Development of micro-scale soil structures at the Damma glacier

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Soil organic matter (SOM) and mineral constituents interact closely at the submicron scale forming the soil structure and providing biogeochemical interfaces. Soil structure itself plays a key role for carbon stabilization, microbial activity but also soil fertility and pollutant transport. However, the interaction mechanisms, the structural organization of the submicron structures and their evolution with time are still not fully understood.

A great chance to study soil evolution and thus the evolution of soil structures are glacial retreats. To understand the complex interplay between SOM and minerals during initial soil formation the foreland of the Damma glacier (Switzerland) was intensively investigated [1, 2].

To visualize the differentiation of the spatial distribution, heterogeneity and structural organization of SOM and minerals with time, clay sized fractions from the soil chronosequence investigated by Dümig et al. 2012 [2] were analyzed using scanning electron microscopy and nano-scale secondary ion mass spectrometry (NanoSIMS).

NanoSIMS provides spatial information about elemental/isotopic distributions at the submicron scale. Soils architecture was revealed by imaging the spatial distribution of organic (e.g.: ^{12}C, $^{12}C^{14}N$) and mineral (e.g. ^{28}Si, $^{27}Al^{16}O$, $^{56}Fe^{16}O$) constituents.

We were able to show the formation of heterogeneous micro-scale soil structures within a very short timeframe after the glacial retreat. The older the soils were, the higher was the spatial heterogeneity and thus complexity of the formed micro-aggregates. In contrast to the bulk data, the idea that ferrihydrite has a great influence on the formation of the organo-mineral associations could not be certified. Furthermore our data points towards a rather strong interplay between SOM and minerals containing Al.

[1] Dümig *et al* (2011) Geoderma **163**, 83-94, [2] Dümig *et al* (2012) Geochim. Cosmochim. Acta **85**, 1-18