Investigating soil processes across the Hawaiian Islands using U-series nuclides

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The Hawaiian Islands are an ideal place to test the use of U series disequilibria as a tracer of soil processes and as a means of investigating the controls on soil weathering rates. Previously established soil sequences in Hawaii provide a unique opportunity to independently examine the effects of age, rainfall, and topographic position while holding other soil forming factors roughly constant. Additionally, parent material chemistry is well known, and atmospheric dust deposition fluxes are low, globally speaking, and well characterized.

We analyzed the isotopes ^{238}U, ^{234}U, ^{230}Th, and ^{232}Th across both climate and age gradients (from 180 mm yr^{-1} to 2500 mm yr^{-1} on 170 ka soils, and from 20 ka to 4100 ka at 2500 mm yr^{-1}). Geochemical fractionation of these isotopes is initiated at the start of weathering. Disequilibrium among these isotopes is used to determine the timing of the geochemical transformations, and evaluate the most appropriate model to describe U and Th leaching kinetics in these basalt-derived soils. Our analysis takes advantage of the extensive previous characterization of these soils, including identification of parent material age, dust inputs, water budgets, soil mineralogy, and trace element budgets [1],[2].

[1] Chadwick *et al*. (2003) *Chem. Geol*. **202**, 195-223. [2] Pett-Ridge *et al*. (2007) *Chem Geol*. **244**, 691-707.

Continental sources of Nd to seawater – Past and present

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Seawater Nd almost exclusively is of continental pedigree, mostly stemming from dissolution of particle-bound Nd transported by rivers and wind to the oceans. Detrital particles exchange Nd with local water masses through a number of complex interactions collectively known as "boundary exchange". The isotope composition of water masses closely correlates with the epsilon Nd of the detrital source areas (Piepgras & Wasserburg 1987; Tachikawa *et al*. 2003; Jeandel *et al*. 2006; Arsouze *et al*. 2007).

We show that the epsilon Nd of detrital matter is inversely correlated with the bedrock age of river drainage basins (epsilon Nd = -0.023 bedrock age [Myr] + 0.12; r^2=0.74). The present-day, globally averaged epsilon Nd of detrital inputs to the ocean (-7.2) is very similar to average seawater (-7.6), and corresponds to an average bedrock age of ~320 Myr. The fact that this age is ~100 Myr younger than the average bedrock age of the non-glaciated Earth surface indicates that young continental margins contribute disproportionately to the detrital flux to the ocean.

Keto & Jacobson (1988) have attempted a global reconstruction of seawater epsilon Nd for the past 800 Myr. If this record is inverted using the above correlation between epsilon Nd and bedrock age, early Phanerozoic source areas of continental detritus must have been older than during the Jurassic, Cretaceous and Quaternary. This observation is consistent with Nd isotope compositions of sedimentary rocks from North America, that point to a rejuvenation of continental source areas of detrital matter following the onset of the Caledonian-Appalachian orogeny (Patchett *et al*., 1999). We argue that changes in the Nd isotope record of seawater mirror changes in the composition and age structure of bedrock in those source areas that control the delivery of detrital matter to the ocean basins.