Paleoceanographic changes of the Japan Sea during the last 130 ka based on high-resolution multi-proxy analyses of MD01-2407 Core

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Over-55m-thick, continuous hemi-pelagic sequence was retrieved from Oki Ridge, southern part of the Japan Sea, at the water depth of 930m. We conducted high-resolution multi-proxy analyses for the upper 13m of the core that covered the last 130 kyrs. The sediments are mainly composed of olive gray silty clay to clay that contains calcareous and siliceous microfossils to various degrees with occasional intercalations of thin ash layers. The sediments show decimeter-scale faint color banding with dark layers usually being characterized with preservation of fine parallel lamination. The age model for the studied interval was constructed based on correlation of the dark layers with C-3 core, which was previously taken from Oki-Ridge and revised age model was constructed based on 14C dating and tephrochronology, and oxygen isotope stratigraphy for stage 5/6 boundary.

Multi-proxy analyses were conducted with high spatial resolution up to 1.25 cm interval that corresponds to temporal resolution of approximately 125 yrs. Analyzed items include sediment color, water content, major element composition (Al, Si, Fe, Ca, K, Ti, Na, and S), organic carbon, carbonate carbon, total sulfur, total nitrogen, alkenone compounds, detrital grain size distribution, and oxygen and carbon isotopes of planktonic foraminifera. The results revealed presence of distinct millennial-scale oscillations for eolian dust grain size, eolian dust content, organic carbon and carbonate carbon contents that clearly correspond to Dansgaard-Oeschger Cycles. Such millennial-scale oscillations of these parameters are also evident for the later half of the last interglacial period (MIS 5.1 to 5.4), showing the similarity with the GRIP d18O record. On the other hand, the early half of the last interglacial period is characterized with rather low amplitude variations of organic carbon and carbonate carbon contents, and larger and variable eolian dust grain size and content. The former difference is probably explained by the difference in sensitivity of the Japan Sea system to the nature of the influx water into the sea during the peak interglacial periods. Whereas the latter difference is probably explained by the northern shift of the axis of westery jets and consequent change of the eolian dust transport regime during the peak interglacial periods since the eolian dust grain size and content variation patterns at the northern site (KT94-15-5) are different from those at Oki Ridge and show the patterns similar to the GRIP d18O record during the early half of the last interglacial period (Eemian).

The distinct millennial-scale oscillations are not obvious for alkenone temperature and d18O of planktonic foraminifers throughout the studied interval. In case of alkenone temperature, it tends to be low during glacial periods and high during interglacial periods. In addition, last interglacial period was warmer by as much as 3degree C than Holocene, and penultimate glacial maximum was colder by as much as 5degree C than the last glacial maximum. Thus, the amplitude of temperature increase during deglaciation was more drastic at termination II compared to termination I. D18O of planktonic foraminifers, on the other hand, shows a distinctly different pattern compared with alkenone temperature. Namely, it shows lighter values during Holocene, MIS(Marine Isotope Stage) 2, 5.5, and 6 and heavier values during MIS 1/2 transition, MIS 3 to 5.4, and MIS 5/6 transition. This pattern is also quite different from the d18O variation pattern in open ocean settings, and should reflect variations in regional hydrology specific to the Japan Sea.