Japan Geoscience Union Meeting 2015
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MIS34-01 Room:301A Time:May 27 16:15-16:30

Fire activity in Japan influenced by spring temperature and vegetation type

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In Northeast Asia, the climatic effect on natural fire activity is poorly understood. We analyzed charcoal particles in Lake Biwa sediments, central Japan, deposited for 150,000 y to evaluate the climatic effect on fire activity. Between 130,000 and 40,000 y ago the charcoal concentration is mostly consistent with spring insolation on site driven by orbital forcing or the oxygen isotope ratio of worldwide marine sediments. Meanwhile, the variation of charcoal concentration related to vegetation change; the peak of the charcoal concentrations were in the periods with dominance of the conifer forest. This findings indicate that fire activity was controlled by spring temperature with the influence of vegetation type.

Keywords: fire activity, charcoal particle, spring temperature, spring insolation, vegetation type, Lake Biwa sediments

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MIS34-02 Room:301A Time:May 27 16:30-16:45

Chronology of Lake Biwa sediments: integration of radiocarbon ages, tephrochronology and environmental magnetism

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The Quaternary sedimentary sequence of Lake Biwa, located in central Japan, provides continuous terrestrial records of past climate changes in East Asia including detailed records of Asian monsoon activity from the Middle Pleistocene to the Holocene. We constructed a common chronological framework for multiple sediment cores from Lake Biwa for the past 50 kyrs. An age-depth model of a 18.42-m long piston-core (BIW07-6), recovered between Takashima and Okinoshima Island in central part, was constructed under the age constraints of thirteen AMS radiocarbon dates of terrestrial macrofossil and six known-ages of widespread tephra layers. Using this age model, we estimated the model ages of ten horizons at which characteristic features were observed in the time series of anhysteretic remanent magnetization (ARM). ARM is a measure of fine ferrimagnetic mineral flux into the sediment, representing a proxy of hydrological changes around Lake Biwa. Therefore the characteristic features of the ARM variation serve as tie-points of core-to-core correlations in Lake Biwa, as well as the horizons of tephra deposits. We thus obtained age-depth curves for other core samples, which were well constrained with the tephra ages, the ARM events and additional radiocarbon dates from each core. The integrated age model has an acceptable accuracy to assess terrestrial environmental changes in millennial scales and can be adapted for paleolimnological studies in other regions.

Keywords: Lake Biwa, age model, last glacial period

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MIS34-03 Room:301A Time:May 27 16:45-17:00

Oxygen isotope analysis of speleothem water inclusion: glacial temperatures reconstruction

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Speleothem inclusion water isotopic compositions are promising new climatic proxies. The applicability, however, is limited by low water content and challenging analytical difficulties. We have developed a precise and accurate isotopic technique based on cavity ring-down spectroscopy with a low sample-amount requirement of 20-260 nL of inclusion water from only 77-286 mg of stalagmite deposits in Gyokusen Cave, Okinawa Island, Japan. The 1σ reproducibility is $\pm$0.24permil for δ^{18}O and $\pm$1.8permil for δD. The isotope values of inclusion water samples from the two most recently layers are within the expected range of isotopic monitoring data for drip water and rainwater at the island.

Keywords: stalagmite, speleothem, fluid inclusion, oxygen isotope, CRDS

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MIS34-04 Room:301A Time:May 27 17:00-17:15

Centurial-scale cycle observed in oxygen isotope of Holocene stalagmite from central Japan

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Oxygen isotope of stalagmites records local climatic conditions via the meteoric isotope values in water recharge area. Previous studies in China and Japan have revealed that variations in stalagmite oxygen isotope likely indicate variations in intensity of the Asian monsoons. We here present U-Th age and oxygen isotope of two stalagmites collected from the central Japan, which appear prominent centurial-scale cycle. Uppermost 5.3 cm of stalagmite OT02 from Gujo City (Gifu Prefecture) exhibit 9 cyclic changes in its oxygen isotopic values in a period of 8.5-2 ka. Estimated ˜650-yr wave length broadly conforms with that of solar activity reconstructed based on radio carbon anomaly. Temperature change was unlikely responsible for the stalagmite isotope because the phase unmatched with the solar activity. The oxygen isotope was low during the cold phases of lower solar activity. The oxygen isotope of OT02 records the change in average isotopic composition of the meteoric water. Meteoric water samples collected at a reference site (Ogaki City) clearly indicate seasonality in the oxygen isotope values. Meteoric waters in winter generally record low isotopic values, likely owning to the Rayleigh distillation that occurs in water vapor mass from the Japan Sea. The records of OT02 can be the change in the winter proportion of meteoric water. This would have increased the stalagmite oxygen isotope during colder periods. A similar ˜650-yr cycles appear in the Holocene stalagmite from Odai (Mie Prefecture). The periodicity is also conformable with historical climatic periods, such as Little Ice Age and Medieval Warm Period. We suggest that such cyclic change can be extended back to 8 ka.

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MIS34-05 Room:301A Time:May 28 11:00-11:15

Deep ocean circulation and water temperature variation in Late Cretaceous based on carbon and oxygen isotopes of benthic

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Oceanic anoxic event 2 (OAE 2) occurred by global climatic warming in the latest Cenomanian to earliest Turonian. Global climate was gradually getting cool just after OAE 2. In the North Atlantic, deep water called NCW (Northern Component Water) was formed (Frank and Arthur, 1999; MacLeod et al., 2011; Martin et al., 2012), and oxygenated bottom water was flowing into North Atlantic by opening of Central Atlantic Gateway (CAG) between South Africa and South America in the early Turonian (Poulsen et al., 2001). Otherwise, climatic cooling from the early Campanian had affected SCW (Southern Component Water) forming in Southern high latitude and this deep water had flowed into Pacific (Brady et al., 1998; Huber et al., 1995; Murphy and Thomas, 2012; Robinson and Vance, 2012; Robinson et al., 2010).

It is cleared that deep water was sourced from high latitude during cooling time from the Campanian to Maastrichtian. However, deep ocean circulation before the Campanian has not yet clarified: especially, deep-water source during the warming periods. In this study, we reconstruct deep-ocean circulation during the late Cretaceous. We selected epifaunal species of benthic foraminifera from core samples in North Atlantic, South Atlantic, Southern Ocean, and Indian Ocean, to analyze carbon and oxygen isotopes in Kochi Core Center in Japan. We report new findings on deep-sea circulation and water temperature changes from the Cenomanian to Maastrichtian by compiling analyzing data and previous literature data.

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Keywords: Cretaceous, Deep ocean circulation, carbon isotope, benthic foraminifera

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MIS34-06 Room:301A Time:May 28 11:15-11:30

Response of terrestrial climate to Cretaceous OAE2 observed in a sequence of Canadian Pacific coast

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Abstract

Across the Cretaceous Cenomanian / Turonian (C/T) boundary interval, a short-term event characterized by sediments rich in organic matter dominated over extended area of various oceanic setting around the world. This pronounced oceanic event is called Oceanic Anoxic Event 2 (OAE2). Considerable disturbance of global surface carbon circulation has been suggested during the event. Across the OAE2 interval, carbon isotope ratios of sedimentary organic carbon and carbonates show unique positive excursions, which are identified throughout the world. On the other hand, influence on the terrestrial environment during the event associated with the carbon cycle disturbance has been less discussed.

To understand the possible terrestrial climatic response related to this carbon cycle perturbation, Haida Gwaii, Pacific coast of western Canada, was studied. Limited macrofossils and carbon isotope stratigraphy well indicate the OAE2 interval through the section. Concentration of polycyclic aromatic hydrocarbons (PAHs) through continuous sequence in Haida Gwaii was evaluated as proxies for the terrestrial environment in the period of OAE2. Likely origin of PAHs in the sedimentary rocks is wildfire; terrestrial vegetation and/or soils can be the source. On the other hand, they can potentially be generated from thermal maturation. In the studied section, gradual increase of PAHs (pyrene, benzo(*e*)pyrene, benzo(*a*)pyrene, benzo(*b*)fluoranthene and benzo(*ghi*)perylene) content was observed within the OAE2 interval. Based on comparison of this increasing pattern with other thermal maturation indices (MPI-1, CPI), wildfire is concluded as the main origin of the PAHs. Increase of PAHs associated with OAE2 suggests the climate of the North American Pacific coast gradually turned into condition that is prone to induce frequent wildfire during the period of OAE2.

Haida Gwaii, presumably located around 35oN during the period of OAE2 (Ward et al., 1997) was dominated by the prevailing westerlies (Upchurch et al., 1999) whereas the latitude is seasonally controlled by subtropical high pressure belt (SHPB) at present. Hasegawa et al. (2013) suggested expansion-shrinkage oscillation of Hadley Cell associated with global climate during Cretaceous. Haida Gwaii located near the northern edge of SHPB could be a region sensitive to such Hadley Cell oscillation. Our observation of PAHs from the studied section could provide important information for discussion on Hadley Cell expansion under declining trend of climate associated with OAE2.

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Keywords: Oceanic Anoxic Event, Cenomanian Turonian Boundary, Hadley Circulation, Subtropical High, Polycyclic Aromatic Hydrocarbon (PAHs)

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MIS34-07 Room:301A Time:May 28 11:30-11:45

Detailed age determination of Cretaceous shallow marine - non-marine strata

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Introduction

It is very difficult to determine detailed age of pre-Quaternary shallow marine and non-marine sequences because they are usually very poor in age diagnostic fossils. However, age determination of such sequences is important to demonstrating past sea level changes as well as evolution of terrestrial fauna and flora. Since the shallow marine and non-marine sequences contain abundant wood fragments, carbon isotope stratigraphy is appropriate method for determining the age of those strata. This study attempted to determine the detailed age of the Cretaceous shallow marine?non-marine sequence of the Kuji Group using carbon isotope stratigraphy and U-Pb ages of tuffs.

Geologic outline of the Kuji Group

The Kuji Group is about 800-m-thick sequence exposed in the eastern coast of Iwate Prefecture. This group overlies unconformably the Jurassic accretionary complex (Rikuchu Group) and is unconformably overlain by the Paleogene non-marine sequence (Noda Group). The group consists mainly of sandstone and conglomerate with subordinate amount of coal and coaly mudstone, and is composed of the Tamagawa, Kunitan and Sawayama Formations in ascending order.

Since the Kuji Group yields abundant well-preserved plant and terrestrial vertebrate fossils such as dinosaur and reptiles (e.g., Hirayama et al., 2010), detailed age determination of this strata is critical for reconstructing terrestrial fauna and flora of the Cretaceous East Asia. The group also intercalates a lot of felsic tuff beds throughout the sequence which provides good anchor points for correlation of carbon isotope curves between the Kuji Group and other marine sequences.

Method

About 500 sandstone and coaly mudstone samples for carbon isotope analysis and 8 felsic tuff samples for U-Pb dating were taken from the sections of the Tamagawa coast, Edanari, Osawada, Natsui and Sawayama streams. For the tuff samples, zircons were separated using heavy liquid, and zircons of 50 grains randomly by a handpicking were pressed into soft PFA sheet, and their surfaces were polished using 3- and 1-μm diamond paste. The U-Pb isotopic age of zircons were determined using LA-ICP-MS at the Nagoya Univeristy. For the carbon isotope analyses, wood fragments were picked up from the disaggregated sediments, and the carbon isotope of the wood fragments of the sample was then measured using a mass spectrometer (IsoPrime) in line with an elemental analyzer EuroEA3000.

Result and discussion

The U-Pb isotopic ages of tuffs from the Kuji Group range from 95 to 80 Ma, and the carbon isotope ratio of the fossil wood fragments of this group changes between -27.0?-20.9 ‰. We correlated the carbon isotope curves among the Kuji and the Yezo groups and the English Chalk with the help of many anchor points of the U-Pb isotopic ages and several macro fossils. As the result, we identified exact Cretaceous stage boundaries of the Cenomanian/Turonian, Turonian/Coniacian, Coniacian/Santonian and Santpnian/Campanian in the Kuji Group. The bone bed containing dinosaur in the Osawada stream is assigned to be lower Coniacian.

Keywords: Cretaceous, Carbon isotope, U-PB age, tuffs

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MIS34-08 Room:301A Time:May 28 11:45-12:00

Orbital influence on productivity and bottom current in the western equatorial Pacific: environmental magnetic approach

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The Western Pacific Warm Pool (WPWP) has highest water temperature in the global ocean, and its spatiotemporal variations have significant impacts on large-scale atmospheric circulation and global hydrology. An environmental magnetic study was conducted on sediment cores of late Pleistocene age taken from water depths of 2500 to 4500m in the West Caroline Basin (WCB) offshore northern New Guinea to understand better the paleoceanography in WPWP. Sediments in the southern part of WCB are deposited under the influence of relatively strong bottom water currents parallel to the New Guinea Trench; this is evidenced by sediment grain-size spectra, anisotropy of magnetic susceptibility, and 3.5 kHz sub-bottom profiling records.

Magnetite dominates magnetic mineral assemblages of the sediments. This is evidenced by that isothermal remanent magnetization (IRM) acquisition curves are mostly explained by a low-coercivity component, and that the Verwey transition is obvious in low-temperature measurements. Existence of the sharp central ridges on first-order reversal curve (FORC) diagrams and transmission electron microscopy indicate the occurrence of biogenic magnetite, in addition to magnetostatically interacting pseudo-single-domain and multi-domain magnetites of probably terrigenous origin.

The ratio of anhysteretic remanent magnetization susceptibility to saturation IRM (k_{ARM}/SIRM, a proxy of biogenic to terrigenous magnetic mineral component) and acid solvable component (˜carbonate content) are synchronous with northern-hemisphere summer insolation; peaks of the former two correspond to the insolation maxima. This suggests that in WCB ocean productivity and then population of magnetotactic bacteria are higher when the Australia-Indonesian summer monsoon is stronger at the insolation maxima. The precessional frequency is visible in volumetric magnetic susceptibility (k) variations at sites shallower than the carbonate compensation depth (CCD), but the eccentricity frequency becomes dominant in carbonate-free mass susceptibility (χ_{cf}). Sediment redistribution by bottom water currents, whose strength and paths may vary with glacial/interglacial changes, may be responsible for the eccentricity frequency in χ_{cf}.

On the Ontong-Java Plateau (OJP) to the east of WCB, on the other hand, the precessional frequency appears in k, but the eccentricity frequency dominates k_{ARM}/SIRM variations. This suggests that the k_{ARM}/SIRM ratio at OJP could be influenced by a terrigenous supply via the Equatorial Undercurrent, but not by the strength of the monsoon.

Keywords: environmental magnetism, Western Pacific Warm Pool, West Caroline Basin, paleoceanography

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MIS34-09 Room:301A Time:May 28 12:00-12:15

M-B boundary age constrained by high-precision U-Pb zircon dating of a widespread tephra in a sedimentary sequence

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Geomagnetic polarity reversals, including the Matuyama-Brunhes boundary (MBB), are critical markers in age calibrating sedimentary sequences with volcanic rocks. Most age determinations for the MBB use marine astronomically-tuned benthic and planktonic foraminiferal oxygen isotope records to date the mid-point in the transition of the virtual geomagnetic pole (VGP). During the MBB and other reversals, the Earth's geomagnetic field intensity dropped significantly, resulting in the increased production of cosmogenic radionuclides, including ^{10}Be, in the upper atmosphere. Hence, the MBB has also been recognized as a positive spike in the ^{10}Be flux recorded in marine sediments and an Antarctic ice core.

The MBB has a frequently cited age of 780 ka, which derives from astronomically-tuned benthic and planktonic oxygen isotope records from the eastern equatorial Pacific. This marine astronomically-dated MBB age is supported by ^{40}Ar/^{39}Ar ages of Maui lavas at 781-783 ka, revised by the recent reference age of Fish Canyon Tuff sanidine (FCTs) standards. However, an understanding of post-depositional remanent magnetization (PDRM) processes shows that lock-in of the geomagnetic signal occurs below the sediment?water interface in marine sediments, which then yields ages for geomagnetic events that are too old. Because this age offset is influenced by sedimentation rate, those records with higher sedimentation rates should minimize the PDRM lock-in problem. In fact, younger astrochronological MBB ages of 772-773 ka have been reported from high sedimentation rate records. These MBB ages are consistent with records of cosmogenic nuclides in marine sediments and an Antarctic ice core, although they are not supported by radiometric timescales.

Here, we present a high-precision U-Pb zircon age of 772.7 $\pm$ 7.2 ka from a marine-deposited tephra just below the MBB in a forearc basin in Japan. Because the U-series dating is relatively free from issues about standardization and decay constants, this U-Pb zircon age coupled with a newly obtained oxygen isotope chronology yields a highly accurate MBB age of 770.2 $\pm$ 7.3 ka. Our MBB age is consistent with those based on the latest orbital-tuned marine sediments. We provide the first direct comparison between orbital tuning, U-Pb dating, and magnetostratigraphy for the MBB, fulfilling a key requirement for calibrating the geological timescales.

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MIS34-10 Room:301A Time:May 28 12:15-12:30

Abrupt intensification of North Atlantic Deep Water formation at the Nordic Seas during the late Pliocene transition

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Southward flow of dense North Atlantic Deep Water (NADW) and northward flow of warm surface water constitute the Atlantic Meridional Overturning Circulation (AMOC). The AMOC is an important component of the present climatic system because it plays a major role in controlling the northward transport of heat and moisture [Ramstorf, 2002]. In order to understand the evolution of the climatic system during the late Pliocene transition (LPT), during which the global climate changed from warm and relatively ice-free conditions to a colder and more glacial climate in the Northern Hemisphere [Lisiecki and Raymo, 2005], it is crucial to reveal changes in the NADW. However, details of the past evolution of the NADW during the LPT are still poorly understood because of the lack of suitable paleoceanographic proxy data.

Here, we developed a new rock-magnetic method to determine constituent of sediments and report on the evolution of NADW during LPT. North Atlantic deep-sea sediments drilled at the Gardar Drift (Integrated Ocean Drilling Program site U1314) were used for rock-magnetic measurements. We measured isothermal remanence (IRM) acquisition curves of 252 samples collected from 199.3 to 299.2 mcd of the core, which correspond to ages between 2.22 and 2.91 Ma at an average resolution of 3 kyr.

First derivatives of the IRM curves were decomposed into two end-member components. Consequently, residuals of the decomposition were sufficiently small throughout the study interval, thus confirming that the Gardar Drift sediments represent a mixing of the two end-member components: high-coercivity and low-coercivity components. Changes in the components agree well with those of the LR04 oxygen isotope data of benthic foraminifera [Lisiecki and Raymo, 2005]; the fraction of high-coercivity component periodically changed with the interglacial?glacial cycle. Variation trends of the sediment constituents drastically changed at ca. 2.68 Ma. Average values of the fraction of high-coercivity component increased after ca. 2.68 Ma from $38 \pm 13\%$ to $68 \pm 22\%$ because of the increase in high-coercivity component during the interglacial period.

Fraction changes of the high-coercivity component represent variation of the Iceland-Scotland Overflow Water, a branch of NADW formed at the Nordic Seas. The drastic increase in the high-coercivity component during the interglacial period suggests that intense NADW formation at the Nordic Seas abruptly started at ca. 2.68 Ma.

Keywords: North Atlantic Deep Water, Iceland Scotland Overflow Water, Nordic Seas, Late Pliocene transition, IODP Exp. 306

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MIS34-11 Room:301A Time:May 28 12:30-12:45

Reconstruction of changes in marine primary productions by biomarker analysis of sediments from the Gulf of Cadiz during

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The Gulf of Cadiz (GoC) has been regarded as an important area for investigating water exchange through the strait of Gibraltar. Particularly, change of Mediterranean Outflow Water (MOW) circulation was evaluated by contourite depositional pattern in the GoC (e.g. Hernández-Molina et al., 2014). The Azores Front (AF), which is known as northeastern margin of the subtropical gyre and regional upwelling area, is located at around the Canary Islands. Although the AF is not penetrated into the GoC at the present, microfossil records suggested penetration of the AF and enhanced productivity during the last glacial period (e.g. Rogerson, 2004). Thus, the GoC is sensitive to change of Atlantic ocean circulation, and can be key region of mid-latitudinal paleoclimatic and paleoceanographic circulation. However, sediment core samples prior to the Pleistocene had not been recovered until IODP Exp. 339 (2011 Nov. to 2012 Jan.), and paleoceanographic records have been hardly reported. Hence, we performed biomarker analysis on the sediment samples recovered by IODP Exp. 339 to reconstruct variations in marine primary production and paleoceanographic change around the GoC from late Miocene to late Pliocene.

We detect C_{27} to C_{29} sterols (eukaryotic algae biomarker), long-chain alkenones (haptophyte biomarker), dinosterol (dinoflagellate biomarker), and long-chain alkyl diols (eustigamatophyte and diatom biomarkers) from all studied samples. The C_{28} and C_{30} 1,14-diols are known as *Proboscia* diatoms biomarker, while esutigmatophyte are assumed as the main origin of C_{28} and C_{30} 1,13-diols and C_{30} 1,15-diol in marine sediment. Recently, upwelling indices based on diol composition such as Diol Index 1 and 2 (DI1 and DI2) were proposed (e.g. Rampen et al., 2014). Concentrations of long-chain alkenones and C_{28} sterol to total organic carbon (TOC) increased at ca. 4.2 Ma. The C_{28} sterols were mainly composed of brassicasterol, which is the major sterol alkenone-producing haptophyte. Thus, these results suggest increase of haptophyte production. While, consecutive contourite sediment was found after 4.5 – 4.2 Ma. Hence, we cannot eliminate possibility that the increases of these biomarker concentrations are attributed to efficient preservation of sedimentary organic matter due to development of contourite depositional system. On the other hand, the 1,14-diol concentrations as well as DI1 and DI2 values increased during 3.4 – 3.2 Ma, which indicates high contributions of *Proboscia* diatom to marine production. Benthic foraminiferal δ^{18}O records indicate that global climate was thought to be colder during 3.4 – 3.2 Ma even in the warm Pliocene epoch (Lisiecki and Raymo, 2005). Particularly, local maximum of foraminiferal δ^{18}O values was observed at cold period of the MIS M2 (ca. 3.35 – 3.24 Ma). Thus, increases of diatom productions in the GoC might be explained by ocean and wind circulation changes caused by global cooling. Furthermore, sea surface temperature (SST) estimated in the IODP U1313 site (mid-latitudinal Atlantic Ocean) indicated that the North Atlantic Current (NAC) was weakened and glacial-like ocean circulation was established from 3.4 Ma to MIS M2 (Naafs et al., 2010). From these results, it is concluded that diatom productions increased as results of penetration of the AF into the GoC permitted by the glacial-like ocean circulation and enhanced vertical mixing during 3.4 – 3.2 Ma.

Keywords: North Atlantic Ocean, Pliocene, MIS M2, Biomarker, Diatom, Mediterranean Outflow Water

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MIS34-12 Room:301A Time:May 28 14:15-14:45

Marine tephra as an important tool for paleoceanography and paleoclimatology

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Tephra is a product of volcanic eruption, and volcanic ash, which is thought to be geologically synchronous, is an important key bed to connect the events found in lacustrine and marine sequences. Tephra grain is an important component of marine sediments, especially around the volcanic islands such as the Japanese islands. Tephra grains have been supplied to marine environments not only directly by the volcanic eruptions as fall tephras, but also by erosion of terrestrial and marine beds. Fall tephra is an important tool to identify relationship among the environmental changes found in terrestrial, lacustrine and marine environments. Exact correlation of regional climatic events is extremely important to understand global climatic changes. Comparison of terrestrial and marine radiocarbon ages of the same tephra provides us information on the local reservoir effect. Because the local reservoir effect is influenced by ventilation and ocean circulation, regional reconstruction of local reservoir effect is useful for understanding the three dimensional ocean circulation changes in the glacial and deglacial oceans.

Keywords: tephra, marine sediments, marine reservoir effect, environmental change, key bed

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MIS34-13 Room:301A Time:May 28 14:45-15:15

Absolute paleomagnetic intensity and tephrochronology: Absolute calibration of relative paleomagnetic intensity stacks

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Absolute geomagnetic paleointensities (APIs) have been estimated from igneous rocks, while relative paleomagnetic intensities (RPIs) have been reported from sediment cores. These two datasets have been treated separately, as correlations between APIs and RPIs are difficult on account of age uncertainties. We present a procedure for directly correlating APIs with RPIs of a RPI stack. Correlations between APIs and RPIs were conducted with virtually no associated age errors using both tephrochronologic correlations and RPI minima. Using the stratigraphic positions of tephra layers in oxygen isotope stratigraphic records, we directly compared the RPIs and APIs reported from welded tuffs contemporaneously extruded with the tephra layers. In addition, RPI minima during geomagnetic reversals and excursions were compared with APIs corresponding to the reversals and excursions. The comparison of APIs and RPIs at these exact points allowed a reliable calibration of the RPI values. In this study, we applied the Tsunakawa-Shaw method to 20 welded tuffs to increase API dataset. We obtained mean paleointensities for 16 of the 20 welded tuffs. Since eight of the 16 welded tuff units were correlated with the oxygen isotope stratigraphy, they can be added to the API data used in the correlation procedure. Combining these API data with the reported data, we correlated API data with RPIs from the PISO-1500 stack. For 13 correlation points, RPIs of the PISO-1500 stack showed a linear relationship with virtual axial dipole moments (VADMs) calculated from the APIs, indicating that the PISO-1500 stack has a linear relation to the axial dipole moment. The correlation procedure with increased API data can contribute to constraining the relation between RPI of a RPI stack and API and calibrating a RPI stack to absolute values.

Keywords: welded tuff, widespread tephra, absolute paleointensity, relative paleointensity, oxygen isotope stratigraphy

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MIS34-14 Room:301A Time:May 28 15:15-15:30

Hydroclimate variations in southwestern Japan over the past 1500 years inferred from oxygen isotope ratios in tree rings

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Oxygen isotope ratios (δ^{18}O) in tree-ring cellulose have been widely used to reconstruct hydroclimate variations and atmospheric circulations over monsoon Asia. However, most of previous reconstructions based on tree-ring δ^{18}O cover only the past several hundred years, and therefore millennium-scale reconstructions are yet to be developed. Here we present a well-replicated 1500-year tree-ring δ^{18}O chronology that was constructed using living and fallen dead trees (*Cryptomeria japonia*) in Yakushima Island, southwestern Japan. First of all, core or disk samples were absolutely dated by matching ring-width patterns among different trees. Then a total of 14 trees were selected for isotopic analysis. We employed the 'plate method' to isolate cellulose component directly from a 1.0-mm wood plate. Each annual ring of cellulose was separated using a razor blade. Finally δ^{18}O of individual ring was determined using a continuous flow isotope ratio mass spectrometer coupled to an elemental analyzer. The δ^{18}O time series were highly correlated with one another, suggesting that common climatic signals are preserved in all the sampled trees. Because the δ^{18}O series did not show prominent age-related trends, all the series were simply normalized to have the same mean during the overlapping segments. The normalized series were then averaged to construct the final chronology. Response analysis using ambient climate records for the last 50 years indicates that tree-ring δ^{18}O is mainly governed by summer relative humidity. We therefore interpret this record as a proxy of hydroclimate related to East Asian summer monsoon. Low-frequency variations in our chronology are similar to those of a Northern Hemisphere temperature reconstruction. More specifically our reconstruction shows a relatively dry (wet) condition during the Medieval Warm Period (the Little Ice Age). Centennial-scale fluctuations of sea surface temperatures in the equatorial Pacific may play a role in modulating long-term hydroclimate changes in southwestern Japan.

Keywords: Tree rings, Oxygen isotope, Yakushima Island, Monsoon

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MIS34-15 Room:301A Time:May 28 15:30-15:45

The change of sedimentary environment for past of 350 years in the Lake Mokoto, Hokkaido, Japan

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In the coastal area of the Sea of Okhotsk in the east part of Hokkaido located to for subarctic zone, many brackish-water lakes are distributed. Especially, the Okhotsk brackish-water lake group around Abashiri City is constituted by major lake in Japan such as Lake Abashiri, Lake Mokoto, Lake Tofutsu, and Lake Notoro. In this study, The change of sedimentary environment in Lake Mokoto is discussed by sedimentologic and geochemical high-resolution analysis of the cores collected from Lake Mokoto.

Mokoto has two-layer structure of intermediate salinity surface waters and high salinity bottom water. The bottom water in Lake Mokoto shows the anoxic conditions in summer season.

The 09Mk-2C cores collected from Lake Mokoto shows the length of 3.87m. In Lake Mokoto, there were the Ta-a tephra (AD 1739) at the 3.5m depths and Ko-2c (AD 1964) at the 3.87m depths.

The cores collected from Lake Mokoto consist of organic mud with the lamination in all cores. In 09Mk-2C core, the core top 185 cm shows the black (L value: ca 5), and it seems to indicate the seasonal anoxic environment as present. The organic mud below 100cm depth shows black (L values: ca 13-15). In the observation by the soft X-ray photograph, the cyclic lamina set is observed in the core from Lake Mokoto. It is considered that this cyclic lamina set is the verve.

Phosphorus contents in 09Mk-2C core show the relatively high values (ca 0.1wt%) above192cm depth. However, Phosphorus is not detected below this horizon up to 290cm depths. Same Trend was observed to 09Mk-1C core. According to result of this core, the increasing of phosphorus contents may be caused by drainage of pollution from stock farm. The horizon of phosphorus increasing is estimated to AD1957 from the number of cyclic lamina set. In report, domestic animal increased at AD1955 in the drainage basin. This timing is consistent with phosphorus increasing. The thickness of lamina set is about 7mm before late 1960s for the age of cyclic lamina set. After that, the thickness of lamina set is about 25mm.It is suggest that Lake Mokoto is aggrading by sediment from drainage basin under high sedimentation rate.

Keywords: Coastal Lagoon, Lake Mokoto, lamina, Ta-a tephra, Ko-2c tephra, anoxic

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MIS34-16 Room:301A Time:May 28 15:45-16:00

Centennial-scale variability in lower trophic level productions off Tomakomai, Hokkaido

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Nutrients in the surface marine waters support lower trophic productivity and fisheries productivity through food webs. In the latter of 20th century, nutrient levels represented by PO4 showed a decreasing trend in the western North Pacific (Limsakul et al., 2001; Minobe, 2013; Tadokoro et al., 2009). This decreasing trend is the largest rates in the world ocean; decreases in productivity of lower trophic levels have also been reported in this area (Boyce et al., 2010; Tadokoro et al., 2009). The decreasing trend of nutrients may be attributed to intensification of subtropical gyre circulation and Kuroshio-Oyashio Extension due to global warming; the effect extends basin-wide (Minobe, 2013). Heretofore, it is unclear that this nutrient decreasing trend results from global warming or is in case of natural variability. Understanding to what extent nutrient depletion due to natural variability contributes to this decreasing trend is important to predict oligotrophication in the North Pacific in the 21st century. However, only 40-year records from observations of nutrients have prevented us from unraveling patterns of long-term natural variability and its amplitude. Here we present long-term record of nutrient levels in the Coatal Oyashio region, western North Pacific, by using proxies of lower trophic levels which sensitively responds to nutrient levels, in order to elucidate long-term natural variability of nutrients and its amplitude.

Results of biogenic opal, algal- and zooplankton-derived pigments showed centennial- or millennial-scale variability for the last 3000 years. Based on flux of biogenic opal, chlorophyll a + derivatives and SCEs, the centennial-scale variability caused depletions from a peak to a trough by 19-42%, 12-19% and 11-65%, respectively. This indicates that diatom productions have substantially varied on centennial timescales. Assuming that amplitude of the diatom production variations was directly attributed to nutrient levels, the depletions on centennial timescales is as large magnitude as that in PO4 (23%) in the late 20th century. The biogenic opal flux is low level at present and the decreasing trend since 19th century is considered to be part of centennial natural variability. Similar centennial-scale variability is also found in the sardine fossil scale records from Japan and off California, records of salmon abundance from Alaska, and PDO index reconstructed from tree ring width from the North America. Centennial climate changes over the Pacific may be associated with the centennial variability in the biological productivity in each region of the North Pacific and PDO. Further studies on this centennial natural variability, including a network of more productivity reconstructions in the western North Pacific and the driving mechanisms, are needed for long-term predictions of nutrient level and fisheries productions.

Keywords: centennial variability, lower trophic level production, Coastal Oyashio, nutrients, PDO

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MIS34-17 Room:301A Time:May 28 16:15-16:30

Intensity variation in ocean circulation with iceberg surges after intensification of Northern Hemisphere glaciation

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Ice sheets linked with ocean circulation play an important role in global climate change. Here we show millennial-scale rock magnetic records together with ice rafted debris (IRD) counts indicating links between ice sheet collapse and ocean circulation after the intensification of Northern Hemisphere glaciation (NHG). We report an abrupt variation in the activity of water circulation associated with an IRD event in Marine Isotope Stage (MIS) 104 weakened to a similar degree to that occurred in MIS 100, the first pronounced glacial period in which widespread glaciation occurred in the northern hemisphere at the intensification of NHG.

We analyzed a sediment core IODP Site U1314 in the Gardar Drift in the North Atlantic. In this study, we analyzed sediments from 239.5 to 245.5 mcd (m composite depth) at 2 cm resolution, which corresponds to the age between 2.58 and 2.62 Ma according to the age model by Hayashi et al. (2010). This interval includes MIS 104, which is a prior glacial interval to MIS 100. We compare the result in MIS 104 to that in MIS 100 in the preceding study (Ohno et al., 2014, JpGU).

We sieved 0.5 g sediments and counted IRDs larger than 150 μm. As a result, two IRD events were confirmed at about 2.602 Ma and 2.610 Ma. Magnetic hysteresis parameters, S-ratio (Mr_{-100mT}/Mr_{1T}) and IRM (isothermal remanent magnetization) acquisition experiments were done by using an Alternating Gradient Magnetometer (MicroMag 2900, Princeton Measurement Corporation).

Rock magnetic records showed 2 types of variation: a long-term variation with glacial-interglacial cycle and a short-term variation associated with an IRD event. The IRM acquisition curves in all samples were well explained by a mixture of two components (of high and low magnetic coercivity, respectively). The variation in the proportion of two components are interpreted as variation in the content of basaltic sediments transported by North Atlantic Deep Water. Therefore, the variation in the proportion of two components indicates the variation in the intensity of deep water circulation. Increase in the component of high magnetic coercivity indicates active deep water circulation at interglacial period. In contrast, increase of the component of low magnetic coercivity indicates inactive circulation at glacial period.

In addition to the long-term variation in IRM acquisition curve during 2.58-2.61 Ma (for thirty thousand years), short-term variation associated with an IRD event occurred at 2.602 Ma and 2.610 Ma. The component of high magnetic coercivity in IRM acquisition curve decreased by 68% (from 73% to 5%) within about a thousand years at 2.602 Ma. Succeedingly, it increased to the same proportion as before the event within a time interval of 10 thousand years. In addition, another short-term variation occurred without IRD event at Gauss-Matsuyama geomagnetic polarity transition.

In our previous study in MIS 100, we reported repetition of sudden decrease and gradual increase in component of high magnetic coercivity associated with IRD events. It is well known that the continental ice sheets grew much larger in MIS 100 compared to in MIS 104. However, our study suggests that the comparable level of decrease in deep water circulation occurred at not only in MIS 100 but also in MIS 104.

Keywords: ice rafted debris, rock magnetism, ice sheet collapse, deep water circulation, North Atlantic Deep Water

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MIS34-18 Room:301A Time:May 28 16:30-16:45

Rapid sea-level fall during the earliest phase of Marine Isotope Stage 19 in Osaka Bay, Japan

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Marine Isotope Stage (MIS) 19 is climatologically important as an orbital analogue of the Holocene, besides its stratigraphic importance as a candidate for the Early-Middle Pleistocene boundary. We conducted diatom analyses of marine clay sediments in the 1700-m core of the Osaka Group to estimate sea-level changes during MIS 19. The marine condition and diatom assemblages in Osaka Bay are strongly affected by eustatic sea-level change. The homogeneous fine clay sediment and its high average accumulation rate (63 cm/kyr) can yield millennial to centennial scale sea-level changes. Variations in diatom assemblages are classified into four ecological categories ; marine, marine-brackish, brackish,and freshwater. Marine taxa define marine zone, ranging in depth from 405.60m to 390.62 m. Diatom assenmblages clearly show precession-related signals for two sea-level highstands correlated with MIS 19.3 and 19.1, and a lowstand with 19.2, respectively. In addition, we found a rapid sea-level fall event in the earliest phase of MIS 19. This event suddenly began at a depth of 403.88 m with rapid decrease in marine-planktonic diatoms, and strong increases in marine-benthic and freshwater-planktonic diatoms, followed by a relatively gradual recovery to the pre-event levels at a depth of 403.27m. An astronomical age model shows its duration of 783ka-782ka. We examined benthic marine oxygen isotope records from deep-sea and coastal marine sediments, some of which have a signal comparable to the sea-level fall event in the earliest MIS 19, suggesting the temporal expansion of global ice sheet. The rapid sea-level fall during the period concerned may reflect a global event.

Keywords: sea-level change, Marine Isotope Stage 19, Middle Pleistocene Transition, diatom, Osaka Group, Matuyama-Brunhes Transition

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MIS34-19 Room:301A Time:May 28 16:45-17:00

High-resolution climate variation during marine isotope stage 11 from a core of Osaka Bay, southwest Japan

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Climate of marine isotope stage (MIS) 11 has been investigated by many researchers, regarded as an analogue for the Holocene. MIS 11 is a super-interglacial characterized by its high sea-level and long duration. To reveal millennial to centennial scale climate changes of this interglacial in comparison with sea-level variations shown by diatoms, pollen analyses were conducted on a 1700-m core of Osaka Bay over a depth range from 162 m to 222 m. The core has an average sedimentation rate of about 60 cm/ka, dated with a linear age model based on the orbital tuning, reinforced by tephrostratigraphy and magnetic polarity stratigraphy. Cold climate shown by dominance of coniferous tree taxa in the latest stage of MIS 12 was replaced by cool climate dominated by deciduous tree taxa mainly composed of Fagus, a cool proxy, in the earliest MIS 11. The vegetation in MIS 11 was gradually dominated by deciduous tree taxa. The proportion of Quercus (Cyclobalanopsis), a warm proxy, increased with sea-level rise and reached its maximum at sea-level highstand of MIS 11.3. After the thermal maximum, Quercus (Cyclobalanopsis) gradually decreased with fluctuations and coniferous tree taxa such as Cryprtomeria and Sciadopitys increased, both indicating cooling and wetting. After MIS 11.3, the climate shows clear precession-related signals correlated with changes in the diatom sea-level proxies. Pollen taxa, especially Alnus and non-arboreal pollen, also show environmental changes. From the latest stage of MIS 12 to the earliest MIS 11, a marsh environment was dominant during the post-glacial sea-level rise. In the early stage of MIS 11, the post-glacial warming is clearly shown by the rapid increase of Quercus (Cyclobalanopsis), and the warming is interrupted by a short-term cooling that ranges in age from about 416 ka to 413 ka based on the linear age model. The temporal cooling almost coincides with the sea-level fall or stagnation suggested by the diatom sea-level proxies. A similar cooling event has been reported from Europe, Lake Baikal and the Antarctic. Therefore, the cooling event in the early MIS 11 may be global and accompanied by an ice volume increase.

Keywords: Marine Isotope Stage 11, Paleoclimate, Paleovegetation, Pollen analysis, Osaka Bay sediments

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MIS34-20 Room:301A Time:May 28 17:00-17:15

High-resolution climate variations during the last interglacial period from an Osaka Bay core

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The last interglacial period is characterized by an extremely high sea-level and warm climate. To reveal detailed features of climate for this period, pollen analyses were conducted on a sedimentary sequence in a 1700-m core from Osaka Bay. At least 400 tree pollen grains were counted for each sample. A marine sediment layer correlated with the last interglacial ranges in depth from 73.6 m to 61.4 m, with the highest sea-level at 69.5 m according to diatom assemblage data. An average sedimentation rate of 0.548 m/ka (R=0.999) is calculated with nine age control points above marine isotope stage (MIS) 17 in the core. A linear age model using the average sedimentation rate and calibrating the sea-level peak to the MIS 5e highstand (Rohling et al., 2008) suggests the marine layer spans in age from 130 ka to 108 ka. The time span almost agrees with that of MIS 5e. The climate change based the age model is as follows. Before 130 ka, *Picea* is dominant, indicating a cold climate during MIS 6. From 130 to 125 ka, the proportion of cool-temperate deciduous broadleaved taxon *Fagus* gradually increases, suggesting gradual warming, coinciding with the postglacial sea-level rise that is shown by the gradual increase of pelagic diatom *Thalassiosira* spp. After 125 ka, *Fagus* turns to decrease, while *Quercus* including warm-temperate evergreen broadleaved taxon *Quercus* (*Cyclobalanopsis*) gradually increases and reach a maximum. The thermal maximum occurs slightly after the highest sea-level. After 115 ka, temperate conifers *Cryptomeria*, *Sciadopitys* and *Taxaceae-Cephalotaxaceae-Cupressaceae* begin to increase, suggesting a gradual wetting. The wet climate continues even after MIS 5e. Subtropical taxon *Lagerstroemia* occurs throughout the last interglacial. These climate variation features seem to be consistent with those of the last interglacial climate from Lake Biwa.

Keywords: Last interglacial, Paleoclimate, Osaka Bay, Pollen analysis

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MIS34-21 Room:301A Time:May 28 17:15-17:30

Pliocene paleoceanographic reconstruction off the Kumano based on planktonic foraminiferal modern analogs

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The Modern Analog Technique (MAT) is a powerful method to reconstruct paleoenvironment by means of a modern dataset (Hutson, 1979; Overpeck et al., 1985; Prell, 1985). In this method, a paleoenvironmental property for a fossil assemblage is calibrated by nearest modern assemblages. Therefore, this method is completely rely on the size and coverage of the modern dataset. According to previous multi-technique studies, the MAT is more sensitive than the Imbrie-Kipp transfer function method.

A global modern database of planktonic foraminifera has been well established by international projects. However, the global dataset is based on specimens in different test size (>150 micrometers) from that of Japanese workers (>125 micrometers). As a Japanese regional dataset, Imbrie-Kipp factor loadings were presented for 81 surface sediment samples along the Pacific coast of Japanese Islands (Takemoto and Oda, 1997). We newly developed a FORTRAN program of the MAT using the square chord distance (SCD) based on Imbrie-Kipp factor loadings of a given sample and the modern 81 samples of Takemoto and Oda (1997). We applied this program to Pleistocene 147 samples obtained from IODP Sites C0001 and C0002 drilled off the Kumano region, northwestern Pacific. As a result of this, vertical temperature changes (0-300 m in depth) of both winter and summer seasons for the last 1.8 million years were reconstructed successfully with low SCD values (less than 0.25). The depth gradient of the summer water temperature in the reconstructed profile indicates stepwise increases around 1.59 Ma (MIS 54) and 1.01 Ma (MIS 28).

Keywords: Planktonic foraminifera, Pleistocene, Modern Analog Technique, Kumano, IODP

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MIS34-22 Room:301A Time:May 28 17:30-17:45

Salinity change in the tropical western Pacific at 5.2 ka when an abrupt tropical climate change occurred

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It has been reported that an abrupt mid-Holocene climate event that marked the transition from early Holocene (pre-5,000-yr-B.P.) conditions to cooler, late Holocene (post-5,000-yr-B.P.) conditions was widespread and spatially coherent through much of the tropics. This abrupt event was occurred around 5,200 yr ago and was coincident with structural changes in several civilizations. While these evidences are obtained from ice core records and/or lake levels, little has been discussed using marine data. Especially, obtaining accurate estimate of the past δ^{18}O (salinity) distribution in tropical surface waters is crucial to establishing the role of the tropical oceans in global climate change. In this study, Sr/Ca ratios and δ^{18}O values in a fossil coral collected from Vanuatu were measured to reconstruct past sea surface temperature (SST) and salinity. The age of the fossil coral is 5212 $\pm$ 10 based on the precise U-Th dating method. Sr/Ca and δ^{18}O were then analyzed with an approximate time resolution of 2 month. XRD analysis and SEM observation revealed that skeletal material was composed of only aragonite. As a result, slightly higher mean SST and about 0.5 per mil enrichment of δ^{18}O relative to modern seawater have shown from 5.2 ka coral. The result is corresponding to the previous study from Great Barrier Reef which has suggested that the temperature increase enhanced the evaporative enrichment of δ^{18}O in seawater.

Keywords: coral, Holocene, abrupt climate change, salinity

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MIS34-23 Room:301A Time:May 28 17:45-18:00

Reconstruction of Andaman Sea coastal environment during the past 500 years

OTA, Yuki[1*] ; KAWAHATA, Hodaka[1] ; YOKOYAMA, Yusuke[2] ; MURAYAMA, Masafumi[3] ; INOUE, Mayuri[4] ; MIYAIRI, Yousuke[2]

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The Andaman Sea is a semi enclosed marginal sea in the northern Indian Ocean. Marine sediment of Andaman Sea is supplied not only from Ayeyawady - Salween river system but also from surface current from the Bay of Bengal driven by Indian monsoon. Although the change of coastal sediment environment in Andaman Sea is important for understanding climate system associated with livelihood, their reconstruction remains unclear. In this study, a marine sedimentary record sampled at a water depth of 75 m (core length: 450cm) in coastal environment of the Andaman Sea (15^{o}N, 96^{o}E, southwestern Myanmar) was used to reconstruct the paleo-environmental change over the past 500 years. We find the evidence from ^{14}C ages that the sediment rate decreased between about 150∼170 cm bsf (1600∼1750 cal yr A.D) of the core. Moreover, grain size analysis reveals finer between about the 150∼170 cm bsf part. Therefore, our results suggest the reduction of sedimentary supply into Andaman Sea coastal area from rivers around 1600∼1750 cal yr A.D. There is a possibility that these results were reflected various environmental changes (e.g. onshore precipitation).

Keywords: sedimentary condition, Andaman Sea, grain size analysis

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MIS34-P01 Room:Convention Hall Time:May 27 18:15-19:30

Paleoenvironmental changes in NW Panthalassa through the Toarcian OAE: Stratigraphy and geochemistry of the Toyora area

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The early Toarcian (Early Jurassic) oceanic anoxic event (T-OAE) was a significant palaeoenvironmental perturbation that led to marked changes in ocean chemistry and climate, and which also had a severe impact on marine ecosystems. In addition, this event is characterized by the widespread occurrence of a ˜3?7 ‰ negative excursion in the carbon-isotope (δ^{13}C) composition of marine organic and inorganic matter and terrestrial plant material. This feature of the event indicates a pronounced perturbation to the global carbon cycle. Despite such global impacts of the event, the precise palaeoenvironmental changes during the event from sections outside of the Boreal and Tethys realms are uncertain. Thus, to resolve this issue and further expand our understanding of the nature of the event, here we investigated the Nishinakayama Formation of the Toyora area, southwest Japan, which represents shallow-marine strata deposited at the northwestern margin of the Panthalassa Ocean. First, we established high-resolution carbon-isotope chemostratigraphy. A characteristic δ^{13}C negative excursion was recognized around the middle part of the Nishinakayama Formation, allowing accurate international correlation. Then, we carried out geochemical analyses to reconstruct palaeoenvironmental conditions at the northwestern Panthalassic margin. Our results indicate that in the studied succession, organic-matter enrichment persisted through the early Toarcian, but elemental redox proxies and ichnofabrics do not support persistent bottom-water anoxia through the δ^{13}C excursion. Analysis of terrigenously derived major and trace element abundances and palynology, coupled with sedimentological observations, revealed an increase in coarse-grained sediment, phytoclast size, and terrestrial organic-matter close to the onset of the δ^{13}C negative excursion. These lines of evidence potentially suggest a marked strengthening of detrital sediment flux and hence hydrological cycling and continental weathering. This is consistent with previously published evidence from Boreal and Tethys realms.

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MIS34-P02 Room:Convention Hall Time:May 27 18:15-19:30

Silicoflagellates and surface water-mass variation at ODP Site 704 in the South Atlantic Ocean for the last 10Myrs

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At ODP Site 704 (46.9○S, 7.4○E) in the South Atlantic Ocean, we estimated latitudinal migration of subpolar and subtropical surface water masses for 10 million years on the basis of silicoflagellate fossil assemblage variations in the sediment core samples. Biogeographical silicoflagellate distribution corresponds to cold water and subtropical water masses. This distribution pattern can be applied to the estimation on latitudinal migration of subpolar/subtropical boundary. Although the fossil preservation was poor in the oldest period from 10Ma to 6.5Ma, the extinct genus *Bachmannocena* considered as a temperate or cosmopolitan species was observed for the period. Continuous occurrence of the cold water genus *Distephanus* was observed from ˜6.5Ma to present. The modern annual sea-surface temperature (SST) is 5.6 ℃ at the studied site, and silicoflagellate assemblage is composed of the genus *Distephanus*. The relative abundance of sea ice-related species in the silicoflagellate assemblages increased from 2.7Ma. However, subtropical genus *Dictyocha* intermittently dominated the assemblage from 5.7Ma to 4.0Ma. The co-occurrence of cold and subtropical water species suggest that the subpolar/subtropical boundary or the mixed water had covered the studied site. The temporal increase of subtropical silicoflagellates at the same periods had been reported at ODP Site 1165 (64.4○S) located in further south near the Antarctic. However, it should be noted that alkenone SST did not show the clear increase at the study site for the occurrence period of *Dictyocha*.

Keywords: silicoflagellate, biogeography, paleoceanography, Ocean Drilling Program (ODP), South Atlantic Ocean

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MIS34-P03 Room:Convention Hall Time:May 27 18:15-19:30

Relative sea level records using high-resolution radiocarbon dating based on new sediment cores from the Bonaparte Gulf

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Sea level is the best indicator of the ice volume change, which plays an important role on the global climate in the Quaternary period (e.g., IPCC AR5). The last glacial maximum (LGM), centered around 20,000 years ago, is a key period for understanding the climate system because the global ice volume reached its maximum. However, the sea level record during the LGM is not enough to understand the relationship between the climate and ice volume changes. Here we present the sea level records during the LGM using the new cores from the Bonaparte Gulf, northwestern Australia.

The Bonaparte Gulf is a suitable site for reconstructing the ice volume change since this region is located at far-field site: location that is distant from the former ice sheet and the adjustment of glacio-hydro-isostatic effect is relatively small. During the cruise of KH11-1 in winter 2011, more than 20 cores were obtained from the various water depths, which provide the continuous sea level records in the Bonaparte Gulf. In this study, over 400 radiocarbon dates of molluscs and organic matters were measured together with total organic carbon, total nitrogen and stable carbon isotope of organic matters. Moreover, cores were investigated by the sedimentology using a CT scan and major elemental analysis. Furthermore, the results were compared with the paleo tidal model to assess the sea level error by the tide in this region. We suggest that sea level fall occurred at ˜21,000 years ago and the duration of the LGM is shorter than the previous studies (eg, Clark et al., 2009, Lambeck et al., 2014).

Keywords: Last Glacial Maximum, Relative Sea Level, Radiocarbon Dating, Marine Sediment Core

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MIS34-P04 Room:Convention Hall Time:May 27 18:15-19:30

Variations in sedimentary environments around the Ryukyu Arc since 25 kyr based on CNS elements

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In this study, we analyzed $_{14}C$ dates, grain size, and CNS element contents using sediment cores collected at the eastern edge of the backarc and forearc of the Ryukyu Arc, and demonstrated different temporal variations in $CaCO_3$ contents and C/N ratios compared with previous studies of the Okinawa Trough cores. Increases in $CaCO_3$ contents and decreases in C/N ratios, from the Last Glacial Maximum to the Holocene, in the Okinawa Trough backarc basin correspond with sea-level changes. These results demonstrate that the sedimentary environment in the Okinawa Trough is influenced by sediment supply from mainland China, and reveal temporal variations reflecting changes in the Yangtze River mouth that accompany sea-level changes. In contract, $CaCO_3$ contents of cores in this study are double those in the Okinawa Trough cores, and show an increasing trend at 7.5-6.0 cal kyr BP. Additionally, in the forearc core, the profile of $CaCO_3$ content decreases at 11.5-8.1 cal kyr BP. These variations of $CaCO_3$ contents suggest that marine productivity changed with trophic conditions in sea surface. In addition, the lateral transport of terrigenous sediment by the Kuroshio and Ryukyu currents might contribute to an increased $CaCO_3$ content by reducing the influence of dilution. Variations in the C/N ratio after 7.8 cal kyr BP suggest that the Kuroshio Countercurrent has varied in strength at 1-2 kyr intervals since the early Holocene, influencing the deposition of terrigenous organic matter from the Okinawa Islands in the deeper parts of the east backarc.

Keywords: CNS elements, deposition process, sea level change, Kuroshio Current, Ryukyu Islands

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MIS34-P05 Room:Convention Hall Time:May 27 18:15-19:30

Biogenic opal changes in the Gulf of Alaska for the last 50 kyrs

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Gulf of Alaska is known as high productivity area mainly by diatoms. Diatom is a phytoplankton with biogenic frustules and can be frequently preserved in sediments. Therefore, sedimentary biogenic opal content is used as a proxy for past diatom productivity (e.g. Ragueneau et al., 2000). During the Integrated Ocean Drilling Program (IODP) Expedition 341 held in 2013, Site U1418 was drilled near the continental margin of the Gulf of Alaska (58 ′ 46.6 ″ N, 144 ′ 29.6 ″ W, and 3,667 m water depth)(Expedition 341 Scientists, 2014). At Site U1418, continuous sediments for the past 1 Myrs with foraminifera and diatoms were recovered from five holes. Age model was constructed by oxygen isotope stratigraphy of planktonic foraminifera (*Neogloboquadrina pachyderma* sinistral) supported by paleogeomagnetic and microfossil datums (Asahi et al., 2014). In this study, biogenic opal contents for the last 50 kyrs were measured using 120 samples from upper 60 m core depths. Biogenic opal was analyzed by extracting with an alkaline solution (2M $NaCO_3$) and molybdenum yellow colorimetric method (Mortlock and Froelich, 1989). In order to estimate paleo-flux of biogenic opal, accumulation rate (AR; g cm^{-2} kyr^{-1}) was calculated based on wt% of biogenic opal, sedimentary density, and sedimentation rate between age control points. Averaged biogenic opal ARs at Site U1418 during the Marine Isotope Stages (MIS) 2 and 3 were 3.60 g cm^{-2} kyr^{-1} and 6.89 g cm^{-2} kyr^{-1}, respectively. Note that most of Holocene sediments were not recovered at U1418. Because of low biogenic opal AR during MIS 2, it is possible to consider that diatom productivity was low during deep glacial period. The present Gulf of Alaska is known as high nutrient low chlorophyll (HNLC) region owing to lack of iron which phytoplankton needs in their production. It is also well-known that eolian dust increased in glacial periods and provided iron to the sea (e.g., Kohfeld and Harrison, 2001). Decreased biogenic opal AR during MIS 2 at U1418 does not support iron fertilization scenario which expects increased productivity by iron supply from eolian dust during glacial period. As these results, the decrease in diatom productivity may have been driven by increased light limitation due to expanded sea-ice cover in the Gulf of Alaska (de Vernal and Pedersen, 1997).

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Keywords: Biogenic opal, Gulf of Alaska, Last glacial period, IODP

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MIS34-P06 Room:Convention Hall Time:May 27 18:15-19:30

Paleoenvironmental changes during last interglacial and MIS 6 in Kuroshio region off Honshu based on planktic foraminif

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Introduction

The Kuroshio Current is the western boundary current, that is a part of the North Pacific subtropical gyre. The Kuroshio plays a main role in heat transport from the tropical ocean to the subarctic North Pacific. Paleoenvironmental changes in the Kuroshio region during the last glacial period to the Holocene were studied during several decades (e.g., Oda and Takemoto,1992,Ujiie and Ujiie,1999,Ikehara et al., 2009). Before the last glacial period, paleoenvironmental changes of the surface and intermediate waters in the Ryukyu Arc region were investigated based on planktic foraminiferal analyses (Ujiie and Ujiie, 2006). However, there are no many study examples for the Kuroshio variability before the last glacial period in the south of Japanese islands. Therefore we studied to reconstruct a paleoenvironmental changes during last interglacial and Marine Isotope Stage (MIS) 6 in the Kuroshio region.

Sample and Methods

A long piston core MD012422 (32?08.7'N, 133?51.8'E, water depth 2737m) was obtained from the continental slope off Shikoku and a piston core KR09-15 PC1 (33?17.7348N, 136?38.3966E, water depth 1951m) was also obtained from the Kumano Trough. In these cores, the planktic foraminiferal assemblage was analyzed for penultimate deglaciation (Termination Ⅱ) from the glacial MIS 6 to the last interglacial period (MIS 5e) to reconstruct variation of the Kuroshio Current. The age model of MD012422 was built based on the oxygen isotope stratigraphy of *Globigerinoides ruber* (Ikehara et al., 2006). The age model of KR09-15 PC1 was also established based on the oxygen isotope stratigraphy of *Globorotalia inflata*. Each sample was washed through 63 μm opening sieve, prior to the drying procedure. After that each dried sample was again sieved thought 125μm opening sieve for planktic foraminifera faunal analysis.

Result and Discussion

A total of 36 planktic foraminiferal species were identified in this study in MD012422 off Shikoku. Twenty-six species were also identified in PC1 off Kumano. The obtained assemblage data are classified into four groups (Ujiie et al., 2003, Ujiie and Ujiie, 2006), which are related with surface water conditions. In this study, we focused on the Kuroshio species, which are composed of *Pulleniatina obliquiloculata* and *Neogloboquadrina dutertrei*. The abundance of Kuroshio species showed high in both sites for MIS 5e. But, their abundance decreased off Kumano for MIS 6. Therefore we interpreted that the Kumano Trough region was not influenced by a warm Kuroshio during the penultimate full glacial MIS 6. For the last interglacial MIS 5e, the Kuroshio was flowing through the similar position with modern.

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MIS34-P07 Room:Convention Hall Time:May 27 18:15-19:30

Change in monsoon climate and lake-water-level recorded in middle Pleistocene Paleo-Kathmandu Lake sediments

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In order to reconstruct terrestrial Indian monsoon record during the MPT (Middle Pleistocene Transition) and to clarify the causes of lake-water-level changes, pollen and other microfossils analyses were conducted on the lacustrine sediments in the southern Kathmandu basin on southern slope of the Central Himalaya.

We reconstructed continuous record of vegetation and climate changes from ca. 1000 ka to 500 ka on the basis of pollen analysis of a 114-m-long drill core at Champi. In addition, changes in ratio of other proxy: sponge spicules, phytoliths and plant fragments are analyzed and compared with the reconstructed climatic record

On the basis of changes in relative abundance and assemblage of fossil pollen, nine pollen zones are constructed. Pollen zone 9, 7, 5 and 3 indicate cold and dry climate and zone 8, 6, 4 and 2 indicate warm and wet climate. Cold index (*Abies* and *Tsuga*) and dry index (*Artemisia* and Chenopodiaceae) increase during period of cold climate after zone 7. Cold index (*Abies* and *Tsuga*) and dry index (Gramineae) increase much more under cold climate after zone 5 and at the same time, ratio of arboreal pollen begins to cyclically change. A comparison of pollen zones with MIS (marine isotope stage) and magnetostratigraphic study indicate that pollen zones from 8 to 2 correspond to MIS 27-15. The pollen diagram suggests that climate of the Kathmandu Valley became cool and dry at 900 and 700 ka (pollen zone 7 and 5), and cyclic climatic change started at 700 ka. These changes seem to correspond to abrupt increase and cyclic changes of global ice volume in the MPT.

Sponge spicule decreases its ratio during the period of dry climate, therefore it could be ascribed to shrinking of habitat of sponge due to the lowering of lake-water under dry climate. Abrupt and rapid decrease of sponge spicule and diatom at around 50 m in depth suggests rapid lowering of lake-water-level for a moment. This change possibly is caused by drain of lake water owing to occasional break of the dam, because the pollen zone 2 indicates warm and wet climate which implies increase of lake-water-level.

Keywords: Indian monsoon, Kathmandu basin, lacustrine sediments, pollen analysis, sponge spicle

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MIS34-P08 Room:Convention Hall Time:May 27 18:15-19:30

Reconsideration of the existence of marine clay beds in KD-1 and KD-2 drilling cores in Kyoto Basin

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Research programs including seismic reflection surveys and deep drillings were carried out at the Kyoto Basin between 1998 and 2002 for clarifying underground structure of the basin. Deep drilling cores taken at three sites, KD-0 in the southern part of the basin (Ogura-ike), KD-1 in the central part (Hokotate Park south of JR Kyoto station) and KD-2 in the northern part (Nijo-jo Castle), were composed of thick strata of the Osaka Group and Pleistocene terrace deposits. Marine clay beds, the key beds in the Osaka Group, were identified at five horizons in KD-0 and KD-1 cores (Ma3, Ma4, Ma5, Ma6 and Ma9 beds) and three in KD-1 core (Ma5, Ma6 and Ma9 beds) according to the color of sediments, results of fossil and pollen analyses and stratigraphic correlations of volcanic ash layers (Kyoto City, 2003). Kitani and Kamo (2010) reconsidered the stratigraphy of KD-0 core, and identified 13 marine clay beds in the Osaka Group (Ma0, Ma0.5, Ma1, Ma1.3, Ma2, Ma3, Ma4, Ma5, Ma6, Ma7, Ma8, Ma9 and Ma10 beds) and one marine clay bed in terrace deposits (Ma12 bed).

In order to reconsider the existence of marine clay beds in KD-1 and KD-2 cores, we performed measurements of electric conductivity (EC) and pH of stirred clayey sediments in water on 15 mud layers in KD-1 core and 14 layers in KD-2 core based on the method of Yokoyama and Sato (1987). In KD-1 core, samples of marine clay beds identified in Kyoto City (2003) showed high EC and low pH values, and were regarded as marine sediments based on the criteria of Yokoyama and Sato (1987). A mud layer above Ma9 bed was also found to show high EC and low pH values, and marine diatom fossils were found in the mud sample by smear slide observations. The layer may be correlated to Ma10 bed. In KD-2 core, samples of Ma5 and Ma6 beds had high EC and low pH values. Other samples including that of Ma9 bed had low EC and higher pH of 6-7, and were regarded as fresh water sediments. It may be implied that the sea water invasion occurred at the formation age of Ma10 bed (about 0.34Ma) in the central part of the Kyoto Basin, and that the northern part has been under the fresh water environment after the formation age of Ma6 bed (about 0.62Ma).

Keywords: Kyoto Basin, marine clay bed, Osaka Group

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MIS34-P09 Room:Convention Hall Time:May 27 18:15-19:30

The response of terrestrial climate variations in the orbital cycles based on a marine pollen records

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A pollen analysis of drilled marine core, that is effective for long-scale and continuous paleoclimate reconstruction because marine sediments have direct d18O-based timescales, which is absent in terrestrial materials. In this study, we carried out pollen analysis to the core C9001C drilled off Shimokita Peninsula, for paleoclimate reconstruction and compose pollen stratigraphy during the Brunhes paleomagnetic chron. As a result, during the interglacial periods is dominated by cool temperate pollen assemblages that is similar to the present-day Shimokita vegetation. In contrast, during the glacial periods is dominated by subarctic pollen assemblages, and the weak glacial periods or the transition periods of interglacial to glacial dominated by cool mixed pollen assemblages. In order to extract more detailed paleoclimate information we apply the modern analogue technique to our pollen records. As a result, paleoclimatic parameters suggested two different variations of paleo-temperature and paleo-precipitation, these are good correlates glacial-interglacial cycles and summer insolation variations, respectively.

Keywords: pollen, paleoclimate reconstruction, marine core

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MIS34-P10 Room:Convention Hall Time:May 27 18:15-19:30

Paleolimnological changes of Lake Maruwanminami-ike and Maruwan-Oike in Soya Coast, East Antarctica during the Holocene

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The Antarctic Ice Sheet is the largest mass of ice on Earth. In the Antarctic Ice Sheet, there are huge amount of freshwater, approximately 60 % of all freshwater on earth. Furthermore, the present Antarctic Ice Sheet contains enough water to raise sea level almost sixty meters, so that only a small change in their volume would have a significant effect to the earth. Antarctic coastal lakes are invaluable archives of paleoclimate and paleoenvironment changes due to the retreat of Antarctic Ice Sheet. In Soya Kaigan (Coast) of Lutzow-Holm Bay region, there are many coastal lakes in ice-free areas. Hydrological changes of coastal lakes located below 20 m ASL from marine to freshwater environments are result from the recession of glaciers and subsequent isostatic uplift.

In this study, we estimate the Holocene environmental change of Soya Kaigan inferred from the analyses of a lake sediment core of Lake Maruwan-Oike (Mw4C-01) and Maruwanminami-ike (MwS4C-01) in Rundvagshetta ice-free area. We conducted Radiocarbon dating and Elemental Analyses by Matsumoto et al. (in prep) to carry out Total Carbon, Total Organic carbon, Total Nitrogen and Total Sulfur. In addition to these results, I clarify assemblage changes of fossil diatoms in the sediment core Mw4C-1 using a characteristic of diatoms living apart by water conditions such as salinity. From the results of diatom analyses and previous analyses, we will report about the Holocene hydrological and environmental changes in detail.

Keywords: Antarctic coastal lakes, Paleoenvironment, Paleolimnology, Diatom analysis, the Holocene

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MIS34-P11 Room:Convention Hall Time:May 27 18:15-19:30

Heinrich events and activities of winter monsoon recorded in bottom sediment of Lake Inawashiro

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Coastal areas along the Japan Sea are regarded as second largest rainy area in Honshu Island. Relatively heavier rainfall in these areas is caused by heavy snowfall during winter thus named heavy snowfall area by Heavy snowfall area special measures law. In order to know future trend of this snowfall, we selected Lake Inawashiro of Fukushima prefecture, Tohoku region as a monitoring site where melted snow from surrounding mountains flows in during spring. We analyzed grain size of 5 millimeter thick sediment at 2.5 centimeter interval which were drilled at the central part of the lake with 28 meter length. The sediment is composed chiefly of thinly bedded alternation of light and dark layers which have several millimeters thickness and is intercalated by 15 tephra layers and 30 pairs of light and dark layers with several centimeters thickness. We made an age model using dates of widespread tephras and radiocarbon ages of sediments and converted depths of sediments into ages. We analyzed frequency of grain size change with REDFIT method. The result shows 7000 year cycle from 45ka to 10ka. In addition, dates of maxima of grain size well correlates with those of Heinrich events. Also those dates well correlate with those of ice rafted debris weight in Japan Sea sediment. Grain size profile shows reverse grading at the lower part of thick light and dark layers and normal grading at the upper part. In addition, light colored lower parts are rich in periphyton diatoms living preferably in acidic water. These results show that sediment in lake Inawashiro is intercalated by many flood sediments. Based on the results that ages of maxima in grain size profile well correlate with those of Heinrich events and that event sediments are flood sediment origin, we concluded that abrupt cooling made winter monsoon stronger and caused heavy snowfall along Japanese island and large floods by melting snow. Report of IPCC WG1 does not suppose abrupt cooling during this century. Consequently, global warming is expected during this century. In that case, winter monsoon will be weakened and it will be apprehensive that water resources for rice planting and hydroelectric power generation will be decreased.

Keywords: Heinrich events, winter monsoon, lake sediment, drilling core, climate change

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MIS34-P12 Room:Convention Hall Time:May 27 18:15-19:30

Heinrich events and activities of winter monsoon recorded in bottom sediment of Lake Biwa

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Coastal areas of Honshu Island along the Japan Sea have heavy snowfall and second rainy areas to coastal areas along the Pacific Ocean. This heavy snowfall supplies large volume of melting water and is used for rice planting and become energy source for hydroelectric power generation. Snowfall in winter is firmly related to winter monsoon which blows over the Japan Sea. Consequently, monitoring snowfall can lead to monitoring the intensity of winter monsoon. In order to clarify historical winter monsoon intensity change, we selected Lake Biwa where Mount Ibuki that has heavy snowfall is very near. We carried out chemical analysis of bottom sediment of 18 meters long piston cored at the central part of Lake Biwa. The sediment consists chiefly of muddy sediment and is intercalated by some tephra layers. Depths of the sediment were converted into ages by the age model based on the age of wide spread tephras and radiocarbon dates of sediment. The result shows that frequency of 6ky is present in the total carbon content profile and that of biogenic silica. Ages of minima of total carbon content together with those of total carbon/total nitrogen ratio correlates well with those of Heinrich events. Calcium content profile shows 7ky frequency and minima of calcium content correlate with Heinrich events. On the other hand, phosphorus content shows the same frequency, however, maxima of this content correlate with those of Heinrich events. Among these profiles, that of phosphorus well correlates with that of lake level change which is shown by sand content profile obtained from drilling sediment near the river mouth of Echi river. Phosphorus content is lower during higher lake level. This result shows opposite tendency that manganese and phosphorus contents are higher during high lake level. Based on those results following sedimentation model is proposed. During the periods of abrupt cooling, snowfall was heavier than other periods. At the time of cooling, large volume of melted snow transports calcium rich detritus materials in spring which are supplied from Ibuki mountains those composed mainly of limestone. On the other hand, production of organic materials decrease during cold periods and transportation of organic materials also decreases. Furthermore, because chemical weathering on land is weakened, transportation of phosphorus and manganese becomes smaller. Therefore, calcium content shows normal correlation to snowfall volume whereas that of phosphorus shows reverse correlation. Based on the fact that the ages of this kind of sedimentation correlate with those of abrupt cooling, activities of winter monsoon was stronger at those periods and snowfall became larger which made lake level higher than usual owing to large volume of melting snow.

Keywords: Heinrich events, winter monsoon, lake sediment, drilling core, climate change

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MIS34-P13 Room:Convention Hall Time:May 27 18:15-19:30

Continental response to millennial-scale climate change during the last glacial to Holocene period

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Here we report analytical results of minor elements in Lake Baikal sediment which contain environmental response to the climate changes during the last 33 kyr.

Keywords: Conitnental interior of Asia, Lake Baikal, Terrestrial environmental system, Minior elements, Uranium, Climate changes

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MIS34-P14 Room:Convention Hall Time:May 27 18:15-19:30

Relationship between early summer precipitation in Japan and the El Nino-Southern Oscillation over the past 400 years

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The El Ni$\tilde{n}$o-Southern Oscillation (ENSO) potentially influences East Asian Summer Monsoon (EASM) rainfall, but the relatively short instrumental rainfall record hinders the progress of a longer-term understanding of this relationship. To partially overcome this issue, we reconstruct precipitation from tree-ring oxygen isotopes (δ^{18}O) in central Japan from AD 1612 to 1935. Our results show that tree-ring cellulose δ^{18}O is significantly correlated with May-June (MJ) rainfall in central Japan, allowing us to examine the relation between the EASM summer rainfall and ENSO during the past 400 years. Time- and frequency-domain comparison of the tree-ring δ^{18}O record and recent ENSO reconstructions show a common high-frequency (3-8 year) variability that characterized the mid-17th, late 18th and late 19th centuries. Similar analyses of instrumental MJ precipitation and several ENSO indexes during the 20th century reveal that this high-frequency oscillation reappeared from AD 1980. Comparison of ENSO and Pacific Decadal Oscillation (PDO) indexes reveals that the ENSO-EASM relationship is strong when ENSO variance is high, and the PDO phase may modulate the ENSO-EASM relationship over the past four centuries.

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MIS34-P15 Room:Convention Hall Time:May 27 18:15-19:30

Oxygen isotopic records of stalagmite OT02 collected Gujo City, Gifu Prefecture

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A 13-cm-long stalagmite OT02 from Gujo City (central Gifu Prefecture) recorded climatic information of two separated periods of Marine isotopic stage 3 (MIS-3) and Holocene. Oxygen Upper and lower parts of the stalagmite differ in oxygen isotopic values; the lower MIS-3 part are 0.5-1.0 permil higher than the upper Holocene part. This difference is comparable to one that has been reported from stalagmites in south China, revealing that the Gifu stalagmite was formed under the influence from East Asian summer monsoon (case 1). However, meteoric water samples collected at a reference site (Ogaki City) clearly indicate seasonality in the oxygen isotope values. Meteoric waters in winter generally record low isotopic values, and the records of OT02 can be the change in the winter proportion of meteoric water (case 2). OT02 is unique in terms of different periodicity recorded in the oxygen isotopic composition; ˜650-yr cycles in the Holocene interval and millennial-scale changes in the lower MIS-3 interval. The Holocene cycle are most likely responded to the swell of solar activity that affected to proportion of winter rainfall (case 2). In contrast, the millennial-scale changes in the lower OT02 are likely associated with Dansgaard-Oschger (D-O) events. Eight bands of low oxygen isotope during a period of 55-35 ka follow the spacing of the dark layers in deep-sea sediments from the Japan Sea. In each cycle, the stalagmite increases transparency to the upward, and suddenly becomes darker at the base of the upper cycle. Similarly, oxygen isotopic values gradually increase in each cycle and rapidly decrease at the base of the upper cycle. Although some of millennial changes in the Gifu stalagmite indicate D-O cycles cannot be seen in the Greenland ice sheet, our records suggest that the central Japan was under the influences of D-O cycles. Oxygen isotope records of the lower OT02 are consistent to case 1 interpretation rather than case 2. Assuming this, it became dry during a gradual cooling period and shifted wet with an abrupt warming.

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MIS34-P16 Room:Convention Hall Time:May 27 18:15-19:30

Oxygen isotopic records of the stalagmite KA01 from Kiriana in Mie Prefecture, Japan

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It has been considered that the stalagmite oxygen isotope is reflected from rainfall intensity of the water reserve area. Especially, the records from south China have been treated as proxy of the intensity of the East Asian Summer Monsoon (EASM). However, some resent studies suggested that the Chinese stalagmite records rather indicate the change in proportion of the Indian Monsoon from southwest and the Asian Monsoon from southeast. In Japanese Islands located at the east margin of the Asian Monsoon area, the rainfall during summer is almost exclusively brought from EASM. Thus, the EASM intensity was more directly recorded in the Japanese stalagmites than in the Chinese stalagmites.

We studied the stalagmite KA01, a 35-cm-long specimen that has been formed from 12.6 ka to 1.3 ka. KA01 and some Chinese records share similar features, such as higher values around 12 ka, depressed intensity during 7-9 ka, and the trend change from increasing to decreasing at 2.8 ka. However, KA01 exhibits smaller amplitude of the isotopic change than the Chinese specimens. The reduced amplitude of KA01 was likely attributed to the shorter distance of the vapor transportation, which reflected on the condensation ratio. Thus, our isotopic profile of KA01 is probably more faithful record of the EASM and therefore can be valuable for considering the Holocene evolution of the East Asian climate system.

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MIS34-P17 Room:Convention Hall Time:May 27 18:15-19:30

Observation of fluorescent laminae structure in stalagmites for lamina counting and results of U-Th dating

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Stalagmites are recognized as a powerful tool to reconstruct paleoclimate. However, it is difficult to date stalagmites. Dating methods of stalagmites are mainly U-Th dating and laminae counting. U-Th dating sometimes shows stratigraphic inverted results, whereas laminae counting has a problem that we have little information about the annual laminae (for example, when and how they are formed? or what they look like?). In this study, I analyzed stalagmite samples collected at Taga Mine, Shiga Prefecture, Japan. I try to reveal the characteristics of laminae in stalagmites and investigate U-Th age.

Stalagmite samples have fluorescent laminae, which can be divided into three types: lamina A, lamina B and wavy lamina. Lamina A is normal type, lamina B is relatively ambiguous lamina and wavy lamina is of wavy shaped. According to FE-SEM image, both lamina A and wavy lamina consist of small particles (diameter is several 10˜100nm). Lamina B can not be observed by FE-SEM probably because particles smaller than 10nm can not be resolved due to polishing scratches. Wavy lamina has many gaps filled with mud. This indicates that wavy lamina is formed when mud covers the stalagmites and prevents calcite growing.

In previous researches, main component of fluorescent laminae may be fulvic acid. Thus the small particles of FE-SEM images may be fluvic acid. To confirm this, I use micro-Raman spectroscopy, micro-FT-IR, SEM-EDX. However, all analyses can not reveal what the small particles are, probably because the small particles are too small to analyze. The result of EPMA indicates that laminae A contains mud. However, the strength of laminae A is not proportional to that of Si and Al peaks, hence Si and Al are not Principal component of lamina A.

I dated stalagmite samples by U-Th dating and I got stratigraphic inverted results: the upper parts of stalagmites are older than the lower parts of them. I calculate the quantity of contamination substance in stalagmite which can influence the U-Th age. In consequence, the stratigraphic inverted results of U-Th dating are probably because of contaminations by mud. On the other hand, humic substances in stalagmites possibly influence U-Th dating.

Keywords: speleothem, lamina, paleoclimate

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MIS34-P18 Room:Convention Hall Time:May 27 18:15-19:30

Cave air monitoring and chemical analysis of drip water at Inazumi cave, Oita, Japan

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10 month cave air monitoring and chemical analysis of drip water were conducted at Inazumi cave, Oita, Japan, from February to December, 2014, to understand the processes and mechanism of recording paleoclimate in stalagmite. Cave air CO_2 was measured for the cave monitoring, and EC, pH, HCO_3^- and Ca^{2+} were measured for chemical analysis of drip water.

Special sampling techniques were designed for two sampling sites, SS2 and SS3, to highlight the relationship between cave air CO_2 and drip water chemistry. At SS2, the drip waters, before and after hitting on three handrails arranged in tandem in limestone cave (SS2-U, -M2, -M3 and -L, respectively), were sampled. At SS3, the drip waters, befor contacting with the cave air (BCWA) and after hitting on the artificial stalagmite, were sampled (BCWA, SS3-U, -M, -L, respectively).

At SS2, as the drip water hit on the handrails, HCO_3^-, Ca^{2+} and EC showed decreasing trend respectively and this trend became significant during winter when the cave air CO_2 was low. Only pH was negatively correlated with other drip water parameters the above. This suggests that the two conditions, 1) the cave air CO_2 is lower and 2) water film gets thinner as the drip water hits on the handrails, promote more CO_2 degassing and $CaCO_3$ precipitation.

At SS3, HCO_3^- and Ca^{2+} between BCWA and the drip water after contacted with the cave air showed almost the same concentration during summer, high cave air CO_2 season, however, marked significant margin between them during winter, low cave air CO2 season. This result suggests that once drip water contacts with lower cave air CO_2, more CO_2 degassing and CaCO3 precipitation are promoted.

S.I.cc, standing for Saturation Index of Calcium Carbonate, and $\triangle pCO_2$, the difference of partial pressure of drip water ($pCO_{2-dripwater}$) and of cave air ($pCO_{2-caveair}$), were calculated if CO_2 degassing and $CaCO_3$ precipitation takes place or not. S.I.cc showed positive value at SS2 and SS3 during almost all monitoring periods, indicating $CaCO_3$ is produced almost all the time. However, $\triangle pCO_2$ showed frequently negative value at SS2 and SS3, indicating that CO_2 is not degassed from the drip water and the following $CaCO_3$ precipitation is not taken place and that most of drip water sampled already degassed CO_2.

This research implied that CO_2 variation is a main forcing factor to control HCO_3^- and Ca^{2+}, main components in drip water to form $CaCO_3$-made-laminae used for reconstructing paleoclimate; however, the calculation of $\triangle pCO_2$ showed that $CaCO_3$ would not be produced from drip water. To solve the contradiction, another approach such as development of new sampling method will be necessary.

Keywords: Paleoclimatology, Stalagmite, drip water, cave air monitoring

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MIS34-P19 Room:Convention Hall Time:May 27 18:15-19:30

Characterization of Aeolian Dust, Sediment, with SEM-EDS Automated Particle Analysis

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SEM-EDS automated particle analysis, which is the automated particle analysis combined with a scanning electron microscope (SEM) with energy dispersive X-ray spectroscopy (EDS), is a very powerful method to characterize particle mixtures of several different substances. With this method, we can analyze a large number of particles, more than 10,000 particles one by one, directly. The analyzed data, the shape and size as well as the composition of each individual particle, are stored for the characterization of the mixtures and classified into about some groups with similar composition, same minerals, and so on automatically. We have successfully applied this method to the characterization of a few rocks and sediments by using this method [1], [2] and [3]. Detailed analysis of rocks and sediments would give important information on mountain uplift, river contention and erosion process. In this study, we extend our efforts to aeolian dusts and sediments, for example Beijing Urban Aerosols and Gobi Kosa Dust. They were purchased from National Institute of Environmental Studies (NIES), which distributes them as environmental certified reference materials. Classification was made of their composing particles. Furthermore, statistically averaged concentrations of elements obtained in the present study were compared with those listed in the NIES document. For example, in Beijing Urban Aerosols, we analyzed 30,000 particles and classified by their composition. The average of the particles size is 6 μm and the distribution of the particle size is 1- 40 μm. These particles contained quartz, feldspar, gypsum, calcite and other material. In addition, a lot of hydro sulfates and sulfides were detected with clay minerals. In the presentation, we will show more detailed descriptions of the correlation between Beijing Urban Aerosols and Gobi Kosa Dust, and other sediment analysis results.

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[3] H. Muto, A. Shimada, 2014, SEM-EDS Automated Particle Analysis of Mineral Compositions of River Sand, the annual academic conference of the Japan Society of Microscopy 2014.

Keywords: Sediment, Aerosol, SEM, EDS, Particle analysis

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MIS34-P20 Room:Convention Hall Time:May 27 18:15-19:30

A chronostratigraphic study of the upper Anno Formation, Awa Group, distributed in the middle part of the Boso Peninsula

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Since the Awa Group, distributed in the central Boso Peninsula, has a good continuous exposure, abundant microfossils and many intercalated treiceable tephra beds, a lot of stratigraphic studies have been conducted so far. Okada et al (2013) reported magnetostratigraphy of the upper Anno Formation exposed along the Minato and Shikoma rivers, which concluded that the Mammoth reversed subchronozone (3.207-3.330Ma) and the Gilbert-Gauss boundary (3.596Ma) were recognized at the horizon of between the An155 and An157 tephra beds and at the horizon near the An127 tephra bed, respectively. However, sampling resolution, which is about 10m in the stratigraphic interval at the Shikoma river route, is not sufficient to deny a possibility that the subchronozone is recognized as the Kaena reversed subchronozone (3.116-3.032Ma). We therefore conducted resampling with a higher resolution in order to refine the magnetostratigraphy with a better temporal resolution.

For paleomagnetic, rockmagnetic and oxygen isotopic measurements, we sampled 1-5 mini-cores and sedimentary rocks with about 300g by dry-weight at 117 sites, respectively. The samples were taken downward from the horizon just below the Kurotaki unconformity in Shikoma river route.

We performed alternating-field demagnetization (AFD) and thermal demagnetization (ThD) in order to extract primary components from the specimens. Additionally, we carried out a magnetic hysteresis parameter analysis and a thermomagnetic analysis to detect rockmagnetic parameters. The results exhibit that most specimens consist pseudo-single domain magnetites as the magnetic carrier of natural remanent magnetizations. Characteristic remanent magnetizations (ChRMs) calculated from both of AFD and ThD results did not pass the reversal test, indicating that secondary magnetization components are not able to be removed completely with the both demagnetization technics. However, we judged that the ChRMs from ThD would be reliable to evaluate the polarities, since the secondary components are quite small. Accordingly, we confirmed polarity boundaries at depths of 96-98.4m, 22.5-26.6m and 11.4-14.7m. Because the polarity boundary at the deepest site is near the An127 tephra bed as well as the previous study, it is compared to the Gilbert-Gauss boundary. The polarity boundaries at depths 22.5-26.6m and 11.4-14.7m correspond to the upper and lower boundaries of the Mammoth reversed subchronozone, respectively, since there is no other polarity reverse from the deepest polarity boundary to the middle polarity boundary. Sedimentation rate between the Gilbert-Gauss boundary and the lower boundary of the Mammoth reversed subchronozone, and between the lower and the upper boundaries of the Mammoth are evaluated as about 27cm and about 9cm, respectively. The significantly decreased sedimentation rate observed during the Mammoth subchron corresponds to the horizon between the An155 and An157 tephra beds. Nakajima and Watanabe (2005) reported that the horizon between the An155-2 and An156-4 tephra beds was eroded by a slump at the Shikoma river route. We consider that the significantly decreased sedimentation rate attributes a hiatus due to erosion by slump.

We, hence, plan to extract foraminifers from sedimentary rock samples from the same sites of paleomagnetic mini-cores, and measure oxygen isotopes. After that, we are going to discuss chronostratigraphy using oxygen isotope stratigraphy and magnetostratigraphy.

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Keywords: Magnetostratigraphy, Oxygen isotope stratigraphy, Chronostratigraphy

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MIS34-P21 Room:Convention Hall Time:May 27 18:15-19:30

On the glacial carbon reservoir in the deep-sea

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Numbers of studies has been performed to seek the glacial carbon reservoir in the deep-sea. Radiocarbon age offset between co-existing benthic and planktic foraminifers is widely used to estimate ventilation rate of the glacial deepwater. However, reconstructed results in previous studies were divided into two groups: comparable to the present and much older than the present. The discrepancy is caused by sediment disturbance inferred from major change in depth-age curve and estimation of regional marine reservoir age. These suggest an importance of primary information on sediment core sample and radiocarbon data.

Keywords: Glacial period, Carbon reservoir