

Paleoceanography of the Eocene Arctic basin based on sulfur and organic carbon analyses

Yusuke Ogawa[1]; KOZO TAKAHASHI[2]; Toshiro Yamanaka[3]

[1] Earth and Planetary Science, Kyushu Univ.; [2] Earth and Planetary Sci., Kyushu Univ; [3] Fac. Sci., Okayama Univ.

IODP Expedition 302, Arctic Coring Expedition (ACEX), recovered 428 m long sediment cores on the Lomonosov Ridge in the central Arctic Ocean. In the Eocene section of the cores pyrites are abundantly encountered as framboidal pyrites. The microfossil assemblages of the Eocene section indicate the presence of low-salinity water mass in the Eocene Arctic Ocean. The objectives of this study are to reconstruct the presence of sea water and environmental condition of the Eocene Arctic Ocean by the measurement of total organic carbon (TOC), total sulfur (TS), and sulfur isotope compositions ($\delta^{34}\text{S}$). The sediment samples investigated in this study range from 200 to 370 mbsf whose section is composed of three lithological units; 200 - 220 mbsf of Unit 1/6, 220 - 315 mbsf of Unit 2, and 315 - 370 mbsf of Unit 3. The biostratigraphic datum showed the Late Early to Middle Eocene (55 - 44 Ma).

The TOC values are high in all intervals ranging from 2 to 4 wt%. This indicates that the Eocene Arctic Ocean was highly productive. TS values are also high and the mean value of Units 2 and 3 is about 4 wt%. The TS values are especially high in Unit 1/6, showing the maximum value of 19 wt%. The $\delta^{34}\text{S}$ values are about -37 per mil in Units 2 & 3, and less than -50 per mil in Unit 1/6.

Total sulfur content of the sediments can be used as the freshwater-sea water environment proxy. Sulfur is preserved as pyrite in the marine sediment through microbial reduction of sulfate of sea water. Large isotopic fractionation in the sulfate reduction results in light isotopic value of sulfur and thus pyrite has light isotope value less than 0 per mil contrasted with that of sea water sulfate ($\delta^{34}\text{S} = +21$ per mil). The TS values of the Eocene sediments indicate the presence of a large amount of sea water in the deep water of the Eocene Arctic Ocean. The $\delta^{34}\text{S}$ values of Units 2 and 3 are commonly observed in the marine sediments. This means that sulfate was never depleted by the sulfate reduction indicating open system sulfate reduction. These results suggest the sufficient supply of sea water and the presence of a large volume of sea water mass in the Eocene Arctic Ocean. The Eocene Arctic Ocean was semi-closed basin separated by shallow sill or sills from outside water mass. The results of sulfur analyses indicate sufficient deep water exchange between the Arctic and the world oceans. The significantly light $\delta^{34}\text{S}$ values in Unit 1/6 probably reflect the extremely large sulfur isotope fractionation of sulfur reducing bacteria.