Tracing oxidative weathering using rare earth elements and Nd isotopes in the iron oxide fraction of river sediments: Insights from the Amazon Basin

Gabriel Moizinho* , Germain Bayon† , Martin Roddaz‡[1], Marina Rabineau§ , Daniel Aslanian¶ , Marie-Laure Rouget[2], Anne Trinquier , and Roberto Ventura Santos‖[3]

[1]Géosciences Environnement Toulouse (GET) – Institut de Recherche pour le Développement, Université Paul Sabatier - Toulouse 3, Observatoire Midi-Pyrénées, Centre National de la Recherche Scientifique : UMR5563 – Observatoire Midi-Pyrénées 14 Avenue Edouard Belin 31400 Toulouse, France

[2]IUEM, Université de Bretagne Occidentale – Université de Bretagne Occidentale [UBO] – France

[3]Laboratório de Geocronologia, Instituto de Geociências, Universidade de Brasília (Geochronos) – Instituto de Geociências, Universidade de Brasília Campus Universitário Darcy Ribeiro ICC - Ala Central CEP 70.910-900 - Brasília DF, Brésil

Résumé

Continental chemical weathering exerts a fundamental control on global biogeochemical cycles and atmospheric CO over geological timescales, which strongly depends upon the nature of eroded source rocks. Yet disentangling the contributions of specific lithologies to weathering fluxes in large river catchments still remains challenging. Here, we use rare earth elements (REEs) and neodymium (Nd) isotopic compositions in paired clay and Fe-oxide fractions separated from river suspended material to investigate both sediment provenance and chemical weathering patterns across the Amazon River system. Our results reveal distinct geochemical signatures among the three main sources of sediments to the lower Amazon River, the Solimões, Madeira, and Cratonic domains. The cratonic Tapajos and Negro rivers exhibit shale-normalized REE patterns characterized by low mid-REE enrichment relative to both light and heavy-REE, as expressed by low concavity index values (CI _˜ 1.4) and minimal Nd isotopic decoupling ($\Delta\epsilon$NdFeOx-Clays) typifying a silicate weathering regime. The Solimões Domain and Lower Amazon River are characterized by high $\Delta\epsilon$NdFeOx-Clays values (4.5–5.5) with intermediate CI values of Fe oxides (_˜2) interpreted as largely reflecting erosion and/or chemical weathering of ancient marine sediment depositsand. Finally, the Madeira River exhibits intermediate $\Delta\epsilon$NdFeOx-Clays values (_˜3) and significantly higher CI values of Fe oxides (> 2.5) compared to other domains across the Amazon watershed. We show that such mid-REE enrichment in riverine Fe phases relates to oxidative weathering of black shales in upstream source regions of the Madeira catchment. Our findings further demonstrate the utility of combining detrital clay and associated Fe oxide geochemistry for reconstructing sediment routing and lithology-specific chemical weathering signals in river

*Auteur correspondant: gribeiro@ifremer.fr

†Auteur correspondant: Germain.Bayon@ifremer.fr

‡Intervenant

§Auteur correspondant: marina.rabineau@univ-brest.fr

¶Auteur correspondant: daniel.aslanan@ifremer.fr

‖Auteur correspondant: robertoventurasantos@gmail.com

systems. Future application of this approach to sedimentary archives at continental margins could provide unique constraints on past linkages between tectonics, chemical weathering, and the long-term carbon cycle over million-year timescales.

Mots-Clés: Oxidative weathering, rare, earth elements, Nd isotopes, Amazon Basin