Japan Geoscience Union Meeting 2012
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STT58-P01 Room:Convention Hall Time:May 24 17:15-18:30

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

TOBI, Marina[1*], Kenichi Okushi[2], SUGISAKI, Saiko[3], HYODO, Masayuki[4]

[1]Earth Planet. Sci., Kobe Univ., [2]Human Development, Kobe Univ., [3]Polar, Soken Univ., [4]Kobe Univ. R. C. Inland Seas

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

HYODO, Masayuki[1*]

[1]Kobe University

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

ODA, Hirokuni[1*], Xixi Zhao[2], Huaichung Wu[3], YAMAMOTO, Yuzuru[4], KITAMURA, Yujin[4]

[1]Geological Survey of Japan, AIST, [2]University of California, Santa Cruz, [3]China, [4]Japan Agency for Marine-Earth Science and Technology

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