desert (we interpret as representing earlier jump of the WJ to the north of the Tibetan Plateau) together with the large precipitation in northern China (e.g., Hong et al., 2005) and small precipitation in central to southern China (e.g., Hu et al., 2008; Kubota et al., 2010). This may indicate that multicentennial to millennial-scale changes of the (seasonal) WJ path during the Holocene caused dynamic changes of the EASM precipitation, with earlier jump of the WJ to the north of the Tibetan Plateau increased precipitation in northern China and decreased precipitation in central to southern China.

The presented events were coincide within the dating error with the events revealed from the GISP2 sodium and potassium ion records, which are considered as reflecting the intensity of Icelendic Low and Siberian High, respectively (Mayewski et al., 1997; Meeker and Mayewski, 2002), and the events revealed from the stalagmite oxygen isotope record from Pink Panther Cave in southwestern United States, which is considered as reflecting (at least partly) precipitation of North American monsoon, suggesting the events spread at least hemispheric-scale and reorganization of the atmospheric circulation systems may happen from low to high latitudes. We will further discuss the possible cause of the coupled WJ-EASM variations during the Holocene.

Keywords: East Asian Summer Monsoon, Westerly Jet, Millennial-scale, Quartz, Electron Spin Resonance

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APE33-19 Room:103 Time:May 24 14:30-14:45

The separation from global and local components of climate signals by comparison between two lake sediments

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East Asian Monsoon (EAM) is dictating many parts of East Asia including Japan. In summer, EASM (East Asian Summer Monsoon) brings moist and warm climate in the region, whereas EAWM (East Asian Winter Monsoon) is characterized as cold and relatively dry air originated from Siberian High, which intensified in boreal winter. According to paeloclimate archives, there had been frequent rapid climate changes both in and outside of North Atlantic region during the last glacial period, which ended up at around 10 ka. The ultimate mechanisms are still unknown though it has been pointed out that ocean circulation had been played an important role (Yokoyama and Esat, 2011).

In order to reconstruct past environments, stable isotopes are a useful tool and can be used as fingerprints of events because of their unique values of each materials. One of which is stable 87Sr isotope and is usually produced by decay of 87Rb. From measured 87/86Sr isotopic value of samples and expected source, it is able to estimate the source areas of sample materials, and also their degree of contribution.

Lake Biwa and Lake Suigetsu are located only 20 km in distance at very similar latitude, so they are expected to have influences from regional climate in similar fashion. However, these two lakes have different catchment areas, so it is expected to be able to separate global and local signatures of environmental changes comparing two lakes.

In this study, samples from Lakes Biwa and Suigetsu are analyzed by ICP-MS. Concentrations of 61 elements are measured, and Sr isotopic ratio using TIMS for 30 samples from sediment of Lake Biwa are also analyzed. Sedimentary fluxes are fluctuated in the sediments, though the timing and magnitude of changes are not identical. From comparison of data sets of two lakes, the fluctuation of Aluminum flux indicated that sedimentation of lakes are correlated to each other, suggesting that the sedimentation of two lakes are mainly controlled by climate systems, whereas the period between 45˜37 ka are not correlated. The divergence found in the sedimentary characteristics might have controlled by local environmental changes in these two lakes. Further, Aluminum flux fluctuation showed clear cyclic peak during Last glacial to present which timings are correlated to Heinrich Event (which is known as ice rafting event of North Atlantic).

Strontium isotopic ratios in Lake Biwa sediment showed similar peak with Aluminum, which are correlated with HE. This indicates the change of source areas of sediment had occurred at the time of HE.

This study demonstrated that the merits of measuring two nearby lakes, which have different geological settings. From comparison of two lake sediments, regional and local influences to two lakes were successfully separated.

Keywords: lake sediments, lake Suigetsu, lake Biwa

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APE33-20 Room:103 Time:May 24 14:45-15:00

Effects of age uncertainty on the Site 609 IRD record

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The last-glacial hematite-stained grain record (HSG) obtained from classic DSDP Site 609 was originally reported to exhibit 1476+/- 584 year cyclicity and interpreted to indicate the presence of a ”1500-year cycle”. Here, this record is reinterpreted in the context of an updated chronology based on newly calibrated radiocarbon dates (Marine09) from 15 to 35 ka and correlation to the North GRIP ice core layer-counted chronology (GICC05) to 60 ka. This new age model results in periodicity at primarily ˜1000- and ˜2000-years, bands that are both consistent with the original reported results and periodicity of related Holocene proxy records.

A ˜1500-year oscillation is also detected. However, it is non-stationary and mainly limited to the interval from 60 to 70 ka, the age of which is derived solely from an ice flow model (ss09sea), subject to the highest uncertainty of the entire record, and exhibits the greatest offset from the original chronology. The effects of age uncertainty on cycle length were modeled, and results indicate that the 1500-year oscillation is less robust than the 1000- and 2000-year oscillations. Though the presence of a 1500-year cycle cannot be entirely ruled out, similar analysis of synthetic series constructed from sine waves of corresponding frequencies indicate that it is a relatively minor component.

Keywords: IRD, periodicity, age model

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APE33-21 Room:103 Time:May 24 15:00-15:15

Temperature and salinity estimates in the Japan Sea during the past 18 kyr

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The Japan Sea has shallow 4 straits (<130 m) that connect to the Pacific Ocean to exchange seawater, and thus sea-level lowstand (ca.-120 m) during the LGM might had limited vigorous seawater exchange between the Japan Sea and the Pacific through the straits. Only through the narrow and shallow Tsushima strait, the glacial Huang He River supplied fresh water to the semi-closed Japan Sea, forming low-saline surface conditions at the time (e.g., Oba and Murayama, 1995). This low-saline surface condition during the LGM was relieved by intrusion of Oyashio Current into the Japan Sea through the Tsugaru strait from 18 ka (Oba and Murayama, 1995). Although Ishiwatari et al. (2001) have tried to reconstruct sea-surface temperatures (SSTs) during the past 36 ka based on alkenone unsaturation ratio, the low-saline conditions during the early deglacial periods make SST estimates from alkenone uncertain (Harada et al., 2008; Fujine et al., 2006). Here, we present planktic foraminifera Mg/Ca-derived SST and Ba/Ca ratios, together with benthic and planktic foraminifera $d^{18}O$ from a sediment core in the Japan Sea.

The studied sediment core (YK10-7-PC09) was taken from 738 m water depth off Niigata. The thick lamina layer was observed in a section from 420 cm to 750 cm core depth, which corresponds to the sediments during Heinrich 1 and glacial periods and we have used the sediment samples above 450 cm core depth. The age model for the core was based on 7 AMS ^{14}C data of planktic foraminifera. We have used Marin09 and dR of 0+/-100yr to convert the conventional ^{14}C ages to the calibrated ages. $d^{13}C$ and d^{18} of benthic (*Uvigerina.* spp) and planktic foraminifera (*N.incompta*, *N.pachyderma(s)*, *G.bulloides*) were measured by MAT 253 (CMCR, Kochi University), whereas trace metal/Ca ratio of planktic foraminifera were measured by Thermo Finigan Element II (University of Toyama). Precision (1sigma) of Mg/Ca, Mn/Ca, and Ba/Ca ratios obtained by the SF-ICP-MS in our laboratory was 0.97%, 0.49%, and 1.63%, respectively.

The $d^{18}O$ records from planktic foraminifera were almost same as the records from L-3 core (Oba and Murayama, 1995), and one of striking features is a significant increase of $d^{18}O$ values from 0.6 permil to 3.4 permil during the early deglaciation (18-15 ka). The Mg/Ca-derived SSTs (from *G.bulloides*) showed a slight increase from 5 to 8^{o}C during 18-7 ka; SSTs did not change significantly during 18-15 ka and warmed ~3^{o}C during the B/A period. Importantly, the SST evolution in the Japan Sea exhibited a close similarity with the SST variation reconstructed off Tokachi under the influence of Oyashio Current (Sagawa and Ikehara, 2008), with ~1^{o}C offset, corroborating the previous result that the Japan Sea was influenced by Oyashio Current at the time. Using paired $d^{18}O$ and Mg/Ca-derived SST, we have attempted to estimate $d^{18}Osw$ (Oba et al., 1980) and revealed that ~4 permil increase in regional $d^{18}Osw$ took place at 18 to 15 ka. Although $d^{18}Osw$ values are linearly related to salinity , the slope and intercept of $d^{18}Osw$-salinity relation can be changed by evaporation and precipitation fluxes and $d^{18}O$ values of fresh water, resulting in different $d^{18}Osw$-salinity equations in various basins. If the $d^{18}Osw$-salinity relation in the modern Okhotsk Sea ($d^{18}Osw$ = 0.3195 x Salinity - 13.561; Yamamoto et al., 2001) was applied to the early deglacial periods in the Japan Sea, we can roughly estimate paleo-salinity; 24 psu at 18 ka and 33 psu at 15 ka. Given that the source of fresh water for the glacial Japan Sea was the Haung He River, heavier $d^{18}O$ values as an intercept might be appropriate. If so, estimated paleo-salinity at 18 ka will be less than 20 psu. Although the exact estimate of paleo-salinity is quite difficult, the fact that Ba/Ca ratios of planktic foraminifera exhibit a similar trend as the regional $d^{18}Osw$ and very high values up to 2 micromol/mol at 18 ka corroborates that the Japan Sea was severe less-saline surface conditions during the LGM.

Keywords: Japan Sea, Mg/Ca, Ba/Ca, $d^{18}O$

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(May 20-25 2012 at Makuhari, Chiba, Japan)

APE33-22 Room:103 Time:May 24 15:30-15:45

Chemical states and sedimentary records of Lake Baikal sediment.

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Lake Baikal occupies the largest water volume in the world's freshwater lakes, and is located in the eastern part of Eurasian continent. The Lake Baikal sediment contains a detailed record of paleo-environmental changes in the deep continental interior. In this study, we analyzed the abundance of chemical compositions in the sediment core from the Lake Baikal. In addition, to investigate redox conditions in core BSS06-G2, we determined the Mn oxidation state, Mn in the sediment. The sediment Mn oxidation state was determined based on the Mn K-edge x-ray absorption near-edge structure (XANES) spectra captured using a synchrotron radiation beam.From the geochemical evidences, it is suggested that the BSS06-G2 U have almost never mobilized with changes in the post-depositional redox condition. Therefore, distributions of the uranium concentration in sediment can be regarded as a primary sedimentary record of Lake Baikal region and their variations were revealed to synchronize with paleo-environment changes in the North Atlantic Ocean.

Keywords: Lake Baikal, Lacustrine sediment, Uranium, XANES analysis, Paleo-environmental change

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APE33-23 Room:103 Time:May 24 15:45-16:00

Mid-Holocene paleoenvironmental changes and paleoclimatic changes by solar activity in San'in District, weatern Japan

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Evidence shows that solar activity influences climate on a global scale. In the mid-latitude region, climate change is expected to change precipitation patterns. Concurrently, variation in solar activity may influence phytoplankton productivity. It seems that these changes should be recorded in sediment and organic matter deposits in coastal lagoons. In this study, we discuss the relationship between climate change and solar activity in the mid-Holocene in the northern hemisphere mid-latitude region based on grain size analysis, total organic carbon (TOC) content in coastal lagoon sediment core samples.

The INB core was drilled to produce a high resolution record of Holocene paleoenvironmental change in the San'in District, western Japan. The core is 19.17m in total length and is divided into Unit I-VII by lithofacies. Holocene sediment, primarily organic silt, forms Unit III and above in this core. Unit III was deposited from 8.4 to 5.4 ka, when sea level rose during the Jomon transgression; its depositional environment is a coastal lagoon. Progradation of the river mouth during the sea level rise lead to an increase in the C/N ratio of organic matter. Unit IV contains the volcanic Shigaku pyroclastic flow (the sixth stage of volcanic activity of the Sanbe volcano), and Unit V reflects deposition in a freshwater lake or swamp. Above this aggredational sediments were deposited by small rivers.

This study focused on the coastal lagoon sediments of Unit III (8.4 to 5.4 ka); we carried out CNS elemental analysis and grain size analysis with a resolution of approximately five years. TOC content is variable and increases from 0.5 to 5%. Variation of TOC, TS, C/N ratio and Mean grain size are synchronized, and relatively well correlated with atmospheric radiocarbon 14C (Delta ^{14}C) and therefore with solar activity. But it is seen that phase shift in the lower portion of Unit III. A positive peak of Delta ^{14}C indicating low solar activity and a cold period shows high TOC content because of concentration of TOC. On the other hand, a negative peak in Delta ^{14}C indicates a warm period, and has a low TOC content because of clastic dilution. During the warming climate, the river run-off increased and carried much terrestrial organic carbon with fine clastics and nutrient. Planktonic organic carbon contents of sediments were diluted by the clastics. This trend is also observed in a sediment core of Nakaumi Lagoon in San'in District, where it is due to a dilution effect caused by increased precipitation and high productivity because of a higher nutrient load during a warm interval (Sampei et al.,1997).

Keywords: San'in District, Mid-Holocene, total organic carbon content, Delta ^{14}C, paleoclimatic changes, solar activity

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APE33-24 Room:103 Time:May 24 16:00-16:15

East China Sea mid-Holocene sea surface temperature reconstructed from Sr/Ca measurements for corals from Kume Island

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The Holocene, a period for the last 11,700 years, is generally recognized as a stable and warm period which sea level has relatively been constant (Yokoyama and Esat, 2011). Growing number of studies, however, have been reported the millennium scale climate changes during this time (e.g., Bond et al., 2001, Wanner et al., 2011), but mechanism of millennium scale climate change has yet to been solved. Particular attention has been paid for the cold episodes during the Holocene and global mapping efforts to understand the natures of events are undertaken (Wanner et al., 2011), yet there are still limitations of spatial and temporal coverages of paleoclimate data. One such an area is the East China Sea (ECS) where the region currently being under influenced from both East Asian monsoon (EAM) and the strength of Kuroshio Current (Sun et al., 2005, Kubota et al., 2010). Various studies based on sedimentary archives have been conducted to reconstruct EAM changes in the past though little efforts are made to produce seasonally resolved longer (ie. $>$ 1,000 years) EAM records.

Coral has annual banding with rapid growth rate like a tree-rings thus it enables us to reconstruct paleoclimate with seasonal time scale. Sr/Ca ratio is a highly reliable indicator of SST amongst various other chemical proxies in their skeleton and being widely used (e.g., Beck et al., 1992). Yet, only study using this method to reconstruct ECS paleoceanography is from Kikai Island using modern and 6 ka corals (Morimoto et al., 2007). The study was not able to provide information for the late Holocene, such as 3 to 4 ka.

In this study, fossil corals were collected from Kume Island, Okinawa, and analyzed both radiocarbon and Sr/Ca ratio to reconstruct mid- to late-Holocene paleoceanography. Two fossil corals (3.8 cal kyr BP and 4.5 cal kyr BP) are obtained and are revealed as pristine since they met the rigorous screening criteria of diagenesis based on XRD and SEM analyses. Two modern corals were collected from Sesoko Island, also located in Ryukyu Islands, to establish the equation of Sr/Ca-SST.

Reconstructed SST in 3.8 cal kyr BP showed colder condition than today ($p<0.01$). This might be corresponding to the cold event previously reported as PME (Pulleniatina minimum event) in ECS (e.g., Xiang et al., 2007; Ujiie et al., 2003). They also suggested that magnitude of those changes were not comparable between summer and winter during the Holocene. Further analyses of coupled Sr/Ca and oxygen isotopes will allow us to separate both SST and salinity and hence can provide detailed information of ECS paleoceanography.

Keywords: East China Sea, East Asian Monsoon, coral, Holocene, Sea Surface Temperature, Sr/Ca

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

APE33-25 Room:103 Time:May 24 16:15-16:30

Rapid sea-level changes and routing of meltwaters during the termination I

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Sea level rise had been occuerred as much as 130 m since the last glacial maximum (LGM) centered around 20,000 years ago. Advancement of geochemistry as well as geophysics allow us to depict detailed pictures of interactions among climate subsystems and the timing of sea-level changes have been synchronous with those changes. In this presentation, I will review recently updated sea-level records for the last 20,000 years and discuss linkages with global climate changes.

Keywords: Paleoclimatology, Paleoceanography, Sea level, Ice Sheets, Antarctica

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APE33-P01 Room:Convention Hall Time:May 24 17:15-18:30

Toward an establishment of ”Standard Paleosite” in and around Japan

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Varved sediment obtained from the Lake Suigetsu, central Japan, provides a terrestrial radiocarbon calibration model and a chronology of paleoenvieonemental change during the last 70,000 years (Nakagawa et al., in press). Likewise the Lake Suigetsu, varved sediments were found in the Lakes Ichinomegata and Ogawara, northern Japan. These varved sediments have a big potential to establish high-resolution chronology to reconstruct past climatic changes. The western North Pacific is known as a terminal region of the great ocean conveyer. In general, 14C ages of the surface water are older than the atmospheric values (marine reservoir effect). The North Pacific has very old 14C ages. Because of the large marine reservoir effect, it is hard to establish reliable age model of marine sediment cores in the North Pacific. Further, there are large uncertainties of past marine reservoir effect in the glacial to deglacial periods.

If we can tie chronologies between Lake Suigestu sediments (and other varved cores) and marine sediment cores, we will be able to evaluate past marine reservoir effect around the Japanese Islands. Reconstruction of the past marine reservoir effect reduces age model uncertainties and helps understanding past ocean circulation. A key for the connection is tephra. Tephras deposited in the Lake Suigetsu provide precise chronology. We propose an application for the tephra chronology in the Lake Suigetsu to marine sediment cores around the Japanese Islands by collaborative work between lake and ocean paleo-communities.

Keywords: Age model, Carbon cycle, Glacial Interglacial cycle, Tephra, Varved sediment, Marine reservoir effect

Japan Geoscience Union Meeting 2012
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APE33-P02 Room:Convention Hall Time:May 24 17:15-18:30

Biogeochemical cycling of phosphorus in the 45˜50Ma Arctic Ocean: Constraints from speciation analysis (IODP Exp302)

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The modern Arctic Ocean plays a key role in regulating global climate system, because it is a site of high albedo by sea ice and of deep water formation as a driving force of thermohaline circulation through which heat and nutrients are transported. However, the Arctic sea ice did not always exist in the past. Integrated Ocean Drilling Program (IODP) Expedition 302 Arctic Coring Expedition (ACEX) has revealed that the seawater temperature was substantially high (10˜14^{o}C) and no sea ice was formed before 45Ma when sea ice started to form (e.g., Brinkhuis et al., 2006; Moran et al., 2006; Marz et al., 2010). In a warm Arctic Ocean, the thermohaline circulation was weak enough to stagnate the deep ocean and to develop anaerobic environment, like the modern Black Sea. Nutrient recycling is likely to have been much different from that of today. In order to clarify the geochemical cycle of phosphorus, a bio-essential nutrient element, we performed sequential extraction analyses for different forms of phosphorus using ACEX samples. We utilized a method modified after Schenau et al. (2000), which is based on a SEDEX method by Ruttenberg (1992) where phosphorus-bearing species in sediments are chemically extracted into five different forms; (1) absorbed P, (2) Fe_{oxide}-P, (3) carbonate fluorapatite (CFAP) + $CaCO_3$-P + hydroxylapatite (HAP), (4) detrital P, and (5) organic P. In the method of Schenau et al. (2000), the above (3) was divided into two phases: non-biological CFAP and biological HAP and $CaCO_3$-P.

Our working hypothesis is as follows: If the Arctic Ocean was warm and closed by surrounding continents, the seawater would have stratified and become anaerobic, where bacterial sulfate reduction was active. Phosphorus in the sediment would have been preserved mainly as organic P that likely originated from decay of plankton. Fe oxide-P is considered to be less important as a sink of P, because free Fe would have been depleted due to extensive pyrite formation (Ogawa et al., 2009). CFAP could be an important sink of P because its abundance increased with increasing age and depth (Fillippelli and Delaney, 1996). If continental weathering was enhanced by an increase in rainfall in a warm climate during the 49˜48 Ma Azolla Event, increased weathering flux of phosphorus would have enhanced primary productivity.

Keywords: IODP, ACEX, SEDEX method, Phosphorus phase

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

APE33-P03 Room:Convention Hall Time:May 24 17:15-18:30

Production and destruction of biogenic carbonates through the year in the Arctic Ocean

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The Arctic Ocean is one of the most sensitive realms to global climate changes in the world oceans. It is concerned that oceanic acidification accompanied by global warming allows dissolution of carbonate shells of phyto- and zooplankton and it could be affected oceanic food chain in near future. In this study, we show the result of carbonate production and destruction changes through the year in the Arctic Ocean using faunal and micro focus X-ray CT analysis. Time-series samples of sinking particles were obtained at Stn. NAP10t (75N, 162W, water depth 1,975 m) in the Northwind Abyssal Plain, the Arctic Ocean. Deployed time was from Oct. 2010 to Sep. 2011. The sediment trap cups were deployed at 300 m (shallow) and 1,300 m (deep) water depth and 26 samples were recovered from each water depths. Sampling interval for each bottle was 13-15 days.

Total mass flux (TMF, mg/cm2/day) between both water depths showed clear relationship with the seasonality. Relative higher TMF were observed in late Autumn(November - December), and Summer (August). In fact, contributors of TMF were not only carbonate shells but also some kind of phyto- and zooplankton (diatoms, Copepods, Shrimps, and other gelatinous plankton). From the perspective of biogenic carbonates, primary producers were planktic foraminifers, pteropods, and bivalves and their shells were observed in each bottles commonly. However favorable seasons for their growth were different each other: Primary producers of biogenic carbonates during the late Autumn were the pteropods and small bivalves. On the other hand, planktic foraminifers were most dominant fauna in the Summer. It suggests that faunal alternations between carbonate-shelled plankton has been occurred through the year in the Arctic Ocean. In this presentation, we will show the micro-focus X-ray CT images of planktic foraminifers, pteropods, and bivalves shells and will discuss about the carbonate dissolution in the water column.

Keywords: Arctic Ocean, time-series records, production, dissolution, calcium carbonate, micro-focus X-ray CT

Japan Geoscience Union Meeting 2012
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APE33-P04 Room:Convention Hall Time:May 24 17:15-18:30

Reconstruction of marine production changes from middle to late Miocene in the Ishikari Basin, Hokkaido, Japan

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Diatom production in sea surface layer has been known to increase throughout North Pacific Ocean during the middle -late Miocene (Barron, 1998). The enhanced diatom production might result from change of biogeochemical cycles associated with coevolution between herbaceous C_4 plant and marine diatom (Falkowski et al., 2004), although the increase of diatom production was explained by change of deep water circulation. In addition, Sawada (2006) reported that increase of kerogen delta ^{13}C was almost simultaneous to increase of diatom biomarker concentrations in Neogene neritic sediments of central Japan, and suggested that marine production was presumably enhanced by more efficient input of terrigenous matter in the Neogene paleo-Japan Sea. However, there are few studies on the Neogene-order linkage between terrestrial and marine environmental changes. In the present study, we analyzed marine and terrestrial biomarkers in mudstones of the Miocene Kawabata Formation, which is mainly composed of turbidite, to evaluate interaction between marine productivity and terrestrial input.

We analyzed mudstones from the Kawabata Formation in the Higashiyama route, Yubari area, Hokkado, Japan. This formation was formed in the Ishikari Trough that had be associated with birth of Japan Islands and was filled by turbidite. The Kawabata Formation is important for evaluating tectonic history of Hokkaido including uplift of Hidaka Mountains, and therefore, deposited age was determined by fission track dating of tuff layers and diatom biostratigraphy (Kawakami et al., 2002). We used mudstone samples deposited from ca. 13Ma to ca. 10Ma. We determined total organic carbon (TOC), and analyzed solvent-extractable biomarkers by GC/MS.

The TOC values of all samples are nearly constant (0.5 % ~ 0.8 %). Sterane and hopane isomer ratios indicate that organic matters in these sediments are immature. Concentrations of diatom biomarker such as higher branched isoprenoid (HBI) alkane and HBI thiophenes, as well as dinoflagellate biomarkers such as dinosterane were higher before ca. 13Ma and after ca. 10Ma. Moreover, increase of these algal biomarker concentrations are almost simultaneous to decline of Pr/Ph ratios, so that higher primary production in sea surface layer might result in occurrence of anoxic bottom waters.

It is also found that terpenoid biomarkers originated from terrestrial higher plants are abundantly contained in the Kawabata Formation. The terpenoid biomarker-based higher plant parameter (HPP), which varies depending mainly on conifer abundances, decreased from the lowermost layers except around 10 Ma. This suggests that conifer-dominant vegetation declined in paleo-Hokkaido areas from the late to middle Miocene. In addition, concentrations of terrestrial plant terpenoids frequently varied throughout the Kawabata Formation. This variation might be attributed to those of terrestrial input as organic matters in the Ishikari Basin. We will present more detailed discussion for marine productivity change related to terrestrial organic matter input by using both marine and terrigenous biomarkers.

Keywords: Neogene paleoceanography, land - ocean interaction, marine primary production, paleo-Japan Sea, turbidite, biomarker

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APE33-P05 Room:Convention Hall Time:May 24 17:15-18:30

Temporal change of the sources of aeolian dust delivered to Japan

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Change of atmospheric circulation system in the past is an important issuefor studies of paleoclimate. Bulk chemical compositions, trace elements,isotopic ratios have been used as proxies to investigate such materialtransportation on the surface of the earth. However, chemical processes suchas weathering may affect such proxies. Utilizing the feature that the oxygenvacancies in quartz correlate with ages of host rocks in the range up to1Ga, Toyoda and Naruse (2002) found that the origin of aeolian dustaccumulated in Japan are different between in MIS 1 and 2. Nagashima et al.(2007) found that the origin of Japan Sea sediments changed with time from the oxygen vacancies and the crystallinity indexes.

In the present study, the temporal variation of possible origin of aeoliandust accumulated in Japan in the recent past is investigated. Dust samples representing atmospheric deposition were collected in a 1.5m^2 plastic open surface collector installed in the observation field of observatories at Akita for one month.Finer grainsize fractions in 1969 and in 1971 showed higher value of oxygen vacancies, which are estimated from the intensity of the E_1' center in quartz. This may be due to the fact that finer faction came from China as aeolian dust whilecoarser fractions are local.

The value of oxygen vacancies in finer fractions decreases with time between1960 and 1988 while crystallinity indexes are constant. These resultsindicate that aeolian dust originated from China has changed its origin inthe recent past. This may correspond to the previous observation that $^{90}Sr/^{137}Cs$ in the deposition decreases with time (Igarashi et al., 2009).

Japan Geoscience Union Meeting 2012
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APE33-P06 Room:Convention Hall Time:May 24 17:15-18:30

YR11 and SG12: Paired projects to explore linkage between East Asian Summer Monsoon and Westerly Jet during the Holocene

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Hydrological cycle in Asia is strongly influenced by spatial pattern and intensity of East Asia Summer Monsoon (EASM). Recent study by Sampe and Xie (2010), based on detailed analysis of meteorological data set, revealed a close genetic relation between the westerly jet (WJ) and EASM front. Preliminary examination of our paleoclimatic data set also suggests the relationship between the position of WJ over East Asia and the intensity of EASM precipitation over South China on millennial time-scale during the Holocene. In order to confirm this relationship and test whether the similar relationship is maintained on shorter time-scales, we organized two projects YR11 and SG12.

YR11 is a project to reconstruct distribution of EASM precipitation over the Yangtze River drainage during the late Holocene with decadal time-scale. To accomplish this objective we first examine provenance of detrital silt and sand throughout the drainage of modern Yangtze River so as to develop a new method to estimate relative contribution of detrital sediments from various branches of Yangtze River to the sediments discharged to the Yangtze River Delta. Next, we will drill the Yangtze River Delta to retrieve sediment cores that are expected to preserve high resolution record of Yangtze River discharge with flood events. By applying a newly developed method to quantitatively estimate the provenance, we hope to reconstruct changes in the area of heavy precipitation over the Yangtze River drainage.

SG12 is a project to reconstruct the changes in the position of WJ axis over East Asia during the Holocene with decadal to annual resolution using the Lake Suigetsu sediments. Our previous studies proved aplicability of the provenance tracing method of eolian dust to the Lake Suigetsu sediments. Because the Lake Suigetsu sediments have annual lamination and extremely well-dated through the extensive studies under SG06 project (lead by Nakagawa), the sediments will provide us a rare opportunity to examine changes in eolian dust flux, grain size and provenance on annual time-scale. To accomplish this objective, we plan to drill Lake Suigetsu again in this summer.

The outline of the paired projects and preliminary result of YR-11 project will be presented at the meeting.

Keywords: East Asian Summer Monsoon, Westerly Jet, Yangtze River, Lake Suigetsu, sediments, eolian dust

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APE33-P07 Room:Convention Hall Time:May 24 17:15-18:30

Holocene oxygen isotopic records of Itoigawa stalagmites and climate change

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A stalagmite is a valuable paleoclimatic proxy and it is known that its stable isotopes record temperature, rainfall amount and vegetation changes. Especially in tropical and monsoonal regions the oxygen isotope shows inverse correlation with rainfall amount. Previous studies suggested that oxygen isotopic records from caves in south China reflected the intensity of Asian Summer Monsoon (ASM).

We examined stalagmites (FG01 and FG02) collected from a cave in Itoigawa, Niigata Prefecture. They have transparent appearance and relatively straight growth center. Stable isotope analysis was conducted by means of mass spectrograph (Finnigan Delta-plus) and the age was determined by U-Th isotopic compositions measured using MC-ICP-MS (Finnigan NEPTUNE). The dating results showed that the upper part of FG01 was deposited during Holocene and the lower part of FG01 and FG02 were during the Late Pleistocene (mainly 21-30 ka).

The oxygen isotopic record in FG01 is considered to reflect rainfall amount, meaning that heavier rain has lower oxygen isotopic ratio. This was supported by oxygen isotope of rainwater in Toyama and the rainfall record over the past 90 years in Takada, SW Niigata Prefecture. With the relatively stable value from Hendy Test, it can be considered that the isotopic equilibrium has been maintained between the cave drip-water and precipitated calcite.

Two factors are considered to have affected oxygen isotope of FG01. First is the Asian Winter Monsoon (AWM). The isotopic trend of FG01 is different from that of the stalagmite collected in Dongge Cave, SW China. This is because of the difference in dominant moisture source. Rainfall in Southern China is mainly brought by the ASM, of which intensity is recorded in the stalagmite oxygen isotope. On the other hand, climate in Niigata is largely influenced by the AWM leading heavy snowfall, so the stable isotope of the Itoigawa stalagmites probably reflects its strength. The isotopic profiles of FG01 show an inverse correlation with that of Dongge Cave between 4500 and 1000 year B.P. This suggests that the two monsoons worked inversely with each other during the period. However, the inversed trend was not observed in the older period that includes the Holocene Climate Optimum. Moreover, isotopic value of FG01 tends to decrease during this warm period. This is opposite to the general expectation in the warming climate: AWM and winter snowfall likely decreased and stalagmite oxygen isotope increased. Therefore, the second factor, the Tsusima Warm Current (TWC), may affect the stalagmite oxygen isotope in Fukugahuchi by providing moisture to cold-dry air of AWM. Indeed, the abundance of Dictyocoryne spp, dominant species in TWC, in the Holocene core sediment from offshore of Oki Island is well correlated with the isotopic curve of FG01. This indicates that the intensified inflow of Tsushima Current in early Holocene increased winter rain and snowfall in the Japan Sea side.

Keywords: stalagmite, Holocene, climate change

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Millennial-scale surface water property change in the southern Japan Sea during the Marine Isotope Stage 3

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The deep sea environment in the glacial Japan Sea was more sensitive to surface climate change than today because of semi-closed situation due to sea-level low stands. The hemipelagic sediments in the sea are characterized by alternations of bioturbated, organic-poor light layers and finely laminated, organic-rich thin dark layers during the Marine Isotope Stage (MIS) 3. Such sedimentological evidence indicates drastic changes in bottom oxygen level during MIS3. Two possible mechanisms that explain depleted oxygen in bottom water are suggested. First, the dissolved oxygen consumption in bottom water was increased by high productivity due to upwelling. Second, the supply of dissolved oxygen to bottom water was decreased due to enhanced density stratification. These should be quite different situations in terms of surface water density structure. However, there are a few surface water property records at this time.

Here we conducted d18O and Mg/Ca analyses of planktonic foraminifera for a radiocarbon-dated sediment core KR07-12 PC3, which is taken from intermediate depth (329 m) of the southern Japan Sea. Sea surface temperature (SST) and d18O of seawater (d18Osw), which is a proxy of salinity, were reconstructed to reveal variations of surface water property during the MIS3. Results clearly showed millennial-scale surface environmental change. Reconstructed SST ranges from 4 to 9 degreeC which is much lower than modern SST (seasonal range: 11 to 26 degreeC) at the core site. Variations of SST and d18Osw were positively correlated (r = 0.78).

This positive correlation can be regarded as a mixing of two distinct water masses of high SST, d18Osw and low SST, d18Osw. The only one current of warm and saline water flows into the Japan Sea today is the Tsushima Warm Current (TWC). Therefore, the alternation of high SST, d18Osw and low SST, d18Osw during MIS 3 is explained by periodic changes in the strength of TWC inflow. This is consistent with planktonic foraminiferal assemblage in the East China Sea (ECS), which indicates the alternation of two water masses, Kuroshio-related water and coastal water. The millennial-scale variation of the TWC inflow into ECS and Japan Sea played an important role in determining surface water density.

Keywords: sea surface temperature, marine isotope stage 3, Japan Sea, planktonic foraminifera, Mg/Ca thermometry

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Indian monsoon variations obtained from Lonar crater lake in the Deccan Plateau, India

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Indian monsoon is an important component of the Earth's climate system to understand regional and global climate dynamics. Various geological archives including marine sediment records from Indian Ocean reveal evolutions of the monsoon (e.g. Clemens and Prell, 2003) yet, few reconstructions are available from the Indian sub-continent. Therefore, we study geology of Lake Lonar in the Deccan Plateau, India. Lonar crater is one of the best-preserved impact structures on Earth and there is a saline lake with depth of 6 m in the center of the crater (Maloof et al., 2010). The crater cavity is filled with breccia overlain by 30 to 100 m of unconsolidated sediment (Fudali et al., 1980). 40Ar/39Ar step heating experiments of the Lonar crater melt rocks yielded a precise and statistically robust combined isochron age of 570 +/- 47 ka (Jourdan et al., 2011). This suggests that Lake Lonar sediment can possibly provide the records of Indian monsoon for the last 500,000 years or more.

Keywords: Lake Lonar, Indian monsoon, crater

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Climate simulation of the last millennium: some notes on comparison with proxy-based reconstructions

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Coordinated simulations of the last millennium climate are being organized in the WCRP-CMIP5/PMIP3 framework for coupled atmosphere-ocean general circulation models and in a community-based framework for earth system models of intermediate complexity. The authors participate in both, and carried out several experiments. An increasing number of model output becomes available widely to the community. While the direct comparison between reconstructions and model simulations is tempting immediately after the data become available, there are several issues that have to be considered. Difficulties arise from the relatively weak forcing and consequent small ratio between externally-forced climate change and unforced (time-invariant forcing) internal variability. We argue that useful comparisons can be made by 1) first distinguishing externally-forced ”signal” and internally-generated ”noise” using both forced and unforced simulations; 2) extracting the ”signal” with ensemble simulation; and 3) running the model separately with individual forcings. Examples will be presented for variations in the Northern Hemisphere and Greenland temperature.

Keywords: last millennium, simulation, PMIP

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Construction of tree-ring cellulose oxygen isotope chronology in central Japan during last millennium

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<<Introduction>> So far, most of high-resolution paleoclimate reconstructions in Japan have been restricted after 17th century and climate changes in Middle Age of Japan (11-16th centuries) have not been clarified well although numerous famines and warfare occurred at that time. Because tree ring samples can be recovered even from the Middle Age as old architectural wood and excavated archaeological wood, we may create millennium scale of tree-ring chronologies including the Middle Age. In this study, we focus on the tree-ring cellulose oxygen isotope ratios which demonstrate similar inter-annual variations among different species and individuals, reflecting summer hydroclimate. We construct nearly millennium length of its chronology in central Japan and discuss its chronological, climatological and historical significances.

<<Material and Methods>> In this study, we analyzed three wood samples. (1) Cypress tree cut in 1960s at Nakatsugawa, Gifu (810 rings, Nagoya University Museum), (2) Cedar tree collapsed in October, 2009 at Ise, Mie (481 rings, Ise-Jingu Shrine), (3) Cypress old architectural wood at Okuwa, Nagano (351 rings, Chiko-Ji Temple). Each wood sample was cut into 1mm thickness of thin plates and directly applied for chemical treatments for cellulose extraction. After separation of each year ring under binocular microscope using a design knife, the cellulose fragment was wrapped by Ag foil in duplicate for each year ring and applied for oxygen isotope measurement using TCEA/IRMS (Xu et al., 2011). Among the three samples analyzed, the radiocarbon measurements of sample (3) have revealed that it was living during 11-14th centuries. Although we have known the felling years of sample (1) and (2), those samples were applied for cross dating together with sample (3) by comparison of their tree-ring cellulose oxygen isotope time-series with those of a cedar tree at Uda, Nara and two cypress trees at Agematsu, Nagano whose calendar years have been fixed by traditional dendrochronological methods as 1611-1756 AD (Yamaguchi et al., 2010) and 1730-2005 (Nakatsuka, 2010), respectively.

<<Results and Discussions>> First, we compared the data from sample (1) with those of cedar at Uda, Nara and cypress at Agematsu, Nagano and found very good matching periods (r=0.62 ($p=9.98\times10^{-12}$) and r=0.57($p=7.22\times10^{-14}$)), indicating that sample (1) corresponds to the period from 1121 to 1930 AD. Second, we made the isotopic time-series of sample (2) overlap those of sample (1) and cedar at Uda, Nara, resulting in highly matching periods (r=0.44 ($p=1.23\times10^{-10}$) and r=0.57 ($p=7.89\times10^{-11}$)), and confirmed that the innermost ring of sample (2) corresponds to 1529 AD. Third, the living period of sample (3) was determined by comparison of its oxygen isotope time-series with those of sample (1) (r=0.66 ($p=3.14\times10^{-22}$), so that it covers from 1034 to 1384 AD which coincides with the 14C age. The high correlations of tree-ring oxygen isotope time-series among all different species and locations not only suggest that the time-series reflect past summer hydroclimate but also indicate an fact that the time-series of tree-ring oxygen isotope ratios from 11th to 20th centuries can be applied for annually resolved dating of any wood samples of any species from last millennium in central Japan.

The time-series of tree-ring oxygen isotope ratios of sample (1) shows large variability with 50-120 yrs periodicities during 12-16th centuries, suggesting the potential linkage between climate changes and social upheaval during the Middle Age in Japan. The multi-decadal variations during 13-14th centuries coincide well with those of oxygen isotope time-series of stalagmite in China and India (Zhang et al., 2008; Berkelhammer et al., 2010), indicating that the large variability of tree-ring oxygen isotope ratios in central Japan reflects the variations of summer monsoon activity, covering all over Asia including Japan, China and India.

Keywords: tree ring, cellulose, oxygen isotope, dating, central Japan, middle age

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Carbon and Oxygen Isotopic Variation over the Last 1000 Years of a Stalagmite from West Java, Indonesia

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Equatorial region are important because of driving global atmosphere circulation. Though climate changes during the past few millennia have been reconstructed using stalagmites and lake sediment recently, there are only a few high resolution (especially annual- to centennial-scale) paleoclimate records in equatorial region. Stalagmites provide continuous paleoclimate records in land and are dated accurately by U-Th dating. For that reason many studies use oxygen and carbon isotope ratios of stalagmites as paleoprecipitation proxies (e.g. Zhang et al., 2008; Jex et al., 2011).

This study aims to reconstruct variation of past precipitation in Asian equatorial region by analyzing carbon and oxygen isotope ratios (d13C, d18O) from the annually laminated stalagmite CIAW15a, which is obtained from Ciawitali Cave in West Java, Indonesia. Watanabe et al. (2010) reveals d13C and d18O of CIAW15a is affected by kinetic fractionation occurring in the cave and proposes the possible process that d13C and d18O of CIAW15a record variation in local precipitation amount through kinetic process in the cave. Based on the previous study, this study did the following things:

(1)d13C and d18O time series of CIAW15a are compared with instrumental precipitation data and evaluated as proxies to reconstruct past precipitation.

(2)Annual d13C and d18O are analyzed along the growth axis following Izutani (2010), and precipitation before instrumental observation is reconstructed.

d13C and d18O are dated using the average thickness of the uppermost 106 layers. We compared temporal variation between precipitation data and isotopic data of the stalagmite CIAW15a dated using the average thickness of 44.8 micrometer. There are significant negative correlations. Further analysis reveals that d13C and d18O of CIAW15a have high correlations with precipitation amount in rainy season (December-April).

SOI (Southern Oscillation Index), which is an index of ENSO (El Nino/Southern Oscillation), shows no significant correlation with d13C and d18O of CIAW15a. In this region ENSO has high correlation with precipitation in dry season (June-October), while d13C and d18O reflect precipitation amount in rainy season (December-April). Therefore, it supposes that ENSO was not recorded clearly in d13C and d18O variation.

Annual d13C and d18O of CIAW15a were analyzed over the last 1000 years. d13C and d18O are dated using U-Th age model. d13C and d18O variations are synchronous in 10-30 year order during the last 600 years, indicating that they reflect kinetic processes in the cave relating to variation of local precipitation amount. Higher d18O (d13C) of CIAW15a in AD 1425-1625 and 1760-1800 are consistent within age error with periods of droughts recorded in lake sediment from East Java (Rodysill et al., 2012; Crausbay et al., 2006).

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Comparison of Stable Isotope Time Series of Stalagmite and Meteorological Data from East Java, Indonesia

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Speleothems continuously grow up and can be accurately dated by U-Th disequilibrium. Because of these characters, in recent years, speleothems attract attention of scientist as geological materials from which a paleoclimate is reconstructed.

Climatic phenomena of the Southeast Asia equatorial region affect climates all over the world (e.g. El Nino-Southern Oscillation). However, there are only a few paleoclimatological studies using speleothems in the region. These preceding studies have an agreement that precipitation is the factor of stable isotopic variations on stalagmites. However, they disagree about stable isotope fractionation and process controlling d18O and d13C values of stalagmites. Each stalagmite may have individual stable isotope fractionation and individual process controlling d18O and d13C values of the stalagmite.

In this study, firstly, we constructed a high-resolution age model by comparing the U-Th disequilibrium age with the counts of the bandings in the stalagmite BRI09a, which was collected in Bribin Cave, East Java, Indonesia. Secondly, we checked for equilibrium vs. kinetic fractionation on the stalagmite BRI10a, which was collected in Bribin Cave, East Java, Indonesia. Thirdly, we compared d18O and d13C values of the stalagmite BRI10a with instrumental precipitation data on Yogyakarta, Indonesia, in order to judge whether its d18O and d13C variation are proxies of paleo-precipitation.

We constructed a high-resolution age model by comparing the U-Th disequilibrium age with the counts of the bandings in the stalagmite BRI09a. U-Th disequilibrium age of the stalagmite BRI09a was 1038+/-52 yrs. The result of bands counting of the stalagmite BRI09a was 879+/-10 layers at the top of the dated section and 1018+/-38 layers at the base of the dated section. In the thin section of the stalagmite BRI09a, We did not observe hiatus and, when we collected the stalagmite BRI09a, it was growing. These results suggest that the growth layers of BRI09a are dominantly annual. However, the top edge of BRI09a in thin section may be chipped, because of difference between U-Th disequilibrium age and the result of bands counting.

For oxygen and carbon stable isotope time series determinations of the stalagmite BRI10a, in which we constructed a high-resolution age model (Fukunaga, 2010, graduation thesis), 70 samples collected along the growth axis on the stalagmite BRI10a was analyzed using a mass spectrometer. d18O and d13C variations of the stalagmite BRI10a have the good correlation ($R=0.75$, $p<0.01$). d18O and d13C values of the stalagmite BRI10a are higher than an estimated d18O and d13C values from the drip water on the supposition that equilibrium fractionation occurred on the stalagmite BRI10a. These results suggest kinetic fractionation with CO2 degassing.

d18O and d13C variations of the stalagmite BRI10a show the good correlation with precipitation in rainy season on Yogyakarta ($R=-0.59$, $p<0.01$, $R=-0.44$, $p<0.01$). Oxygen and carbon stable isotope time series of the stalagmite BRI10 were proxies of local precipitation. However, SOI and NINO-4, which are El Nino-Southern Oscillation index, do not show the good correlation with d18O and d13C variations of the stalagmite BRI10a because of the difference of the season in which precipitation show correlation with them. Accordingly, oxygen and carbon stable isotope time series of the stalagmite BRI10 were not good proxies of SOI and NINO-4.

We constructed a high-resolution age model in the stalagmite BRI09a and showed that d18O and d13C variations of the stalagmite BRI10a are useful proxies of local precipitation. We will be able to compare between d18O and d13C variations of two stalagmites, BRI09a and BRI10a which were collected from the same cave. After this study, a comparison between two stalagmites, BRI09a and BRI10a will advance our knowledge of stable isotope variations of stalagmites and relation between stable isotope variations of stalagmites and precipitation.

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Relationship between modern speleothem formation and surface weather in Southeast Asian equatorial cave

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To predict future climate change and prepare it is large scientific and social problem. For precise climate prediction, it is necessary to reconstruct high time and space resolution paleo-climate (especially past 2000 years) by paleo-climate proxies and reflect the result to climate model. Equatorial Southeast Asia, where include Indonesia, is well affected by El Nino Southern Oscillation (ENSO). ENSO do not only directly affect to precipitation in tropical Southeast Asia, but also significantly affect to middle and high latitude climate through heat transport (Hastenrath, 1991). However, continuous paleo-climate data in that area is few (IPCC, 2007), thus paleo-climate reconstruction is particular necessary.

Speleothems are useful as a pleo-climate proxy because they are grown continuously in cave (Fairchild et al., 2006). Watanabe et al. (2010) revealed that oxygen and carbon isotopic ratios in the stalagmite calcite are useful as an effective proxy of ancient precipitation, because annual precipitation amounts have negative correlation with delta ^{18}O and delta ^{13}C values in stalagmite sample. However, relationship between modern speleothem formation and surface weather (e. g. recording mechanism of precipitation in stalagmites, how large or in which season precipitation is recorded in) is not revealed clearly. Thus, cave monitoring studies (cave and surface climate, dripwater chemistry, modern speleothem growth experiment) are starting actively (e. g. Boch et al., 2011; Tremaine et al., 2011). But, few are studied in equatorial region.

Baldini et al. (2008) revealed that seasonal airflow direction change, which was driven by seasonal air temperature difference fluctuation between cave and surface, fluctuated cave air CO_2 concentration, and that might influence delta ^{13}C in stalagmite. Tremaine et al. (2011) revealed that seasonal cave air CO_2 concentration variation fluctuated CO_2 degassing rate from dripwater, and then produced seasonal variation of speleothem precipitation rate. However, these were studied in temperate region. In equatorial region, it is predicted that intra-daily variation of cave air CO_2 concentration is main cause which fluctuate growth rate and stable isotope composition, because it is considered that cave airflow direction is dominated by intra-daily surface air temperature fluctuation rather than seasonal.

Thus, in this study, cave monitoring, which included surface meteorological observation (air temperature, precipitation and delta ^{18}O), cave meteorological observation (air temperature, airflow direction and speed and CO_2 concentration), chemical analysis of dripwaters (pH, Ca^{2+} concentration, HCO_3^- concentration, partial pressure of CO_2 ,calcite saturation index, delta ^{13}C, and delta ^{18}O) and speleothem growth experiment (growth rate, delta ^{13}C, and delta ^{18}O), is started from October 2011 in Petruk Cave, Central Java, Indonesia. High time resolution monitoring (2 hour interval) is conducted in addition to 1 to 3 month interval monitoring which is generally conducted in temperate caves. Aim of this study is to reveal relationship between speleothem formation (growth rate and stable isotopic composition) and surface weather in equatorial cave through obtain time series monitoring data and compare them mutually.

Keywords: cave, stalagmite, carbon dioxide concentration, dripwater, equatorial region, Indonesia

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Temporal variation of mineral composition in the drainage area of the Ohno River, Ohita, Japan

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The Ono River is located in the northeast Kyushu Island, which has the head water region at the Mt. Kuju and Mt. Aso, flows eastward combining some tributaries from the south, and then flows northward to the Beppu Bay. Surface geology of the drainage area is roughly divided into two as andosol in the northeast and brown forest soil in the south. Such contrasting detrital provenances could provide a variety of grain composition to the marine sediments deposited in the Beppu Bay. The No. 5 boring core was drilled at a landfill site on the mouth of the Ono River. The core continuously recovers 97 m length and consists of Holocene marine sediments. The variety of the sediment facies would give us a good opportunity to reconstruct the terrestrial environment of hinterland (the Ono River Basin) through the detailed analysis of the detrital mineral composition.

Detrtal fraction contained in marine sediments can be generally used as climate proxies because variations in provenance and mineralogy could be affected by the precipitation distribution and weathering intensity. Change in the surface soil composition could be observed if a well-preserved depositional soil sequence was found. In order to detect the change in provenances and interpret the terrestrial environment using detrital proxies in the marine sediments, it is necessary to know the variability or range of the mineral composition of a particular provenance during the targeted time periods. Fortunately, we found a suitable soil sequence on the foot of the Mt. Kuju at 850 m altitude, which covers the similar time interval as the No.5. The soil sequence consists of brown loam overlain by the alternation of tephra and andosol. We tried to compare the variations in mineral compositions both for this soil sequence and the No.5 core since about 8,000 yrs age.

We conducted a powder X-ray diffraction analysis (XRD) and color (visible light reflectance) measurement to determine the major mineral composition. Used samples were extraction residues by organic solvent, which were dried and powdered before XRD and color measurement. Major minerals were identified and evaluated semi-quantitatively using the height of their diagnostic peaks. The sediment color was examined through $L*$, $a*$, and $b*$ indices.

The No. 5 core mainly consists of smectite, illite, chlorite (or kaolinite), amphiboles, quartz, feldspars, and amorphous materials with minor calcite. Amorphous material is supposed to mainly consists biogenic opal. Amorphous material is higher during 7000 to 3500 yrs BP which suggests the decrease in detrital input due to the Jomon transgression. All the detrital minerals show opposite variation. The detrital mineral composition such as quartz / feldspars ratio is higher during 0 ? 2000 yrs BP and before 7000 yrs BP which suggests a change in terrestrial condition. On the other hand, The Mt. Kuju soil sequence (KSS) mainly consists of smectite, illite, chlorite (or kaolinite), amphiboles, quartz, felspars, and amorphous materials assoiated with gibbsite. Amorphous material is supposed to mainly consists volcanic glass. Crystalline minerals such as smectite, illite, chlorite, and quartz are higher in loam (up to 7000 yrs BP), and quartz increases at the top andosol of the KSS (after 3000 yrs BP). Volcanic glass began to increase just before quartz decreased at about 7000 yrs BP when feldspars increased alternatively. Quartz / feldspars ratio both in terrestrial soil and marine sediment, which show lower value between 3000 and 7000 yrs BP, suggests that the change in surface soil composition could affect the mineral composition of the marine sediments.

Keywords: Ohno River, Mt. Kuju, Beppu Bay, Soil, Mineral composition

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Last 100ka biogenic silica content variation in Lake Biwa, Japan and its factors

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Biogenic silica content (BSC) variation during the last 100ka has been clarified by using molybdenum-yellow method. Samples analyzed were taken at Off-Takashima Drilling Site of Northern Lake Biwa and the time resolution was less than 100 years.

Biogenic silica is one of the main components of diatom frustules and its content variation is regarded as to reflect primary production changes in lakes. Production rate of diatoms is influenced by temperature and precipitation during blooms. Consequently, BSC is used as one of good indicators of climate change at Lake Baikal and Lake Malawi, for example.

Result of frequency spectrum analysis shows good correlation of BSC variation to that of Milankovitch precession cycle and obliquity cycle and the result of shorter term frequency spectrum analysis showed that of ocean circulation and solar activity.

BSC of Lake Biwa also shows short term variation lasting decades to centuries. These variations can be correlated to those of Chinese Interstadials and Greenland Interstadials.

Keywords: Lake Biwa, biogenic silica, interstadials, molybdenum-yellow method

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Last 120ka to 250ka climate changes as deduced from the biogenic silica content of Lake Biwa, central Japan

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The aim of this study is to clarify historical variation of primary production rate through measurement of biogenic silica content (BSC) in lake sediment using molybdenum-yellow method. Samples analyzed were taken at Off-Takashima Drilling Site in 1986. As a part of our research aiming at clarifying variation of primary production history during the last 250ka, BSC analysis was carried out regarding the last 120ka to 250ka, which corresponds to MIS 6 to 8, with a time resolution ca. 400 years.

The result shows good peak correlation to those of delta O18 at Sanbao/Hulu stalagmite record, which mean Chinese Interstadial Number (CIS) B1 to B24. Result of frequency spectrum analysis using SPECTRUM shows good correlation of BSC variation to that of Milankovitch precession cycle of 23kyr and 19kyr which are also recognized during the last 140ka. Short term frequency spectrum analysis using REDFIT 3.8e was applied to BSC variation of kilo year cycles, which recognized 5 cycles, namely, 3.4, 2.3, 1.5, 1.2 and 1.0kyr cycles with more than 95 % confidence level. These periodicities have also been confirmed in the Off-Takashima drilling sample during the last 120ka which mean that those periodicities have affected climatic changes of central Japan during the last two glacial cycles.

Keywords: Lake Biwa, Biogenic silica content, climate change, sediments, periodicity

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Lake-level change history estimated by acoustic record and their factors during the last 45,000 years in lake Nojiri

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Acoustic stratigraphic analysis of acoustic records obtained by Uniboom revealed that lake-level change repeated eight times in lake Nojiri, central Japan, during the past 45,000 years. Comparison of the lake-level record with a profile of pollen composition, TOC concentration changes both in lake Nojiri, oxygen isotope record of NGRIP and those of Sanbao/Hulu caves, show the lake level rose during cold stages and the lake level fell during warm stages. Especially, high lake levels correspond with the global cooling events such as Younger Dryas, Heinrich events and Bond events. The factors for the lake-level rise during cold stages are, decreased evaporation due to cooling and increased snowfall due to enhanced winter monsoon. The factors for the lake-level fall during warm stages are, increased evaporation due to warming and decreased snowfall due to weakened winter monsoon. Grain-size profile of loesses from Loess Plateau corresponds well with that of intensity of winter monsoon deduced from lake-level record.

Keywords: Lake Nojiri, lake-level fluctuation, acoustic record, cold event, snowfall, winter monsoon

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A 28-kyr record of environmental change in NE Japan inferred from the Lake Ichi-no-Megata sediments

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Continuous geochemical data of 37-m thin laminated sediment core from Lake Ichi-no-Megata (maar), northeast Japan provides a 28,000-year history of the response of the lake and its surroundings to global climate change in the northeastern Japan. Principle component (PC) analysis of 17 major and trace elements in the bulk sediment samples indicated that PC-1 score (explain 46.1% of all chemical variables) may reflect the paleo lake productivity and detritus inputs from the surrounding area caused by monsoonal-climate change. We interrupt this correlation that warm and humid climate leads to the high stand of lake productivity and the low input of detritus minerals when the PC-1 score is low (negative), and the vice versa.

On the other hands, seventy four AMS 14C dates enabled us to establish the detailed chronology agreed well with tephrostratigraphy. The event-free composite depth versus calendar plots indicates a stable deposition environment since after 28,000 cal yr BP.

In the last glacial after 28,000 cal yr BP, the PC-1 score has fluctuated with millennial scale and temporally increased at the periods of 27, 25-24, 22-21, 19-18, and 16 cal kyrs BP. These climate cool/dry events could be compared with the stadials in the North Atlantic region such as the Heinrich events.

During the last glacial-interglacial transition (the LGIT, 15-9 ka), the PC-1 score began to became negative gradually at 14,500 cal yr BP, that means the onset of the B/A warming interstadial. After that, the score temporally increased between 12,100 and 11,200 cal yr BP. This temporal climate deterioration seems to be the Younger Dryas (YD) stadial. However, the YD term is not simultaneous compared with the records in the North Atlantic region as well as the affected area of Asian monsoon activities and the Westerlies as China and Japan. It needs to discuss more about it.

In the Holocene, one large change of the PC-1 score was occurred at 1,100 cal yr BP. Compared with the pollen data on the same core, this change may be caused by the human impacts to the lake surrounding area that are forest tree cutting to make buildings. Except this, the score has fluctuated with millennial scale, suggested that Holocene climates in the northeastern may have fluctuated caused by a solar activity.

Keywords: Major and trace elements, Principal component analysis, Lake Ichi-no-Megata, LGIT, human impacts, monsoonal-climate change

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Geomorphological evolution and environmental variation after a deglaciation in the highland of central Peru

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We attempt to reconstruct past environment after deglaciation by using a glacier lake on the central Peru. For this, we had undertaken field investigation as echo sounding and piston coring at Lake Yauriuiri, which is 130 km apart from Nazca city. The lake is one of typical glacier lake at height of 4,384 m. By the seismic record of the lake bottom from echo sounding, it is identified that 10-m thick mud layer with the intercalated fine sand layers on the bedrooks. And, two sediment cores were taken from the southwestern point at 50 m in water depth. The length of the cores is 50, and 170 cm, respectively. Lithology of the sediment shows that almost homogenous dark grey slit with two thin brownish flood-origin layers. We have analyzed physical properties, magnetic susceptibility, color reflectance, chemical compounds by XRF with multiple radiocarbon dating for the whole core section. Our preliminary results indicated two cyclic variations of $L*a*b*$ values, magnetic susceptibility, suggesting that past lake level fluctuation over the last 2,000 years caused by climate changes. These past environmental variations in Lake Yauriuiri may have the similar pattern with other records in inland area of Peru as well as off shore Peruvian marine records.

Keywords: Peru, glacier lake, climate change, echo sounding, Nazca

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Environmental history and flood events during the last 80 years in Lake Marunuma, Gunma Prefecture, Japan

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Lake sediments are, in general, regarded as to preserve environmental history of lakes and their surroundings. Recent studies clarified the existence of lake level change, climate change, floods, tsunamis and earthquake records in sediments. This study restores the existence of flood record, which occurred during the last 80 years, at lake Marunuma of Gunma prefecture.

Older Marunuma was a small lake formed after damming up by lava flows of Nikko-Shirane volcano and its initial diameter was ca. 600m. After the construction of artificial dam in 1930, lake level rose 28m higher.

In addition to the bottom surface sediments taken at all lake area, two short cores were taken at older lake bottom. Samples were described based on naked eye observation, soft-X ray photographs were taken, water content was measured at every 1cm in thickness and grain-size was measured using Mastersizer 2000 of Malvern Instruments Co. also at 1cm interval.

We distinguished flood sediments as to having coarser grain size, lower water content and lower transparency of soft-X ray photos. Statistically significant difference in grain size existed between normal sediment and flood sediments. Sedimentation rate was calculated as 0.2cm per year assuming that the sediment depth which shows minima of grain size and water content to be AD1930, when artificial dam was constructed. Time resolution of the record is ca.5 years based on sampling interval.

Comparison of meteorological events and ages of event sediment shows that five events of large flood can be correlated during the last 80 years. This means that sedimentary record of Lake Marunuma well correlates to those historical flood events at lower Tone River.

Keywords: Lake Marunuma, Event sediment, Flood events

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Vegetation and paleoenviroment during the Last Glacial around the border of Musashino and Yodobashi Uplands, Tokyo

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Peaty deposits around the Last Glacial Maximum (LGM) were cropped out from Site A of Tachikawa terrace (the construction site of 9th building), in the College of Humanities and Sciences, Nihon University. The vegetation history of this outcrop around AT tephra was investigated on the basis of pollen analyses.

About 32,000 years ago, in the vicinity of the investigated area, swamp woods of Alnus were dominant, accompanying conifer and cool-temperate-subarctic deciduous broad-leaved trees in swampy land and upland. It became a little warmer at about 30,000 years ago, the conifer and the cool-temperate subarctic deciduous broad-leaved trees decreased, and temperate to cool-temperate deciduous broad-leaved trees increased instead. Then, the climate became colder toward LGM and the cool- temperate subarctic conifer increased. The commencement of cold climate was shortly before AT tephra fallout.

The pollen diagrams of this site and another site of neighboring Sakuragaoka High School, Nihon University show continuous vegetation change before and after AT tephra. Moreover, those were compared with those of the Nogawa peat, the Shimo-Oshima peat and Kashima IMAGES core, including AT tephra. At a result, the cool-temperate- subarctic conifer forest began to increase shortly before AT tephra, and those were strongly increased shortly after the deposition of AT tephra. This cold phase corresponds to LGM.

Another site B, boring core samples were taken from Musashino Upland in the College of Humanities and Sciences, Nihon University. In this site, the formations of Tachikawa Loam, Musashino Loam, and the uppermost part of Shimosueyoshi Loam are overlying gravel layer. Among these formations, some peaty horizons are included. Therefore pollen analysis for this core may be a good example for clarifying the vegetation history for the past 100,000 years, especially early to middle of the Last Glacial Period.

From the result of pollen analysis, Alnus was dominant in the depth of 6 m peaty deposit, but Cryptomeria japonica was dominated around the depth of 8 m. And also, Hemiptelea which existed in MIS5 and maybe before LGM in Japan was found at the depth of 5 m. The vegetation history of the site B is examined in more detail to clarify climatic and environmental change during the last 100,000 years in eastern part of Musashino Upland.

Keywords: Musashino, Last Glacial Period, pollen, vegetation change, Japan

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Depositional environment changes during the last 20000 years based on carbon and nitrogen around the Okinawa Island

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In order to reconstructing the depositional process after last glacial maximum (LGM), we collected two gravity cores located in the eastern (GH08-2004) and western (GH10-2013) area of Okinawa Island and analyzed Total organic carbon (TOC), Total nitrogen (TN), Total inorganic carbon (TIC), ratio of TOC and TN (C/N ratio). TOC and TN of GH08-2004 show increases toward 14000 cal BP from 26000 cal BP and then decreases toward 7000 cal BP. C/N ratio shows a decrease toward 7000 cal BP from 14000 cal BP. TIC decrease between 8000-12000 cal BP, and then rapidly increase toward 3000 cal BP. While, TOC and TN of GH10-2013 decrease toward 5000 cal BP from 14000 cal BP and then increases toward the present. C/N ratio decrease to 8 from 10 during 9000 to 11000 cal BP and after that, increase toward 9 with frequent variations between 8 and 10. TIC values increase to 5% from 3.5% between 4000 and 8000 cal BP.

Variations in TOC, TN, C/N ratio and TIC indicate that the supply of terrestrial organic matter increased during the sea-level lowstand of LGM and then amount of deposited in calcium carbonate from bioclasts increased accompanying with sea-level rise in a broad way. Increase in C/N ratio of GH10-2013 after 9000 cal BP implies that terrestrial organic matters frequently supplied from surrounding islands.

Keywords: Organic carbon, C/N ratio, Inorganic carbon, sediment, sea-level change, Okinawa

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Paleoceanographic study of submarine cave with air-chamber

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A submarine cave named Ginama cave is located on the northwestern coast of Hedo Point, Okinawa Mainland, Japan. The entrance of the cave lies about 16 m deep. The cave is about 40 m long and ascends until it reaches sea level, thus forming a closed air-chamber at its farthest extension. We measured water temperature and salinity in the cave at 14 October 2011 and collected sessile fauna on the wall with a hammer and chisel. The humidity is almost 100 percent at the air-chamber, because we could see our breath. This implies that the formation of speleothems may be stopped within the air-chamber. Salinity increased from 11.7psu at water surface at the air-chamber to 32.9psu at 11m depth. Skeletal shells of cave-dwelling bivalve Pycnodonte tanighchii and coralline sponges Acanthochaetetes wells and Astrosclera willeyana were collected at the wall between 2 and 7 m depth. On the other hand, the living individuals of coralline sponges are observed at the cave wall below 11 m depth.

Keywords: submarine cave with air-chamber, sessile fauna, environmental changes, Okinawa

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Oxygen isotopic composition of the Bering Sea bottom water during the Last Glacial Maximum: constraints from pore water

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1.Introduction

North Pacific Intermediate Water (NPIW) is defined as the salinity minimum water at depths of 300-800 m in the North Pacific Ocean. Today, the main origin of NPIW is thought to be Okhotsk intermediate water, which is formed by brine rejection during the sea-ice formation on the continental shelf in the Okhotsk Sea in winter (Yasuda, 1997). Studies of microfossil assemblages such as foraminifera and radiolaria suggest that during the Last Glacial Maximum (LGM) NPIW was derived from the Bering Sea (Ohokushi et al., 2003; Tanaka and Takahashi, 2005). However to date, no quantitative evidence (for example, salinity, temperature, or isotopic composition data for water) directly indicates past changes in NPIW sources.

In this study, we reconstructed the distribution of oxygen isotopic compositions of bottom water between 1008 m and 3173 m water depth at the Bering Sea shelf break and Bowers Ridge during the LGM on the basis of the vertical profiles of oxygen isotopic composition in pore waters from International Ocean Drilling Program (IODP) Sites U1339, U1341, U1343, U1344, and U1345. We expect that the reconstructed distribution of oxygen isotopic compositions is a clue to discuss the past changes in NPIW sources.

2. Method

For oxygen isotopic composition measurements, pore water was analyzed by using a stable isotope ratio mass spectrometer (IRMS) (GV IsoPrime, UK) with an automated CO2-H2O equilibration system. Each analysis was performed on a 200-ml water sample. The results for each sample are averages of duplicate analyses.

3. Model

We used a model approach reported from that of Schrag and DePaolo (1993) and following studies (Schrag et al., 1996; 2002; Paul et al., 2001; Adkins et al., 2002; Malone et al., 2004) estimating the glacial-interglacial change in oxygen isotopic composition (delta value) by fitting the numerically simulated depth profile of pore water oxygen isotopic composition to the observed oxygen isotopic composition peak of pore water at 25-45 meters below the seafloor (mbsf), associated with the last deglaciation.

We modeled the oxygen isotopic composition of pore water profiles above 200 mbsf in 50-cm increments by using the one-dimensional diffusion/advection tracer equation. The absolute magnitude of changes in the oxygen isotopic composition of bottom water to input into the model is set as a function of the spliced the benthic foraminiferal oxygen isotopic composition records fixed relative to the magnitude of the oxygen isotopic composition since the LGM.

4. Results

The pore water profiles from all sites showed the expected pattern of isotopic peak left from the LGM bottom water. The oxygen isotopic compositions increased over the first 25-50 m below sea floor (mbsf), followed by a decrease. The oxygen isotopic compositions deeper than 150 mbsf from the Sites U1343 and U1344 increased with increasing depth. The increase of the oxygen isotopic compositions deeper than 150 mbsf may reflect the interaction with clay mineral or advection of fluid from deeper sedimentary column.

Our fit to the data yields the delta values of 0.9-1.0 per mil at Site 1139 (water depth: 1868 m), 1.2-1.3 per mil at Site U1341 (water depth: 2140 m), 0.6-0.7 per mil at Site U1343 (water depth: 1953 m), 0.7-0.8 per mil at Site U1344 (3177 m), and 0.6-0.7 at Site U1345 (water depth: 1008). The globally averaged delta value due to ice volume change since the LGM was estimated as 1.0-1.2 per mil (e.g. Schrag et al., 1996; 2002; Clark and Mix, 2002). The small delta value in the Sites U1343, U1344, and U1345 from the Bering shelf break compared to the globally averaged delta value would reflect the locally decreased oxygen isotopic composition probably due to the low salinity bottom water at the shelf break during the LGM. Thus our result highly suggests that low salinity water sank into deeper depth at the shelf break during the LGM in the Bering Sea.

Keywords: Bering Sea, Last Glacial Maximum, NPIW, oxygen isotopic composition, pore water

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Paleoceanography of a piston core collected from north Emperor Seamount, northwestern Pacific

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Paleoceanography of a piston core collected from north Emperor Seamount, northwestern Pacific

Keywords: Emperor Seamount, marine core, oxygen isotopic stratigraphy, tephra, IRD

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An attempt to use current permafrost thickness to constrain the Last Glacial Maximum temperature in eastern Siberia

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The thickness of permafrost changes in responding to changing climate conditions. Since this process takes place as a result of thermal conduction from the surface, its response time becomes much longer for thick permafrost, compared with the timescale for climate change (Lachenbruch et al, 1982). The goal of the study is to constrain the ground temperature history using this characteristic of permafrost.

Genral circulation models (GCMs) has been used to calculate LGM climate, prescribing the reconstructed forcing conditions (i.e. orbital patameters, trace gases, topography, etc). Using temperature outputs from those experiments and assuming that the pattern of the climate history over last glacial cycle is basically follows the ice-core based temperature reconstruction, we ran a one-dimensional permafrost model to calculate the temperature profile variation for the north and central Siberia. Here, only spatially averaged characteristics of permafrost, such as permafrost thickness of the region or ground thermal properties, are discussed, to constrain the general temperature pattern over Siberia.

A series of 1-D experiments for ground temperature profiles are conducted to calculate temperature profile history in Siberia over last glacial cycle and to give the present (i.e. 0ka) value of permafrost thickness. The pattern of the climate history is assumed to be same, while the strength in LGM cooling is treated as a parameter for these experiments. Reflecting the long response time, the calculated 0ka permafrost thickness is strongly dependent of LGM temperature condition for such deep-permafrost area, varying from 200m to 600m for given conditions.

1-D ground temperature experiments suggest that strong cooling is required to explain the current deep permafrost thickness in eastern-central Siberia. Results from climate models, in which the difference in surface temperatures between LGM and present are larger in inland Siberia than arctic coast region, are consistent with the present permafrost thickness distribution.

Keywords: permafrost, last glacial maximum, ground temperature, numerical experiment, paleoclimate

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A negative feedback on pCO2 by shelf organic matters

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In the past 800 thousand years and before industrialization, the largest variations in atmospheric CO2 concentration (pCO2) occurred in connection with the glacial cycles that characterized Earth's climate over this period. The mechanisms responsible for the glacial-interglacial pCO2 changes have remained unresolved. One curious feature of at least the last four glacial-interglacial cycles is that atmospheric pCO2 reached about the same upper limit of 280 ppm during peak interglacial periods and about the same lower limit of 180 ppm during peak glacial periods. Here, we show using a numerical model of earth system that enhanced shelf sediment weathering during glacial sea-level low stand tends to raise pCO2 and thus stabilize it from further reduction. This is because not all nutrients from weathering will be utilized by biology but more importantly because the spatial distributions of carbon and phosphate from weathering become decoupled in such a way that carbon is preferentially stored in the upper ocean and phosphate in the deep ocean. This finding, combined with observations of preferential remineralization of phosphate in shelf sediment diagenesis, would predict enhancement of biological production during interglacial high stand and stabilization of pCO2 from further increase. The impact of sea level-driven continental shelf exposure and submersion on CO2 is therefore a negative feedback that may have contributed to limiting the variation of Pleistocene pCO2 to the observed 100 ppm range.

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Multiple steady states of Northern Hemisphere ice sheets and the timing of glacial cycles

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Multiple steady states of Northern Hemisphere ice sheets and the timing
of glacial cycles
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Wax and Wane of large Northern Hemisphere ice sheet occurred in the past few million years, characterized by a transition from a period of 40 thousand years cycle with small amplitude of ice sheet change to 100 thousand year cycle with a large amplitude, known as the Middle Pleistocene transition. Although the characteristics of the glacial cycle is well observed, the mechanism what determines the 100ka cycle and what controls the terminations are still under debate. Here we show that the pattern of the growth of the ice sheets during a glacial cycle follows the hysteresis (multiple steady states) structure of North American ice sheet versus insolation by modelling the three dimensional ice sheet. The 100 ka termination is punctuated by Northern American ice sheet responding basically to the precession cycle and summer insolation through its delayed bedrock depression and the large scale calving. Terminations occur when the summer insolation increases after a minimum eccentricity even under constant CO2 level. Obliquity modifies the role of precession and becomes important for a glacial cycle especially when the eccentricity is small. The North American ice sheet is slightly more favorable for faster growth than Eurasian ice sheet when the ice sheet expands over Labrador and Hudson Bay, and suppresses the growth of Eurasian ice sheet through the atmospheric planetary wave feedback. As a result, the North American ice sheet can have affected the hemispheric climate and punctuated the ice sheet change in Eurasia and in Antarctica through CO2 and sea level change. Furthur we show that a cooling due to, for example, the draw down of long term CO2 level of 20ppm or so at most from 240ppm to 220ppm is enough for a switch from 40 ka cycle response to 100 ka cycle response of Northern Hemisphere ice sheet.

Keywords: ice age cycle, paleoclimate, ice sheet