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The estimate of the denitrification using nitrogen gas excess in the Sea of Okhotsk

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A fixed-nitrogen (NO3-, NO2-, NH4+) is one of the important biological limiting factors in the global ocean, which plays an important role in driving carbon cycle with primary production. Its budget is the apparent imbalance and unclear despite the importance of a fixed-nitrogen in the ocean. In the high latitudinal region, both the carbon and nitrogen cycles have been already changed critically (e.g., Emerson et al., 2001). The Sea of Okhotsk is a part of formation area of intermediate water affecting the climate in the North Pacific. In this region, there is significant denitrification due to high productivity. The global warming may strengthen the extent of denitrification. Unfortunately, there is few estimation of denitrification in the Sea of Okhotsk in order to clarify the change derived from global warming. We measured argon (Ar) and nitrogen (N2) gasses and firstly tried to estimate quantitatively the extent of denitrificaion in the Sea of Okhotsk with considering the bubble injection process. Dissolved N2, Ar and DO were obtained at six stations within this region in August, 2007 by using the method of a gas chromatography developed by Tanaka and Watanabe [2007].
According to Devol et al. [2006], the amount of N2 excess in the Sea of Okhotsk was estimated by the normalized N2:Ar ratios as follows:

[N]excess = [(N2 : Ar)sample – (N2 : Ar)background]$\times\alpha\times$[N](t,s)

where (N2:Ar)sample is the normalized ratio within the denitrifying waters and (N2:Ar)background is the normalized ratio predicted for a parcel of water outside the denitrifying zone with the same density. We here used (N2:Ar)background obtained from the best fit line through the Oyashio region in the North Pacific. α is a correction term [U+3000] for the bubble injection process and [N](t,s) is the atmospheric equilibrium saturation of N2 calculated from temperature and salinity data.
With considering several recent hydrological physical data [Itoh et al., 2003; Ohshima et al., 2006], we estimated the total water-column inventory of Nexcess and the denitrification rate in the Sea of Okhotsk to be 4.3$\pm$1.7 mol m-2 and 0.4-1.3$\pm$0.5 T mol y-1, respectively. This estimation of the denitrification rate in the Sea of Okhotsk was about half of that in the Arabian Sea where is known as the oxygen deficient zones, contributing significantly to the global water-column denitrification .