Reconstruction of sea surface temperatures in the Scotia Sea during the past warm periods based on GDGT paleothermometry

*Ishii Hana[1], Osamu Seki[2], Masanobu Yamamoto[3], IODP Expedition 382 Scientists[4]

1. Graduate School of Environmental Science, Hokkaido University, 2. Institute of Low Temperature Science, Hokkaido University, 3. Faculty of Environmental Earth Science, 4. IODP Expedition 382

The Mid-Pliocene Warm Period (MPWP: 3.264-3.025 Ma), MIS5e (129-116 ka), and MIS 11 (424-395 ka) have received particular attention as a possible analogue of near-future climate since global temperatures in the periods are estimated to be 1-3 degrees warmer than the pre-industrial level. One of the serious concerns potentially caused by the future global warming is sea level rise due to mass loss of continental ice such as Antarctic ice sheet. Geological records and model simulations suggest a smaller Antarctic ice sheet in these eras compared to the present, suggesting that the ice sheet is vulnerable to global warming. Recent observations show that the basal melting of the ice shelf due to the intrusion of warm water under the ice shelf is a key process to lead to Antarctic ice mass loss. Therefore, reconstruction of ocean temperature during past warm periods when ice sheet melting occurred is important to better understand the sensitivity of the ice sheet to the oceanic forcing. However, there is no long-term and continuous SST data in the south of the Antarctic Circumpolar Current (ACC), because of the lack of robust temperature proxies applicable to the Antarctic region.
In this study, we applied GDGT palaeothermometry to reconstruct SST variations during the past warm periods from core U1537 (59 ºS, 40 ºW) collected from the Scotia Sea. GDGTs are a tetraether lipid produced by marine archaea and their composition is highly dependent on growth temperature. Since GDGs are commonly found in polar sediments, it has the potential to reconstruct past temperature in the polar region. We applied conventional indices of GDGT (TEX86 and TEX86L) and a new approach, OPTiMAL, which calibration is based on machine learning for SST reconstruction. The OPTiMAL based SST is found to be the most consistent with the temperature record in the Antarctic ice core among them. In addition to the SST reconstruction, the hydrogen isotope ratios of fatty acids, which are plankton biomarkers, were also measured to reconstruct the meltwater pulse events. In this presentation, we will discuss the link between the southern high latitude ocean temperature and the Antarctic ice sheet variabilities.

Keywords: Pliocene, paleo temperature reconstruction, Scotia Sea

