



The distribution of N^* in the Sea of Okhotsk and the use of N^* as a biogeochemical tracer of the Okhotsk Sea Intermediate Water

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Nutrient data collected from the Sea of Okhotsk in July 1998, September 1999, and June 2000 were used to calculate N^* , the deviation from the stoichiometric relationship between nitrogenous nutrients and phosphate. The intermediate water off eastern Sakhalin had low N^* values, below -5 umol kg^{-1} , and this led to very low N^* values of approximately -11 umol kg^{-1} in the northwestern shelf bottom water. The low N^* distribution was consistent with distributions of low temperature and low salinity at densities of 26.75 to 26.85 $\sigma\text{-theta}$ which are characteristic of the Okhotsk Sea Intermediate Water (OSIW) and dense shelf water (DSW). To assess N^* as a new tracer of OSIW and to determine whether the low N^* signature is created by in situ biogeochemical processes or reflects a conservative property of the water mass, we also analyzed $d^{15}\text{NO}_3^-$ (the nitrogen isotopic ratio of nitrate). Although low N^* usually suggests the occurrence of denitrification in a water column with large isotopic fractionation, neither the intermediate nor shelf bottom waters had high $d^{15}\text{NO}_3^-$ values; this suggests that denitrification in a water column did not cause these low N^* values. The extremely low N^* of the shelf bottom water was likely caused by sedimentary denitrification with little isotopic fractionation and phosphate dissolution from sediment. The low N^* of the intermediate water must be unaffected by in situ biogeochemical processes but reflect intrusion of the shelf bottom water into the offshore intermediate layer. Our results showed that N^* acted as a conservative tracer of OSIW. Because N^* is reset at the shelf bottom unlike other tracers, N^* is a valuable tracer of OSIW originating from continental shelf areas.