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過去 1.8 万年間の日本海の水温と塩分復元
Temperature and salinity estimates in the Japan Sea during the past 18 kyr

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The Japan Sea has shallow 4 straits (<130 m) that connect to the Pacific Ocean to exchange seawater, and thus sea-level lowstand (ca.-120 m) during the LGM might had limited vigorous seawater exchange between the Japan Sea and the Pacific through the straits. Only through the narrow and shallow Tsushima strait, the glacial Huang He River supplied fresh water to the semi-closed Japan Sea, forming low-saline surface conditions at the time (e.g., Oba and Murayama, 1995). This low-saline surface condition during the LGM was relieved by intrusion of Oyashio Current into the Japan Sea through the Tsugaru strait from 18 ka (Oba and Murayama, 1995). Although Ishiwatari et al. (2001) have tried to reconstruct sea-surface temperatures (SSTs) during the past 36 ka based on alkenone unsaturation ratio, the low-saline conditions during the early deglacial periods make SST estimates from alkenone uncertain (Harada et al., 2008; Fujine et al., 2006). Here, we present planktic foraminifera Mg/Ca-derived SST and Ba/Ca ratios, together with benthic and planktic foraminifera $d^{18}O$ from a sediment core in the Japan Sea.

The studied sediment core (YK10-7-PC09) was taken from 738 m water depth off Niigata. The thick lamina layer was observed in a section from 420 cm to 750 cm core depth, which corresponds to the sediments during Heinrich 1 and glacial periods and we have used the sediment samples above 450 cm core depth. The age model for the core was based on 7 AMS ^{14}C data of planktic foraminifera. We have used Marin09 and dR of 0+/-100yr to convert the conventional ^{14}C ages to the calibrated ages. $d^{13}C$ and d^{18} of benthic (*Uvigerina.* spp) and planktic foraminifera (*N.incompta*, *N.pachyderma(s)*, *G.bulloides*) were measured by MAT 253 (CMCR, Kochi University), whereas trace metal/Ca ratio of planktic foraminifera were measured by Thermo Finigan Element II (University of Toyama). Precision (1sigma) of Mg/Ca, Mn/Ca, and Ba/Ca ratios obtained by the SF-ICP-MS in our laboratory was 0.97%, 0.49%, and 1.63%, respectively.

The $d^{18}O$ records from planktic foraminifera were almost same as the records from L-3 core (Oba and Murayama, 1995), and one of striking features is a significant increase of $d^{18}O$ values from 0.6 permil to 3.4 permil during the early deglaciation (18-15 ka). The Mg/Ca-derived SSTs (from *G.bulloides*) showed a slight increase from 5 to 8^{o}C during 18-7 ka; SSTs did not change significantly during 18-15 ka and warmed ~3^{o}C during the B/A period. Importantly, the SST evolution in the Japan Sea exhibited a close similarity with the SST variation reconstructed off Tokachi under the influence of Oyashio Current (Sagawa and Ikehara, 2008), with ~1^{o}C offset, corroborating the previous result that the Japan Sea was influenced by Oyashio Current at the time. Using paired $d^{18}O$ and Mg/Ca-derived SST, we have attempted to estimate $d^{18}Osw$ (Oba et al., 1980) and revealed that ~4 permil increase in regional $d^{18}Osw$ took place at 18 to 15 ka. Although $d^{18}Osw$ values are linearly related to salinity , the slope and intercept of $d^{18}Osw$-salinity relation can be changed by evaporation and precipitation fluxes and $d^{18}O$ values of fresh water, resulting in different $d^{18}Osw$-salinity equations in various basins. If the $d^{18}Osw$-salinity relation in the modern Okhotsk Sea ($d^{18}Osw$ = 0.3195 x Salinity - 13.561; Yamamoto et al., 2001) was applied to the early deglacial periods in the Japan Sea, we can roughly estimate paleo-salinity; 24 psu at 18 ka and 33 psu at 15 ka. Given that the source of fresh water for the glacial Japan Sea was the Haung He River, heavier $d^{18}O$ values as an intercept might be appropriate. If so, estimated paleo-salinity at 18 ka will be less than 20 psu. Although the exact estimate of paleo-salinity is quite difficult, the fact that Ba/Ca ratios of planktic foraminifera exhibit a similar trend as the regional $d^{18}Osw$ and very high values up to 2 micromol/mol at 18 ka corroborates that the Japan Sea was severe less-saline surface conditions during the LGM.

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