Importance of atmospheric inputs on biogeochemical cycles in a tropical andesitic watershed (Guadeloupe): Insight from Li-Sr-Nd isotopes

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In this study, we measured Sr, Nd and Li concentrations and isotopic compositions in the surface reservoirs (rain waters, atmospheric dusts, litter, rocks, soil, soil solution and river samples) of a small forested andesitic watershed located in the tropical rain forest of Guadeloupe. This catchment is characterized by highly depleted soils, mainly composed of mature secondary minerals.

Soil samples Sr isotopes ratios (between 0.7086 and 0.7155) and Nd isotpes ratio (between 2,71 and -8,39) are intermediate between andesite and Saharan dust endmembers revealing the significant contribution of atmospheric deposition to soil composition. These results and mineralogical data point toward a multi-layered soil profile which has been built by successive volcaniclastic episodes separated by periods of dust deposition. The 87Sr/86Sr ratio in litter samples ranges between 0.70966 and 0.71019 and also attests the importance of atmospheric sources in the base cation nutrient pool.

Li isotope composition measured along a 12.5 m deep soil profile varies from +3.9‰ near the surface to -13.5‰ at 11 m depth. Compared to unweathered andesite (+5‰), the deep soil signature is in agreement with preferential incorporation of light Li into secondary minerals. In the top soil however, our results also emphasized that atmospheric depositions (wet and dry) are a main source of Li to the soil. The decreasing δ^7Li with increasing depth is consistent with a vertical gradient of incorporation of heavy atmospheric Li, this input being maximal near the surface.

In this tropical Caribbean context, with very thick and cation poor soil, atmospheric deposits (sea salts and Saharan dust) have therefore a strong impact on soil genesis. Because of thick saprolite layer, vegetation is isolated from primary minerals and the atmospheric inputs constitute a significant nutrient supply for vegetation growth.