



Colloidal forms of iron in rivers from the central Amazon basin

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The understanding of forms of iron and their various biogeochemical interactions remains an important issue in environmental science. For instance, colloidal iron oxides are known to play an important role on mobility and bioavailability of various metals, through their reactivity, their high surface area and ubiquity at the Earth's surface. The recognition of iron forms in natural systems is critical for predictive modeling of Fe speciation involving water, mineral and organic compounds. However, related relevant field and experimental data are still sparse. The present study focuses on naturally occurring forms of iron in suspended material from various rivers of the central Amazon Basin. This basin represents a giant collector of weathering and erosion products originating from several distinct pedoclimatic regions with various stages of degradation related to hydromorphic, eluvial and podzolic processes. Accordingly, related rivers exhibit a wide variety of physical chemistry parameters.

Particulate ($>0.2 \mu\text{m}$) and colloidal ($0.2 \mu\text{m} - 5 \text{kD}$) fractions were collected on rivers of the central amazon basin using tangential flow ultrafiltration. Recovered solids were analyzed combining X-ray diffraction, Fourier-transform infrared spectroscopy (FTIR), electron paramagnetic resonance spectroscopy (EPR), high resolution transmission electron microscopy (HRTEM) and micro proton-induced X ray emission analysis (μPIXE).

By contrast to the particulate fraction containing minerals, the colloidal fractions are dominantly composed of “humic substance”-like material with various contents of iron. EPR reveals the presence of Fe^{3+} complexed to organic matter (Fe^{3+} -OM) and of colloidal iron oxides. The significant presence of iron nanooxydes is confirmed either quantitatively by coupling EPR and μPIXE data (assuming no divalent Fe is present), or by HRTEM which reveals 20-50 Å Fe-colloids associated to organic matter. Besides, estimate of Fe^{3+} -OM content clearly exhibits a decreasing trend as a function of river pH. This trend differentiates the pedoclimatic regions drained by the rivers. Modeling chemical data with the ECOSAT code shows that this trend indicates a geochemical control of Fe by complexation onto organic matter and formation of oxyhydroxide phase. It is interpreted as originating from the dominant processes occurring in the soils upstream, although the evolution of iron forms in the water column during transport cannot be excluded. For instance, the relatively high content of iron complexed to organic matter in the Rio Negro is consistent with the weathering process in podzols. In addition to the data on major rivers, results from streams draining a zone of ferralitic soil-podzol transition near the Jau River (Rio Negro Basin) will be presented and discussed by reference to the Rio Negro.

References

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