Variations in sea surface environments recorded by algal biomarkers in the Japan Sea off the western coast of Hokkaido (IODP Site U1422) over the last 250 ka

*Asako Suzuki[1], Ken Sawada[2], Satoshi Furota[3], Yaeko Igarashi[4], Tomohisa Irino[5]

1. Graduate School of Science, Hokkaido University, 2. Department of Earth and Planetary Sciences, Faculty of Science, Hokkaido University, 3. Japan Agency for Marine-Earth Science and Technology, 4. Institute for Paleoenvironment of Northern Regions, 5. Faculty of Environmental Earth Science, Hokkaido University

The Japan Sea is a marginal sea that is closed by four straits, and the surface and deep waters are characterized by the Tsushima Warm Current (TWC), and Japan Sea Proper Water, respectively. In glacial-interglacial cycle, the sea surface environment in the Japan Sea has repeatedly changed by sea level fluctuation. It is reported that intense cooling of surface waters in the northern Japan Sea occurred caused by intensification of the East Asian Winter Monsoon (EAWM), but there have been few researches in this area. Thus, we analyzed algal biomarkers of a sediment core from the site U1422 (northern Japan Sea) of IODP Exp. 346 for the last 250ka. In particular, we apply the paleothermometer using long-chain alkyl diols, which are thought to be produced by diatoms and eustigmatophyte algae in addition to a proxy for sea surface temperature (SST based on alkenones, which are produced by haptophyte algae. The long-chain alkyl diols were also used as the proxies for upwelling intensity and inflow of fresh water, and thus, can provide multiple information for reconstruction of marine paleoenvironment.

The sediment cores studied were recovered at Site U1422 in the northern part of the Japan Basin (the Japan Sea off the western coast of Hokkaido) at 43°45.99’ N, 138°49.99’ E by Integrated Ocean Drilling Program (IODP) Expedition 346. We focus the duration from the MIS 8 to the present (-ca. 250ka). Lipids were extracted with dichloromethane/methanol, and separated to aliphatic, aromatic and polar fractions. Lipids were identified and quantified by GC-MS and GC-FID.

The SSTs based on alkenones and alkyl diols basically fluctuated along the glacial-interglacial cycles. The alkenone-based SSTs were found to be much higher than the diol-based SSTs during the MIS 2-3. The reasons of the differences are likely to be high contribution of distinctive alkenone producer during these stages. In our study, we calculated not only $U^{K'}_{37}$ but also the index containing tetra-unsaturated alkenone (U^{K}_{37}) in the SST estimate, because the tetra-unsaturated alkenone is abundantly detected in several samples. The U^{K}_{37}-based SSTs generally tend to be lower than those estimated by $U^{K'}_{37}$.

Diol Indices 1 and 2, which are proxies of upwelling intensity, are overall low levels. These results indicate that consistent upwelling system is hardly developed in the northern Japan Sea. However, the indices increase in the MIS 2, implying that vertical mixing was promoted as a result of the surface cooling in this stage. Moreover, the C_{32} 1, 15-diol ratio, which is considered as an indicator of fresh water input into marine environment, tended to increase at the transition periods, such as the glacial to interglacial periods. These results suggest that fresh water arisen by melting of snows and ices accumulated on lands was flowing into the Japan Sea through the rivers during these transitions. The increasing spikes of the diol-based fresh water index are also observed during the glacial periods. This can be attributed to the fresh waters arisen by sea ice melting that came from the northward and/or affected by the inflow of TWC as a result of sea-level falling.

Keywords: Northern Japan Sea, Algal biomarker, Alkenone, Diol, East Asian Monsoon, Quaternary

