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Role of suspended particulate matter in governing dissolved Nd in the Southern East Pacific Rise hydrothermal plume

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The role of suspended particulate matter (SPM) in modulating dissolved Nd gains importance in hydrothermal settings where particle dynamics and scavenging play important roles in trace metal behaviors. Here we use seawater Nd isotopes and concentrations ([Nd]) from a Southern East Pacific Rise (SEPR) hydrothermal plume, sampled during the US-GEOTRACES GP16 Eastern Pacific Zonal Transect, to report how they are influenced by particles.

Within the plume (2200-3000 m, identified by ^{3}He) dissolved Nd isotope ratios at both vent and distal stations are ~0.3-0.4 ε_{Nd}-units more positive than shallower samples, approximately the analytical uncertainty. These results support previous conclusions that hydrothermal activity is not a significant source of seawater Nd [1]. In contrast, seawater [Nd] near vent stations exhibit a prominent decrease, which attenuates with increasing distance from the SEPR [2]. Within the SEPR plume there is a loss of 7-12% of the dissolved Nd inventory compared to proximal stations outside the plume, consistent with a 6-10% loss seen at the TAG site in the North Atlantic [3]. This cannot be explained by SPM concentration alone, possibly due to SPM loss to the sediments. The major SPM end-member phases are lithogenic minerals, $CaCO_3$, organic particulates, biogenic opal, and authigenic $Fe(OH)_3$ and MnO_2 [4]. The end-member partition coefficients (K_d) (solid/solution) were calculated by solving a set of equations representing the bulk partition coefficients (D) of each sample, expressed as the linear sums of the pure end-members, weighted by their fraction of the total mass of particles. The K_d of MnO_2 (10^8 g/g) is higher than that of $Fe(OH)_3$ (10^7), and lithogenic minerals (10^6). A regression model with scavenged Nd as the dependent variable reveals MnO_2 as a significant ($p<0.001$) sink term within the plume. These results show both particle composition and abundance play important roles in Nd biogeochemical cycling.

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