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Link between soil aggregate system and bedrock weathering

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During pedogenesis, the development of the soil aggregate system may be strongly dependent on the type of bedrock lithology and its alteration. Linked with the initial spatial structure of its fracture and void system, physical and biogeochemical weathering causes rock disintegration, mineral dissolution an element freeing. These processes provide the basic authigenic aggregate forming materials such as rock and mineral fragments and colloids, but also precipitates due to element transfer. Yet, additional material inputs for surface transformation, alteration and aggregation may result from seepage originating from upstream compartments. This seepage suspension is enriched by mobile mineral and organic matter that infiltrates into the bedrock void system thereby fueling aggregate forming materials and composite building units to exposed surfaces of the bedrock.
We study the alteration processes of the fractured and weathered rim of lithified bedrocks in transition to soil and the aggregate system of the soil cover. The objective is to gain a profound understanding about the formation of aggregates and aggregate structures in soils. Spatial sequence are explored starting from the unweathered bedrock, regolith, subsoil and topsoil of different bedrock types (sedimentary, magmatic and metamorphic rocks). Methods employed cover stereo and polarization microscopy (millimeter to micrometer scale), scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDX, micrometer to nanometer scale), FTIR-spectroscopy as well as inductively coupled plasma mass spectrometry (ICP) in order to gain information about textural, petrological, mineralogical and chemical properties.
Typical alteration characteristics of the investigated bedrocks are dissolution features of rather unstable minerals vs. precipitation and alteration of clay minerals and the mobilization of Fe-(hydr)oxides. The decementation by dissolution and the alteration of clay minerals supports the breakup and disintegration of the rock particles. Stable minerals such as the quartz fragments are incorporated in the covering soil forming the nucleus of soil aggregates. Generally, initial dissolution features (edge pits, solution pores and vugs) enlarge the surface roughness and the reactive surface area in the unstable minerals promoting further mineral solution, rock disintegration and element transfer into soil. In return clay mineral coatings may inhibit further dissolution of unstable minerals, but provide surfaces with large roughness for the adsorption of colloids, organics and aggregate precipitation from soil suspensions.