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

STT58-01 Room:106 Time:May 24 15:30-15:45

Geomagnetic secular variation in Japan from archeomagnetic data

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We have made a new archeomagnetic database in Japan covering the past 2000 years. Now we report a new geomagnetic directional secular variation model derived the database.

Geomagnetic direction changed within a cone with the half angle of 20 degrees, and it had at least 6 changes in the moving direction which indicates a characteristic geomagnetic changes. Especially the last two drastic changes in 1150 and 1600 are able to be consistent with magnetic jerks.

We will also talk the potensial of age estimation with using the geomagnetic seuclar variation curve appling to new paleomagnetic data with unknown age.

Keywords: geomagnetic secular variation, archeomagnetism, geomagnetic changes

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STT58-02 Room:106 Time:May 24 15:45-16:00

High-resolution magnetostratigraphy of Lake Biwa sediments

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Magnetostratigraphy is ”the element of stratigraphy that deals with the magnetic characteristics of rock units.” Although magnetic polarity of remanent magnetization is generally used for identification of magnetostratigraphic units, other features of geomagnetic field variation, such as paleointensity change and paleosecular variation, provide basis of high-resolution magnetostratigrapy for time periods shorter than magnetic polarity intervals. In addition, variation of magnetic properties of strata, such as magnetic susceptibility, can be utilized for stratigraphic correlations, in case that variation of magnetic properties reflects environmental changes in regional or global scale.

Lake Biwa, located in central Japan, contains a thick sedimentary sequence deposited in lacustrine or fluvial environments during the Pleistocene. Magnetostratigraphic and tephrostratigraphic analysis of deep-drilling cores from the central basin showed that about 800-m thick sediment has been deposited for the last 1.3 m.y. It was also revealed that anhysteretic remanent magnetization (ARM), a measure of magnetic mineral content in sediment, provides a good proxy of hydrological changes around Lake Biwa since the last glacial period. While low-field magnetic susceptibility is most widely used for stratigraphic correlation of core samples and detection of paleoenvironmental changes, ARM is more sensitive to concentration of ferrimagnetic minerals such as small magnetite grains. We interpret that the increased ARM represents enhanced precipitation probably associated with higher monsoon activity. Characteristic features of the ARM records are identified at horizons consistent with widespread tephra layers in 4 piston-cores recovered from wide area in Lake Biwa. It is therefore suggested that the ARM features can be used for stratigraphic correlation at least in Lake Biwa. These features may be assumed as regional or global time markers, because the ARM records are apparently synchronized with the oxygen isotope records from stalagmites in China and the Greenland ice cores.

Keywords: Lake Biwa, magnetostratigraphy, climate change, geomagnetic excursion, environmental magnetism

Japan Geoscience Union Meeting 2012
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STT58-03 Room:106 Time:May 24 16:00-16:15

The age of Matuyama/Brunhes polarity reversal: Paleomagnetic records, astronomical tuning and radiometric dating

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Channell et al. (2010) suggested that the midpoint of the M-B boundary lies at 773.1 ka, ?7 kyr younger than the presently accepted astrochronological age for this polarity reversal (780-781 ka). Their results are based on the five high-resolution Matuyama-Brunhes polarity transition records from the North Atlantic placed on isotope age models produced by correlation of the d18O record to an ice volume model. According to this results, they further inferred that the 40Ar/39Ar Fish Canyon sanidine (FCs) standard age that best fits the astrochronological ages is 27.93 Ma, which is younger than the two recently proposed FCs ages of 28.201 +- 0.046 Ma (Kuiper et al., 2008) and 28.305 +- 0.036 Ma (Rene et al., 2010). However, recent study by Ganerod et al. (2011) suggested an age of 28.393+-0.194 Ma for FCs based on paired 40Ar/39Ar and 206Pb?238U radiometric dating supporting the calibrations of Kuiper et al. (2008) and Renne et al. (2010). Furthermore, recent study by Rivera et al. (2011) suggested an age of 28.172+-0.028 Ma for FCs based on cross-calibration with an astronomically tuned age of A1 tephra sanidines in the studied sequence of Faneromeni section in Crete. The discrepancy is significant that needs to be investigated carefully in terms of every aspects of the whole system involved. We therefore review the literatures related to the topic including the solar system dynamics, geomagnetic reversal morphologies, climate system responses, calibration procedures of radiometric dating and the recording mechanisms of each parameters to the sediments involved.

Keywords: Matumaya/Brunhes polarity reversal, radiometric dating, paleomagnetic records, astronomical tuning, reliability of polarity transition age, Fish Canyon sanidines

Japan Geoscience Union Meeting 2012
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STT58-04 Room:106 Time:May 24 16:15-16:30

New method for the chronostratigraphic reconstruction of Pliocene marine sediments at the subpolar North Atlantic

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We established a new method to reconstruct chronostratigraphy of subpolar North Atlantic sediments during the Pliocene by using a new hybrid environmental proxy. Pliocene sediments recovered at IODP Site U1314 in the Gardar Drift (North Atlantic) are characterized by the paucity of foraminiferal tests, and this hampered the establishment of an age-depth model of the sediments by the orbital tuning method using an oxygen isotope record. Therefore, we created the hybrid environmental proxy by combining magnetic susceptibility and natural gamma radiation as a tuning material. In the hybrid proxy record, glacial-interglacial climate variations are extracted and the small-scale variations (attributed to ice-rafted debris) are eliminated. We established a high-resolution age model for the sediments at IODP Site U1314 during 2.76-2.10 Ma by tuning the hybrid proxy record to the global standard oxygen isotope record (LR04 stack). We would point out the possibility that our tuning method may be applicable to other Pliocene sediments in subpolar North Atlantic regions.

Keywords: chronostratigraphy, Pliocene, marine sediments, North Atlantic, magnetic susceptibility, natural gamma radiation

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STT58-05 Room:106 Time:May 24 16:30-16:45

Paleoceanographic significance of diatomaceous ooze under the subarctic convergence in the North Atlantic (IODP Site U13

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Stratigraphic variation in foraminiferal assemblage and oxygen isotope was examined using the late Pleistocene diatomaceous deposits collected under the subarctic convergence in the North Atlantic. Oxygen isotope from surface and subsurface dwelling planktic foraminifers (*Globigerina quinqueloba* and *Neogloboquadrina pachyderma* sinistral) revealed that mat-forming diatom, *Thalassiothrix longissima*, occurred extremely abundant under cooler surface water condition, while it occurred commonly under warmer surface water one. The evidence suggests that deposition of the diatom mats is closely related to the surface water conditions.

Keywords: Planktic foraminifera, North Atlantic, Quaternary, IODP

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STT58-06 Room:106 Time:May 24 16:45-17:00

Global synchroneity of Quaternary calcareous nannofossils datums betweem North Atlantic and Northwestern Pacific Oceans

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Quaternary calcareous nannofossil datums and their chronostratigraphic framework have been discussed over the last 20y mainly based on their correlation to magnetostratigraphy or oxygen isotope stratigraphy (e.g. Raffi and Rio 1979; Thierstein et al, 1977). These studies indicate that Quaternary nannofossils datums show a small diachroneity between different latitudes and Oceans. Some studies indicated diachroneity were thought to be causally related to discontinuity coring or low resolution study because of low sedimentation rate.

We studied high-resolution Quaternary calcareous nannofossils biostratigraphy to clarify the relationship between nannofossils events and oxygen isotope stratigraphy using the continuous sediments sequence from Integrated Ocean Drilling Program (IODP) Site U1308 in the North Atlantic Ocean and IODP Site C9001C in the Northwetern Pacific Ocean (off the Shimokita Peninsula). We clarify the critical stratigraphic positions of both the first occurrence of Emiliania huxley and the last occurrence of Pseudoemiliania lacunosa between Site 1308U and Site C9001C. The P. lacunosa extinction is just below the highest peaks of marine isotope stage (MIS) 12, whereas the first occurrence of E. huxley has also a just below the highest peaks of MIS 8. Results show the global synchroneity of calcareous nannofossil evolutions between different latitudes and Oceans.

Keywords: calcareous nannofossil, biostratigraphy

Japan Geoscience Union Meeting 2012
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STT58-07 Room:106 Time:May 24 17:00-17:15

Magnetostratigraphy of the Plio-Pleistocene Konso Formation in the southern Main Ethiopian Rift, East Africa

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The Plio-Pleistocene Konso Formation in the southern end of the Main Ethiopian Rift, Ethiopia, has produced abundant Oldowan and Acheulean (Early Stone Age) artifacts. The formation yields many mammalian faunal fossils including those of Homo erectus and Australopithecus boisei. The Konso formation comprises fluvial and lacustrine sediments and contains more than 30 tephra layers. $^{40}Ar/^{39}Ar$ dates of some of these tephra layers and correlation with the Pleistocene tephra layers of the Omo-Turkana Basin sediments (southwest of Konso) indicate that the formation had been deposited between ca. 2.0 and 0.75 Ma. Despite intensive faulting and post-depositional deformation, the relative stratigraphy of almost all outcrops of the Konso Formation has been established, based on detailed and careful tephra correlation. Paleomagnetic analyses performed on samples of volcanic ashes and finer sediments taken from such outcrops define the upper and lower boundary of the Olduvai Subchron and the Matuyama-Brunhes boundary in the Konso Formation. A short normal polarity zone was detected immediately below the tephra layers with $^{40}Ar/^{39}Ar$ dates of around 1.6 Ma, possibly correlated with the Gilsa Event and/or the Stage 54 Event. The three magnetic polarity boundaries and single short polarity event in the Konso Formation provide reliable age constraints to the occurrence and development of the Acheulean lithic assemblages in this region of East Africa.

Keywords: Main Ethiopian Rift, Konso Formation, Magnetostratigraphy, Tephrostratigraphy, Acheulian lithic assemblages

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A preliminary result of magnetostratigraphy of a sediment core from Chukchi Rise, Arctic Ocean

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Elucidation of climate changes in the Arctic Sea has gradually been regarded as important since 1960s when geological surveys commenced in the Arctic region. The sea has a unique marine environment with poor bioproduction and high resolved carbon dioxides, resulting that the sea bottom sediments have a unique biostratigraphy and isotope stratigraphy. Before 1980, accumulation rates (a.r.) of the Arctic Sea sediments were estimated to be several mm/ka or less based on magnetic polarity stratigraphy. As a result, the Matuyama-Brunhes boundary was often estimated to lie at ˜1m below seafloor. However, radiocarbon dates and biostratigraphy obtained after 1980s revealed that a.r. was as high as several cm/kyr all over the Arctic ocean. The new a.r. revised the former interpretations that reverse polarity chrons/subchrons could be correlated to the short reverse polarity intervals observed in the Arctic Ocean and Norwegian-Greenland Sea cores. The short intervals are now correlated with excursions during the Brunhes Chron. Recently, excursion stratigraphy is often used for dating Arctic cores.

Sediment cores were collected in 2009 at the Chukchi Rise in the Arctic Ocean during the JAMSTEC cruise MR09-03 whose objects are environmental changes of temperature, hydrological cycle, bioproduction and distribution of sea-ice. The core sites are located at different water depths between 74 degrees 26 minutes N and 75 degrees 28 minutes N and from 165 degrees 40 minutes W and 165 degrees 44 minutes W. This study aims at elucidation of paleoenvironment in the Arctic Ocean. We used core PC01 and pilot core PL01 collected at a 558 m water depth on the west slope of the Chukchi Rise (75 degrees 28 minutes N, 165 degrees 40 minutes W). As the first step, a paleomagnetic investigation was conducted to establish magnetostratigraphy for dating.

237 cubic specimens were collected for magnetic measurements. Natural remanent magnetizations were measured using a super-conducting magnetometer. All the specimens were subjected to alternating field and thermal demagnetizations. Characteristic remanent magnetizations (ChRM) were calculated using principal component analysis. The result shows that normal polarity ChRMs are dominant throughout the core except some parts. Negative inclination zones are found at 77.3-79.3cm, 164.3-186.8cm, 210.6-220.1cm, 251.1-265.4cm. These may be excursions. We will conduct rock magnetic analyses to confirm that they are real geomagnetic phenomena. Using photoluminescence and radiocarbon dating results that will be obtained in near future, we finally establish excursion stratigraphy.

Keywords: Magnetostratigraphy, Excursion, Arctic Ocean

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Characterization of magnetic polarity boundaries

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Magnetic polarity stratigraphy is often used for dating various kinds of sediments. Magnetic polarity data can easily provide reliable chronostratigraphy to the cores of deep-sea and lake bottom sediments that have relatively uniform accumulation rates. To the contrary, it is often difficult by the magnetostratigraphic method to reliably date terrestrial sediments that span short times and have no absolute age control. However, if a magnetic polarity boundary has distinctive characters, we can confidently correlate it with the standard geomagnetic polarity time scale. We review detailed paleomagnetic and paleoclimatic data across polarity boundaries, and examine if they uniquely characterize a polarity boundary, with respect to the polarity boundaries for the last 2.6 Ma (the Gauss-Matuyama, upper and lower boundaries of the Reunion, Olduvai, Cobb Mountain, and Jaramillo Subchrons, and Matuyama-Brunhes). We also review the magnetostratigraphic investigations for anthropologically important Homo erectus fossils outside Africa, and discuss their reliabilities.

Keywords: geomagnetic polarity boundary, magnetostratigraphy, climatostratiraphy, hominid dispersion

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STT58-P03 Room:Convention Hall Time:May 24 17:15-18:30

Magnetostratigraphy of sediments contaminated by drilling induced magnetization: A case study from IODP Exp. 322

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Sediments recovered bydrilling are often affected by drilling induced remanent magnetization (DIRM). Integrated Ocean Drilling Program (IODP) Exp. 322 by D/V 'Chikyu' was one of such a drilling expedition. The DIRM might have been induced by the use of magnetic steel core barrels during rotary coring accompanied by the vibrations, frictions and twisting stress. In some cases, magnetization intensities of DIRM were more than ten times that of natural remanent magnetization (NRM). Typically, DIRM could have been removed by alternating field demagnetization (AFD) up to 10 mT. However, samples heavily contaminated by DIRM showed steep inclinations even after AFD up to several tens of mT. The samples were also contaminated by secondary magnetization during Brunhes (viscous remanent magnetization) and remagnetization events such as injection of fluids into the formation etc. In order to extract reliable polarity of primaly magnetization at the time of deposition as far as possible, we conducted regression analysis proposed by Kirschvink (1980) extensively with the aid of PaleoMag developed by Craig Jones (http://cires.colorado.edu/people/jones.craig/CHJ_PMag_overview.html).

The procedure is based on the recognition of linear segments and/or great circles depending on the contamination levels and degree of overlap on the coercivity spectrum. We could maximize the recognition of reversed polarity interval and minimize the misinterpretation of normal polarity interval at the same time. Some of the samples were identified as doubtful based on clear criteria. Finally we present the resulting magnetostratigraphic interpretation for Hole C0011B and C0012A of Exp.322.

[Reference]

Kirschvink, J. L., The least-square line and plane and the analysis of paleomagnetic data, Geophys. J. R. Astron. Soc., 62, 699-718, 1980.

Keywords: magnetostratigraphy, drilling induced remanent magnetization, Miocene, Pliocene, decontamination, remagnetization circle