Climatic variation in Japan during the last 150 ky inferred from sediment core MD01-2421, off Kashima

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The northwest Pacific Ocean, where the cold Oyashio Current and the warm Kuroshio Current meet each other today, is the most sensitive region in the North Pacific for monitoring the relative intensities of the Oyashio and Kuroshio Currents as the latitudinal position of the Kuroshio Front in response to the past climatic change. The Kuroshio Current, a western boundary current, carries heat from low latitude to high latitude and should influence the paleoclimate change of Japanese Islands, and was also likely related to global climate change. The present study aims at reconstructing the terrestrial cliamate on Japanese Islands and the associated latitudinal shift of the Kuroshio Front during the last two glacial-interglacial cycles.

A long giant piston core (MD01-2421, 45.82 m length) was recovered from 2,224 m water depths off the central Japan during the IMAGES (WEPAMA) cruise in 2001. Sediment age model is based on Oba and others (unpublished). The linear sedimentation rate (LSR) above 8 m during the Holocene is extremely high (80 cm /ka), compared to the mean value (30 cm /ka) of this core. In order to examine the variabilities of air temperature and precipitation, we analyzed detrital mass accumulation rate, grain size, and mineral composition, and pollen assemblage.

Detritus mass accumulation (MAR) is calculated as the product of LSR, DBD, and detritus%, which is higher during MIS 1 and 5a to 5b. In order to understand the mechanism of detrital MAR variability, we examined the variability of mineral and grain size composition of detrital fraction. Contents of detrital minerals such as quartz, feldspars, amphiboles, clay minerals, and volcanic glass were normalized by detritus% and, then, a principle composnent analysis was conducted on their variations. Variability of detrital mineral contents could be explained using 3 factors. Factor 1 is explained by the relative abundance of volcanic glass (lower Factor 1 corresponds to higher volcanic glass). Factor 2 represents the relative contribution of clay minerals (lower Factor 2 corresponds to higher clay minerals). Factor 3 is characterized by the decrease of feldspars and the increase of clay minerals which indicates the variability of weathering intensity). Factor 3 (weathering intensity) is higher during MIS 1 and 5a to 5b), which suggests higher precipitation during these periods. Higher precipitation could also explains the higher MAR of detritus which was provided through runoff. Relative abundance of sand size grains and silt / clay ratio show millennial-scale fluctuation patterns but they are somehow irregular. Maxima of these coarse-grained materials correspond to volcanic glass-rich intervals (minima of Factor 1). This suggests that the grain size is mainly determined by the contribution of sand to silt-size volcanic glass and the change in transport process of detrital materials, which could be appearing in the grain size variability, can not explain the MAR variation.

Temperature Index of pollen assemblage which is defined as the relative abundance of broad leaf trees to coniferous trees shows higher temperature during MIS 1, early MIS 3, early MIS 5a, early MIS 5c, MIS 5e, and the latest MIS 6. This result suggests that the onland air temperature always leads the changes of marine SST indices and marine oxygen isotope (ice volume) changes by several thousands of years. Monsoon (high precipitation) indices such as Cryptomeria and Sciadopitys abundances are higher during later halves of MIS 1, 5a 5c, and 5d. Significant maxima of precipitation indices during MIS 1 and later half of MIS 5a-5c are consistent with the high precipitation events expected from detrital composition in the identical periods. Highest precipitaion occurring during MIS 5a is attributed to the increased temperature contrast between air and sea surface due to significant drop of air temperature along the Pacific margin of the central Japan.