Weathering process on tropical volcanics islands (Guadeloupe, Martinique and Réunion) by using U-series

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The volcanic islands of Guadeloupe, Martinique and Réunion, are particularly interesting for the study of landscape erosion. Their lithology is andesitic (Martinique, Guadeloupe) to basaltic (Réunion). They are located in a tropical climate with high temperatures (24°C to 28°C), high precipitation, sharp relief and very dense vegetation. These characteristics favour high weathering rates with significant variations, over a short distance, from one basin to another.

We have taken samples from main streams of Guadeloupe, Martinique and Réunion (dissolved phase, particles and sand) as well as some thermal springs. U, Th, Ra isotopes have been analysed by MC-ICP-MS and TIMS in order to calculate the rates and timescales of erosion.

The isotopic characteristic of the sand shows that part of the erosion process occurs not only by leaching soils but also directly inside the river bed (by impacts of blocs).

Although Martinique, Guadeloupe and Réunion are very similar in many respects, the process of erosion varies in each island : Martinique and Guadeloupe have very thick soils (~100 m) compared to around 1m in Réunion. Average chemical erosion rates for Guadeloupe and Martinique (122t/km^2/yr) and associated atmospheric CO_2 consumption rates (1.35 10^6mol/km^2/yr) are out of the temperature correlation defined by Dessert *et al.* (2001), which includes Réunion 63-170t/km^2/yr and 1.3-4.4 10^6 mol/km^2/yr, Louvat et Allegre, (1998).

Physical erosion is very discountinous and producing by pulse. During dry season in Guadeloupe and Martinique we have obtain, by U-Th balance,very low values (max 4 10^2 t/km²/yr) . In Réunion, mean value had been calculated (max 9 10^3 t/km²/yr) by geochimical trace and major elements balance by Louvat et Allegre (1998). Geomorphologist’s estimation for a river in rising during flood season is 8 10^5 t/km²/yr (Fevre *et al.*, 2004). Those values are modulated by the quantity of infiltrated water (which can be 80% of precipitation). We will compare those values to U-series results, discuss the steady-state hypothesis and the different timescales involved by each estimation.

References

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Influence of overstory vegetation on long-term chemical weathering rates

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The influence of overstory vegetation on long-term base cation depletion rates in soil is significant in the context of global climate cycles, soil health and forest management, and neutralization of acid deposition. Because other variables that influence chemical weathering in natural systems are often not controlled (i.e. parent material composition, elevation, land-use history), studies that isolate overstory effects on chemical weathering are limited, particularly on timescales that would be evident in the pedogenic record. In this study, we examine the influence of northern hardwood, red pine, white pine, and Norway spruce forests on base cation depletion and long-term chemical weathering in underlying soils. We utilize a unique field site, Marsh-Billings-Rockefeller National Historical Park, to isolate vegetative effects from other soil forming factors on 100 yr timescales. We find that conifer species deplete the upper horizons of the soil to a greater extent than northern hardwood forests, but at greater depths, northern hardwood soils are more depleted. Bulk long-term weathering rates are significantly higher under northern hardwood forests(39.5±2.8 meq*m^{-2}*yr^{-1}) than any of the conifer species(32±3.3 meq*m^{-2}*yr^{-1}). Furthermore, depletion profiles suggest that the species examined differ fundamentally in the mechanisms by and depths at which they most aggressively deplete the soil. In the upper soil horizons, strong weathering agents released from forest floor decomposition and fine root exudation (carbonic acid, low molecular weight organic acids, chelating ligands) in conifer stands, particularly Norway spruce, are more aggressively weathering the soil than under the deciduous trees. At greater depths, the high annual nutrient demand of northern hardwoods results in a more depleted soil than that under conifer stands. As whole, but particularly at depth, northern hardwood soils are more depleted in mineral sources of macronutrients than soils under conifer species when other soil forming factors are constant, which has important implications for forest management and global change, particularly in the Northern Forest..