DISTRIBUTION IN SPACE AND TIME OF IRON ISOTOPES IN PARTICULATE MATTER FROM THE AMAZON RIVER AND ITS MAIN TRIBUTARIES

RÉPARTITION DANS L’ESPACE ET LE TEMPS DES ISOTOPES DE FER DANS LA FRACTION PARTICULAILRE DU FLEUVE AMAZONE ET SES PRINCIPAUX AFFUENTS

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OBJECTIVES

✔ Study potential variations of iron isotopes in the Amazon River and its tributaries, relative to various parameters, such as:

- different locations;
- different climates / periods of hydrological cycle;
- different levels of water column (depth profiles);
- different types of water (white, black, clear).

✔ Compare results to river systems located in different areas of the world, both boreal and intertropical
IRON

- $^{54}\text{Fe}: 5.80\%$
- $^{56}\text{Fe}: 91.72\%$
- $^{57}\text{Fe}: 2.20\%$
- $^{58}\text{Fe}: 0.28\%$

$$\delta^{57}\text{Fe}(\text{‰}) = \left( \frac{^{57}\text{Fe}/^{54}\text{Fe}_{\text{ech.}}}{^{57}\text{Fe}/^{54}\text{Fe}_{\text{IRM-M-14}}} - 1 \right) \times 1000$$
IRON ISOTOPES

✓ Sensitive to redox states
✓ Tracers of different sources

✧ Rivers (tributaries, soils, vegetation)

✧ Oceans (from rivers, aerosols, fluids of sediments’ pores)
SAMPLING & METHODS
Three field campaigns:

Napo, Ucayali, Marañon (Peru)
Negro, Solimões, Amazonas,
Madeira, Tapajós (Brasil)

October and November 2009; July 2010

Samples filtered in field with 0.45 μm membranes (celulose acetate) – Dissolution of membranes for recovery of suspended matter (SM) – HNO₃, H₂O₂, HF & HCl 6N
IRON IN SUSPENDED MATTER (SM)
✓ purified by anion chromatography
✓ analysed by MC-ICP-MS (Geocronology Laboratory – University of Brasília & GET, Toulouse)
✓ Ni-doping technique applied to correct for mass bias during MC-ICP-MS measurements (Poitrasson and Freydier, 2005)
✓ Milhas hematite standard - $\delta^{57}\text{Fe}$ value of $0.757\pm0.067‰$ (2SD), relative to the IRMM-14 isotopic standard – good agreement with previous published data ($0.746\pm0.062$, Poitrasson & Freydier, 2005) - good stability AND accuracy of the equipment

Multicollector – Inductively Coupled Plasma Mass Spectrometer (MC-ICP-MS) – Geocronology Laboratory – University of Brasília
RESULTS
Studied Sites:
Depth Profile - ÓBIDOS
ICP-AOS

Mn - behavior in suspended matter

MC-ICPMS

Fe - behavior in suspended matter
Fe/Mn ratios – behavior in suspended matter
Total Particular Carbon & Organic Particular Carbon

Similar pattern for Santarém Station!
Surface samples represent the whole section
DEPTH PROFILE – MANICORÉ - suspended matter

Surface samples represent the whole section
Black waters – more humic, acid pH – organic matter signature
upper soil horizons, rich in organic matter – similar isotopic signatures
Temporal Series
ÓBIDOS
Temporal Series Óbidos – Suspended Matter Iron Concentration (MC-ICPMS)
Flux of elements - Fe, Mg, Al
Tons per day

Flux of elements - Mn
Tons per day
Temporal Series Óbidos – Iron Isotopes – Suspended Matter

![Graph showing water discharge curve and δ57Fe values over the months of March to December 2009 with error bars. The curve peaks in May and June and dips in August. The δ57Fe values range from approximately -0.10 to 0.30 per mil.]
DISCUSSION

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Data from: Bergquist & Boyle, 2006; Ingri et al., 2006; Escoube et al., 2009; Song et al., 2011
BOREAL
X
INTERTROPICAL RIVERS
Iron Isotopes – Amazon River at Óbidos

Boreal x Tropical Rivers - TIME SERIES

CONTINENTAL CRUST

Tropical River - Amazon at Óbidos (this study)
Iron Isotopes – Kalix River (Sweeden) & Amazon River

Contrasting behaviour between equatorial and boreal
CONCLUDING REMARKS

✓ Surface samples seem representative of the whole river section

✓ Results obtained for depth profiles (Madeira & Amazonas) and for the temporal series (Amazonas) are similar the continental crust’s $\delta^{57}\text{Fe}$ ($\sim 0.1\%_o$, Poitrasson, 2006)

✓ Negro River – only station with distinct $\delta^{57}\text{Fe}$ values (but $\neq$ Bergquist & Boyle (2006) : 1% discrepancy!

✓ Contrasting with boreal rivers, where $\delta^{57}\text{Fe}$ values in suspended load varies by up to $\sim 0.6\%_o$ along the year (Ingri et al., 2006)

✓ Very little Fe isotope fractionation during Fe transfer from soils to rivers in intertropical zones (see also: Poitrasson et al., 2008)
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GRACIAS!
Thank you!
Obrigada!
Merci!

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