Volatiles and trace elements in rejuvenated-stage lavas from Niihau, Hawaii: Evidence for carbonatite metasomatism

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We present volatile, trace element, and radiogenic isotopic compositions for Niihau rejuv-enated-stage lavas (RSL). These lavas display trace element heterogeneity greater than RSL from other islands, with enrichments in Ba, Sr, and LREE. Niihau RSL also have high and variable H_2O/Ce and Cl/La (620 and 39, respectively). We model trace elements of most RSL by small degrees (1-15%) of melting of depleted peridotite recently metasomatized by a few percent of an incipient melt from the Hawaiian plume. Compositions of Niihau RSL are best explained by addition of 0.1 to 0.4% carbonatite, to a depleted peridotite less enriched in incipient melt than the source of other RSL. Our model is consistent with deep melting of carbonated eclogite within the plume to produce carbonatite melt and silica-undersaturated silicate melts that metasomatize the surrounding mantle. The metasomatic component is best preserved at the margins of the plume sampled during flexural uplift-related melting.

Saprolite and the evolution of upland landscapes – Links between erosion and weathering in Sierra Nevada, CA

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Saprolite weathering is widely studied from a geochemical perspective; little attention, however, is directed to understanding what geomorphic role the saprolite system may play in influencing the patterns and rates of landscape evolution. We present an adapted set of equations to calculate rates weathering and physical erosion based on immobile elements and *in situ* produced cosmogenic ^{10}Be concentrations. Our approach differs from previous calculations of Riebe *et al.* [1] because we make the critical assumption that ^{10}Be derived rates of denudation reflect only soil production and cannot be used to derive total denudation rates in landscapes with deep saprolite (>2m) due to nuclide attenuation. Lastly, we present field data from a climate sequence in the western Sierra Nevada, CA that show previously unquantified links between weathering and soil mobility. Our field data show that the rate of physical erosion (21-88 $t km^{-2} y^{-1}$) increases with saprolite weathering intensity and rate (20-137 $t km^{-2} y^{-1}$). Fractional mass loss due to weathering ranges from 37-65% (as shown by the measurements of the immobile element Zr). Furthermore, soil and saprolite weathering are inversely related, whereby saprolites that experience the most weathering lie under weakly weathered soils.

We suggest that saprolite weathering reduces coherence of rock and increases transportability, thus reducing soil weathering by shortening residence times. Additionally, the nature of the relationship between physical erosion and saprolite weathering in the Sierra Nevada is modulated by dominant processes of sediment transport; sites eroding primarily by bioturbation display a stronger erosion-weathering relationship than our sites with abundant tree throw. This study quantifies feedbacks between saprolite weathering and physical and chemical processes in the soil and suggests that the saprolite system plays a very large and often overlooked role in the long term evolution of upland landscapes.

[1] Riebe *et al.* (2003) *GCA* **67**, 4411-4427.