

Variations in sea surface environments recorded by algal biomarkers in the Japan Sea off the western Hokkaido (IODP Site U1422) over the last 700 ky

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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 the deep water is occupied with 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. Therefore, this area is also important from anthropological and archaeological points of view in the northeastern Asia. However, only a few paleoenvironmental studies have been conducted in this area, which motivate us to establish a high-resolution and long-term reconstruction of paleoceanographic condition using an appropriate sediment archive.

In this study, we analyzed algal biomarkers of a sediment core collected from the northern Japan Sea for the last 700 ky. In particular, we apply the paleothermometer using long-chain alkyl diols, which are thought to be produced by diatoms and *eustigmatopyte* in addition to a proxy for sea surface temperature (SST based on alkenones, which are produced by haptophyte algae). Recently, the long-chain alkyl diols were used as the indices not only for SST, but also for 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) Expedition 346. We focused on the duration from the present to the MIS16 (-ca. 700 ka). 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 with 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 differences are likely attributed to ecological differences of these algae including habitat water depth and seasonality of the production, as well as high contribution of distinctive alkenone producers during these.

Diol Indices 1 and 2, which are proxies of upwelling intensity, are overall low levels. These results indicate that consistently strong upwelling system is hardly developed in the northern Japan Sea. However, the

indices increase in the glacial ages, implying that vertical mixing was promoted as a result of the surface cooling.

Moreover, the C32 1, 15-diol ratio, which is considered as 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.

Keywords: IODP, Algal biomarker, The Japan Sea, The Quaternary, Diol, Alkenone