Constraining the effect of climate and rock porosity on weathering extent in the volcanic island of Santa Cruz (Galapagos, Ecuador)

Rose PAQUE[1], Ilia ALOMIA HERRERA[1,2] , Marcus CHRISTL[3], Franz ZEHETNER[4], Jean DIXON[5], Veerle VANACKER[1]

[1] Earth and Life Institute, George Lemaître Center for Earth and Climate Research, UCLouvain, Louvain-la-Neuve, Belgium.

[2] FIGEMPA, Universidad Central del Ecuador, Quito, Ecuador.

[3] Laboratory of Ion Beam Physics, ETH-Zurich, Switzerland

[4] BOKU, University of Natural Resources and Life Sciences, Vienna, Austria.

[5] Montana State University, Bozeman, USA.

Keywords: Geomorphology, Soil weathering, Rock porosity, Climatic gradient, Weathering thresholds

Abstract : Tropical volcanic islands are global hotspots of chemical weathering. Understanding weathering processes in volcanic soils is important to constrain ecosystem processes and to manage and restore landscapes. Few quantitative data exist on geomorphic processes in pristine volcanic ecosystems, as most volcanic ecosystems are prone to intensive land use and management. We work in the Galapagos Islands, a UNESCO World Heritage Site, and an emblem of a pristine ecosystem. Our 10 monitoring sites on the island of Santa Cruz cover a ~10 km long NW-SE stretch with a 10 fold increase in precipitation rates. At five elevation sites along the transect, we monitor two sites: one that is developed on a basaltic lava flow and another one that is developed on a basaltic scoria cone. By controlling for the age and composition of the basaltic parent material, we focused on the unique natural soil-landscapes that developed along the sharp hydroclimatic gradient. The extent of chemical weathering was determined using geochemical mass balances. We then explore climate-driven variations in weathering degree along the hydroclimatic gradient. The results show strong spatial variation in chemical weathering extent, that coincide with the observed hydroclimatic gradient. However, weathering extent along the climosequence do no show linear changes between sites, indicating a weathering threshold due to climate. This non-linear behavior is valid for soils developed on the two parent materials, pointing also the role of rock porosity on soil weathering extent.