

Changes of water structures in the Sea of Japan during the Late Pliocene

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An analysis of fossil ostracode assemblages in the Kuwae Formation, central Japan, clarify the paleoenvironmental changes related to glacial and interglacial cycles during MIS G19 and G10 (Irizuki et al., 2007). Added to this, temperate intermediate waters which were warmer than those of today, were existed in interglacial periods during 3.5 to 2.8 Ma. Radiolarian faunas inferred that enhancement of ventilation due to global cooling started at approximately 2.5 Ma (Kamikuri and Motoyama, 2007). However, temperatures of the temperate intermediate waters and the timing are uncertain. So, our aims are to clarify quantitative temperatures of shallow and intermediate waters during the late Pliocene based on Mg/Ca, and to discuss change of water structures in the Sea of Japan.

Siltstones collected from the Kuwae Formation along the Tainai River were soaked in H₂O₂ for 24 hours before they were washed. Ostracode shells of genus *Krithe* (intermediate water species) and *Cytheropteron miurense* and *Cytheropteron sawanense* (shallow water species) were taken from the residues, and their Mg/Ca were measured by ICP-AES at Kochi University. Two intervals were identified in the study section based on quantitative temperature of intermediate and shallow waters and their vertical changes. Intermediate water temperatures ranged between 0 and 10 °C and fluctuated in short-time intervals during MIS G19-G16, although they were stable and showed a small amplitude between 3 and 7 °C during MIS G15-G13. Moreover, difference in temperature between shallow and intermediate waters was large in MIS G19 and G16, but was small in MIS G15-G13. These temperature difference and shifts suggest that strong stratification of shallow and intermediate waters during MIS G19-G16 changed to a condition in which temperature gradients were small due to enhance of ventilation in the Sea of Japan. MIS G15 and G13 were characterized by a large oxygen isotope values compared with those in other inter-glacial periods of the study intervals. The relative cooling in inter-glacial periods might be caused a beginning of ventilation in the Sea of Japan.

Keywords: Sea of Japan, Late Pliocene, ostracode, Mg/Ca, water structure

Sedimentary Rhythms in the Middle Miocene Onnagawa Formation in Northern Japan

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The Middle to Late Miocene bedded siliceous rocks, are widely distributed in the Pacific rim. Typical examples are the Monterey Formation, distributed along the coast of California, and the Onnagawa Formation in northern Japan. The Onnagawa Formation is mainly composed by alterations of porcellanite and siliceous mudstone, called "hard-soft alternation", and finer alternations of light and dark porcellanites, in which parallel lamination is relatively well preserved. These alternations show centimeter- to meter-scale rhythms, where meter-scale rhythm is interpreted as reflecting variations in the water mass structure within the Japan Sea induced by sea-level oscillations paced by Milankovitch cycles (Tada, 1991). On the other hand, centimeter-scale rhythm reflects millennial-scale changes whose origin and cyclicity are still poorly understood.

In this study, we aim to reveal origin and cyclicity of light-dark alternation in the Onnagawa Formation, their relationship with variation of water mass structure in the Japan Sea, and implication to global climatic change.

We will create the perfectly continuous column of the Onnagawa Formation and construct detailed age model based on microfossil biostratigraphy and cyclo-stratigraphy. Then we will calculate the silica and detritus fluxes, respectively, from chemical composition of the siliceous rocks. We will discuss temporal variation of the water mass structure in the Japan Sea and its relation with global climatic changes.

In this presentation, we will introduce the results of our field study in Yashima area in northern Japan.

Keywords: Miocene, Onnagawa formation, Sedimentary rhythm

Reconstruction of detrital flux to Lake Suigetsu during the past 20kyrs based on Color and XRF data

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Lake Suigetsu is known for its highly precise age-depth model based on numerous ¹⁴C dating combined with varve counting and wiggle matching with Chinese stalagmite record. For this reason, the sediments are capable of providing extremely precise and high resolution records of past climatic changes. Several paleo-climate reconstruction studies have been conducted based on pollen and diatom analyses of the Lake Suigetsu sediments. However, studies focusing on its detrital material were rare because its detrital component is expected to be a mixture of eolian dust, detrital material derived from surrounding slope of the lake, and suspended material derived from Hasu River that flew into Lake Mikata and came into Lake Suigetsu through a narrow and shallow channel, and it is difficult to separately evaluate materials from these different sources. However, our recent study revealed that it is possible to evaluate the contribution of the detrital material derived from Hasu River through Lake Mikata (See our presentation #01575 in Paleoclimatology and paleoceanography session).

In this study, we tried to reconstruct temporal changes in the flux of detrital material derived from Hasu River during the past 20kyrs based on Color data and XRF data of the major element composition of the sediments analyzed by XRF. We estimated the end-members to explain variations in major element chemical composition using Q-mode factor analysis and oblique rotation of reference vectors. We extracted 4 end members and found that characteristics of factor 2 resemble those of Hasu River suspension. Because number of major element composition data are limited, we estimate contribution of factor 2 to the sediment based on color data. We estimated contents of factor 2 using Multi-regression analysis between color data and factor 2 loading (composition). Factor 2 flux was calculated from factor 2 contents, dry bulk density, and linear sedimentation rates, and the result shows long-term and short-term trends. The short-term trend is characterized by sudden increases and subsequent gradual decreases of factor 2 flux where the sudden increases coincides with sedimentation of "event layers" that could represent earthquake. The long-term trend, which seems to reflect intensity of river discharge from Hasu-River, seems to reflect rainfall intensity, shows mirroring image against stalagmite record in China suggesting that precipitation decreased in Suigetsu area when precipitation increased in South China.

Keywords: Lake Suigetsu, Deglaciation, Holocene, Factor analysis, Multi-regression analysis

The East Asian winter monsoon variability during the past 150,000 years

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The response of the East Asian winter monsoon variability to orbital forcing is still unclear, and hypotheses are controversial. We present a 150,000 yr record of sea surface temperature difference (delta SST) between the South China Sea and other Western Pacific Warm Pool regions as a proxy for the intensity of the Asian winter monsoon, because the winter cooling of the South China Sea is caused by the cooling of surface water at the northern margin and the southward advection of cooled water due to winter monsoon winds. The delta SST showed dominant precession cycles during the past 150,000 yr. The delta SST varies at precessional band and supports the hypothesis that monsoon is regulated by insolation changes at low-latitudes (Kutzbach, 1981), but contradicts previous suggestions based on marine and loess records that eccentricity controls variability on glacial-interglacial timescales. Maximum winter monsoon intensity corresponds to the May perihelion at precessional band, which is not fully consistent with the Kutzbach model of maximum winter monsoon at the June perihelion. Variation in the East Asian winter monsoon was anti-phased with the Indian summer monsoon, suggesting a linkage of dynamics between these two monsoon systems on orbital timescale.

Keywords: The East Asian winter monsoon, The South China Sea, The Western Pacific Warm Pool, Precession, Sea surface temperature