Particulate and colloidal matter from the Rio Negro/Solimões mixing zone (Amazonia, Brazil) : insight from structural chemistry

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At the Earth's surface, elements are mobilized during alteration and erosion processes, and exported mainly via rivers towards oceans as particulate, colloidal and dissolved forms. A major contribution to these exportations at global scale originates from intertropical area, and the interpretation of mass balance requires the understanding of trapping and mobilization of elements as solid matter. This study focuses on particulate and colloidal matter in the mixing zone of Rio Negro and Solimões, which form Amazon river. Previous geochemical studies reported a non conservative partition of some elements including metals, resulting from mixing of waters with contrasting chemistries and suspended matter contents. Our objective is to understand the role of transported solids, in relation with redistribution of elements. This requires to determine the nature and proportion of solid phases in the particulate and colloidal fractions, together with their fate during mixing of waters.

Samples were collected in September 1997 during one of the cruise of the Hibam project in both Rio Negro and Solimões (end members) and at several km distances downstream. Tangential flow ultrafiltration was used to concentrate particulate (63µm-0.2µm) and colloidal (0.2 µm-5kD) fractions. Grids for Transmission Electron Microscopy (TEM) were prepared in the field by embedding aliquots of water in hydrophilic resin. Solid matter was further separated in the laboratory by ultracentrifugation and ultrafiltration of supernatents (5 kD cuttoff).

Owing to the nature of transported phases (crystalline, amorphous, mineral and organic), this study requires the combination of traditional tools (X-ray diffraction, TEM) and spectroscopies sensitive to local structural order and having low detection limits (Fourier transformed infrared spectroscopy, UV-visible spectroscopy, Electron Paramagnetic Resonance (EPR)). The nature of transported solids in the particular fractions is known to consist of phases inherited from soils (clays, quartz, iron oxy-hydroxides, organic matter...), in various proportions according to their origin. Impurities and defects can reveal several generations of the same mineral in materials from the Earth's surface (Muller et al., 1995). They provide probes for studying particle mixture in the studied zone. By comparison to the particulate fractions, the colloidal fractions are more organic in all samples, but still contain crystalline phases such as kaolinite or quartz. In addition to the nature of colloids, attention is paid specifically to speciation of ferric iron as determined through EPR spectroscopy. Indeed, using this methodology for suspended matter from organic-dominated streams (Cameroon), an important colloid-mediated transport of ferric iron as Fe3+-Organic matter complexes and amorphous oxides was recently quantitatively evidenced (Olivié-Lauquet et al., 1999). Results are coupled to geochemical analyses and discussed by reference to the degree of water mixing.

MANAUS 99

International Symposium
Hydrological and Geochemical Processes in Large Scale River Basins

November 15-19, 1999, Manaus, Brazil

PROGRAM and ABSTRACTS

Organized by HiBAm
Hydrology and Geochemistry of the Amazon Basin

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Manaus-99