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Iron cycling in the Amazon River Basin: the isotopic perspective

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With the global climate change and increasing anthropic pressure on nature, it is important to find new indicators of the response of complex systems like the Amazon River Basin. In particular, new tracers like iron isotopes may tell us much on processes such as the chemical exchanges between rivers, soils and the biosphere.

Pioneering studies revealed that for some river waters, large δ57Fe fractionations are observed between the suspended and dissolved load (Bergquist and Boyle, 2006), and isotopic variations were also recognized on the suspended matter along the hydrological cycle (Ingri et al., 2006). On land, soil studies from various locations have shown that δ57Fe signatures depend mostly on the weathering regime (Fantle and DePaolo, 2004; Emmanuel et al., 2005; Wiederhold et al., 2007; Poitrasson et al., 2008). It thus seems that Fe isotopes could become an interesting new tracer of the exchanges between soils, rivers and the biosphere.

We therefore conducted Fe isotope surveys through multidisciplinary field missions on rivers from the Amazon Basin. It was confirmed that acidic, organic-rich black waters show strong Fe isotope fractionation between particulate and dissolved loads. Furthermore, this isotopic fractionation varies along the hydrological cycle, like previously uncovered in boreal waters suspended matter. In contrast, unfiltered waters show very little variation with time.

It was also found that Fe isotopes remain a conservative tracer even in the case of massive iron loss during the mixing of chemically contrasted waters such as the Negro and Solimões tributaries of the Amazon River. Given that >95% of the Fe from the Amazon River is carried as detrital materials, our results lead to the conclusion that the Fe isotope signature delivered to the Atlantic Ocean is undistinguishable from the continental crust value, in contrast to previous inferences.

The results indicate that Fe isotopes in rivers represent a promising indicator of the interaction between organic matter and iron in rivers, and ultimately the nature of their source in soils. As such, they may become a powerfull tracer of changes occurring on the continents in response to both weathering context and human activities.

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