Paleo-variation of lithium isotope geochemistry during basalt weathering in Hawaii

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Lithium isotopes have been used as a tracer of silicate weathering but the relationship between river water δ^7Li and silicate weathering rate still need to be established with precision. Here, we report Li concentrations and Li isotope composition of soils developed along a 4 million year humid-environment chronosequence on the Hawaiian Islands. Previous work has shown that with age the basalt weathering becomes less important to the soils and atmospheric inputs become more important. The soils also show mineral evolution from glass, olivine and feldspar to nanocrystalline secondary minerals and finally to crystalline products such as goethite and kaolin. Significant Li depletions (up to 90%) relative to parent basalts are systematically enhanced towards the surface and along the chronosequence. δ^7Li values of the younger soils (< 20 ka) are consistent with that of fresh basalt, regardless of the depth. This supports that the lack of significant Li isotope fractionation during rock leaching, as exhibited by experimental investigations (e.g. Verney-Carron et al., 2011) and that little influence of Li atmospheric inputs for the younger soils. δ^7Li values for the older soils (≥ 20 ka) are more variable with depth with the higher values (up to 14‰) systematically measured in the most surficial horizons. Mass balance calculations show that dust Li input accounts for up to 20% of the total Li input, while rainwater Li input is negligible with less than 1%. Results suggest that Li isotope compositions of regolith are mainly controlled by various processes during weathering and secondary mineral formation.