Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-01 Room:202 Time:May 27 11:00-11:15

High-resolution paleo-observatory network: Strategy and Speculation

TADA, Ryuji[1*] ; NAKAGAWA, Takeshi[2] ; IKEHARA, Ken[3] ; YAMAMOTO, Masanobu[4]

[1]Graduate School of Science, the University of Tokyo, [2]Ritsumeikan University, [3]AIST, [4]Faculty of Environmental Earth Science, Hokkaido University

Climatic changes are manifestation of the dynamic behavior of the earth system, and observing changes in various spatio-temporal scales is essential to understand the dynamics and implications of the changes. In this respect, paleoclimatic studies are expected to provide the data that can be used to this purpose. Progress of paleo-science enabled us to produce high-resolution time series data of various proxies that affords us to discuss the timing and nature of paleoclimatic changes. However, it is still difficult to correlate such paleo-records obtained from different sites with high temporal precision and high temporal resolution. Consequently, it remains difficult to reconstruct spatio-temporal structures of climate changes, with high spatial resolution data with wide areal coverage. In addition, kinds of proxies and their quality are different from site to site, and inter-calibration efforts are rarely conducted.

Here we propose a systematic approach to 1) retrieve continuous and high-quality paleoclimatic/paleoceanographic archives of Quaternary at key sites both from land and under the sea, 2) correlate these archives from multiple sites with high temporal precision and resolution to construct paleo-observatory network, 3) date archives with high precision and resolution to construct the master age model that can be projected throughout the network, 4) analyze the archives to extract high resolution and precision inter-calibrated paleoclimatic/paleoceanographic parameters, and 5) compile the data to construct the raw database that can be used for data assimilation and reanalysis. Utility of such data sets will be discussed.

Keywords: paleoclimate, paleoceanography, observatory network, East Asia, Quaternary, high-resolution

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-02 Room:202 Time:May 27 11:15-11:35

Precise age determination of the marginal sea sediments recovered by IODP Expedition 346 ”Asian Monsoon”

SAGAWA, Takuya[1*] ; TADA, Ryuji[2] ; IKEHARA, Ken[3] ; IRINO, Tomohisa[4] ; ITAKI, Takuya[3] ; SUGISAKI, Saiko[2] ; KUBOTA, Yoshimi[5] ; KARASUDA, Akinori[2] ; CHUANG, Xuan[6] ; NAGAHASHI, Yoshitaka[7] ; SATOGUCHI, Yasufumi[8] ; NAKAGAWA, Takeshi[9] ; MURRAY, Richard W.[10] ; ALVAREZ-ZARIKIAN, Carlos A.[11] ; EXPEDITION 346, Scientists[11]

[1]Faculty of Sciences, Kyushu University, [2]Department of Earth and Planetary Science, Graduate School of Science, The Univeristy of Tokyo, [3]Institute of Geology and Geoinformation, National Institute of Advanced Industrial Science and Techn, [4]Faculty of Environmental Earth Science, Hokkaido University, [5]National Museum of Nature and Science, [6]School of Ocean and Earth Science, Univ. of Southampton, [7]Fukushima University, [8]Lake Biwa Museum, [9]Ritsumeikan University, [10]Earth & Environment, Boston University, USA, [11]Integrated Ocean Discovery Program, Texas A&M University

High quality sediment sequences are recovered from seven sites in the marginal sea surrounded by the Eurasian Continent, Japanese islands, and Korean Peninsula during the Integrated Ocean Drilling Program Expedition 346”Asian Monsoon.” The sediment sequences from deeper sites are characterized by alternation of dark-light color layers of varied thickness from centimeter to tens of centimeter. Because the dark-light alternation pattern is common to all sites, correlations of the dark-light alternation among sites will provide us precise isochronous surfaces on millennial time-scale. We are trying to construct high precision age model by combining correlations of sediment sequences and several kinds of age constraints, i.e. magnetostratigraphy, biostratigraphy, and tephrochronology. When this is achieved, the well-dated sedimentary records along depth and latitudinal transects will tell us a new insight concerning the East Asian monsoon system during the Quaternary.

Time relationship between the dark layer deposition in the marginal sea and well-dated paleoclimate records is also a key to understand the climate system in terms of the cause-and-effect relationship. In order to investigate this, we propose to construct precise age model by correlating marine sediment off the Wakasa Bay and the varve sediment of Lake Suigetsu using tephra layers as well as invisible ”micro tephra” preserved in both sediments. Recently, macrofossil radiocarbon data from the varve sediment of Lake Suigetsu is adopted into the calibration curve IntCal13. Therefore, the correlation between marine and Suigetsu sediments will allow us to investigate time relationship of the dark layer deposition with Dansgaard-Oeschger cycles.

Keywords: Integrated Ocean Drilling Program, Expedition 346, East Asian monsoon, Dansgaard-Oeschger Cycle

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-03 Room:202 Time:May 27 11:35-11:50

Spatial-temporal reconstruction of Holocene SST in the Japan Sea based on radiolarian assemblages

ITAKI, Takuya[1*] ; MOTOYAMA, Isao[2] ; YAMADA, Yasumi[3] ; MATSUZAKI, Kenji M.[1] ; IKEHARA, Ken[1] ; TADA, Ryuji[4]

[1]Geological Survey of Japan / AIST, [2]Department of Earth and Environmental Sciences, Yamagata University, [3]Marine Works Japan Ltd, [4]Department of Earth and Planetary Science, Graduate School of Science, The Univeristy of Tokyo

The Tsushima Warm Current (TWC), which is only source of oceanic water in the Japan Sea during Holocene, transports heart, salt and nutrients from the East China Sea via the Tsushima Strait, and plays important roles of climate and ecosystem of the Japan Sea. In this study, we reconstructed Holocene changes of sea surface temperature (SST) based on radiolarian fossil records from more than 20 cores. In south of the polar front, the SST increased significantly through 12.5 ka to 8 ka, and showed millennial scale oscillations after that. On the other hand, low SST conditions have continued at north of the polar front due to weak influence of the TWC.

Keywords: paleo sea surface temperature, microfossils, paleoceanography, polar front

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-04 Room:202 Time:May 27 11:50-12:10

Glacial to Holocene changes in watermass structure in the western North Pacific

OKAZAKI, Yusuke[1*] ; SAGAWA, Takuya[1]

[1]Kyushu University

In the modern North Pacific, no deep water is formed due to well-established halocline. Instead, well-ventilated watermass called North Pacific Intermediate Water (NPIW) at depths of about 300 to 800 m is distributed. The glacial Pacific Ocean had two water masses: well-ventilated and nutrient-depleted glacial North Pacific Intermediate Water (GNPIW) above ~2000 m and less-ventilated and nutrient-enriched deep water below ~2000 m (Keigwin, 1998; Matsumoto et al., 2002). Compared to today, the NPIW volume under glacial conditions was significantly higher extending down to about 2000 m, exhibiting pronounced hydrographic boundary at ~2000 m. The glacial Pacific watermass structure was reconstructed based on stable carbon isotopes of epibenthic foraminifera. However, there are several problems in the North Pacific: (1) poor calcium carbonate preservation particularly during the late Holocene hampers core-top calibration; (2) rare occurrence of epibenthic foraminiferal species (e.g., *Cibicidoides wuellerstorfi*) in the subarctic Pacific; (3) taxonomy of *Cibicidoides* sp. in the subarctic Pacific is ambiguous. Core MD01-2420 obtained from the western North Pacific off Japan was with high sedimentation rates (>20 cm/kyr) and no radiocarbon age reversal. Nearly continuous occurrence of *Cibicidoides wuellerstorfi* was confirmed. In this presentation, we will discuss on the significance and potential of glacial watermass structure reconstruction in the NW Pacific using depth-transect cores near Core MD01-2420.

Keywords: watermass structure, LGM, benthic foraminifera, NW Pacific

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-05 Room:202 Time:May 27 12:10-12:25

Development and application of Japan Sea Paleoenvironmental Database (JSPED)

OZAKI, Kazumi[1*] ; HIRASE, Shotaro[1] ; KUSAMA, Yuko[1] ; IWASAKI, Wataru[2] ; YOKOYAMA, Yusuke[1] ; KAWAHATA, Hodaka[1] ; TADA, Ryuji[2] ; YAMAMOTO, Masanobu[3]

[1]AORI, The University of Tokyo, [2]Graduate School of Science, The University of Tokyo, [3]Graduate School of Env. Earth Science, Hokkaido University

The Japan Sea has seen fundamental changes in environmental conditions in response to the glacial-interglacial cycles, particularly the spatiotemporal variations of sea surface temperature (SST) and oceanic redox states. These climatically-driven changes along with geochemical and tectonic variations in boundary conditions such as sea-level, patterns of ocean current and oxygen distribution all would have affected evolution and distributions of diverse species. From this point of view, a comprehensive paleoenvironmental database of the Japan Sea will be a powerful tool for elucidating paleoenvironmental variations in geological past, and will provide useful information for testing hypothesis on relationships between past environmental changes and evolution. Here we develop a new database, Japan Sea Paleoenvironmental Database (JSPED), with the aim of a collaboration of paleoceanography and phylogeography. In this study, we will summarize the temporal variations of SST distributions over the last 20 kyr and its relationship with genetic diversity of several fish species in the Japan Sea, and discuss the future direction toward updates of JSPED.

Keywords: The Japan Sea, Database, Sea surface temperature, Glacial-interglacial cycles, Alkenone

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-06 Room:202 Time:May 27 12:25-12:45

On the comparison of high-temporal resolution data and model simulation in paleoclimate studies

YOSHIMORI, Masakazu[1*] ; ABE-OUCHI, Ayako[2]

[1]Hokkaido University, Faculty of Environmental Earth Science, [2]The University of Tokyo, Atmosphere and Ocean Research Institute

It is becoming common practice to take parallel approach of climate reconstruction and modelling in paleoclimate studies. Proxy data reveal the fact that the earth experienced in the past, provide opportunity to evaluate the model performance under a wide range of environmental conditions and are used to estimate the fundamental properties of the climate system (e.g., climate sensitivity). Modelling serves as a tool to quantitatively test the proposed hypothesis or to provide a mechanism of the reconstructed climate change. Models may also be used to suggest a location for additional proxy data to be acquired for a particular climatic event or to provide pseudo-proxy data for which statistical reconstruction techniques for limited number of samples are tested. More recently, the data assimilation techniques are applied to paleoclimate reconstruction. In all these studies, classical issues in the data-model comparison (regardless of forward or inverse modelling) are relevant, and we review and discuss them in preparing for the coming era of high-resolution proxy data.

Proxy data are often compared with model simulations along time axis. While the dating errors in the data may be more easily taken into consideration in this approach, there are many aspects that need to be concerned. It is often unclear what spatial scale that the data represent, and whether that spatial scale is resolved in the model. In addition, it is subjective to the bias in simulated spatial patterns because proxies often locate in the sensitive region to the changes in the climate pattern. More meaningful comparison would be made if spatially integrated reconstruction or the climate index constructed from multiple sites is used. It is often unclear whether the reconstructed climate variation represents internal variability inherent in the climate system or the change forced by the condition external to the climate system (e.g., volcanic eruptions). This is not independent from the spatial-scale issue as the internal variability usually predominates in smaller scales. More meaningful comparison would be made for the externally forced change that is demonstrated by the model ensemble simulation.

We highlight these issues by conceptual examples and Pacific Decadal Oscillation simulated in the last millennial simulations.

Keywords: paleoclimate modelling, last millennium, Pacific Decadal Oscillation

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-07 Room:202 Time:May 27 14:15-14:30

Total organic carbon contents of the MD01-2407 core from Oki ridge, Japan Sea for the last 600 ka

KUMON, Fujio[1*] ; TAKIZAWA, Yuko[2]

[1]Fac. Sci., Shinshu Univ., [2]Graduate School of Science and Technology

The authors have performed TOC and TN analysis on MD01-2407 core taken from Oki ridge, Japan Sea, at 125 or 250 years interval. The core covers the last 600 ka in age, and the temporal change of TOC is similar to the delta ^{18}O curve (LR04) as a whole, but there is some discrepancy in the warmest period, that is, in the interglacial period. Except for this warmest ages, TOC of the sediment core can be well correlated also to the delta 18O curves from Greenland and Antarctica. TOC of the sediment can be an excellent proxy in mid-latitude area around the Japanese islands.

Keywords: organic carbon content, Oki ridge, climate change, Japan Sea, proxy, MD01-2407

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-08 Room:202 Time:May 27 14:30-14:45

High resolution inter-Site correlation of dark-light layers in the sediments drilled during Exp.346 and its application

KARASUDA, Akinori[1*] ; TADA, Ryuji[1] ; IRINO, Tomohisa[2] ; MURRAY, Richard[3] ; ZARKIAN, Carlos[4] ; EXP.346, Scientists[5]

[1]University of Tokyo, [2]Hokkaido University, [3]Boston University, [4]Texas A&M University, [5]IODP

The Quaternary hemipelagic sediments of the marginal sea surrounded by the Eurasian Continent, Japanese islands, and Korean Peninsula are characterized by centimeter- to decimeter-scale alternations of dark org-C-rich and light org-C-poor layers that are traceable throughout the marginal sea and known to be recording millennial-scale variability of East Asian summer monsoon [EASM] associated with so-called Dansgaard-Oeschger cycles. Based on previous data of ODP Legs 127 and 128, these alternations of dark and light layers started at ca. 2.5Ma and became more frequent after ca. 1.5Ma (Tada, 2005). However, it was impossible to make perfect inter-site correlation of dark and light layers because of frequent core gaps.

During IODP Exp.346 Asian Monsoon, we drilled 3 or 4 holes per site to retrieve completely continuous sedimentary records covering the last 2.6 Ma at 7 sites within the marginal sea. By constructing perfectly continuous splices, it becomes possible to make perfect inter-site correlation of dark and light layers covering at least the last 1.5 Ma.

We first revised spliced sections of U1424 by detailed inspection of core photographs. We started with U1424 because Quaternary sediments at this site seem most continuous without any interruption of sedimentation and magnetic reversals are best defined. Consequently, U1424 is the best site to establish high-resolution and high-precision age model. We found small-scale repetitions and/or lack of intervals by low angle faults most likely formed by drilling, which are easily overlooked if sediments are poorly stratified. For these disrupted intervals, we chose alternative intervals from other hole to revise the spliced sections and construct a perfectly continuous spliced core photograph for Site U1424 for the last 2.6 Ma. We also revised color and MST data according to the revised spliced sections.

We also revised spliced sections for other sites (U1425, U1426), which are at shallower water depths than Site U1424, and established high-resolution inter-site correlation of dark and light layers, with which we can project the high-resolution age model of U1424 to other sites. The high-resolution inter-site correlation also allowed us to examine the difference in color, physical, and chemical properties of each dark and light layers between the 3 sites.

Keywords: IODP, Sediment, Correlation, marginal sea

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-09 Room:202 Time:May 27 14:45-15:00

A relationship between seawater Ba/Ca ratio and salinity in surface waters in the East China Sea

KODAIRA, Tomohiro[1*] ; HORIKAWA, Keiji[1] ; WAKISAKA, Etsuko[1] ; ZHANG, Jing[1] ; MURAYAMA, Masafumi[2]

[1]Graduate school of Sci. and Eng. Univ. of Toyama, [2]Univ. of Kochi

Planktonic foraminifera Ba/Ca ratio has been discussed as a paleo-salinity proxy (e.g., Lea and Spero, 1994; Honisch et al., 2011). An advantage of this proxy is that Ba^{2+} incorporation into living planktonic foraminifera shells is linearly dependent on [Ba^{2+}] in the water, with a constant partition coefficient for Ba (D_{Ba} = 0.15), independent of environmental parameters such as temperature, salinity, and pH. Applying this proxy to estimate past sea surface salinity requires a modern relationship between seawater Ba/Ca and salinity. In addition, single source for river water might be a prerequisite to make a binary mixing of river waters with high [Ba^{2+}] and saline seawater with low [Ba^{2+}]. The Changjiang River accounts for about 90% of the total river discharge in the East China Sea (ECS). Therefore, it is considered that planktonic foraminifera Ba/Ca ratio can be used to estimate paleo-salinity proxy in the ECS.

In this study, we collected surface seawater samples (upper 100 m depth) in the Yellow Sea and the ECS during KH13-4 cruise in early July 2013 (*R/V Hakuho-Maru*), and investigated a relationship between seawater Ba/Ca ratio and salinity in the ECS. Seawater samples were filtered by 0.2 μm membrane filter onboard. Ba/Ca ratios were measured by an isotope dilution method using ICP-MS (HP4500). Analytical precision of Ba/Ca ratio was 0.9%.

Seawater Ba/Ca ratios were strongly correlated with salinity although the Yellow Sea and the ECS represented different regression lines. Freshwater sources in the Yellow Sea represented higher [Ba^{2+}] than the freshwaters in the ECS. In the eastern part of the ECS (i.e., northern Okinawa Trough) where the eastward flowing Changjiang diluted water mixes with the Kuroshio water, we found the following relationship between seawater Ba/Ca and salinity: Ba/Ca (μmol mol-1) = 36.0 — 0.95$\times$salinity (r^2 = 0.87, 0-30 m, 33-34.5 psu). We will also present planktonic foraminifera Ba/Ca ratios of core-top ECS sediments, and discuss the possibility of using shell Ba/Ca ratios as an independent paleo-salinity proxy in the ECS.

Keywords: Ba/Ca, Surface Salinity, East China Sea

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-10 Room:202 Time:May 28 09:00-09:15

Relationship between variabilities of orbital- and millennial-scale sedimentary rhythms in the Onnagawa Formation

KUROKAWA, Shunsuke[1*] ; TADA, Ryuji[1] ; ITAKI, Takuya[2] ; TAKAHASHI, Satoshi[1]

[1]Department of Earth and Planetary Science, University of Tokyo, [2]Geological Survey of Japan, AIST

It is well known that Late Quaternary climate is characterized by millennial-scale abrupt changes known as Dansgaard-Oeschger cycle [Dansgaard et al., 1993], and the relationship between the millennial-scale variability and orbitally-driven ice volume changes has been explored [Zhang et al., 2014; Tada, 2012]. On the other hand, Tada [1991] demonstrated that the Middle Miocene cm-scale alternations of light- and dark-colored siliceous rocks widely distributed in the Pacific rim reflect millennial-scale paleoclimatic/paleoceanographic variability. Large and unstable ice sheets were present in Antarctica during the Middle Miocene and in the high-latitude northern hemisphere during the Late Quaternary, respectively [Tada, 1990; Zachos et al., 2001]. Because 100-kyr periodicity in the oxygen isotope records of benthic foraminifera, which appears as a result of nonlinear response of ice sheet to the Milankovitch forcing, became dominant in the both ages [Raymo and Lisiecki, 2005; Holbourn et al., 2013], the relationship between millennial-scale variability and 100-kyr periodicity in the oxygen isotope record is suggested. Examination of the relationship between the amplitude and frequency of millennial-scale variability and periodicity of orbitally-driven ice volume changes during the Middle Miocene is essential to better understand the generality and ultimate cause of millennial-scale variability of climate.

Tada [1991] suggested that bedded siliceous rocks observed in the Onnagawa Formation that is widely distributed in northern Japan reflect millennial-scale oceanic variability. However, the timing and duration of millennial-scale variability are not well understood, and the relationship between its variability and periodicities of orbital-scale ice volume changes is not clarified. In this study, we aim to clarify when the Middle Miocene millennial-scale variability became distinct and when it was faded out. We also examine its possible association with 100 ky cyclicity of ice volume changes.

We conducted a field survey in Yashima town, Akita Prefecture and reconstructed the continuous sedimentary records of the Middle Miocene. We constructed the age model based on biostratigraphy. In addition, we defined a silica rank based on the hardness and/or brittleness of the siliceous rocks, extracted cycles of silica rank changes, and applied cyclostratigraphy to fine-tuned the biostratigraphically constrained age model. Based on this age model, we specified the timing of appearance and disappearance of millennial-scale variability, correlated with oxygen isotope curve, and examined the relationship between millennial-scale variability of silica rank and 100-kyr periodicity of benthic oxygen isotope record.

In this presentation, we will demonstrate the applicability of cyclostratigraphy to the Onnagawa Formation to construct more precise age model. We also discuss the relationship between millennial-scale variability of silica productivity and 100-kyr periodicity of ice volume changes.

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-11 Room:202 Time:May 28 09:15-09:30

Issues of Cenozoic tephra study-for beginning of tephroinfomatics

AOKI, Kaori[1*]

[1]Faculty of Geo-Environmental Science, Rissho University

see Japanese abstract

Keywords: tephra, tephrochronology, volcano, D/O cycle, database

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-12 Room:202 Time:May 28 09:30-09:45

Importance of marine tephra to connect the events among the different environments: Examples from northern Japan Trench

IKEHARA, Ken[1*] ; USAMI, Kazuko[1] ; KANAMATSU, Toshiya[2]

[1]Geological Survey of Japan, AIST, [2]CEAT, JAMSTEC

Tephra has deposited among the different environments, and is thought to be geologically synchronous. Correlation of tephras among the different environments gives us key horizon directly connecting the events found in the different environments. Numerous visible and invisible tephras are reported from terrestrial, lacustrine and marine environments on and around the Japanese islands. Thus, correlation of tephras might connect the event beds formed by the past large earthquake and/or tsunami recorded in terrestrial and marine sediment sequences. Many event beds were recognized in the marine sediment cores collected from the trench floor and mid slope terrace along the northern Japan Trench. Using the marine tephra intercalated in the cores and geomagnetic secular variation curves, we can estimate the depositional ages of each event bed. Correlation between the marine event beds and onshore tsunami deposits will give us new information on the past large earthquakes occurred along the Japan Trench. Marine tephra study plays an important role for connecting not only the earthquake and tsunami events but also the other events such as paleoclimatic events recorded among the different environments.

Keywords: tephra, event deposit, Japan Trench, earthquake, tsunami

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-13 Room:202 Time:May 28 09:45-10:00

The outline of the sandbar drilling in the lower reach of Yangtze (YD15) to reconstruct flood history

SAITO, Keita[1*] ; TADA, Ryuji[1] ; ZHENG, Hongbo[2] ; IRINO, Tomohisa[3] ; WANG, Ke[3] ; LUO, Chao[4] ; TSUNAZAWA, Yuya[1] ; SUGISAKI, Saiko[1]

[1]University of Tokyo, [2]Nanjing Normal University, [3]Hokkaido University, [4]Nanjing University

East Asian Summer Monsoon (EASM) drives the hydrological cycle in East Asia, and its intensity and spatial pattern strongly affect lives of billions of people living there. Thus, it is important to investigate the behavior and controlling factors of EASM by reconstructing the spatiotemporal distribution of EASM precipitation in past. Climate in the drainage of Yangtze River is under the influence of EASM. It is known that there are positive correlation among precipitation, water discharge, and sediment yield (>90% is in the form of suspended particulate matter) in Yangtze drainage. Thus the provenance of the sediments discharged from the river mouth is thought to reflect the spatial distribution of EASM precipitation within the drainage.

To reconstruct the behavior of EASM during the late Holocene, the sediment cores covering the past 6000 years were recovered from the rivermouth area of Yangtze in 2013 (YD13). However, based on the analysis of Cs isotope, the uppermost part of the sedimentary sequence corresponding to the last 100 years was absent. Thus, to calibrate the relative contribution of sediments from the upper versus middle to lower reaches to the relative contribution of the water discharge from the upper versus middle to lower reaches, we need to retrieve the continuous sedimentary sequence covering at least the last 150 years. We plan to drill the active sandbar in the lower reach of Yangtze for this purpose (YD-15). The provenance of sediments in YD15 core covering the last 150 years will be analyzed and the result will be compared with the observational records of precipitation and water and sediment discharges. Preliminary result will be reported.

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-14 Room:202 Time:May 28 10:00-10:15

Provenance variability associated with East Asian Summer Monsoon precipitation change during the middle to late Holocene

WANG, Ke[1*] ; TADA, Ryuji[2] ; IRINO, Tomohisa[1] ; ZHENG, Hongbo[3] ; SAITO, Keita[2] ; SUGISAKI, Saiko[2] ; UCHIDA, Masao[4]

[1]Hokkaido University, [2]The University of Tokyo, [3]Nanjing Normal Univ., [4]National Institute for Environmental Studies

Hydroclimate variations associated with the East Asian Summer Monsoon precipitation exert significant impacts on lives of people inhabiting within the Yangtze River drainage and the coastal zone. Seasonal shift of main precipitation area is attributable to the reposition of northern limit of summer monsoon, which would lead to provenance and composition changes of suspended materials transported by the Yangtze River. Consequently, the interannual to millennial time-scale variability of the position of rain belt mentioned above could be recorded in the long-term change in compositional variation of the sediment originated from the suspended materials of the Yangtze River. The subaqueous Yangtze delta and the inner shelf of the East China Sea (ECS) are of primary importance owing to massive inputs of terrestrial materials from the Yangtze River. We could expect to recognize provenance changes in core sediments taken from the Yangtze subaqueous delta core YD13-1 and the inner shelf of ECS core MD06-3040 in association with spatial variability of EASM precipitation.

Provenance of sediment particles were evaluated on the basis of the electron spin resonance (ESR) signal intensity and crystallinity index (CI) of grain size separated quartz. Comparison the core sediments taken from the subaqueous Yangtze delta and the inner shelf of the East China Sea sites with modern Yangtze River sediments suggested that the Yangtze River would be a predominant source of the subaqueous Yangtze delta and mud belt on the inner shelf deposits. Moreover, detailed examination of quartz provenance within the Yangtze River drainage using ESR and CI enable us to discriminate the sediment contributions from the upper-middle/lower reaches, southern tributary, and northern tributary of the Yangtze drainage. Most of ESR in fine silt fraction of core YD13-1 samples from fine sandy layers and coarse silt layers of probable flood origin showed smaller values compared to the background sediments just above or below. This observation suggested that big flooding occurred mainly in the upper reaches of the Yangtze drainage. Variability of the main location of EASM precipitation (EASM front) on multi-centennial to millennial-scale has been detected from this result, which showed heavier precipitation in the Hangjiang and Jialinjiang with contribution from southeastern side of middle-lower reaches (Lake Dongting and Poyang) during 5-3.8 cal kyr BP, and in the Hangjiang, Jialingjiang, and Minjiang during 3.8-1.6 cal kyr BP, in the Minjiang and Jialingjiang during 1.6-1.0 cal kyr BP, and in the Minjiang and Jinshajiang with contribution from Hanjiang during 1.0-0.6 cal kyr BP. Temporal variations in ESR in fine silt fraction of core MD06-3040 sample showed the similar feature as YD13-1, which suggested both cores shared the same provenance changes on millennial time-scale. Modal grain size in fine silt of core MD06-3040 showed notable decrease at the timing of the lower EASM precipitation (presumably drought events) such as 6 cal kyr BP, 5.3 cal kyr BP, 4.5 cal kyr BP, 3.7-3.3 cal kyr BP, 2.2 cal kyr BP, 1.4-1.3 cal kyr BP, which also coincided with the dry periods derived from stalagmite δ^{18}O records in southern China and high salinity events recorded in the cores from northern ECS. The evolution of monsoonal climate with abrupt events in the Yangtze River drainage has been associated with spatio-temporal heterogeneity of precipitation area within the Yangtze drainage most likely resulted from migration of the EASM front. Fine silt fraction of both cores YD13 and MD06-3040 captured climatic signal delivered from the Yangtze drainage. High precipitation (detected in grain size at MD06-3040 site) is correlated with higher contribution of material from the upper reaches of the Yangtze drainage since 5 cal kyr BP. The stronger EASM has been associated with high precipitation and northwestward shift of monsoon front.

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-15 Room:202 Time:May 28 10:15-10:30

OSL dating of Holocene Yangtze delta sediments: implications for sedimentation mechanisms

SUGISAKI, Saiko[1*] ; BUYLAERT, Jan-pieter[2] ; MURRAY, Andrew[3] ; TADA, Ryuji[1] ; ZHENG, Hongbo[4] ; WANG, Ke[5] ; SAITO, Keita[1] ; IRINO, Tomohisa[5] ; UCHIDA, Masao[6]

[1]University of Tokyo, [2]Aarhus University, [3]Technical University of Denmark, [4]Nanjing Normal University, [5]Hokkaido University, [6]National Institute for Environmental Studies

Flood events in the Yangtze River are associated with variation in East Asian Summer Monsoon (EASM) precipitation. Understanding the frequency and scale of the EASM precipitation during the Holocene is a key to understanding the mechanism and cyclicity of floods and droughts. Because about 70% of the annual discharge occurs during the flood season, the Yangtze delta sediments provide a good archive of EASM precipitation. In this study, we investigate the possibility of applying OSL dating to establishing high-resolution chronologies for the Yangtze delta sediment cores YD13-1H and G3. The objectives of this study are: (1)test whether fine grained quartz in present day suspended particle matter (SPM) is fully bleached or reset before deposition, (2) where possible, test quartz fine- and coarse-grain OSL dating against radiocarbon shell ages, (3) interpret the sediment transport processes through the differential bleaching of quartz and feldspar OSL signals.

We show that the SPM collected from the surface water column of the Yangtze River during the flood season is well-bleached (offset ˜60 years). Fine-grained pro-delta sediments are thus potentially a good dosimeter for OSL dating. OSL ages sediment cores indicate a pronounced change in sedimentation rate at ˜6 ka and ˜2ka. These events are consistent with what is known of the evolution of the Yangtze catchment and delta. The delta began to build at ˜6 ka (Zhao et al., 1979), and human activities increased significantly in the catchment at ˜2ka (Chen et al., 1985). The question of whether significant deposition was limited to 2 ka and 6 ka, or whether the record has been disturbed by erosion/reworking remains. These issues are discussed in terms of the reliability of the quartz OSL ages, the degree of bleaching by comparison with polymineral OSL signals, and the relationship of the OSL ages to the sedimentary record.

Keywords: Optically stimulated luminescence, Holocene, Yangtze Delta

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-16 Room:202 Time:May 28 10:30-10:45

Typhoon and Baiu-season precipitation reconstructed by the flux of suspended detrital material in Lake Suigetsu

SUZUKI, Yoshiaki[1*] ; TADA, Ryuji[1] ; NAGASHIMA, Kana[2] ; IRINO, Tomohisa[3] ; YAMADA, Kazuyoshi[4] ; NAKAGAWA, Takeshi[5] ; KOJIMA, Hideaki[6] ; SG12/06, Project members[7]

[1]Univ. Tokyo, [2]JAMSTEC, [3]Hokkaido University, [4]Museum of Natural and Environmental history, Shizuoka, [5]Ritsumeikan University, [6]Wakasa-Mikata Jomon Museum, [7]none

To resolve the mechanism of climate change such as monsoon variability and change of typhoon track, it is important to reconstruct long-term precipitation changes from the site influenced by these rainfalls. Although it is difficult to quantitatively reconstruct past precipitation, we can utilize the flux of river origin suspended detrital material. Flux of suspended detrital material transported by the river has empirical relationship with river discharge known as the ”rating curve”. Because the flux of the river water reflects the precipitation in the drainage area under the humid condition, it is possible to reconstruct the past precipitation from the flux of detrital material for the lake sediment that effectively trap detrital material from the watershed.

Lake Suigetsu, in central Japan is under strong influence of precipitation by EASM (East Asian Summer Monsoon) and Typhoon. Suspended detrital material in Lake Suigetsu is coming from Hasu River, which is the main water source for Lake Suigetsu but its water does not come directly from the river into the lake but through Lake Mikata. Because Lake Mikata traps most of the coarse fraction of detrital material, only fine suspended detrital material is supplied and deposited in Lake Suigetsu. It is also known that high resolution age-depth model was established for Lake Suigetsu sediment based on over 100 ^{14}C dates in the Holocene interval, which constitutes quasi-ideal opportunity to apply the reconstruction method.

To apply this method, we have to establish the ”rating curve” specific for Lake Suigetsu and its catchment. In this study, we focused on the near-surface sediment of Lake Suigetsu which can be correlated to the observational record of precipitation in this area, and measured the flux of suspended detrital material to the lake. The bottom of Lake Suigetsu is anoxic since 1664, when seawater flowed into Lake Suigetsu because of opening of the Urami channel. Therefore, near surface sediment of Lake Suigetsu has annual lamination (varve). Varve counting and radioactive nuclide analysis were conducted to obtain high resolution age model. The age model was further fine-tuned based on correlation between observational flood events and event layers which are considered to be deposited by flood event. Finally, we obtained high precision age model from 1920 AD to the present with exceptionally low uncertainty such as +/- 1 year or less. Temporal changes in the flux of suspended detrital material were reconstructed based on this age model, which have good correlation with Baiu-season precipitation assuming the power law. It is also revealed that deposition of event layers occur mainly by the typhoon which arrives in the area through the southwestern Honshu from south to north. Based on these results, we would be able to reconstruct precipitation caused by Baiu-rainfall and frequency of typhoon landing event, respectively for the deeper part of the core.

Keywords: varved sediment, precipitation, East Asian Monsoon, typhoon, paleoclimate

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-17 Room:202 Time:May 28 11:00-11:15

Is Lake Suigetsu sediment recording annual-scale dust flux changes?

NAGASHIMA, Kana[1*] ; SUZUKI, Yoshiaki[2] ; YAMADA, Kazuyoshi[3] ; IRINO, Tomohisa[4] ; TADA, Ryuji[2] ; TAKIGAWA, Masayuki[1] ; HARA, Yukari[5] ; NAKAGAWA, Takeshi[6] ; SG06/12, Project members[6]

[1]JAMSTEC, [2]Graduate school of Science, The University of Tokyo, [3]Museum of Natural and Environmental history, Shizuoka, [4]Faculty of Environmental Earth Science, Hokkaido University, [5]Research Institute for Applied Mechanics, Kyushu University, [6]Ritsumeikan University

The depositional flux record of Asian dust during the late Holocene provides key to understand the role of Asian dust in meteorological effects and bio-geochemical cycles. Sea of Japan sediment was typically studies for this purpose. However, dust flux changes with millennial and shorter time-scales was not possible to detect due to the relatively large uncertainties in the depositional rates of the marine sediments.

Lake Suigetsu in Central Japan is known for the annually-laminated sediments which cover at least last 70 kyr. Recently, accurate age model is established for SG06 core based on varve counting and more than 800 radiocarbon dates (e.g., Ramsey et al., 2012; Staff et al., 2013). Lake Suigetsu sediments are expected to contain dust particles from continental Asia, however the dust particles in the sediment matrix are not easy to identify and analyse quantitatively as they are diluted with the detrital materials supplied from surrounding slopes of the lake and from the catchment areas of Hasu River, the water of which drains to the Lake Mikata which in turn is connected to the Lake Suigetsu by a shallow sill. We therefore developed a method to identify Asian dust within lake sediments and apply the method to the near-surface samples of Lake Suigetsu to reconstruct dust flux changes during the last 100 years.

We focus on three mineralogical parameters, the crystallinity of quartz, plagioclase-quartz ratio, and plagioclase type (albite vs. anorthite). These mineralogical parameters were determined for fine-silt sized Asian dust collected at Japan and detrital materials collected at nine sites near lake Suigetsu and from the drainage areas of Hasu River. Compared to the detrital materials from local sites, Asian dust is characterized by the lower crystallinity of quartz, moderate plagioclase-quartz ratio, and anorthite rich plagioclase type. The recognised differences were then applied to the lake Suigetsu sediments to diagnose air-born dusts from continental Asia. The estimated dust flux changes show gradual decrease from the middle of the 1960s to the end of the 1990s, which is well correlated with the decreasing trend of the dust emission frequency at dust source areas (Gong et al., 2007). Furthermore, the dust flux shows annual to decadal-scale changes. We will check whether the estimated flux changes are consistent to the observational records and model simulation results, and further discuss the nature and mechanisms of the Asian dust flux changes.

Keywords: Asian dust, Lake Suigetsu core, Last 100 years, annual variation, decadal variation

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-18 Room:202 Time:May 28 11:15-11:30

Variabilities of water pH and temperature in Lake Biwa based on branched GDGT distribution over the last 280,000 years

AJIOKA, Taku[1*] ; YAMAMOTO, Masanobu[2] ; TAKEMURA, Keiji[3] ; HAYASHIDA, Akira[4] ; KITAGAWA, Hiroyuki[5]

[1]Institute of Geology and Geoinformation, AIST, [2]Faculty of Enviromental Earth Science, Hokkaido University, [3]Beppu Geothermal Research laboratory Institute for Geothermal Science, Kyoto University, [4]Department of Environmental Systems Science, Doshisha University, [5]Graduate School of Environmental Studies, Nagoya University

We generated a 280,000 yr record of water pH and temperature in Lake Biwa, central Japan, by analysing the methylation index (MBT') and cyclisation ratio (CBT) of branched tetraethers in sediments from piston and borehole cores. Our aim was to understand the responses of precipitation and air temperature in central Japan to the East Asian monsoon variability on orbital timescales. Because the water pH in Lake Biwa is determined by phosphorus and alkali cation inputs, the record of water pH should indicate the changes in precipitation and temperature in central Japan. Comparison with a pollen assemblage in a Lake Biwa core suggests that lake water pH was determined by summer temperature in the low-eccentricity period before 55 ka, while it was determined by summer precipitation in the high-eccentricity period after 55 ka. From 130 to 55 ka, the variation in lake pH (summer precipitation) lagged behind that in summer temperature by several thousand years. This perspective is consistent with the conclusions of previous studies (Igarashi and Oba, 2006; Yamamoto, 2009), in that the temperature variation preceded the precipitation variation in central Japan.

Keywords: Lake Biwa, lake sediment, lake water pH, GDGT, MBT, CBT

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-19 Room:202 Time:May 28 11:30-11:45

Temporal variation of very fine elemental carbon in lake sediments in Japan

IRINO, Tomohisa[1*] ; NAKAI, Yoshie[1] ; LU, Song[1] ; YAMADA, Kazuyoshi[2] ; YONENOBU, Hitoshi[3] ; TADA, Ryuji[4]

[1]Hokkaido University, [2]Museum of Natural and Environmental history, Shizuoka, [3]Naruto University of Education, [4]University of Tokyo

Elemental carbon (EC) is a combustion product which is composed of rich C and depleted O, H, S, and N. Biomass burning is major source of Pre-industrial EC, while fossil fuel burning is the most important source since the 18th. EC transferred in the atmosphere as aerosols, and aerosols including EC have a great impact on the climate, where EC is the second strongest contribution to global warming and changing albedo by darkening of snow and ice surface. On the other hand, aerosols including EC have also negative effect on radiative forcing. Although it is difficult to evaluate net EC effect on climate, evaluation of temporal variability of atmospheric EC is necessary to understand the relationship between biomass burning and climate.

EC is not a single chemical compound and distinguished into two types , char and soot. Char is produced by pyrolysis, while soot is formed via gas-to-particle conversion. The char particles which are countable under microscope are called charcoal. There have been many research to reconstruct paleo-fire by counting charcoal, which showed that the fire sometimes synchronize with human activity especially in the late Holocene. However, very fine EC particles that can be transported for a long distance has not been evaluated well for paleo-archive although boreal forest fire frequently emits wide-spread smoke which must have deposited as the sediment in lacustrine and marine environment.

In order to evaluate the flux of biomass burning products transported for a long distance and deposited in marine and lake sediments, we have tried to apply a thermal optical transmittance (TOT) methods to quantify the amount of very fine grained elemental carbon within sediment samples. Organic carbon (OC) and elemental carbon (EC) contents in standard materials such as sucrose, humic acid, fluvic acid, and fullerene were examined by TOT method as analogue carbonaceous materials within sediments. As a result, some OC fraction was turned out to be tolerant to temperature of 550-700 degree C under O2 atmosphere. Therefore, we defined EC as the carbon fraction detected at 700-850 degree C under O2 atmosphere. We applied this method to fine (<2 microns) and coarse (>2 microns) fractions separated from sediments collected from the Lake Kushu in the northern Japan and the Lake Suigtsu in the central Japan. Temporal variation of EC content in the fine fraction shows different pattern than that in the coarse fraction, which suggests that the coarse EC is local signal while the fine EC reflects both local and distal biomass burning frequency. Ratio between fine EC / coarse EC in the sediments from the northern Far East marginal sea and lake could be used as a proxy for regional-scale biomass burning history in northeastern Asia.

Keywords: Lake Kushu, Lake Suigetsu, Elemental carbon, Holocene

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-20 Room:202 Time:May 28 11:45-12:00

Microfossil archives for the high spatiotemporal resolution paleoceanographic reconstruction

KUBOTA, Yoshimi[1*] ; KIMOTO, Katsunori[2] ; SAITO-KATO, Megumi[1]

[1]National Museum of Nature and Science, [2]JAMSTEC

The microfossils usually provide qualitative rather than quantitative paleoceanographic information. The transfer function methods have been developed in several microfossil groups, sometimes providing the quantitative information such as sea surface temperature and salinity. The global sea surface temperature reconstruction by CLIMAP project based on the microfossil assemblages is generally reproduced well by simulation results and consistent with geochemical proxies, suggesting the usefulness of the microfossil data as one of the quantitative paleoceanographic archives in glacial-interglacial time scale. However, there are several issues to deal with for the time-series paleoceanographic reconstruction with high time resolution. For example, a temporal variability of the summer sea surface temperature based on the transfer function of planktic foraminiferal assemblage sometimes does not match up well with the high time resolution geochemical proxies such as Mg/Ca that is thought to reflect summer surface temperature as well. This discrepancy is probably owing to difference in seasonality among the proxies and/or effect of the other factors such as salinity or nutrient on the microfossil assemblages, which should be assessed to illustrate more probable ocean environment in the past. Nevertheless, so far, there is accumulation of microfossil data in the northwestern Pacific including marginal seas. We will present how we utilize the microfossil data as a quantitative marine environment archive, listing the challenges to integrate into the other proxies.

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-21 Room:202 Time:May 28 12:00-12:15

Microfocus X-ray Computing Tomography Technique: Applications for the Ocean Acidification study

KIMOTO, Katsunori[1*] ; KIHARA, Tatsuyuki[2] ; IWASAKI, Shinya[3] ; SASAKI, Osamu[4] ; KANO, Harumasa[4] ; WAKITA, Masahide[1] ; IRINO, Tomohisa[5]

[1]JAMSTEC, [2]Tohoku University, [3]AORI, Univ. of Tokyo, [4]The Tohoku University Museum, [5]Hokkaido Univeristy

The reduction of the oceanic pH?so-called ocean acidification (OA) ?is one of the most concerning issues of recent oceanic environmental changes. Recent observation and culture studies indicate that calcification rates of ocean calcifiers (corals, pteropods, foraminifera, coccolithophores etc) which build external skeletons of calcium carbonates (CaCO3) will decrease and carbonate dissolution rates increase as CaCO3 saturation states of seawater (Omega). However its affections for marine calcifiers in the nature are still largely unknown. It is needed to be quantified such affections to understand marine ecosystems and predict the future environmental conditions.

Here we proposed a new method to evaluate shell density of marine calcifiers by using the Micro-focus X-ray Computing tomography (MXCT) technique. The MXCT has great potential to bring new information for morphometric analysis of biology by the innovating data acquisition. It can get precise transparent tomographic images of individual specimen with spatial resolution in submicron scales. At the same time, MXCT has become possible to achieve the information about shell density quantitatively. Shell density analysis of marine zooplankton measured by MXCT is most accurate and objective compared with any other existing methods (e.g. SEM observations and weight loss etc). This method is applicable to not only living species but also fossil species, therefore it might provide novel information about the OA ongoing in the modern ocean and occurred in the past. We will introduce about the MXCT technique and its latest results in application for our OA research in the North Pacific and the Arctic Ocean.

Keywords: Microfocus X-ray CT, Planktic Foraminifera, Pteropod, North Pacific, Arctic Ocean, Ocean Acidification

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-22 Room:202 Time:May 28 12:15-12:30

Planktic foraminiferal distribution in the subarctic North Pacific and impact of seawater [CO32-] on shell calcification

IWASAKI, Shinya[1*] ; KIMOTO, Katsunori[2] ; SASAKI, Osamu[3] ; KANO, Harumasa[3]

[1]Atmosphere and Ocean Research Institute, The University of Tokyo, [2]Japan Agency for Marine-Earth Science and Technology, [3]The Tohoku University Museum

Planktic foraminifera are oceanic unicellular protozoa with calcareous shell. All extant species of planktic foraminifera are spending free-floating life from surface to intermediate water down to 1000 m. There are a variety of species relate to oceanic environment or water depth where they live (e.g. Hemleben et al., 1989). Therefore, planktic foraminiferal shell in marine sediments has been recognized as useful tool to reconstruct peloenvironments.

The subarctic North Pacific Ocean locates on the termination of ocean general circulation, and high nutrient deep water from south upwelled to mid-depth. As a result of mixing in surface to mid-depth, the subarctic North Pacific has high nutrients concentration and known as a high biological productivity area (e.g. Takahashi et al., 2002). In the paleoceanographic study, therefore, this region has been considered as important area for biological pump and the global carbon cycle. In addition to contribution to paleoceanographic study, the subarctic North Pacific has been recognized as the area where seawater carbonate ion concentration ($[CO_3^{2-}]$) might be significantly reduced by current ocean acidification over the twenty-first century (Orr et al., 2012). Reduction of seawater $[CO_3^{2-}]$ must have impact on calcifying organism such as planktic foraminifera, results in reduction of shell density. Therefore, identification of current planktic foraminiferal distribution and shell density in the subarctic North Pacific is crucial for estimation of impact on planktic foraminiferal ecology by ocean acidification in near future. However, foraminiferal distributions in the subarctic North Pacific Ocean are not well understood. Here we present horizontal and vertical distributions of planktic foraminifera collected by plankton net deployed at nine sites (target depths: 0-50, 50-100, 100-150, 150-200, 200-300, 300-500 m) in the whole subarctic North Pacific Ocean, in order to understand the relationship between foraminiferal assemblage and insitu seawater conditions. Furthermore, we observed internal structure of foraminiferal shell and measured shell density by Micro Focus X-ray CT scanner (MXCT), and compared these results with seawater $[CO_3^{2-}]$.

Keywords: Planktic foraminifera, the subarctic North Pacific, shell density, Ocean acidification

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS28-23 Room:202 Time:May 28 12:30-12:45

Spatial and size distributions of intact and core glycerol dialkyl glycerol tetraethers in suspended particulates

YAMAMOTO, Masanobu[1*] ; OHIRA, Fukashi[1] ; YAMASHITA, Youhei[1]

[1]Faculty of Environmental earth Science, Hokkaido University

We investigated the size and spatial distributions of intact and core glycerol dialkyl glycerol tetraethers (GDGTs) in suspended particulates at different depths from the western North Pacific to understand how GDGTs start to sink in the water column, and what sedimentary TEX86 reflects.

Three different intact GDGTs, mono-hexose (MH), di-hexose (DH), and hexose, phosphohexose (HPH) GDGTs were detected. Concentrations of intact and core GDGTs at all three locations are vey low in the surface water, increase downward and are maximized at 200 m in the twilight zone. There was significant difference in the relative abundance of MH, DH, and HPH GDGTs between the euphotic and twilight zones, which is attributed to the difference of genotypes of Thaumarchaeota.

Intact and core GDGTs were detected in both the 0.2?1.0 micron and >1.0 micron fractions. In the euphotic zone, a significant portion of intact GDGTs were contained in the >1.0 micron fraction. This suggests that either the GDGTs produced by free-living Archaea were quickly incorporated into a larger particle, or GDGTs were produced by attached Archaea. The proportion of intact GDGTs in the >1.0 micron fraction was higher in subarctic than subtropical sites, suggesting that large phytoplankton such as diatoms plays a role in the formation of intact GDGTs in larger particle. The epipelagic (euphotic zone) GDGTs can effectively sink downward and be delivered to sediment. However, some part of mesopelagic (twilight zone) GDGTs exists in the large size fraction. This suggests that mesopelagic GDGTs also potentially contribute to sinking particles.

The TEX86 values of core and intact GDGTs were different in the same sample; the TEX86 decreased in the order of DH, core, and MH GDGTs. Similar depth profiles of TEX86 of intact and core GDGTs in both 0.2?1.0 micron and >1.0 micron fractions suggests that most GDGTs in suspended particulates did not originate from the surface water but was produced on site. The TEX86 values of core GDGTs in the twilight zone are much higher than expected from in situ temperature, suggesting that mesopelagic Archaea have a different TEX86 response to temperature, which was also pointed by Zhu et al. (2013).

Keywords: TEX86, GDGT, Suspended particulates, POM, proxy