Reconstruction of SST Front behavior in the Japan Sea during the Holocene based on Alkenone paleothermometer

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The Japan Sea is a semi-enclosed marginal sea connected to the North Pacific and adjacent marginal seas through four shallow and narrow straits. The Tsushima Warm Current is the only current flowing into the Japan Sea and plays an important role on controlling the environment of the sea by supplying heat, salt and nutrient. Strong north-south Sea Surface Temperature(SST) gradient zone is formed around longitude 40 degrees north in the Japan Sea, and is defined as the SST front. The position of the SST front varies with the depth of the sea. Especially, the boundary between the Tsushima Warm Current and Liman Cold Current, which is defined at 100m depth, is named Sub-Polar Front (SPF).

Choi et al. (2012) reconstructed spatial and temporal changes of the alkenone SST in the Japan Sea during the last 130 ka, and attempted to reconstruct the behavior of the SST front. However, their studies lack information on the central part of the Japan Sea, which is the best place to monitor the position of the past SST front. This study aims to examine past behavior of the SST front position in the central part of the Japan Sea during the Holocene based on the reconstruction of alkenone SST using the 3 cores forming the latitudinal transect in the south central part of the Japan Sea. Reconstructed alkenone SST of PC-8 core located in the central part of Yamato Bank were compared with those of MD01-2407 at Oki Ridge and ODP797 (Xing et al., 2011) from the southern part of the Japan Sea to figuring out the difference in temperature between the north and the south during the Holocene. To identify the water depth and specific season at which the alkenone SST is recorded, I compiled and reexamined a 1-year long time series data-set of the monthly alkenone flux and the sea water temperature at various depths in the Japan Sea (Lee et al., 2011). Based on careful examination of these data, I concluded that the flux-weighted alkenone SSTs at the two sites are close to the temperature at 0-10 m depth during spring to summer.

Reconstructed alkenone SST from the northernmost site (PC-8) in the central part of the Japan Sea show an increasing trend from 10 degrees Celsius to 16 degrees Celsius between 11.1ka and 7ka. On the contrary, reconstructed alkenone SST from the central (ODP797) and southernmost sites (MD01-2407) show more or less constant temperatures around 16 degrees Celsius at the central site and 18 degrees Celsius at the southernmost site after 10ka. North-south alkenone SST difference between the northernmost and southernmost sites was about 7 degrees Celsius in the early Holocene. However, the difference became smaller (ca.2 degrees Celsius) in the middle Holocene (5ka). Comparison with the modern SST distribution from north to south suggests that past SST front was located 2 degrees to the south, and shifted northward during the early to middle Holocene. A possible explanation for this northward shift of the SST front is an increase in volume transport of the third branch of the Tsushima Warm Current. The idea is supported by the observation that radiolarian fossils typical for East China Sea gradually increase after 8ka. Therefore, northward shift of the reconstructed SST front at 10 m depth during spring to summer represents northward shift of the SPF.