Geophysical Research Abstracts
Vol. 18, EGU2016-14640, 2016
EGU General Assembly 2016

Effect of biocrust: study of mechanical and hydraulic properties and erodibility

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It is well-known that lichens and other organisms forming crust on soil or rock surface play important role in weathering but may also protect underlying material from fast erosion. So far, there have been only few measurements comparing mechanical or hydraulic properties of biocrust with its subsurface on locked sand and friable sandstones, so the overall effect of the biocrust is not well-understood. Objective of our study is to quantify the effect of the biocrust on mechanical and hydraulic properties of friable sandstone and locked sand of Cretaceous age in six different localities with varying aspect and inclination and age of exposure in sandpit Strelec (Czech Rep.). On the artificial exposures, biocrust developed within last 10-30 years. Beside measurements of mechanical and hydraulic properties, SEM and mercury intrusion porosimetry in crust and subsurface was performed.

Drilling resistance technique was found an excellent method to distinguish the biocrust from its subsurface (∼3 mm thick biocrust has up to 12 times higher drilling resistance than underlying material). Surface zone with the biocrust has 3 – 25 times higher tensile strength than the subsurface material (1 – 25 kPa). In comparison with the subsurface, the biocrust is considerably less erodible (based on water jet testing). Biocrust saturated hydraulic conductivity is 15 – 240 times lower than the subsurface (6*10 -5 – 1*10 -4 m/s) and its permeability for water vapor is 4 – 9 times lower than subsurface. Presence of the biocrust slows down capillary absorption of water 4 – 25 times. The biocrust is thus forming firm surface which protects underlying material from rain and flowing water erosion and which considerably modifies its hydraulic properties.

Material with crust exposed to calcination, leaching by concentrated peroxide and experiments with zymoliase enzyme strongly indicate that major contribution to crust hardening is provided by organic matter. Based on DNA sequencing the crust is formed by fungi including components of lichens which differ at individual localities.

This research was funded by the Czech Science Foundation (GA CR No. 13-28040S) and Grant Agency of Charles University (No. 386815)