Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.28051

Insights into rare earth element cycling at the Mauritanian margin and implications for the modulation of neodymium isotope signatures under varying redox conditions

SOPHIE A. L. PAUL, ANDREW W. DALE AND MARTIN FRANK

GEOMAR Helmholtz Centre for Ocean Research Kiel

Ocean margins are a high input region of neodymium (Nd) and other rare earth elements (REE) to the ocean. High organic matter inputs lead to elevated (μM) concentrations of dissolved Mn and Fe in sediment pore waters that are released during organic matter degradation. The REE cycling is related to the Mn and Fe cycles, but the exact connection remains poorly understood.

To address this knowledge gap, we present REE and Nd isotope data from pore waters collected along a transect from offshore oxic to suboxic slope and anoxic shelf pore waters on the Mauritanian margin. Our results show that Nd concentrations are enriched in the pore waters compared to bottom waters, ranging from 40 pM offshore to 120 pM at the slope and 305 pM on the shelf.

Shale-normalized (SN) REE patterns of the pore waters indicate fractionation from bottom seawater, which exhibits the typical heavy REE enrichment, pronounced negative Ce_{SN}- and positive Y_{SN}-anomalies. The offshore oxic pore waters display a REE_{SN} pattern similar to seawater, but with less heavy REE enrichment and a smaller negative Ce_{SN}-anomaly. In contrast, the slope site with high dissolved Mn concentrations (up to 10 μM) shows an overall light REE enrichment and a positive Ce_{SN}-anomaly, consistent with REE release from Mn-oxides. At the shelf site with high dissolved Fe concentrations (up to 64 μM), REE_{SN} patterns show middle REE enrichment without anomalies.

Furthermore, pore waters at these three sites exhibit distinct ε_{Nd} signatures ranging from -11.6 at the offshore site to -14.9 at the slope site. These unradiogenic values are in the range of Saharan dust. This suggests that Saharan dust dissolves in the sediment under suboxic conditions, leading to a benthic flux of unradiogenic Nd. Consequently, the bottom waters overlying the shelf and slope are less radiogenic than the offshore seawater, indicating that the benthic flux modulates the seawater Nd isotope signature at this margin.

Overall, this study provides new insights into the complex cycling of REE in an ocean margin environment, shedding new light on the mechanisms controlling benthic REE fluxes and their impact on the bottom waters' Nd isotope signature.