Sulfur isotope geochemistry of the Chukchi Shelf sediments in the western Arctic Ocean since the last deglaciation

*Jonghan Moon[1], Eunje Oh[1], Ji-Hoom Kim[2], Seung-Il Nam[3], Young Ji Joo[4], Min Sub Sim[1]

1. School of Earth and Environmental Sciences, Seoul National University, 2. Petroleum and Marine Research Division, Korea Institute of Geoscience and Mineral Resource, 3. Division of Glacial Environment Research Korea Polar Research Institute, 4. Department of Earth and Environmental Sciences, Pukyong National University

The Arctic is known to sensitively respond to current and past climate changes based on both observations and model simulations, which offers an adequate platform to track environmental developments driven by fluctuating climates. Numerous studies have been carried out to reconstruct post-glacial climate variations on the basis of multi-proxy analyses of Arctic sediments. While sulfate is the most abundant electron acceptor in seawater and sulfide produced via microbial sulfate reduction precipitates iron as pyrite, which forms a sedimentary sink of the trace metal, the sulfur cycle in the Arctic Ocean still remains rather nebulous. The stable isotopes of sulfur can provide a window to the sulfur cycling, because microbial sulfate reduction discriminates against heavier sulfur isotopes.
In this study, we investigate geochemistry –with a specific interest in the sulfur isotopes –of a sediment core (ARA06C-01JPC) from the Chukchi Shelf that spans a period since the last deglaciation. The Chukchi Shelf region records major climatic and oceanographic changes in the western Arctic Ocean during the latest Pleistocene and Holocene, including 1) the final retreat of the Laurentide Ice Sheet and thawing permafrost, 2) the opening of Bering Strait, and 3) the strengthening and weakening of the Beaufort Gyre. The up-core increase followed by a decrease in the pyrite sulfur contents reflects the changing supply of reactive organic matter for microbial sulfate reduction. The sulfur isotope composition, on the other hand, can be attributed to the evolution of porewater micro-environment by the interplay between anaerobic oxidation of methane, sulfate diffusion and microbial sulfate reduction. In combination with bulk geochemistry of total organic carbon and total nitrogen, we interpret that the lag between the increases in pyrite and TOC resulted from the changing fractions of terrigenous and marine organic matter supplied to the study area. The result of this study sheds a new light on the biogeochemical cycles in the Arctic Ocean during the period of dramatic climate changes. By comparing our record with other sulfur isotope studies from mid- and low-latitude sediments, it is expected to build a mechanistic framework for understanding the biogeochemical cycles of sulfur and potentially other key elements, such as carbon and iron.

Keywords: Sulfur isotopes, Microbial sulfate reduction, Sediment cores, Chukchi Sea

