Geophysical Research Abstracts
Vol. 20, EGU2018-12125, 2018
EGU General Assembly 2018

Mount Cameroon (Central Africa): a unique exploratory for assessing the influence of time, precipitation and temperature on pedogenic processes in volcanic parent material

Daniela Sauer (1), Jean Pierre Nguetnkam (2), Selina Tenzer (3), Ludger Herrmann (3), and Thilo Rennert (3)

(1) University of Goettingen, Institute of Geography, Goettingen, Germany (daniela.sauer@geo.uni-goettingen.de), (2) Department of Earth Sciences, Faculty of Science, University of Ngaoundere, Cameroon, (3) Institute of Soil Science and Land Evaluation, University of Hohenheim, Stuttgart, Germany

Andosols represent soils with exceptionally high nutrient and SOM contents. Thus, knowledge on the development of these soils, formed in volcanic materials, and on the influence of various soil-forming factors is particularly relevant. We investigated the suitability of Mount Cameroon (SW Cameroon) for assessing the influence of time, mean annual precipitation (MAP) and temperature (MAT) on pedogenesis in volcanic materials. We hypothesised that the uniform mineralogical composition of the basaltic lava of Mount Cameroon, its numerous Holocene lava flows of different ages, and its special climatic setting, characterised by a vertical MAT gradient (0-29 °C) and a horizontal MAP gradient (2,000->9,000 mm), should allow for systematically analysing the influence of these factors. We selected eight soil profiles on lava flows of varying ages (54 years to several millennia) under contrasting MAP (2,000-2,400 mm versus 8,000 mm) and MAT (26-29 °C versus 8 °C). These profiles were compared with respect to (1) clay formation (clay/silt ratios); (2) formation of pedogenic Fe oxides (Fed/Fet); (3) silicate weathering and leaching of released elements (WIMER = weathering index based on the molar element ratio (Ca+Mg+K+Na)/Al); (4) desilification (Si/Al). We plotted the maximum values of those data that increase with pedogenesis (e.g., Fed/Fet) and the minimum values of data that decrease with pedogenesis (e.g., WIMER) of each profile against time for assessing the influence of time. Soils receiving 2,000-2,400 mm and 8,000 mm MAP were assessed separately. The influence of precipitation was assessed by comparing soils of similar age under contrasting MAP. Clay formation proceeded with soil age. High MAP seemed to enhance clay formation, but differences in clay contents became measurable only after >100 years. Increase in Fed/Fet ratios and decreases in WIMER and Si/Al ratios over time were identified. No response of Fed/Fet ratios to MAP was observed, whereas there seemed to be a response of WIMER and Si/Al ratios to MAP, suggesting that increased MAP leads to enhanced leaching of Ca, Mg, K, Na and Si. A possible explanation for the different behaviour of these indices could be that protective Fe oxide crusts form preferably around the Fe-bearing minerals from which they are released. Such crusts would prevent an enhancing effect of MAP on the weathering of Fe-bearing minerals and associated increase in Fed/Fet. In contrast, Fe-poor silicates would still remain exposed to the surrounding leaching environment. Hence, MAP should enhance weathering of these silicates and leaching of the released mobile elements, thus leading to decreased WIMER and Si/Al ratios. None of the indices Fed/Fet, WIMER and Si/Al showed an effect of temperature. The detection of such effect would require the investigation of soils along a MAT gradient, keeping the factors soil age and MAP constant. Such investigation is indeed possible along a catena on the SE slope of Mount Cameroon, where MAP along the MAT gradient could be kept at 2,000-3,000 mm. Based on the observed trends, we conclude that Mount Cameroon provides a unique natural exploratory for disentangling the influence of time, precipitation and temperature on soil-forming processes.