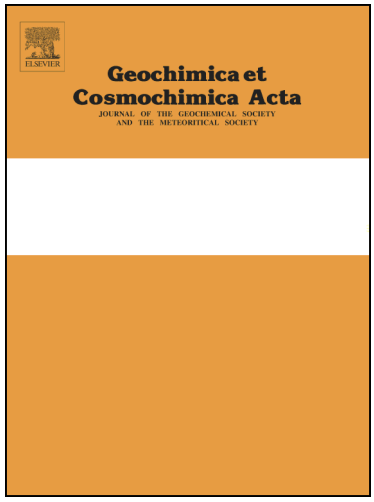

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Aerobic respiration along isopycnals leads to overestimation of the isotope effect of denitrification in the ocean water column

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Abstract

The nitrogen (N) isotopes provide an integrative geochemical tool for constraining the fixed N budget of the ocean. However, N isotope budgeting requires a robust estimate for the organism-scale nitrogen isotope effect of denitrification, in particular as it occurs in water column denitrification zones (ε_{wcd}). Ocean field data interpreted with the Rayleigh model have typically yielded estimates for ε_{wcd} of between 20 and 30‰. However, recent findings have raised questions about this value. In particular, culture experiments can produce a substantially lower isotope effect (~13‰) under conditions mimicking those of ocean suboxic zones. In an effort to better understand prior field estimates of ε_{wcd}, we use a geochemical multi-box model to investigate the combined effects of denitrification, aerobic respiration, and isopycnal exchange on the $\delta^{15}N$ of nitrate. In the context of this admittedly simplistic model, we consider three isopycnals extending from the Southern Ocean to the Eastern Tropical North Pacific (ETNP). We show that the data from the ETNP suboxic zone can be reproduced with an ε_{wcd} of 13‰, given a rate of aerobic respiration consistent with the nutrient data on these isopycnals and a plausible