Linking microstructural and spectroscopic analysis of biological soil crusts – investigation of organo-mineral interactions

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Cyanobacteria and green algae present in biological soil crusts are able to colonize mineral substrates even under extreme environmental conditions. As pioneer organisms, they play a key role during the first phases of habitat colonization and often initialize biochemical weathering of minerals. We combined FTIR and REM/EDX microscopy to study the contact zone of algal and cyanobacterial mucilage with quartz, spars and mica on a ≥40 µm scale in undistrubed biological soil crusts on the first millimeters of the surface of a sandy substrate. REM/EDX microscopy was used to determine the spatial distribution of elements in the profiles, organic compounds were identified using FTIR microscopy. We found accumulation of Al and K in microbially derived organic matter indicating capture of weathering products of feldspars and mica by microbial exsudates (Fig. 1). These exudates served as cementing material between sand particles. FTIR spectra recorded in the contact zone showed typical bands for quartz, phyllosilicates and carbohydrates (Fig. 2). It can be concluded that a combination of analytical microscopic and spectral techniques gives valuable insight into microbially induced organo-mineral interactions on a microstructural level.

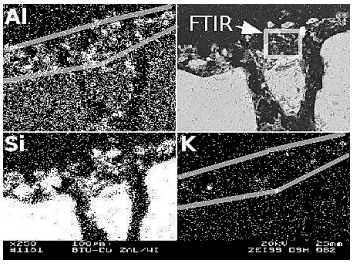

Fig. 1. BSE-signal (top right) and REM/EDX mapping of aluminum (top left), silicon (bottom left), potassium (bottom right)

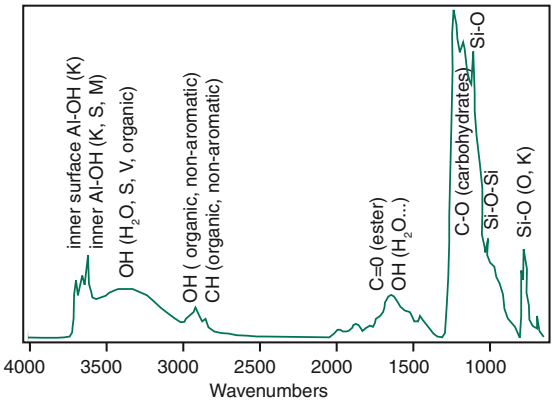

Fig. 2. FTIR-spectrum taken from indicated region (cf. Fig. 1, K – kaolinite, M – clay mica, S – smectite, V – vermicullite, Q – quartz)