Geophysical Research Abstracts,
Vol. 11, EGU2009-8635, 2009
EGU General Assembly 2009

How biological crusts are stabilizing the soil surface? The devolpment of organo-mineral interactions in the initial phase

T. Fischer (1), M. Veste (2), W. Wiehe (1), and P. Lange (2)

(1) Brandenburg University of Technology, Central Analytical Laboratory, Konrad-Wachsmann-Alle 6, D-03046 Cottbus, Germany, fischer@zal.tu-cottbus.de, wiwo@zal.tu-cottbus.de, (2) Brandenburg University of Technology, Research Center Landscape Development and Mining Landscapes, Konrad-Wachsmann-Alle 6, D-03046 Cottbus, Germany, maik.veste@tu-cottbus.de, langep@tu-cottbus.de

First colonizers of new land surfaces are cryptogames which often form biological soil crusts (BSC) covering the first millimetre of the top soil in many ecosystems from polar to desert ecosystems. These BSC are assemblages of cyanobacteria, green algae, mosses, liverworts, fungi and/or lichens. The development of soil surface crusts plays a major role for the further vegetation pattern through changes to the physico-chemical conditions and influencing various ecosystem processes.

We studied the development of BSC on quaternary substrate of an initial artificial water catchment in Lusatia, Germany. Due to lack of organic matter in the geological substrate, photoautotrophic organisms like green algae and cyanobacteria dominated the initial phases of ecosystem development and, hence, of organo-mineral ineractions. We combined SEM/EDX and FTIR microscopy to study the contact zone of extracellular polymeric substances (EPS) of green algae and cyanobacteria with quartz, spars and mica on a >40 μm scale in undisturbed biological soil crusts, which had a maximum thickness of approx. 2 mm. SEM/EDX microscopy was used to determine the spatial distribution of S, Ca, Fe, Al, Si and K in the profiles, organic compounds were identified using FTIR microscopy. Exudates of crust organisms served as cementing material between sand particles. The crust could be subdivided into two horizontal layers. The upper layer, which had a thickness of approx. 200 μm, is characterized by accumulation of Al and K, but absence of Fe in microbial derived organic matter, indicating capture of weathering products of feldspars and mica by microbial exudates. The pore space between mineral particles was entirely filled with organic matter here. The underlying layer can be characterized by empty pores and organo-mineral bridges between the sand particles. Contrarily to the upper layer of the crust, Fe, Al and Si were associated with organic matter here but K was absent. Highest similarity of the FTIR spectra of EPS was observed with carbohydrates, using cellulose, dextran and humic acid Na salt as controls. Obviously, humification does not play a key role during this initial phase of soil formation. It was hypothesized that biological soil crusts facilitate the weathering of mineral substrate by (I) circumventing loss of fine particles with erosion, (II) by chemical treatment of minerals and (III) by catching small mineral-particles by glutinous EPS on the soil surface from the surrounding area.