Late Quaternary sea-ice history in the central Arctic Ocean: TATSCAN analysis of IODP Expedition 302 ACEX sediment cores

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Until the recent when the Integrated Ocean Drilling Program (IODP) Expedition 302 has conducted a deep sea drilling at the central Arctic Ocean, the past Arctic-ice history has been a mystery of the Cenozoic icehouse Earth system. The IODP- Arctic Coring Expedition (ACEX) has successfully recovered over 400m sediment records (about 0 to 55 Ma) on the Lomonosov Ridge in 2004 (Moran et al., 2006).

In order to reconstruct and reveal the ice history in the central Arctic Ocean, we conducted new non-destructive sediment core scanning techniques, TATSCAN, that is a code name of developing original instruments for non-destructive sediment scanning and imaging in range of millimeter and micrometer scale. In the recent, we have newly developed non-destructive energy dispersive type X-ray Fluorescence (XRF) scanner, TATSCAN-F2, for 2-dimensional elemental imaging of the surface of sediment with 1mm- or 1cm- measuring diamter in the length of up to 150 cm. The TATSCAN-X is another non-destructive scanning technique by using transmission X-ray, which can detect and identify discrete shapes such like isolated granule and pebble in the sediment core.

The number of ice-rafted debris (IRD) that was defined as discrete grains more than 1mm in diameter in the X-ray imaging, was direct information of the past Arctic ice recorded in the sediment. IRD increased 1.6 - 1.75 Ma and 0.0 - 0.8 Ma. During 0.8 Ma, especially, IRD significantly became 2 to 4 time richer than previous duration. IRD increased in the glacial and decreased in the interglacial. The IRD variation was consistent with biomarkers in the sediment core. The increase of IRD corresponds to high amount of diagenetic hopanes and to low concentration of other biomarkers such as long-chain organic compounds derived from fresh higher plant, which was mainly supplying by river discharge. The variation of the IRD should be related to expansion of northern Siberian ice-sheet to the Arctic during the cold durations.

High-resolution manganese (Mn) variation corresponding to brownish colored sediment interval was detected by TATSCAN-F2 scanner. It increased in the intervals of with no and less IRD concentration, corresponding to the warm duration. The possible source of Mn in the sediment is transportation of source material such as river draining peat from northern Siberia and/or enhanced Mn-precipitation by active water circulation.