MIS24-02 会場:302 時間:5 月 23 日 16:30-16:45

深海底で起こる脱窒指標としての N_2* の利用可能性
Potential use of N_2* as a constraint of sedimentary denitrification in the deep ocean

重光 雅仁[1*], ニコラス グルーバー[2], 岡顕[3], 田中伸一[4], 山中康裕[1]
Masahito Shigemitsu[1*], GRUBER, Nicolas[2], OKA, Akira[3], TANAKA,Shinichi[4], YAMANAKA,Yasuhiro[1]

[1] 北海道大学, [2] スイス連邦工科大学, [3] 東京大学, [4] 国立環境研究所
[1]Hokkaido University, [2]ETH, [3]University of Tokyo, [4]NIES

Measurements of the concentration of dissolved N_2 in the ocean have the potential to provide an important constraint on the magnitude of marine nitrogen fixation and denitrification, i.e., the main source and sink processes of fixed nitrogen in the ocean. The reason is because N_2 is consumed by nitrogen fixation and produced by denitrification. However, the use is impeded by the observation that, to first order, the oceanic distribution of N_2 is governed by air-sea exchange (diffusive and bubble-mediated), which is driven primarily by temperature-induced changes in the solubility. The effect of gas exchange on N_2 can be largely captured by considering simultaneous measurements of inert noble gases, such as argon (Ar) or neon (Ne), as this is the primary process governing their distribution. This offers the opportunity to use the difference in saturation anomaly between N_2 and one of the noble gases to determine the amount of fixed nitrogen removed or added.

We here define a new tracer N_2* ($=N_2^{obs} - (N_2^{sat}/Ar^{sat})*Ar^{obs}$) to assess the marine nitrogen cycle, and aim to investigate if the new tracer can be used for the purpose by using a global 3-dimensional ocean circulation model (OGCM) and the observations of N_2 and Ar. We explicitly incorporate the air-sea exchange p rocesses of N_2 and Ar into OGCM, and prepare the previously simulated nitrogen fixation (Deutsch et al., 2007), and water-column and benthic denitrification fields which are calculated based on satellite-based estimates of organic-matter production, observed dissolved oxygen and nitrate concentrations combined with simple models of water-column and benthic remineralization.

Available observations of N_2* in the Atlantic and Pacific except for oxygen minimum zones (OMZs) where water-column denitrification occurs showed the following features: 1) N_2* gradually increases with depth from surface to deep waters, 2) N_2* in the deep Atlantic is higher than that in the deep South Pacific, and 3) there is a south to north increase in N_2* in the deep Pacific.

In order to evaluate the role of each source and sink in controlling the features of observed N_2*, we carried out a suite of simulations. These simulations demonstrate that the features are determined mostly by the deep water sedimentary denitrification with minor contributions of shallow to intermediate-depth sedimentary denitrification and water-column denitrification, and nitrogen fixation has little impact on those. Thus, it seems like N_2* can be the tracer of deep sedimentary denitrification in addition to water-column denitrification in OMZs.

キーワード: 海洋窒素循環, 脱窒, 海洋大循環モデル
Keywords: marine nitrogen cycle, denitrification, ocean general circulation model