Influence of a benthic REE source on sedimentary records of ε_{Nd}

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The neodymium isotope (ε_{Nd}) signature of sedimentary solid phases is used as a circulation tracer in paleooceanographic studies. The accurate application of the ε_{Nd} tracer depends on an understanding of the sources and processes that influence the ocean's ε_{Nd} signature. Recent observations of a substantial benthic source of Nd (a rare earth element; REE) to the ocean raises questions of (1) whether the sedimentary solid phases are recording the overlying water mass or a diagenetically altered marine pore fluid signature, and (2) what are the broader implications of a significant benthic Nd source on ε_{Nd} interpretations? To address these questions we attempt to constrain the environmental, geological, and chemical factors that control the elemental and isotopic characteristics of the benthic REE source in the North Pacific. Here, we present the REE concentrations and ε_{Nd} for these sediment, pore water, and overlying water samples from the Oregon margin (U.S.A.) sites at depths of 200, 500, 1200, and 3000 meters.

Specifically, we measured ε_{Nd} and REE concentrations of the bulk sediment (ε_{Nd} of -2.8 to -0.5; 13-22 μg Nd g^{-1} sed), a strong sediment leach (oxides; ε_{Nd} of -2.1 to -0.4; 2100-8200 ng Nd g^{-1} sed), a weak sediment leach (labile component; ε_{Nd} of -2.3 to 0.8; 700-3700 ng Nd g^{-1} sed), pore water (ε_{Nd} of -3.6 to -0.8; 130-790 pM), and overlying water (ε_{Nd} of -3.2 to -0.8; 10-43 pM). REE concentrations indicated an increasing source (from 13 to 32 pmol cm^{-2} yr^{-1} at 500 m and 3000 m respectively) with increasing water depth that was apparently unaffected by the presence of the oxygen minimum zone. Additionally, REE patterns indicated complex interactions between the sediment and the leachable coatings. We used the ε_{Nd} of the pore water and overlying water in conjunction with the ε_{Nd} of the bulk sediment and sediment leaches to examine the influence of benthic recycling processes on the ε_{Nd} of oxide coatings and overlying water. These data suggest the benthic source of Nd may be a primary control on the ε_{Nd} of the marine record. We further argue that our findings, while adding complexity, do not invalidate the use of ε_{Nd} for paleocirculation reconstructions.