

Examining the Rate of Weathering and the Occurrence of “Pedogenic Thresholds” in Hawaiian Basalt Soils

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The Hawaiian Islands offer an excellent opportunity to study the formation of soils over time, due to the existence of extremely diverse soils representing different stages of pedogenesis across the archipelago. This variation can be attributed to Hawai'i's wide range of climate and age fluctuation that produces different weathering rates and soil formation. Because of this, every stage in a soil's life cycle, from hot lava rock to highly leached acid soils, can be found here in Hawai'i. This matrix of conditions makes it possible to look at different weathering rates (controlled by climate) at different pedogenic stages (controlled by age), and indirectly, soil fertility. Primary mineral weathering, soil mineral formation, and the rate at which this occurs largely determine the natural fertility of soils. Chemical weathering releases nutrients within the rock that can then be taken up by plants, but can also contribute to nutrient leaching and a lower capacity for nutrient retention. It is key to note, however, that this rate of chemical weathering is not a linear function, rather, it is linear with abrupt non-linearities (pedogenic thresholds) triggered by the exhaustion of buffer systems within soil that control pH. This project aims to examine the rate of weathering in Hawaiian basalt soils by examining the occurrence of these “pedogenic thresholds”. Mostly importantly, we want to look at the threshold where a peak in soil fertility exists, so that we can better understand the rate at which fertility accumulates and exhausts. Extensive soil sampling was conducted across a matrix of substrate age (young, intermediate, old) and climate (rainfall), allowing for us to see soils at every stage of Hawaiian basalt soil pedogenesis. General soil properties, nutrient analyses, and elemental analyses were conducted and visualized as “weathering curves”, which were constructed to identify non-linearities or “thresholds” in the rate of weathering. We found that pedogenic thresholds, including the threshold where a peak in soil fertility exists, occur at lower rainfalls on older substrates compared to younger substrates.