Geophysical Research Abstracts
Vol. 20, EGU2018-7259, 2018
EGU General Assembly 2018

Chemical weathering in high Andean ecosystems: interaction of vegetation and topography

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At the Earth′s surface, chemical weathering is amongst the most important processes that modulate the land surface, and plays a key role in the biogeochemistry of terrestrial ecosystems. In this study, we explore the effect of topographic position and vegetation on long-term chemical weathering. We sampled thirty soil pits along ten soil toposequences within a 4.2-km^2 catchment in the high northern Tropical Andes. We used a geochemical mass balance to quantify elemental mass gains and losses using immobile element concentrations. The non-allophanic Andosols formed from volcanic parent material showed marked differences in volumetric strain within their profiles. Organic-rich A horizons underwent an average volumetric expansion of 165 %, in contrast to minor dilation of 29 %, 12% and 21% that is observed in the underlying AC, CA and C horizons. The increase of organic C content with increasing strain highlights the importance of biological activity in development of páramo soils.

The base cations showed average mass losses greater than 90% relative to Ti. Silicon showed an average net loss of 55%, while Al and Fe showed losses of 13 and 27% respectively. Along the 10 toposequences, the chemical depletion of major elements (Ca, K, Mg, Na, Si and Al) commonly increases as the distance from the crest increases. Average mass losses per soil profile varied from -900 kg m-^{2} at the upper slope to -1050 and -1036 kg m-^{2} at the mid-slope and lower slope. Chemical mass losses differ between vegetation types, with strongest chemical depletion and mass losses up to -1151 kg m-^{2} in forest soils about 16% and 18% larger than the mass losses in respectively páramo grasslands and cushion plants. This study highlights the importance of vegetation in mineral weathering, and suggests that vegetation type has more influence on páramo soil formation than topography.