Changes in water mass structures in the Bering Sea: Evidence from neodymium isotopes of Fe-Mn oxyhydroxides

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In glacial boundary conditions, flux and locality of the overturning circulations were different from those of the present, particularly in the Atlantic and Antarctic, and such changes may have large effects on modulation of CO2 exchange fluxes between ocean and atmosphere and ocean biogeochemical cycles. In contrast, little is known about water circulation status in glacial boundary conditions, particularly intermediate water circulation and its source, in the subarctic North Pacific (SANP). Here we present neodymium (Nd) isotopic composition in Fe-Mn oxyhydroxides of the Bering Sea sediments (884 m water depth). We found a large glacial-interglacial variation of epsilon-Nd, with radiogenic values (up to +0.8) during cold periods and less radiogenic values during warm periods (less than -1). Furthermore, we observed a distinct negative value (epsilon-Nd = -2.2) at the last deglaciation. Although Sr isotopes in Fe-Mn leachates indicate a minor contamination of detrital fraction, the Sr isotopes do not show a correlation with epsilon-Nd values. Therefore, leached Nd isotopes are interpreted to be mainly derived from ambient sea-water. During cold periods, the radiogenic epsilon-Nd values in the intermediate water are the slightly higher values relative to the modern surface water (epsilon-Nd = 0) in the nearby SANP site. Given these situations, Nd isotope records in the cold periods are best explained by sinking of the surface water to the intermediate depths (at least ˜800 m) through brine rejection during the formation of sea ice in the Bering Sea. This is consistent with previous studies showing glacial dominance of the radiolarian Cycladophora davisiana, indicative of cold, oxygen-rich intermediate waters, in the Bering Sea. On the other hand, the deglacial excursion of the epsilon-Nd (-2.2) is interpreted to reflect an increase in upward-diffusion of the deepwater in response to the shift from the glacial-type deepwater circulation to the modern-type one in the SANP.