Geophysical Research Abstracts
Vol. 20, EGU2018-6762, 2018
EGU General Assembly 2018
© Author(s) 2018. CC Attribution 4.0 license.

Exploring the soil microverse: Instrumental techniques to elucidate the biogeochemical microstructure of soils

Kai Uwe Totsche

Friedrich-Schiller-Universität Jena, Institue for Geoscience, LS Hydrogeologie, Jena, Germany (kai.totsche@uni-jena.de)

Within the soil aggregate system, microaggregates are supposed to be of primary importance, as they are strongly linked to all processes which control interaction, transport and turnover of soil constituents (Totsche et al. 2018). Soil microaggregates are all compound structures – including the organo-mineral associations - smaller <0.25mm, which are composed of mineral, organic and biotic components. They are arranged in a heterogeneous but still vastly unknown spatial pattern. During pedogenesis, microaggregates are formed by a complex interplay of physical, chemical and biological aggregation mechanisms, the quantitative role of which, although progressively more investigated, is still poorly understood. Soil microaggregates are considered the fundamental building blocks for aggregate structure in almost all soils, including soils with an aggregate hierarchy where they are the subunits for increasingly larger aggregates. Microaggregates withstand strong mechanical and physicochemical stress, allowing them to persist in soils for several decades. Their complex three-dimensional structure in combination with the physicochemical heterogeneity of the surfaces defines a microverse with an enormous large variety of ecological niches that seem to be the source of the vast biological diversity of soils even at the microscale. So far, work on microaggregate structure and development has largely focused on organic matter (C,N) stability and turnover. Only limited information is available on the mechanical stability of microaggregates, on the flow and the transport of fluids and solutes within the micro- and nano-porous system of the microaggregates, or on the rates and underlying deterministic or stochastic controls on soil microaggregate formation in space and in time. Much less is known on the role of microaggregates for the fate and biogeochemical cycling of elements like Si, Fe, Al, P, and S while essentially no established knowledge exits on the changes of microaggregates and their properties in time, which opposes our attempts to understand the dynamics and functioning of the soil structure on the nano- to micron scale. In line with this, quantitative approaches for the modelling of the formation, the structure, the properties and functions are in their infancy. Yet, this knowledge is mandatory to functionally link the structure and microarchitecture of soils to the processes of fluid flow and transport, to the activity of soil microorganisms, the turnover and interactions of elements, as well as to the stability of the soil microaggregates themselves. This contribution sheds light on the current state of the art in microaggregate research with specific emphasis on the diverse complementary instrumental techniques required to explore the 3d-structure of microaggregates, the patterns of composition and properties from the nano- to the submicron scale.

References:
Totsche K.U., Amelung W., Gerzabek M.H., Guggenberger G., Klumpp E., Knief C., Lehndorff E., Mikutta R., Peth S., Prechtel A., Ray N., Kögel-Knabner I. (2018) Microaggregates in soils. J. Plant Nutr. Soil Sci. doi:10.1002/jpln.201600451