Seasonal variations of physical and chemical erosion: A three-years survey of the Rhône river (France)

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For obvious logistical reasons, most previous studies on the main world rivers were based on wide scale investigations carried out on short timescales. By comparison, much less effort has been devoted at long term monitoring, as a mean to verify the temporal variability of the average characteristics, temporal trends, and representativity of short-term investigations. Here we report the results of a three years survey (November 2000 to December 2003) of the geochemical composition of major and trace elements in dissolved and suspended matter in the lower Rhône River (France), the largest river of the Mediterranean area. Subsurface water samples were collected in Arles, 40 Km upstream of the estuary, twice a month routinely, and at high frequency during flood events.

We show that the annual average SPM flux of the Rhône River to the Mediterranean Sea (7.25 x 10^6 tons/yr) was largely controlled by the flood events (83% of the solid discharge occurred in less than 12% of the time), and that the precision on the total output flux depends strongly on the precise monitoring of SPM variations during the floods. Chemical budgets have been calculated to discriminate the respective contributions of marine aerosols in rain water, carbonate, silicate and evaporite weathering, as well as anthropogenic inputs.

Our data corroborate previous studies suggesting a strong coupling between chemical and physical erosion fluxes, during the Rhone hydrological seasonal cycle. However, the correlation observed between physical and chemical transport rates is clearly different from that reported on global compilations of annual averages in the largest world rivers.

The steady state model of Gaillardet *et al.* (1995) has been applied to the chemical composition of dissolved and solid products. We show that the Rhône River exports currently much less material than produced at steady-state by weathering in its watershed. The sediment flux inferred from the steady-state calculation (20 x 10^6 t yr^{-1}) is on the same order as those estimated in the literature for the nineteenth and the beginning of the twentieth centuries. This unbalance may suggest that the Rhône is under a transient erosion regime following climate change (i.e. significant decrease of the floods frequency). On the other hand, the unbalance may also be due to the trapping of alluvion by the numerous dams on the river and its tributaries.

Abiotic hydrolysis of glucose-1-phosphate adsorbed at the water-goethite interface

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Phosphorus is essential to organisms. In the environment it occurs mainly as inorganic phosphates or as organophosphates. Due to the high reactivity of the phosphate group, these interact strongly with environmental particles. In order to make the phosphate in organophosphates available for uptake by organisms, hydrolysis is usually required. This process may be mineral-surface-mediated (abiotic) or enzymatic (biotic).

Glucose phosphate is one of the dominant components of the natural organophosphate pool [1]. The aim of the present work is to study the interactions between glucose-1-phosphate and goethite, with respect to adsorption characteristics and the role of the mineral surface in the abiotic hydrolytic process. The work was done in series of batch experiments, measuring ligand adsorption as a function of pH and time. The concentrations of the hydrolytic products glucose and phosphate were also measured. ATR-FTIR spectroscopy was used to evaluate the surface speciation of glucose-1-phosphate. Kinetic data will be presented which show the pH dependent surface-promoted hydrolysis, and these will be discussed in combination with molecular-level results obtained by ATR-FTIR spectroscopy.

References

[1] Turner B.L., *et al*., eds., (2003), *Organic Phosphorus in the Environment*, CABI publishing, Wallingford, UK