



## **Phosphorus distribution and cycling along a climosequence: insights from stable isotopes**

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Climate is beside parent material, biota, topography, time, and human impact a state-factor controlling soil and ecosystem development (Amundson and Jenny, 1991). Whereas a lot of research has been carried out on the effect of most of these factors on phosphorus (P) cycling (Turner and Condron, 2013), less has been done on the effect of climate and, more in particular, precipitation. One of the reasons for that is the difficulty of finding suitable soil climosequences, i.e. sites on a given parent material of a given age exposed for the same time to different climates with little impact of human activity (Vitousek, 2004). Soils found on the Kohala Mountain, Hawaii, provide ideal conditions to investigate the effect of increased precipitation on processes affecting the distribution and cycling of P in soils. These soils have developed on the same parent material, the 150 ky old Hawi lava flow, which consists of alkali basalts with high contents of apatite. Along the climosequence, mean annual precipitation ranges from <200 to >3000 mm. The distribution of minerals, macro- and micronutrients, and the abrupt changes in soil chemical properties are strongly influenced by the precipitation gradient. Organic matter and non-crystalline minerals increase along the climosequence, with amorphous minerals dominating at high rainfall.

We present here preliminary results from a Swiss National Fund project (CLIMP: Forms and dynamics of soil phosphorus along a climosequence on basalt-derived soils), aiming at a better understanding of the links between pedogenic processes and P dynamics. Three domains are present along the climosequence: a mostly dry domain characterized by wind erosion and nutrient depletion at the top soil; an intermediate domain with dry and wet cycles, characterized by nutrient biological uplift and increasing presence of amorphous minerals; and a mostly wet domain, where amorphous minerals dominate and nutrients are lost from the top soil (Vitousek and Chadwick, 2013). We characterized the P soil distribution by chemical extraction and we tried to determine the importance of biological processes by measuring extracellular acid phosphatase activity and using the stable isotopes of oxygen bound to P in phosphate ( $\delta^{18}\text{O-P}$ ) extracted by resin and HCl. First results from six different sites along the gradient indicate that the stronger the weathering and the impact of precipitation are on the sequence, the more the  $\delta^{18}\text{O-P}$  of resin P deviates from  $\delta$ -values expected from a direct dissolution from parent material (e.g. volcanic rocks) or from thermodynamic equilibrium with water (Chang and Blake, 2015). The offset from parent material and isotopic equilibrium might indicate the contribution of extracellular enzymes, such as acid phosphatases or phytases, to bioavailable phosphate in soils, or the contribution of high  $\delta$ -values phosphate directly derived from vegetation.