Assessing the impact of denudation rate on soil chemical weathering intensity: The response of Si isotopes

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Soil chemical weathering intensity is controlled by denudation rate, which increases with tectonic uplift. However, at low uplift (< 200 mm/kyr) and denudation rates, this relationship is not well defined. While silicon stable isotopes have been sucessfully applied to assess weathering intensity of well-developed soils, their use for assessing weathering intensity under low denudation rates has not yet been tested.

Here we apply silicon isotopes to soils from the Internal Zone of the Betic Cordillera, southeast Spain. Three catchments (CAB, FIL and EST) with similar bedrock (micaschist), climate (semi-arid) and vegetation characteristics, were selected along a gradient of increasing denudation rates (20-250 mm/kyr) from EST to CAB.

For each catchment, two soil profiles were described and sampled on ridgetops down to the bedrock. Traditional weathering indexes such as the Total Reserve in Bases (TRB), Cation Exchange Capacity (CEC) and presence of Fe-oxides (Fe_d) were combined with mineralogical analyses to assess the soil weathering degreee. Our data support the idea that the higher the denudation rate, the weaker the chemical weathering intensity.

The Si isotope composition of the soil's clay- and sand-size fractions and bedrock was measured by MC-ICP-MS (Nu Plasma II). Our preliminary data indicate that the Si isotope composition of the sand fraction is similar to that of the bedrock while clay fraction shows a comparatively lighter Si isotopic composition. This is in agreement with previous studies which show preferential incorporation of light Si isotopes in clays during weathering. Thus, Si isotopic compositions in soils may record the impact of denudation rate on chemical weathering in this low uplift rate environment. Our results also suggest that silicon isotopes can provide reliable information on paleoenvironments which were subject to a range of weathering conditions.