Rhizosphere - hot spot for organic carbon allocation between plants, microorganisms and soil minerals

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Due to its large interface between soils and plants, the rhizosphere, the volume of soil around living roots directly influenced by root activity, plays a key role in soil formation. Especially the root derived input of organic carbon into the soil matrix triggers a multitude of soil processes. The formation of associations built by the interaction of minerals with organic matter supplied by the degradation of plant/root residues and plant or microbial exudates is unique to soils. The high input of organic carbon in the rhizosphere (both from plants and microorganisms) in contrast to root free bulk soil, promotes the formation of micro- and macro-aggregates, and thus the development of a 3D soil structure. As the rhizosphere is a hot spot for organic carbon input and microbial activity, it becomes evident that it also plays a special role for the development and turnover of mineral-associated organic matter.

Using the combination of classical chemical analysis (e.g. elemental analyses, ^{13}C-CPMAS NMR spectroscopy) in concert with state of the art imaging techniques (e.g. nano-scale secondary ion mass spectrometry, NanoSIMS) allows to trace photosynthetically fixed plant derived organic carbon into the rhizosphere microbiome and the mineral soil constituents. We will demonstrate the special role of the rhizosphere for the formation of mineral associated organic matter together with the development of micro-aggregate structures. Whereas NMR spectroscopy revealed the more labile composition of mineral-associated organic matter in the rhizosphere with respect to bulk soils, NanoSIMS and stable isotope labelling illustrates the highly active biogeochemical interfaces at the rhizoplane with its associated microbiota and mineral particles.