# Shifts in base cation sources across an incipient, volcanic soil chrono-climosequence

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State factor soil research has demonstrated clear pedogenic thresholds in soil nutrient status that inform ecosystem productivity over hundreds of thousands of years. However, the influence of specific state factors (e.g. mean annual rainfall and soil age) on soil nutrients over shorter timescales is more difficult to characterize. This study assesses the major controls on the source of plant available base cations in incipient volcanic soils using the state factor approach.

We compared Sr isotope and base cation data across a chrono-climosequence (varying mean annual precipitation and soil age) and included two other factors that may influence soil nutrient status (distance to coast and rainfall intensity). The soils were sampled on lava flows ranging from 500 to 7500 years old in the Kona region on the island of Hawaii. Our analysis lumped them into three precipitation categories (950-1060 mm, 1180-1210 mm, and 1450-1500).

We found that the plant available base cations generally increased with soil age, indicating higher soil fertility in the older soils. The plant available base cations decreased with mean annual precipitation, indicating greater leaching losses with more precipitation. The Sr isotopic signature of the plant available nurient pool reveals a greater contribution of rainfall-derived Sr over time at the driest group of sites. In contrast, Sr isotopes of the plant available pool for soils in the wettest sites showed no trend in base cation sourcing with soil age. We propose that variation in distance to the coast and elevation-set preciptation intensity leads to increased soil leaching at some wet sites, which depletes the concentration of base cations supplied by basalt as apparent in the rainfall dominated Sr signatures. Soils in the intermediate precipitation range have Sr isotopic signatures consistent with both the wet and dry site trends; suggesting that these sites lie close to a critical mean annual precipitation amount that marks a shift between these two processes zones.