Chemical weathering and erosion rates in Lesser Antilles: An overview in Guadeloupe, Martinique and Dominica

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Guadeloupe, Martinique and Dominica Islands alike numerous tropical environment present extreme weathering regimes.

Physical denudation is mainly controlled by landside, This reflects the torrential dynamics of the rivers. For Guadeloupe, the mechanical weathering rates are 800-4000 t/km^2/yr.

The lithology is very porous with high infiltration rates, which induces that most of the elements fluxes are produced on subsurface as the chemical erosion rates are 2 to 5 time higher than the rates from surface water. We show how kinetic of chemical weathering rates depends on the age of the lava and subsurface circulation.

In addition, timescale of erosion have been calculated from U-series analyses sediments from rivers. Our results show a large range: from 0 to 150 ka in Martinique and from 0 to 60 ka Guadeloupe. From analyses from the dissolved loads, we propose to evaluate residence times in the river water. It would appear that waters circulation is globally 3 times longer for subsurface water than for surficial water (Rad *et al.* 2011).

Moreover these islands are highly impacted by agriculture. It is therefore interesting to assess the impact of such influence on the weathering rates. Our result show that human activity brings no disturbance on Critical zone processes contrary to what one might think. Indeed, we show that among the combined impact of all parameters (climate, runoff, slopes, vegetation…), the basins age seems to be the control parameter on chemical weathering and land use: the younger the basin, the higher the weathering rate.

We could observe a combined effect between the higher erodibility and a higher climate erosivity of the younger reliefs.

Impact of a small downstream reservoir on metal cycling in acid mine drainage impacted waters

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The results of ongoing work in an acid mine drainage impacted watershed suggests downstream reservoirs play an important role in the cycling of metals and trace elements under variable flow conditions. The former Leona Heights Sulfur mine in Oakland, California produces acid mine drainage (AMD) that enters the Lion Creek watershed. These waters flow into the Lake Aliso reservoir, which is kept full during the dry summer months, thus contributing to the development of chemical gradients. Lake Aliso is drained during the wet winter months, allowing Lion Creek to flow freely across the lake bottom. The different flow regimes in Lake Aliso provide a wide range of geochemical conditions under which to study metal cycling in a single system.

Beginning in July 2009, monthly water samples were collected from Lion Creek and its two tributaries, Leona and Horseshoe Creeks, as well as from the inlet and outlet of Lake Aliso. Leona Creek is the source of AMD impacts within the watershed and Horseshoe Creek represents background watershed conditions. Lion Creek intergrates these two tributaries and discharges into Lake Aliso. Sediment cores collected from Lake Aliso provide a history of lake conditions and metals cycling.

Metals concentrations, including Pb, Cd, Fe, Ni, Cu, and Zn, in the AMD impacted Leona Creek tributary are significantly elevated above levels in the Horseshoe Creek tributary. After these tributaries mix in Lion Creek, measured concentrations of metals at the Lake Aliso inlet are lower than those measured in Leona Creek, due part to dilution by Horseshoe Creek waters. However, dilution alone cannot explain the reduction in metals concentration. Although all metal conentrations are lowered, only Cu (on most sampling dates), Fe, and Pb approach background levels. In addition, whether concentrations of metals at the Lake Aliso outlet are greater than or less than the lake inlet depends on whether the lake is full or empty, as well as the recent precipitation history. Depth profiles of lake temperature, pH, and dissolved oxygen suggest the chemical gradients that develop when the lake is full likely control the mobility of metals. Additionally, sediment cores from the lake exhibit fine scale (sub cm) oscillations in redox conditions.