Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.9138

Geochemical behaviour of neodymium and hafnium isotopes in the Amazon estuary: Quantifying continental inputs and tracing the river plume

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Combined measurements of radiogenic hafnium (Hf) and neodymium (Nd) isotopes have been demonstrated to be a valuable tracer of continental weathering regimes and water mass mixing on short spatial scales [1]. The riverine Hf input into the global ocean is, however, still not quantified, and little is known about the estuarine mixing behaviour of Hf isotopes. We therefore measured dissolved Nd and Hf isotopes and REY concentration distributions in the Amazon estuary and a mangrove-influenced area of the estuary obtained during RV Meteor cruise M147, process study GApr11 of the international GEOTRACES program.

Our results demonstrate that despite the non-conservative behaviour of Nd and Hf concentrations due to large-scale removal, the dissolved Nd and Hf isotopes in the Amazon estuary can be explained by the mixing of 3 endmembers of Amazon River water, Pará River water and seawater. The efficient removal of dissolved REY and Hf occurring in the low-salinity zone did not alter the isotope signature of estuarine water. Admixture of Pará River water with its higher REY and Hf concentrations can explain the shift in the ε_{Nd} and ε_{Hf} of estuarine surface waters to less radiogenic signatures in the high-salinity region of Amazon River estuary, rather than release from sediments or suspended particles as suggested by previous studies that did not sample the Pará River [2]. Based on these results, Nd and Hf isotopes can now be used more reliably to track the river plume and river inputs. For the oceanic budget, the dissolved Nd and Hf fluxes of the Amazon River to the Atlantic are 2.5–2.9 × 10^5 mol/yr and 8.5–9.9 × 10^3 mol/yr while the dissolved Nd and Hf fluxes from the Pará River is 2.3–2.6 × 10^4 mol/yr and 0.9–1.2 × 10^3 mol/yr, respectively. Additionally, groundwater from the mangrove forest area just south of the Para and Amazon mouths can also supply 1.1–2.3 × 10^4 moles of dissolved Nd and 3.4–7.4 × 10^2 moles of Hf to the Atlantic every year.

[1] Goldschmidt, Frank et al. (2002) *Rev. Geophys*. 40, 1001.
[2] Goldschmidt, Rousseau et al. (2015) *Nat Commun.* 6, 7592.