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# Submicron analysis of soil interface composition using NanoSIMS

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Soils are structurally heterogeneous across a wide range of spatial and temporal scales, where processes controlling the stabilisation of soil organic matter or the sorption of nutrients and pollutants happen at submicron scales within soil aggregates or on mineral surfaces. Clay minerals, iron and aluminium (hydr)oxides and charcoal are considered as major components controlling the formation of soil interfaces and aggregates which are relevant for sorption processes. Although the knowledge about the factors controlling these soil processes has substantially improved over the last years, these processes are still hard to evaluate in situ.

The specific features of the novel nano-scale secondary ion mass spectrometry (NanoSIMS) technology, which allows the simultaneous analysis of up to seven ion species with high sensitivity and lateral resolution, make it an unprecedented tool for the analysis of biogeochemical processes and properties of soils. With Cs+ as primary ions, negatively charged ions, like e.g. 12C-, 13C-, 12C14N-, 12C15N- and 28Si-, are collected with a lateral resolution of up to 50 nm. Consequently, the NanoSIMS enables us to explore the elemental and isotopic composition of soils at the submicron-scale.

We will present results obtained at the NanoSIMS 50L at the TU München ranging from model systems (clay minerals, oxides) to natural clay minerals and intact soil macroaggregates. From the data obtained, we are able to identify several mineral species in simplified soil systems of know composition, e.g. quartz, different clay minerals and iron oxides, and to distinguish between organic material and charred particles. Our results show that the organic material closely interacts with minerals and that it can be found in patchy structures mostly on clay mineral surfaces. By incubation experiments with soil fractions and intact soil aggregates using isotopic tracers (13C and 15N) it was possible to track the tracer distributions driven by sorption and diffusion processes at the microscale.

From these first results, we can conclude that the NanoSIMS analytical technology can be applied to a broad range of soil samples and enables us to locate the association of elements/isotopes in soil components at the submicron-scale.