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Geochemical dynamics of neodymium and hafnium isotopes on the Amazon shelf: tracing sediment-seawater interactions

ANTAO XU[1,2], ED HATHORNE[2], FLORIAN SCHOLZ[3], ANDREA KOSCHINSKY[4] AND MARTIN FRANK[2]

[1]Institute of Environmental Physics, Universität Heidelberg
[2]GEOMAR Helmholtz Centre for Ocean Research Kiel
[3]Institute for Geology, Center for Earth System Research and Sustainability (CEN), Universität Hamburg
[4]Constructor University Bremen

The Amazon shelf and slope are key components of the tropical ocean margin systems, which are significant reservoirs of terrestrial minerals and organic matter and are important sources of trace elements (TEs) to seawater. Radiogenic neodymium (Nd) and hafnium (Hf) isotopes trace continental weathering regimes and lithogenic inputs and are also used for the investigation of water mass mixing and the reconstruction of past changes in ocean circulation [1, 2, 3, 4]. However, the global oceanic Nd budget is not balanced given that a substantial Nd input is missing. Boundary exchange (input) along continental margins has been proposed as the dominant Nd source to the ocean [5] Although boundary inputs and exchange likely control the isotopic compositions of seawater, these processes remain poorly quantified. We have therefore analyzed water and sediment samples from the Amazon shelf obtained during RV Meteor cruise M147, process study GApr11 of the international GEOTRACES program.

Highly radiogenic isotopic signatures accompanied by largely elevated dissolved Nd and Hf concentrations in near-bottom waters above the Amazon shelf demonstrate that the dissolution of terrigenous riverine iron-manganese (Fe-Mn) oxyhydroxides in resuspended sediments and/or porewaters control the geochemical behavior of rare earth elements (REEs) and Hf on the Amazon shelf. Isotope mass balance calculations suggest that a mean net Nd flux of $4.1 \times 10^8 \pm 3.5 \times 10^8$ g yr^{-1} is exported to the near-bottom shelf waters from the sediments. Our findings highlight the role of terrigenous riverine Fe-Mn oxyhydroxide minerals in shelf sediments as an important source of dissolved Nd and Hf to the global ocean. However, the supply of Nd and Hf via Fe-Mn oxyhydroxide dissolution is spatially heterogeneous across the shelf, requiring more studies on the mobilization of Nd and Hf from shelf sediments.

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