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Transformation rates of bedrock into saprolite during spheroidal weathering (Rio Icacos basin, Puerto Rico): U-series nuclide evidence

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The rate of alteration controlling the transformation of cohesive bedrock into disaggregated saprolite is a key parameter in modelling the Earth's Surface evolution in response to external forcing (tectonics, climate, human activity). We propose to estimate such rates by using U-Th-Ra disequilibria for the case of spheroidal weathering, a classical process which often defines the transition of bedrock to saprolite in many rock types and many climatic settings. For this purpose, a series of rocks collected along a weathering profile which developed on quartz diorite in the Rio Icacos watershed (Puerto Rico), has been analysed for major and trace element concentrations as well as U-Th-Ra disequilibria, following the approach used in other context [1].

Major and trace element data confirmed that a main part of the chemical weathering in this system occurs at the rindlet/saprolite transition characterized by significant loss of Na, K, and Ca [2].as well as Rb, Sr and Ba. The U-Th variations along the profile however point to a much more complex U-mobility pattern. In particular, U mobility in the weathering profile cannot be controlled only by leaching processes occurring at the bedrock/saprolite transition, but probably also by U inputs linked to aeolian dust deposition and/or by U vegetation recycling. By contrast preliminary Ra-Th data measured along the profile document the occurrence of important Ra-Th fractionation at the rindlet/saprolite transition. Interpretation of the Ra-Th variation along the depth profile by a simple Ra-Th fractionation model allows calculation of a downward

propagation rate of the bedrock-saprolite front of about 8m/100ka, consistent with the surface denudation rate of 6m/100ka determined for this region [3][4]. The preliminary data therefore suggest that the weathering and erosion processes in this watershed have reached a steady state. These results confirm that the study of Ra-Th fractionations in weathering profiles will be useful in constraining the rate of weathering.

[1] Dequincey et al. (2002), Geochim. Cosmochim. Acta 66, 1197-1210; [2] White et al. (1998), Geochim. Cosmochim. Acta 62, 209-226; [3] Brown et al. (1998), Earth Planet. Sci.