

Metal ions transport by colloids in the Amazon basin

M.F. BENEDETTI, J. BOULÈGUE, S. MOUNIER, J.Y. BENAÏM, N. FILIZOLA, P. SEYLER

Organic colloids play a very important role in the geochemistry of major and trace elements in surface and soil waters. They may change mineral sorbent properties by coating and they may affect the speciation of minor and trace elements in surface, lake, sea, and interstitial waters. Adsorption and chelation of trace metals by dissolved ($\text{DOC} < 0.45 \mu\text{m}$) and colloidal organic carbon ($5000 \text{ Dalton} < \text{DOC} < 0.45 \mu\text{m}$) influence the bioavailability, toxicity and transport in rivers. Size fractionation by ultrafiltration coupled with the complexation capacity measurements is a powerful tool to gain knowledge about trace element speciation in aquatic systems. Here we report the distribution of DOC, which passed initially through a $0.20 \mu\text{m}$ filter membrane. The distribution and the degree of association of major and trace elements with the discrete size fractions are presented. Samples were taken in Brazil 1996-97-98 during various cruises on the Rio Negro and on the Amazon river from Manaus to Santarém. Surface water samples were taken and treated on board with sequential cross flow ultrafiltration (ultrasart from Sartorius). All samples were treated in the same way: 50 liters of water were filtered using clean ultrafiltration membranes with the molecular cutoffs of $0.2 \mu\text{m}$, 100kD and 5kD. All membranes were cleaned in the lab with 50 liters of MQ water. In the field the first 5 liters were systematically discarded to prevent sample contamination during the filtration. Total C and metal ion (Na, K, Ca, Mg, Al, Fe...) concentrations were measured in each concentrated fraction and as well as in the permeate. Metal ions were determined by ICP AES and GFAAS. Total organic carbon and dissolved organic carbon were determined with a Dohrman 80 analyser. Mass balance calculations indicate a good recovery of carbon and metal ions (>80%). Total metal complexing capacities (TMCC) were determined by fluorescence quenching at pH 5 using Copper as a quenching probe. The distributions of the C and the metal ions are expressed as the percentage of the sum of the different fractions (i.e.: particulate P $< 0.22 \mu\text{m}$, colloidal $5000 \text{D} < \text{C} < 0.22 \mu\text{m}$, and dissolved $\text{D} < 5000 \text{D}$). For the Rio Negro the colloidal fraction represents 30 to 10 % of the total organic carbon. Particulate and colloidal carbons account for at least 60% of the total organic carbon. In the Rio Solimões and the Amazon after Manaus the dissolved organic carbon represents more than 75 % of the total organic carbon. Thus carbon flux at Obidos once the mixing is completed is essentially due to dissolved organic carbon. The distributions of major and trace elements are also expressed as the percentage of the sum of the different fractions (P, C, and D). Three groups of elements can be distinguished. The group of Na and Si, both elements are found in the dissolved fraction. The group of Mg, Ca, K, for which 50 % of the total amount of each element is found in fraction D while 15% and 35 % are found in fractions C and P, respectively. The group of Al and Fe which are found in the particulate fraction at 99% for all river samples. Complexing properties of the different fractions (i.e. P, C, and D) vary from one river to another. In black rivers 67% of the TMCC is due to the fraction C. For white rivers (Solimões, Madeira) it ranges from 24% to 0%. The fraction P accounts for 0 to 30% of the metal ion complexing capacity for all rivers. The fraction D accounts for most of the metal complexing capacity for white rivers. This conclusion is not confirmed by the distribution of Fe and Al in the fractions below $0.2 \mu\text{m}$. Ninety to 80 % of the concentration of both metal ions is located in the colloidal fraction (C1+C2) and not in the dissolved fraction (D). The strong affinity of Al and Fe for organic ligands is well known. Their distribution may confirm the presence of organic colloids with a specifically high affinity for metal ions. A similar result was previously obtained for small rivers where in the watershed podzolization processes were occurring. However, here in fraction C1 the high concentrations of Fe and Al could also be due to the presence of sub-micron sized Fe or Al oxy-hydroxides. Such minerals were observed by TEM in similar water samples. The association of positively charged oxides at the pH of the samples with negatively charged organic matter could explain the similar distribution of Fe, Al and C for those samples. We are currently undertaking proton titration of the same fractions to see if the overall binding capacity follows the same pattern. Such an information is important to understand the behaviour of the organic matter and the metal ions during the mixing between the Amazon fresh water and the Atlantic seawater.

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



manaus99@apis.com.br <http://www.unb.br/ig/hibam/hibam.htm>

