

Changes in ice drift pattern in the western Arctic Ocean during the last 70,000 years

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Abstract

Recent global warming caused the shrinkage of summer sea ice in the Arctic. The distribution of the sea ice reflects ice drift pattern mainly controlled by the Beaufort Gyre circulation, Transpolar Drift, and Bering Strait inflow. Understanding the ocean circulation in climate regimes different from today is thus helpful to predict the future condition of Arctic sea ice. In this study, we investigated mineral compositions, grain size distribution, ice-rafted debris (IRD) content, glycerol dialkyl glycerol tetraethers (GDGTs), total organic matter (TOC) and total sulfur (TS) in five sediment cores retrieved in the western Arctic Ocean during RV “Araon” ARA02B (August 2011) and ARA03B (August-September 2012) expeditions to reconstruct changes in ice drift pattern in the western Arctic Ocean during the last 70 ka.

IRD-, quartz-, and dolomite-rich layers were found in the last glacial sediments in the Chukchi Sea and Chukchi Borderland areas and they are useful to correlate cores. Based on the distribution of minerals in the surface sediments and geological information, we suppose that dolomite grains were delivered by icebergs discharge from the Canadian Arctic Archipelago. Kaolinite-rich layers were found in the LGM or deglaciation intervals in the restricted area near the Chukchi Plateau. They show high concentration of branched GDGTs and the high C/S ratio. The molecular distribution of the branched GDGTs is typical in those on the shelf sediments in the western Arctic (Park et al., 2014 Marine Chemistry). This suggests that the kaolinite-rich grains were delivered from the nearly continental shelf by sea ice or icebergs. The quartz/feldspar ratio is much lower in the Holocene brown layer B1 than the glacial brown layers B2 and B3, suggesting that the former was delivered from the Siberian margin, whereas the latter from the Alaskan margin. These results indicate a drastic changes in ice drift pattern during the last 70 ka.

Keywords: Arctic Ocean, GDGT, ice-rafted debris