

# Japan Geoscience Union Meeting 2011

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APE031-P01

Room:Convention Hall

Time:May 25 10:30-13:00

## Identification of three tephras and oxygen isotopic stratigraphy of a piston core collected from north Emperor Seamount

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Three tephra layers were interstratified in a piston core taken from north part of Emperor Seamount, northwestern Pacific. These tephras were identified by the chemical compositions of the volcanic glass and the reflective indices of glass shards and minerals. The eruption ages of three tephras can be determined by the standard curve of oxygen isotopic stratigraphy from planktonic foraminifera.

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

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APE031-P02

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## Provenance of surface sediments to the west of Okinawa Island based on mineral assemblage

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A lot of clastic particles are carried into the East China Sea. Their provenance is various, such as Changjiang (Yangtze River), Huanghe (Yellow River), Taiwan Island and inland deserts. Since the contribution of each provenance can be affected by the intensity of wind and river flux, changes in provenances in marine clastic sediments record temporal paleo-environmental changes. Therefore, by analyzing a sediment core in the East China Sea, we can reconstruct the temporal changes in environment around Asia. To interpret the temporal variations in grain size and content of minerals in marine core, it is necessary to know the behavior of present particle transportation in the East China Sea. The objectives of this study are to determine the provenance of ocean surface sediment near the Okinawa Islands and to investigate paleo-environmental changes by applying the results to core samples.

Six surface marine sediments, gravity core sediments (GH10-2008), and riverbed sediments were used in this study. The surface marine sediments and gravity core GH10-2008 were recovered in GH10 cruise around the main Okinawa Island. Riverbed sediments were taken near the river mouth of each site. All the samples were first decalcified with acetic acid. Second, organic matter in samples were dissolved with hydrogen peroxide. After preparation all samples are fractionated by 64 micro meter sieve. For the fine fraction (smaller than 63 micro meter), the sample is fractionated into two fractions, 16-63 micro meter and smaller than 16 micro meter, followed by exploiting Stoke's Law. After fractionated, each samples were dried in an oven at 60C and measured by weight. In order to investigate the spatial variation in mineral composition, the surface sediments and riverbed sediments were analyzed by X-ray diffraction (XRD). Gravity core GH10-2008 was also analyzed to investigate the temporal variation in the mineral composition.

APE031-P03

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## Paleoenvironmental and paleoclimatic record of core MD06-3040 from East China Sea Shelf

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The river-dominated ocean margins play a significant role in global environment system. One of the best examples is the epicontinental shelf of the East China Sea, which receives a large amount of terrigenous material from two of the largest rivers in the world, Yangtze and Yellow Rivers. An elongated subaqueous mud wedge extends from Yangtze River estuary to southward off the Zhejiang and Fujian coasts [1]. It is referred to as the mud belt deposit on the inner shelf of the East China Sea. Most of the sediments in the mud wedge came from Yangtze River. The southward flowing East China Sea Coastal Current on the inner shelf, the northward flowing Taiwan Warm Current on the outer shelf, and the Kuroshio Current have played crucial roles in transporting and trapping most of the Yangtze-derived material in the inner shelf, and preventing the sediments escape into the deep-sea.

IMAGES XIV 2006 Marco Polo II cruise recovered a high quality calypso core (MD06-3040, 27.43.3663 N, 121.46.8822 E, water depth 47m, core length 19.36m) from the mud wedge. Based on high resolution AMS14C dating, the core spans the time period from 10.6 ka to present off South China. We separated grain size distributions into three end-member components EM1, 2, 3 that reflect different transportation mechanisms closely related to the sea-level change and environmental changes using end-member modeling. We use EM3/(EM1+EM3) as a parameter to represent contribution of clay to fine silt fraction relative to coarse silt fraction and Fe/Ti ratio to represent semi-quantitatively Fe content of detrital materials supplied from Yangtze River, which were measured by XRF core scanner. These two parameters show good correlation with  $\delta^{18}O$  records of stalagmites from Dongge and Hengshan Cave in south China, which is believed to be a measure of summer monsoon intensity [2, 3], with larger fine population grain size, lower Fe/Ti ratio, and smaller EM3 (clay to fine silt fraction) contribution and larger EM1 (coarse silt fraction) contribution corresponding to dry periods characterized by heavier  $\delta^{18}O$ .

The increase in fine population grain size and decreases in EM3/(EM1+EM3) and Fe/Ti ratio coincide with weaker summer discharge events of Yangtze River detected at 9.3, 8.3, 7.3, 6.0, 4.8, 3.3, 2.3, 0.7, and 0.4 ka, which also agree well with weaker EASM precipitation events recorded in some of stalagmites and in northern East China Sea [2,3,4]. This indicates that the supply of the detrital materials to the inner shelf and their grain sizes is strongly affected by summer monsoon intensity. Thus, grain size and chemical composition of MD06-3040 core have a high potential to record EASM intensity changes during the Holocene with high resolution. Larger fine population grain size, lower Fe/Ti ratio, and smaller EM3 (clay to fine silt fraction) contribution and larger EM1 (coarse silt fraction) contribution suggest that EM3 decreases relative to EM1, representing less fine Fe-rich minerals and detrital materials supplied from Yangtze River be transported to ECS shelf during dry summer periods. The further analyses of core sediments indicate that the Zhejiang-Fujian Coastal Current has formed and kept stable since about 7 ka BP.

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Keywords: Holocene, paleoclimatic change, East Asian Summer Monsoon

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APE031-P04

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## North Atlantic icebergs in early glacial periods after intensification of Northern Hemisphere glaciation

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<sup>1</sup>National Museum of Nature and Science, <sup>2</sup>Kyushu University

We investigated an iceberg discharge regime in early glacial periods after intensification of Northern Hemisphere glaciation by the examination of rock magnetic properties of marine sediments recovered at Site U1314 in the Gardar Drift (North Atlantic) during IODP Expedition 306. We constructed an age model during 2.76-2.10 Ma by tuning a newly created index [magnetic susceptibility (MS) + natural gamma radiation (NGR)] to the LR04 oxygen isotope stack record between the MIS 80 glacial and the MIS G7 interglacial periods. A NGR-MS index record indicates that a single iceberg surge occurred during individual glacial periods before MIS100, and in contrast, sawtooth-like fluctuations of iceberg surges occurred during glacial periods after MIS 100. In addition, the millennial-scale iceberg surges were dominated within glacial stages during intervals when ratios of LR04 oxygen isotope stack surpassed approximately 3.5 per mil. These are comparable to the climate changes in Pleistocene glacial periods, such as Dansgaard-Oeschger cycles and Bond cycles during the last glacial, suggesting that circum-North Atlantic continental ice sheets have oscillated and have calved icebergs in a similar manner at least since MIS 100.

Keywords: icebergs, intensification of Northern Hemisphere glaciation, North Atlantic

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APE031-P05

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## Mid-Pliocene climate as simulated by the MIROC general circulation model

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The Mid-Pliocene, approximately 3 million years ago, was the most recent interval in the earth's history when global temperatures were significantly warmer than that of modern day. Partly due to a wealth of proxy data, the mid-Pliocene has become a focus of study for paleoclimate modellers who wish to understand the dynamics of warm climates of the past and gain more insight into future climate change.

To simulate the mid-Pliocene climate, we use the MIROC3.2 AGCM and AOGCM constrained by boundary conditions derived from the most up-to-date US Geological Survey data sets which include topography, land/sea mask, land vegetation and ice sheet extent. Sea surface temperatures are also prescribed in the AGCM. For simplicity, orbital parameters and greenhouse gas concentrations are fixed at pre-industrial values, although CO<sub>2</sub> levels are increased to 405ppm.

In the AGCM, the global mean surface air temperature increases by 2.8 deg C, with the largest warming occurring at high latitudes due to reduced ice sheets, reducing the meridional temperature gradient. In the AOGCM, however, there is a global increase of 3.4 deg C because warming at low-latitudes is greater than that of the AGCM. Increased precipitation seen over parts of northern Africa and northern India agree with proxy data. There is also a small weakening of the Atlantic meridional overturning circulation.

Keywords: Pliocene, paleoclimate, climate sensitivity

APE031-P06

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## Oxygen isotope stratigraphy of upper part of the Mera Formation, Chikura Group in the southern Boso peninsula

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It is thought that the Mera Formation of Chikura Group which distributed in the southern Boso peninsula deposited at about 3Ma. Mera Formation is the stratification recorded the detailed change of paleoceanographic events, because it occurred that the glacier at high latitude of northern hemisphere formed for the first time and the climatic change cycle changed at this age (Tiedemann et al., 1994, etc.). So we reconstruct chronostratigraphy of the Mera Formation, based on oxygen isotopic stratigraphy using foraminifers and on magnetostratigraphy, in order to derive paleoceanographical data.

We collect rock sample from the stratification along the Chikura way and the stream in Chiba prefecture Minamiboso city Chikura-cho. We pick up foraminifers from 112 stratigraphic horizon and measure those isotope ration with Iso Prime Multi Prep in Center for Advanced Marine Core Research, Koch University.

### 1. Oxygen isotope stratigraphy

We reconstruct chronostratigraphy of Mera Formtion using the LR04 standard curve (Lisieski and Raymo, 2005) and the age of the Matuyama/Gauss Boundary and that of the top and bottom Kaena subchron. As a result, the age of this studies' field is 2.30-3.14 Ma. The oxygen isotope curve from Mera Formation to Hata Formation shows that deep water temperature of such area tends to have shifted higher relatively as compared with the LR04 standard curve. In this tendency, two possibilities are thought. One is that temperature of deep water rose locally. The other is that depositing depth became shallow modestly. It is hard to think that the former is possible, because it is thought that such area was faced the open sea. Judging from this, it is possible that depositing depth became shallow at such area.

### 2. Estimate about the difference of temperature between surface water and deep water and paleodepth

We estimate the difference of temperature between surface water and deep water from the difference of  $\delta^{18}O$  between planktonic foraminifera and benthic foraminifera using the formula proposed by Oba(1971). As a result, its temperature is about 19.5 degrees. In order to estimate paleodepth of such area, we use the water temperature and depth data of Station224 (Broecker et al, 1982). When its water temperature and depth data is same as the present one, the depth which the difference of temperature between surface water and deep water is 19.5 degrees is about 1000m. So, when this study area deposited, the depth was about 1000m there.

### 3. Sedimentation rate

The average of sedimentation rate from this study area is 62.7cm/kyr. The maximum rate is 93.1cm/kyr (stratigraphic horizon 313.3-345.7m), the minimum rate is 31.6cm/kyr (stratigraphic horizon 76.5-100.8m). Generally, the supply of clast increases in glacial epoch compared with interglacial, so it is thought that sedimentation rate also increases in glacial epoch. Such tendency is showed during about 2.4-2.6Ma. It is thought that the variation of sedimentation rate is affected by glacial- interglacial cycle.

APE031-P07

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## Flux variations of biogenic opal and carbonate from the marine Plio-Pleistocene Chikura Group, southern Boso peninsula, c

Akitoshi Hatakeyama<sup>1\*</sup>, Makoto Okada<sup>2</sup>

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According to oxygen isotopic analyses for deep-sea sediment cores, global climate and the climatic changes prior to 3 Ma are thought to be much warmer and smaller than the present. However, it gradually begins to get cold from approximately 2.7 Ma, and the glacial / interglacial cycle of 40 kyr becomes marked on this boundary (*Tiedemann et al., 1994 ; Shackleton et al., 1995*). Current researches have revealed that continental ice sheets did not exist in the high latitude northern hemisphere prior to 3 Ma, but it has rapidly developed since around 2.7 Ma (NHG; northern hemisphere glaciation). Nevertheless, there is no direct evidence indicating the reason why NHG occurred at that time and it is important to know how NHG has affected the earth's climatic system at that time.

The Chikura Group distributed in the southern Boso peninsula, facing the North West Pacific Ocean, provides marine sedimentary sequences ranging over the late Pliocene / early Quaternary boundary from c.a. 3.4 Ma to 1.2 Ma. Whereas the chronostratigraphical discussion for the Chikura Group has been done by various studies, quantitative discussion for biological productivity has almost never been conducted yet. Consequently, the purpose of this study is to restore more detailed marine environment in the North West Pacific by comparing to biological productivity in other areas. This time, we report preliminary results for biogenic carbonate and opal fluxes.

Biogenic carbonate and opal fluxes vary from 1.3 to 29.1 g/cm<sup>2</sup>/kyr and from 1.0 to 12.5 g/cm<sup>2</sup>/kyr, respectively. With a few exceptions, biogenic carbonate and opal fluxes indicate a trend increasing at interglacial and decreasing at glacial. Additionally, the fluctuation of biogenic opal flux becomes greater after the start of NHG than before. We compared this trend to biogenic opal flux data from Ocean Drilling Program (ODP) Site 882 located on the North Pacific Ocean (*Swann et al., 2010*). As the result, biogenic opal indicated similar biological productivity in North Pacific Ocean and North West Pacific Ocean before NHG, but the biogenic opal flux increases and expands the fluctuation in North West Pacific Ocean, while it decreases and becomes smaller in the North Pacific Ocean after the beginning of NHG.

Keywords: flux variation, Chikura Group, biogenic carbonate, biogenic opal



APE031-P08

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## Multi-biomarker analyses of the Paquier level deposited during the Cretaceous OAE1b in the Vocontian Basin, SE France.

Takuto Ando<sup>1\*</sup>, Ken Sawada<sup>1</sup>, Kazuki Okano<sup>1</sup>, Hiroshi Nishi<sup>2</sup>, Reishi Takashima<sup>2</sup>

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Black shales were occasionally discovered in the mid-Cretaceous formations, and depositions of these sediments are closely associated with the expansion of oxygen-poor water in the ocean, called the oceanic anoxic events (OAEs). In this study, the biomarker analyses of the black shales corresponding to the OAE1b (the Paquier level) from the Vocontian Basin of SE France are carried out in order to reconstruct the changes of environmental systems and marine ecosystems, and to elucidate the mechanism for expansion of anoxic waters during this OAE.

In the Paquier samples, the terrestrial higher plant biomarkers such as the retene and the dibenzofuran are abundantly identified. The concentrations of these biomarkers are relatively low in the Jacob level, but high in the middle part of the Paquier level. Moreover, the concentrations of marine algal biomarkers such as steranes and dinosteranes are high in the Paquier levels. These trends are similar to those of terrestrial biomarker concentrations, which indicate that the nutrient was transported from land to ocean. In the Paquier level the archaeal biomarkers such as 2,6,15,19-tetramethylcosane (TMI) and 2,6,10,15,19-pentamethylcosane (PMI) are detected. Carbon isotope ratios of TMI and PMI range -35 to -20permil, suggesting that these biomarkers are originated from methanogenic archaea. Thus, these expansions of methanogenic archaea during the Paquier levels were possibly related to the intensification of anoxic condition. As mentioned above, the deposition of black shales are strongly related to terrestrial input. In addition, the variations of dinoflagellate and cyanobacteria productions were reconstructed by using aromatic dinosteroids and hopanoids in the Paquier level.

Keywords: Oceanic Anoxic Event (OAE), Cretaceous, paleo-ecosystem, biomarker, supply of terrigenous material



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## 8-myrcycles of the sedimentary rhythms of Triassic-Jurassic lacustrine Newark Super-group and pelagic bedded chert

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The long-period cycles of up to several million years are known in paleoclimate records. However, due to the lack of up to several tens of million years long-term, continuous, and

high-resolution records, the mechanisms of long-period climate cycles are still remain uncertain. In this study, a pelagic bedded chert sequence in Japan and the lacustrine Newark Supergroup in eastern North America have been used to construct an astronomical time scale of approximately 30 myr. long during Triassic-Jurassic. These sequences show a hierarchy of the sedimentary rhythms of astronomical cycles origin including all of the main precession related periods (Ikeda et al., 2010; Olsen, 1986; Olsen and Kent, 1999), with the exception of an unexpected 8-myrcycles. The 8-myrcycles were nearly synchronous between the two sections based on the biostratigraphy, and also synchronous with the amplitude modulation of the approximately 2-myrcycles. The presence of the approximately 8-myrcycles in our sedimentary records would suggest the possible impact of the amplitude modulation of the approximately 2-myrcycle on the Earth system dynamics through non-linear interaction.

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Keywords: chert, lacustrine, cycle, Triassic-Jurassic, lake level, Newark

APE031-P10

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## Timing and cause of desertification in the Tarim basin

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Desertification in the Asian interior is one of the most remarkable climate changes during Cenozoic, which characterizes the transition from the zonal climate distribution to the Asian monsoon climate distribution in the northern hemisphere. Increased number of studies on the timing of desertification in Asian interior has been conducted in the last decade. Based on these studies, the onset of desertification in the Central China seems to have been as early as 22 Ma. On the other hand, the evidence of desertification in the Tarim Basin goes back only to 5 or 7 Ma so far. Especially, the interpretation on the timing of desertification in the Asian interior during the Early Miocene is controversial. The Taklimakan Desert in the Tarim Basin is considered as one of the major source area of aeolian dust deposited in the North Pacific and Chinese Loess Plateau. Thus, it is important to improve our knowledge on the timing and formation process of the Taklimakan Desert in order to reconstruct of paleoclimatic evolution in East Asia.

The studied sequence is located at Aertashi in the southwestern margin of the Tarim Basin, where thick shallow marine to terrestrial sequence since Oligocene to Pliocene is well-exposed. We try to distinguish the eolian dust contribution to detrital materials derived from the western Kunlun Mountains to Aertashi section. We compared Electron Spin Resonance (ESR) signal intensity and Crystallinity Index (CI) of quartz in two size fractions (fine=0-16 $\mu$ m, coarse=63 $\mu$ m<) separated from fluvial sediments. ESR is an analytical technique to estimate the amount of oxygen vacancy in quartz formed by natural radiation, whose amount shows positive correlation with the age of the host rock. Whereas CI of quartz has information on the physical condition of its formation. Therefore, these two parameters give us information on two different aspects of its host rock characteristics, one is the age and the other is the rock type. These two parameters help us to identify the provenance of quartz. We focused on quartz because quartz is a major component of eolian dust and resistant to chemical and physical weathering. The fine fraction may contain eolian grains transported long distance by wind whereas coarse fraction is dominantly composed of grains transported by river stream although this fraction may also contain local detrital grains transported only short distance by saltation or bottom traction in wind. In our previous study, it is demonstrated that ESR and CI of quartz in fine and coarse fractions are similar in river sediments uncontaminated by eolian dust whereas these values are different between fine and coarse fractions of the river sediments contaminated by eolian dust. It is also demonstrated that changes in ESR and CI of quartz in coarse fraction may reflect changes drainage or exposure of new rock types in the drainage area.

Rapid changes in ESR and CI of quartz in coarse fraction occurred around 8 Ma, 5.8 Ma and 3.2 Ma. Especially, paleocurrent direction also changes from westward to eastward around 8 Ma, suggesting changes in drainage area or exposure of new rock types within the drainage area around 8 Ma possibly associated with uplift of the western Kunlun Mountain. The comparison of ESR and CI between the two fractions revealed that these values are different around 8 Ma and 4.2 Ma, suggesting eolian contamination within the fine fraction. These results suggest that the intensification of desertification of the Tarim Basin occurred in association with the uplift of the western Kunlun Mountain around 8 Ma and 4.2 Ma.

Keywords: Tasim Basin, Taklimakan, Aeolian dust, Tibet, Kunlun, ESR

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## Constructing high-resolution age model based on annual bandings of Indonesian stalagmites for paleoclimatology

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Speleothems have the features that they continuously grow up and can be accurately dated by U-Th disequilibrium equilibrium. Accordingly, in recent years, speleothems attract attention of scientist as geological materials from which a paleoclimate is reconstructed. Climatic phenomena of the Asian 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.

In order to reconstruct paleoclimate using stalagmites, our group takes three following steps:

1. Construction of age model by comparing the U-Th disequilibrium ages with the counts of the bandings in a stalagmite.
2. Stable isotope (C, O) analysis along a growth axis of a gotten age model and comparison stable isotope time series with instrumental precipitation data, in order to assess the reliability of stable isotopic ratios of a stalagmite as a climate proxy.
3. Reconstruction of precipitation in the past when there is no instrumental precipitation data.

In this study, 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 at 2007. U-Th disequilibrium age the stalagmite BRI09a was 1038 $\pm$ 52yrs. The result of bands counting of BRI09a was 879 $\pm$ 10 layers at the top of the dated section and 1018 $\pm$ 38 layers at the base of the dated section. These results suggest that the growth layers of BRI09a are dominantly annual.

We also constructed a high-resolution age model in the stalagmite BRI10a, which was collected in the same cave at the same time, and reported in B-PT014 poster session, Japan Geoscience Union Meeting 2010 (Fukunaga et al., 2010). We have two stalagmites with high-resolution age models in the same cave. Thus, we can reconstruct two paleo-precipitations severally from two stalagmites in same cave and compare two reconstruction. This comparison will make advance of the climate proxies on Indonesian stalagmites.

Keywords: speleothem, age-model, dating

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## Description and environmental monitoring in Hokkai Cave, southwestern Hokkaido

Wataru Hasegawa<sup>1\*</sup>, Takanobu Sawagaki<sup>2</sup>, Yumiko Watanabe<sup>1</sup>, Takahiro Tagami<sup>1</sup>

<sup>1</sup>EPS, Kyoto Univ., <sup>2</sup>Faculty of EES, Hokkaido Univ.

The Hokkai-cave is newly-discovered cave in 2006 in southwestern Hokkaido. The cave had been conserved under natural condition. This poster reports the results of Speleological study of the cave conducted during 2006-2009, including geomorphological survey, monitoring of the interior air temperature and ground water currents. The Hokkai-cave was surveyed in 2006, revealing that the cave is the longest cave in Hokkaido (total 479.8 m). The cave has zigzag corridors and small speleothems are found in the cave. The cave floor is mainly made of clay and breakdown gravels. There is a small underground-river in the cave. Interior air temperature (IAT) was monitored during 2007-2009. The air temperature at the inner part of the cave was stable through the year (7.5~7.7 °C), On the contrary, air temperature in the vicinity of the entrance was unstable because of the influence of the outside air temperature (OAT). Air current is driven by the air temperature gradient between the inside and outside of cave. When the IAT exceeds OAT, the current flows from ent.U (upper) to ent.L (lower) and from ent.U to deep zone. On the other hand, when OAT exceeds IAT, the current flow from ent.L to ent.U and from deep zone to ent.U. Hydrological monitoring was done during 2007-2008 in the cave. The underground-river in Hokkai cave usually dried up except during the events of heavy rainfall (about over 40 mm per a day) or snow melting season. Sources of the water may be allogenic recharge from surface streams and dispersed infiltration. The difference of water sources may cause the different type of hydrograph for each water flow event. Recently, it has been popular to reconstruct paleo-climate from cave stalagmite. To study plaeo-climate from stalagmite in Hokkai-cave is important because Southwestern Hokkaido is the northern limit area of East Asia Monsoon which characterize East Asian climate and culture. The results of this study should be valuable basic data for that.

Keywords: cave, speleothem, East Asian Monsoon, temperature monitoring, underground river, Hokkaido

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## Stable isotopes of a submarine cavernicolous micro-bivalve: Potential application to East China Sea

Konatsu Kobayashi<sup>1\*</sup>, Chikako Tamaki<sup>1</sup>, Akihisa Kitamura<sup>1</sup>, Nagisa Yamamoto<sup>2</sup>, Tomohisa Irino<sup>3</sup>, Yosuke Miyairi<sup>4</sup>, Yusuke Yokoyama<sup>4</sup>

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The aragonite micro-bivalve *Carditella iejimensis*, which is less than 3.5 mm in height and length, inhabits the sediment surface within submarine caves at Okinawa, Japan. The many specimens of this species are also found from cored deposits of the submarine caves. To evaluate  $\delta^{18}\text{O}$  values ( $\delta^{18}\text{O}_{\text{shell}}$ ) of the whole shells as proxy of tropical sea surface water temperature, we analyzed  $\delta^{18}\text{O}_{\text{shell}}$  of living whole shells obtained from the  $>1$  mm fraction from submarine caves Daidokutsu (30 m depth) and Shodokutsu (20 m depth) collected at six periods. A significant positive correlation exists between  $\delta^{18}\text{O}_{\text{shell}}$  and  $\delta^{13}\text{C}_{\text{shell}}$  in four of six datasets from Shodokutsu, indicating that vital effects may affect  $\delta^{18}\text{O}_{\text{shell}}$  of *C. iejimensis* of Shodokutsu. On the other hand, the positive correlation is not identified in both six datasets of living shells and dead shells of cored sediments from Daidokutsu. Observed values are very close to the predicted isotopic equilibrium  $\delta^{18}\text{O}$  values from environmental data. These show that  $\delta^{18}\text{O}_{\text{shell}}$  of Daidokutsu can be used as proxy of water temperature and the isotopic composition of the ambient seawater in which the animals live. Based on the  $\delta^{18}\text{O}_{\text{shell}}$  record from well-dated sediment cores recovered from Daidokutsu, anomalously lowering of temperature ( $6.6 \pm 2.5^\circ\text{C}$  relative to the present) and dry events (enrichment in  $\delta^{18}\text{O}$  seawater of 0.5 per mil) occurred at sea surface condition in the southern East China Sea at 6,400 to 6,300 cal. years BP.

Keywords: submarine cave, micro-bivalve, oxygen isotope, temperature

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## Paleoenvironmental variability of the Beppu Bay during the last 3000 yrs based on mineral composition of the sediments

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The Beppu Bay is located at the Pacific side of the southwest Japan opening to the east. Sea surface temperature varies from 10 to 27 degree C nearly in harmony with the seasonal variation of local air temperature. The Bay is also famous for its fishery products. The water depth is 35 m in average and approximately 70 m in the deepest which is located nearly at the center of the Bay. This basin bathymetry makes the bottom water anoxic and scales of sardine and anchovy are well preserved in the sediments. The circulation and ecology in the Bay seems to respond very sensitively to the regional climate, and the past variability is expected to be well-preserved as the sediment archive due to its anoxic condition.

In order to reconstruct the primary production, bottom redox condition, and sediment supplies from the surrounding area, and examine the interrelationship among them, we corrected a 10 m long sediment core BP09-3 at the deepest part of the Beppu Bay. The sediments consists of dark olive or gray diatomaceous mud intercalated by some sand layers. The core covers approximately 3000 yrs from the present. We conducted an 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\*, C\*, and H indices which correspond to brightness, metric chroma (vividness), and metric hue, respectively.

Major minerals detected are illite (or muscovite), chlorite (or kaolinite), quartz, anorthite, pyrite, calcite, opal-A, and halite (sea salt). Opal-A (biogenic silica) is semi-quantified from the hump of background at 22.5 degree 2theta relative to 16 degree 2theta. Clays were roughly quantified using the peak height at 19 degree 2theta. Opal-A is higher between 250 and 550 cmbsf and between 700 and 1000 cmbsf. High opal-A intervals are associated with high L\*, C\*, and low pyrite. Anorthite/quartz ratio is higher in sand layers which is associated with lower H (slightly reddish color). In non-sand layer intervals, anorthite/quartz ratio is lower between 250 and 550 cmbsf and between 700 and 1000 cmbsf. Quartz/clays ratio is nearly constant except for some high values in sand layers. Calcite is generally minor but sometimes higher between 250 to 550 cm.

The appearance of sediment core is bright and vivid at the interval of high opal-A (biogenic silica) which is rarely associated with higher calcite. General anti-phasing between opal-A and pyrite suggests that bottom anoxia was relaxed when high productivity. This could be controlled by storminess which promotes higher nutrient supply to the surface and oxygen supply to the bottom through vertical mixing. Higher opal-A intervals are also associated with lower anorthite/quartz ratio, which suggests the supply of less-sandy detritus or change of provenance in surrounding drainage area. General trends of shown in sediment mineral composition suggest the close relationship between regional climate and circulation in the Beppu Bay.

Keywords: mineral composition, XRD, color measurement, paleoenvironment, Beppu Bay, Southwest Japan

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## Pollen distribution in surface sediments on the Okhotsk Sea

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The objective of this study is to reveal distributions of fossil pollen assemblages in surface sediments on the Okhotsk Sea basin floor as an example of pollen distribution on deep-sea basins. We used top 5 cm sediments of 16 core top samples, belonging to JAMSTEC, taken from the Okhotsk Sea basin. Fossil pollen analyses were done using pollen grains extracted from 1.5 gram in dry weight sediments at each core sample.

As the results, we divided distribution of the fossil pollen assemblages on the Okhotsk Sea basin floor into two zones that are 1) coastal zone (mainly within 100 km from the coast) and 2) pelagic zone. 1) Assemblages of the coastal zone mainly consist of *Betula* and other deciduous pollens which are the main elements of taiga forest, corresponding to vegetations on the neighboring land. Concentration of pollen grains is often over 1000 grains/gram indicating relatively high value as deep-sea sediments. 2); Assemblages of the pelagic zone mainly consist of conifer pollens such as *Pinus* and *Picea*, which are wind-transport type pollens. Concentration of pollen grains is around or less than 500 grains/gram. These observations indicate that pollen assemblages in surface sediments on the Okhotsk Sea basin floor reflect vegetations on the neighboring lands precisely more when the distance from the coast is closer, and relative abundant of wind-transport type pollens such as *Pinus* become larger when the distance is far. Therefore we might say that the distribution of pollen grains has not been affected by ocean current after the pollen grains, transported by wind, fall on the sea surface.

Keywords: fossil pollen, Okhotsk Sea, paleoclimately



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## Pollen analytical studies of lake sediments, Ichino-megata, Oga Peninsula. -Late Vegetation and climate changes around th

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Oga Peninsula, Akita Prefecture located in Northeast Japan is jutting out into the Sea of Japan. There are three maars, Ichi-no-megata, Ni-no-megata, San-no-megata. Lake Ichi-no-megata, the largest maar, is 45m maximum water depth and has flat bottom with a steep slope. We obtained lake sediments from the Lake Ichi-no-megata and analyzed fossil pollen for reconstructing the vegetation and climate changes around the Tohoku region affected by the Sea of Japan.

We obtained three boring cores from the center of Lake Ichi-no-megata from November to December, 2006. The boring core is reached 37.2m in depth. The lake sediments is well preserved lamination (varve), and has volcanic products from San-no-megata maar between 23.7m and 32.3m in depth. There are five identified tephra in this core, B-Tm (1.99m), To-a (2.01m), K-Ah (6.64m), As-K (12.18m) and AT (36.55m). 78 plant remain samples, mainly leaf, are corrected for dating the <sup>14</sup>C age. From the <sup>14</sup>C ages and tephra, it is considered that the sediments core is recorded the environmental changes since 30000 years ago.

283 sub-samples for pollen analysis are corrected by 1cm thickness in random order excluded sand layer. We classified 10 local pollen zones (I-X) by the frequency of arboreal pollen appearances.

The lowest pollen zones (I-IV : 12.50m-8.71m) is characterized by abundance of conifer tree pollen, such as *Picea*, *Abies* and *Tsuga*, with *Betula*. These pollen zones are corresponded to the Last Glacial Maximum, thus this region covered with subarctic conifer forest reflected the cold climate. The dominated pollen taxa are changed dramatically in pollen zones V-VI (12.50m-8.71m). These pollen zones are characterized by decreasing these conifer pollen and increasing deciduous broadleaved tree pollen, *Betula* and *Quercus* sub. *Lepidobalanus*. The vegetation was changed from subarctic conifer forest to temperate deciduous forest by warm climate. *Fagus* is dominated in pollen zones VII-VIII (8.71m-1.62m). The appearance of *Fagus* is reached to 45%, with *Carpinus* and *Quercus* sub. *Lepidobalanus*. *Fagus* forest around the Tohoku region was established at this period. The upper pollen zones (IX-X : 1.62m-top) are characterized by suddenly increase of *Pinus* pollen and decrease of *Fagus* and *Quercus* sub. *Lepidobalanus*. The abundant appearance of *Pinus* indicate the human impact for vegetation around this region from 500 years ago.

The reconstructed vegetation changes from pollen analysis using Ichi-no-megata sediments are well corresponded with other pollen analytical studies in Japan. In addition, the climate changes reconstructed from vegetation changes are corresponded with Global climate changes.

*Fagus* forest around this region established after the forest mainly composed of *Quercus* sub. *Lepidobalanus*. This time lag is occurred by strength of Tsushima warm current inflow into the Sea of Japan. The coast of the Sea of Japan in the Tohoku region, which is covered with *Fagus* forest in the present, has heavy snow caused by northwesterly winter wind and moisture from the sea. It is considered that the inflow of the Tsushima warm current into the Sea of Japan strengthened since 10,000 years ago.

Keywords: Ichi-no-megata, lake sediments, *Fagus* forest

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## Paleoenvironmental changes during the last 460ka shown in biogenic silica profile of Lake Biwa, Japan

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We analyzed biogenic silica content (BSC) of the Takashima-oki Drilling Core over the past ca. 46,000 years with high time resolution in the range of 30-90 years. The BSC record shows strong similarities with Milankovic cycle, D-O events and Heinrich events. Moreover, time-frequency analysis of the BSC record identified major periodicities discussed on several previous studies. In addition, our study in Lake Biwa clarified strong correlation between BSC and observed mean summer temperature during the past 100 years, thus allowed us to derive empirical equation of BSC vs. mean summer temperature. We therefore reconstructed mean summer temperature variation during the past 46 kyr using obtained empirical equations.

Keywords: Lake Biwa, paleoenvironment, sediment, biogenic silica

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## Paleoclimate changes based on high-resolution biogenic silica record from Takashima-oki Drilling Core in Lake Biwa

Takayuki Murakoshi<sup>1\*</sup>, Toshiki Nakanishi<sup>1</sup>, Naoya Iwamoto<sup>2</sup>, Atsuko Amano<sup>3</sup>, Takahiko INOUE<sup>3</sup>, Arata Kioka<sup>4</sup>, Yoshio Inouchi<sup>1</sup>

<sup>1</sup>Human Sciences, Waseda Univ., <sup>2</sup>Ehime Pref. Sci. Museum, <sup>3</sup>AIST, <sup>4</sup>EPS, Univ. Tokyo

We analyzed continuous biogenic silica content (BSC) record at high-resolution over the past 47,000 years from Takashima-oki Drilling Core in Lake Biwa (e.g., Yoshikawa and Inouchi, 1991). The BSC record in wt% (weight percent) unit was analyzed by means of colorimetric molybdenum-yellow method with an average resolution 50 yr. The BSC record shows three major cold ages (Little Ice Age, 8.2ka event, Younger Dryas period), Heinrich events, and Greenland interstadial no.1-12. In addition, we reconstructed mean temperature in summer during the past 47,000 years using the transfer function (Nakanishi et al., 2010) derived from the observation that BSC is strongly correlated with mean summer temperature especially in July (Nakanishi et al., 2009). The result clarified that there was approximately 10 degC during the period, corresponding to the summer temperature difference at present over in Sapporo and in Naha.

Keywords: Lake Biwa, Biogenic silica, Temperature reconstruction

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## Climate changes during the past 150 kyr based on biogenic silica record in Takashima-oki Drilling Core, Lake Biwa

Hiroshige Negami<sup>1\*</sup>, Arata Kioka<sup>2</sup>, Toshiki Nakanishi<sup>1</sup>, Naoya Iwamoto<sup>3</sup>, Yuki Nakamura<sup>1</sup>, Yoshio Inouchi<sup>4</sup>

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Biogenic silica content (BSC) from Takashima-oki Drilling Core in Lake Biwa during the past 150 kyr was analyzed by means of molybdenum-yellow method at high-resolution. Other proxies obtained from the same core such as Median diameter, Md (Saitoh and Inouchi, 2004) and total carbon content, TC (Iwamoto and Inouchi, 2007) were also analyzed in previous studies.

BSC record was correlated with oxygen isotope record of NGRIP ice core (NGRIP members, 2004) and other proxies of the Takashima-oki core. Comparison between BSC and NGRIP record shows that BSC record is synchronous with D-O cycle (Dansgaard et al., 1993; Grootes et al., 1993; NGRIP members, 2004) and that Younger Dryas and Heinrich events no.1-6 (Bond et al., 1993) can be identified in BSC change. The result also suggests that the age model in this study is highly reliable. In addition, BSC record has strong similarities with Md and TC record, which indicates that our BSC got evidence as an proxy of primary production.

Keywords: Lake Biwa, Biogenic silica, Takashima-oki Drilling Core, Paleoclimate, D-O cycle

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## Variation in East Asian summer monsoon over the past 140 kyr inferred from biogenic silica record from Lake Biwa

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Climate in East Asia is strongly controlled by the East Asian summer monsoon (EASM) which yields significant influence on global climate (An, 2000). Previous studies have demonstrated millennial-scale changes in the EASM and its correspondence with the Dansgaard-Oeschger cycles (e.g., Fang et al., 1999; Wang et al., 2001, 2008; Sun et al., 2010). A continuous biogenic silica content (BSC) record at high-resolution from Takashima-oki Drilling Core in Lake Biwa (Yoshikawa & Inouchi, 1991) during the past 140 kyr shows strong similarities with speleothem records from Hulu Cave and Sanbao Cave in central China displaying millennial-scale variation in EASM intensity identified Chinese interstadials (CISs) controlled by summer precipitation changes (Wang et al., 2001; Wang et al., 2008), which indicates that Takashima-oki BSC record illustrates changes in EASM intensity around central Japan. The result, which shows BSC-peak intervals are well corresponded with Greenland interstadials (GIS) 1-25 (Dansgaard et al., 1993; Grootes et al., 1993; NGRIP members, 2004) and CIS A1-A25 (Wang et al., 2008), allows propose Japanese interstadial (JIS) events refer to relatively strong EASM events in terms of summer temperature changes (Nakanishi et al., 2010) around central Japan. It must be noted that the ages of JISs almost coincide with GISs and CISs.

It is considered that dominant long-term variation in summer monsoon intensity is driven by direct summer insolation (Kutzbach, 1981) which oscillates predominantly regulated by the precession cycle mainly at the periodicity of 23 kyr. Orbital changes in EASM intensity in central China (Wang et al., 2008) and South American summer monsoon (SASM) in southeastern Brazil (Cruz Jr et al., 2005) actually respond approximately linearly to insolation changes in mid-July and in mid-February, respectively. Similarly to these observations, long-term change in Takashima-oki BSC is dominated by climatic precession cycle. Further investigations into the both millennial- and orbital-scale climatic responses in central Japan will be the subject of forthcoming work.

Keywords: East Asian summer monsoon, Summer Insolation, D-O cycle, Biogenic silica, Lake Biwa

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## Paleoenvironmental changes during last 700 kyr in Paleo-Kathmandu Lake, based on smear-slide and charcoal analysis

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We performed smear-slide observation and microscopic charcoal grain analysis on the drilled core of the Pleistocene lacustrine sediments from the Kathmandu Valley, in order to examine the potential of sponge spicule, charcoal and phytoliths as proxy of paleoenvironmental changes. On the basis of the analyses, we reconstructed paleoenvironmental changes of the Kathmandu Valley and Paleo-Kathmandu Lake during the last 700 kyr, and pursued the cause of paleoenvironmental changes.

As the results of observation and counting of ratio of four proxy (sponge spicule, plant fragment, phytoliths, pollen) in each smear slide and charcoal grain analysis, it was revealed that climate repeatedly changed seven times of cold-dry and warm-wet, which correspond to MIS15 to MIS12.

Sponge spicule can be used as a proxy of warm and wet climate, as they increase their number during the period of wet and warm climate. Their number seems to have decreased during the period of environmental deterioration in cold and dry climate, because they could have formed gemmules for survival. In the depth above 45m, however, changes in water-level seem to have controlled the population of sponges, because the change in their number correspond to those of benthic diatoms.

Number of sponge spicule and charcoal/plant fragment indicates reverse correlation in the core deeper than 45 m, on the other hand it shows positive correlation in the shallow level shallower than 45 m. This change could be ascribed to the lowering of lake-water. Both plant fragment and charcoal grain increase their number during the dry period, and it is due to the increase of natural fire. Thus, they are good indicator of dry climate. During the MIS12 and MIS6, number of charcoal grain drastically increased eight to ten times than average value. It corresponds to increase of global ice volume in both intervals.

Although tectonic event influenced depositional environments and vegetation in and around the lake after about 80 ka (45 m in depth), spectral analysis of change in number of each proxy clarified that orbital forcing, especially 100 kyr cycle (orbital eccentricity) played the most important factor for controlling environmental changes before 80 ka.

Keywords: Indian monsoon, Kathmandu Valley, lacustrine sediments, smear-slide, charcoal analysis, sponge spicule

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## Non Destructive Prediction of Lake Sediment by Near-infrared Spectroscopy

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The feasibility of near-infrared (NIR) reflectance spectroscopy with aid of multivariate analysis, which is rapid, inexpensive, non-destructive and correct technology, for the prediction of organic and inorganic fraction in lake sediment is reported.

The core samples were collected in Lake Ogawara (40 49 06 N, 141 19 55 E, 0 m a.s.l.) which is a 25 m deep brackish water lake formed on along the Pacific coast in Aomori Prefecture, northeastern Japan. The lake sediment consisted of well-preserved annually formed lamina. This suggests that the long cores are possibly a high-resolution record of past environmental changes. In December 2009, three parallel cores of ~20 m in length were drilled nearly at the center of the lake. A continuous composite profile was established from these cores, which were all divided using plastic cubes (2.3 cm on a side). A total of 2,800 cubes were obtained.

Of the 2,800, 145 cubes (at about each 10 cm interval in core length up to 15 m in depth) were used for conventional and destructive geochemical analyses. Total organic carbon (TOC), total nitrogen (TN), total sulfur (TS) and C/N ratio were measured using an element analyzer (1108, Calbo Erba) and other inorganic compounds were measured using an inductively-coupled plasma atomic emission spectroscopy (ICP-AES, SPS 7700, Seiko Instruments Inc.).

NIR spectra were acquired in a diffuse reflectance mode using a FT-NIR spectrometer (MATRIX-F, Bruker) with fiber optics. To improve the signal-to-noise ratio, 64 scans were accumulated at a spectral resolution of 8 cm<sup>-1</sup> over the wavenumber range of 10,000-4000 cm<sup>-1</sup>. Sediment samples used for conventional analysis were dried at the 100 OC for 24 hours before NIR spectral measurement to avoid the influence of strong absorption due to water.

Each sediments property was predicted from NIR spectra using partial least square (PLS) regression analysis. From the relationship between measured values and predicted values by PLS for each parameter and the observation of statistical results calculated, it is known that PLS analysis provided good regression models. The correlation for determinant for cross-validation of water content, TN, TOC, TS, Al<sub>2</sub>O<sub>3</sub>, Na<sub>2</sub>O/Al<sub>2</sub>O<sub>3</sub>, S/Al<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub>/Al<sub>2</sub>O<sub>3</sub> and Sc/Al<sub>2</sub>O<sub>3</sub> were 0.68, 0.80, 0.77, 0.58, 0.81, 0.53, 0.68, 0.68 and 0.65, respectively. The root mean square error of cross-validation (RMSECV) for each PLS regression model was adequately small. These calibrations demonstrate the ability of NIR spectroscopy for accurately prediction of multiple sediment parameters without any conventional and destructive geochemical analysis.



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## A new lake bottom surface sediment collection method: mini ice finger method

kazuyoshi yamada<sup>1\*</sup>, Timo Saarinen<sup>2</sup>, Hitoshi Yonenobu<sup>1</sup>, Tsuyoshi Haraguchi<sup>3</sup>, Keiji Takemura<sup>4</sup>

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It is well known that natural archives of past environments, such as lake sediments, offer a valuable resource for examining the nature of the interactions between Man and the environment. In particular, annually lake laminated (varved) sediments has the good advantage for paleoclimate study. We can establish accurate chronology by counting lamina sets (varves) as well as clarify paleoenvironment with annual resolution by geochemical and paleontological analyzing of each one year samples. Also from the point view of transfer-function study and quantitative paleoclimate study, it is very important to compare various proxy data from the sediments with observational (meteorological) data over the past century. However, regardless of such our demands as mentioned above, there are a few paleoclimatic reports about lake bottom surface sediments links to modern depositional situation. Most significant problem is that the lake bottom surface sediments have generally much of high water contents, and it is quite difficult to keep sediment for instance when cutting and slicing, after picking core samples up by several kinds of corer or diver due to deformation under those own weight. Thus, it is needed for such research to take sediment completely undisturbed and no any changing and modification such as deformation under those own weight.

To solve this, we hatch out a new lake bottom surface sediment collection method named as mini ice finger method (Saarinen and Wenho, 2005). In this method, sediments are frozen rapidly by powdered dry ice (frozen carbon oxide) with inserting thin pipe into the sediment after taking bottom surface sediments by upper-opened gravity core sampler. Generally, it takes within a half hour to take one frozen sample. Maximum length of sample is 50 cm (Now, we have been testing longer sampling). The method is very convenience and efficient to do without heavy equipment. Only two workers are needed to do everything on a boat. After the field, frozen samples are delivered to the Laboratory, directly. Firstly, we can check sedimentological observation and perform image analysis from cross section surface by a plane. After that, frozen samples were cut to slab samples and done to freeze-dry treatment to use different kinds of analysis as radioactive measurement, geochemical and paleontological research very easily.

In Japan, it is reported that some lakes as Lake Suigetsu, Lake Fukami and Lake Ogawara have the potential to deposit varved sediments up to present, however nobody reports accurate modern deposition of varve. Our preliminary investigation in those lakes indicates that modern varve formation from the sediment-water interface in all lakes was observed without any disturbance during sediment sampling and sub-sampling.

For paleoclimatologist, it is very useful to use our method and only way to reconstruct paleoclimate links to present.

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## Lake-level change history based on acoustic record of Uniboom in Lake Nojiri, central Japan

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Lake-level record is regarded as a good indicator for changes in water mass balance around lakes. Lake Nojiri, which locates at the northern part of central Japan, is a good position for monitoring those changes. Lake-level change history over the past 40,000 years at that lake is reported based on the analytical results of acoustic record. However, until recently, sedimentary evidence has not been obtained. Based on depth record of tephra layers of drilling and those of shallow acoustic record, several cycles of lake-level rise/fall events during the last forty thousand years can be concluded. In addition, we analyzed sequence stratigraphic interpretation of acoustic records, and discussed on the relationship between insolation variability and lake level fluctuations.

Keywords: Lake Nojiri, lake-level change, sediments, acoustic record, tephra, insolation

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## Submarine topographic surveys in Japanese Antarctic Research Expedition

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Japanese Antarctic Research Expedition has carried out landform and geological research on Antarctic land to reveal East Antarctic ice sheet fluctuations. However, detailed bathymetric surveys were not often carried out in East Antarctic Ocean. Submarine topography of Antarctic Ocean provides significant information for continental breakup, sea-floor spreading and environmental change such as ice sheet fluctuations.

On the 51st Japanese Antarctic Research Expedition, the new vessel Shirase equipped with a multibeam echo-sounder operated the bathymetric survey on the first time. Because Shirase carried out continuous bathymetric survey while the contiguous ice-breaking cruise and ramming ice-breaking survey, we were able to obtain area-wide submarine topographic data of East Antarctic Ocean for the first time as Japanese team. We were also able to obtain bathymetric data in Lutzow-Holm Bay area covered with thick ices by ramming ice-breaking cruise. As a result, we found erosional features formed by icebergs, mega-scale glacial lineations and gullies on the continental shelf or continental slope off the shore of Lutzow-Holm Bay and Cape Danley.