Silicate weathering of igneous rocks, elemental mobility, and sources of chemical solutes in rivers of Panama

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Weathering profiles were measured at various scales (mm to tens of m) on intrusive igneous rocks in tropical watersheds of Panama. Compositional gradients document that weathering proceeds by dissolution of feldspar and pyroxene, with base cations effectively leached during weathering in the following sequence of mass loss: Na > Ca > Mg > K. Sr-isotope composition in river waters identify the igneous rock substrate as a primary source component relative to a strongly diluted signal from marine carbonate or atmospheric dust.

The behaviour of a large range of trace elements, measured in-situ by laser ICPMS on cm-sized weathering rinds on a gabbro corestone (49.6 wt.% SiO2), as well as for whole rocks samples along dm to m scales for granodiorite (59.3 wt.% SiO2) and diorite (54.5 wt.% SiO2), respectively, is quantified by open system mass transfer coefficients for all elements measured. Trace element ratio variations that are critical in evaluating igneous processes were quantitatively evaluated and found to be highly variable during weathering (U/Th, Ce/Pb, La/Yb) and dependent on bedrock lithology. REE and most other elements are strongly depleted in weathering rinds. For example, U and Pb, are less depleted (i.e. relatively enriched) compared to Th and Ce, respectively. Even Nb/Ta ratios tend to be slightly reduced in the most altered samples. Chalkophile elements (e.g. Mo, Cd, Sb) display large differences in their enrichment and depletion patterns, suggesting a large role for adsorption of these elements onto residual Fe-oxyhyroxide weathering products.