Paleoclimate changes in the northern East Asia reconstructed by algal biomarker analysis of the ocean drilling core from the northern Japan Sea (IODP Site U1422) over the last 700 kyr

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The Japan Sea is a marginal sea that is connected to the open ocean through four straits, and the surface is characterized by the Tsushima Warm Current (TWC) and Liman Current, and the deep water is occupied by Japan Sea Proper Water. In glacial-interglacial cycles in the Quaternary, the sea surface environment in the Japan Sea has repeatedly changed by sea level fluctuation. It is reported that the land bridge was formed between the continent and Hokkaido, in the northern part of the Japan Sea, during the last glacial maximum (LGM) as a result of sea level fall. Moreover, the northern regions have been significantly affected by the East Asian Winter Monsoon (EAWM) (Ikehara and Itaki, 2007). In the present study, we analyzed algal biomarkers of a sediment core collected from the northern Japan Sea (IODP Exp. 346, site U1422) for the last 700 kyr. In particular, we apply the paleothermometer using long-chain alkenones and alkyl diols, as well as the diol indices such as the upwelling intensity and inflows of fresh water, and thus, can provide multiple information for reconstruction of marine environments.

The sediment cores in this study were drilled 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 during Integrated Ocean Discovery Program (IODP) Exp. 346. We focused on the duration from the present to the MIS 16 (- ca. 700 ka). Lipids were extracted with organic solvents, and separated to aliphatic, aromatic and polar fractions. Lipids were identified and quantified by GC-MS and GC-FID.

The sea surface and subsurface temperatures based on alkenones and alkyl diols basically fluctuated along with the glacial-interglacial cycles. In particular, the diol-based temperatures are found to be well synchronous to the global climatic variations in foraminiferal $\delta^{18}O$. However, the alkenone-based SSTs were hardly concordant with the $\delta^{18}O$ variation. The reasons for the differences are likely to be high contribution of distinctive alkenone producer(s) in the northern Japan Sea regions. The C_{32} 1, 15-diol/total diols ratio ($F\,C_{32}$ 1, 15-diol), which is an indicator of riverine water input into marine environment, tended to increase at the transition periods such as the glacial to interglacial periods, and the timings of relatively warm ages in the glacial 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 at these timings. One pulse coincided with the timing of melt water pulse 1a (MWP 1a), which is known as a global ice-melting event, so this site may have affected by the global climate event. The diol index (DIs 1 and 2), which are proxies of upwelling intensity, tended to increase in the glacial ages, implying that vertical mixing was promoted as a result of the surface cooling.

Keywords: IODP, Algal biomarker, Diol, Alkenone, Japan Sea, Paleothermometry

