The Si isotope fingerprint along a gradient in weathering regimes

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To explore how tectonics set Si stable isotopes in weathering we explore their systematics in secondary precipitates of soils and saprolite derived from a gradient in weathering regimes. The end members of our study sites are the highly weathered tropical soils in the tectonically inactive Highlands of Sri Lanka, representing supply–limited conditions [1], and the rapidly uplifting Swiss Alps, representing the kinetically limited counterpart in which physical erosion dominates [2]. The intermediate weathering regime is located in the southern Sierra Nevada, California, where chemical weathering and physical erosion are about equal [3]. The secondary inorganic Si reservoirs in the weathering zone were sequentially extracted. These are secondary amorphous Si precipitates and secondary clays, separated by performing a hot sodium hydroxide leach for the amorphous Si fraction and a gravitational settling procedure for the clay fraction. Their composition was compared to that of the local primary rocks. We find a clear dependence of Si isotope ratios, measured in secondary precipitates (amorphous and clay fraction), on regolith residence time. Residence times are calculated from *in situ*-^{10}Be derived denudation rates and regolith thickness. The longer the regolith residence time (e.g. several 100 ka in Sri Lanka), the lower are $\delta(^{30/28}Si)_{NBS28}$ values (around -2‰) for the amorphous and clay phases. Settings with shorter regolith residence times (Swiss Alps, Sierra Nevada) show higher $\delta(^{30/28}Si)_{NBS28}$ values (around -0.5‰ for Swiss Alps and -1.5‰ for Sierra Nevada) for the analyzed secondary phases. The modeling approach developed by Bouchez et al. [4] reveals that Si isotopes signatures measured in secondary precipitates of soils and saprolite reflect the ratio of particulate Si export flux by erosion relative to the dissolved import Si flux by rock dissolution ($Si_{solid\text{-}exp}/Si_{diss\text{-}imp}$). Larger $Si_{solid\text{-}exp}/Si_{diss\text{-}imp}$ ratios result in relative higher $\delta(^{30/28}Si)_{NBS28}$ values of the formed secondary silicates. The $Si_{solid\text{-}exp}/Si_{diss\text{-}imp}$ ratio decreases with regolith residence time in the studied settings and is therefore directly a function of the weathering regime.

[1] von Blanckenburg *et al*. 2004, *JGR-ES* **109(F3)**; [2] Norton & von Blanckenburg 2010, *GCA*, **74(18)**, 5243–5258; [2] Dixon *et al*. 2009, *ESPL*, ***34*(11)**, 1507–1521.; [4] Bouchez *et al*. 2013, *AJS*, ***313*(4),** 267–308