Trace elements distribution in the Andean sub-basins of the Madeira river : role of the weathering processes in the freshwaters geochemistry

L. MAURICE-BOURGOIN, F. GASC, F. ELBAZ-POULICHET, P. SEYLER

The distribution of trace elements (V, Mn, Co, Ni, Cu, Zn, As, Rb, Sr, Mo, Cd, Sb, Cs, Ba, Pb, and U) was investigated in surface waters and associated particles in the upper Amazonian basins, in Bolivia. Three main factors of the geochemical characterisation of the studied rivers explained mainly by weathering and dilution processes, are : i) substrate lithology, ii) mining activities, and iii) organic matter content. Using statistical methods (PCA), the combined use of this geochemical data with geological information on each watershed demonstrates the fundamental role of the weathering processes on the trace chemistry of the Andean rivers. The geochemistry of dissolved elements reflects the lithological differences between the Mamore and Beni basins. Andean tributaries of the Mamore R. are characterised by high concentrations of Mn, Sr, Mo, Ba and U while high concentrations of As, Zn, Cd and Cs characterise Andean tributaries of the Beni R. Dissolved Sr, Ba, Mo, Rb, U and to a lesser extend Zn and Cd correlate with major ions and appear to be predominantly derived from soluble rocks (carbonates, evaporites or sulfides essentially contained in shale). Influence of the shale erosion from Silurian and Devonian series explain the high concentrations of V, Zn, Cu and Pb measured in Beni tributaries. Additionally, the high values of Co, Ni and Mn reflects the Palaeozoic detritical series from the drainage basins of the Tipuani and Challana rivers. The higher content of Mn in the Ichilo river may reflects the predominance of carbonate rocks in this Mamore sub-basin. Regarding to the anthropogenic influence, the high Zn, As, and Cd concentrations measured in the Taquesi river can be explained by important mining activities. High values of V measured at the end of the dry season in plain rivers ('black waters') can be correlated with the decreasing of the phytoplancton biomass.

The fractionation of trace elements in SPM has been attributed to the sorting of feldspars during transport in water, and to the mixing between clay minerals and quartz. These minerals, refractory to weathering and introduced in water rivers by mechanical erosion, have not contributed to the dissolved load and the contribution of silicate phases remains rather small.

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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