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Impact of Deforestation on the Iron Elemental and Isotopic cycling in Amazonian Streams

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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 but still relatively preserved natural systems like the Amazon River Basin. In this endeavour, we have been evaluating how iron cycling is impacted by deforestation in Amazonia through its stable isotopes.

We compared waters dissolved fraction (<0.45 microns) of stream pairs from small (~5 km^2) watersheds located in either pristine forest or deforested areas, sampled regularly to study the effect of seasonal variations. They are acidic (pH of 4 to 5.5) black waters with little suspended material. The water temperature, conductivity, major cation concentrations and dissolved carbon organic content is lower in forest streams compared to those from deforested areas. Oxygen and hydrogen stable isotope compositions are heavier in streams from deforested areas.

The O-H isotope systematics from the stream pairs highlight the predominating effect of water evaporation in deforested areas with increasing effects for older pastures. This therefore illustrates the strong impact of deforestation on the water cycle.

Dissolved iron concentrations and stable isotope compositions do not show obvious seasonal effects, but clear evolving interactions between water and soil as the pasture is becoming older. Iron concentrations, isotopic compositions and Fe/C ratio are lower in the stream flowing in the 50 years old pasture relative to forest as a result of likely changes in the iron redox and speciation. However, the difference is less obvious when deforestation is more recent (12 years old). In a stream flowing through an area undergoing slash and burn deforestation within the year, stream dissolved iron concentrations and isotopic compositions are much more scattered, with ∂^{57}Fe values varying by several ‰ as a result of fire or heavy rain events. This likely depicts the disruption of the iron cycling in the water-soil-plant system with strong changes in the soil mineralogy, organic matter characteristics and biomass activity resulting from the forest fire. Our results thus suggest that several decades are needed to reach a new steady state in pastures.