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Plants, microorganisms and soil minerals, how the persistence of soil organic carbon is regulated at microscale interfaces

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Plant derived organic matter (OM), entering soils either as aboveground plant litter or via belowground rhizodeposition or dead roots, undergoes microbial mineralization and transformation and finally ends up in various soil OM (SOM) pools. With two major solid SOM pools besides dissolved OM, namely particulate OM (POM) and mineral-associated OM (MAOM), the initially plant dominated OM is progressively transformed into microbial OM during decomposition. However, as mineral soils comprise highly heterogeneous systems over a wide range of spatial and temporal scales, the microbial transformation of plant OM and the formation of SOM is highly variable in time and space as well. Processes controlling the persistence of SOM are especially determined at nm to µm scales at biological highly active biogeochemical interfaces. Thus, plant litter and roots form distinct soil hot spots for interactions between microbiota, OM and mineral particles that are thought to control the long-term fate of soil carbon. The detritusphere and rhizosphere thus represent soil volumes that host the complex interplay of biological, chemical and physical soil processes that determine the fate of SOM. We will highlight the intricate connection between the transformation of plant derived OM via microbial processing and soil structure formation that lead to the build-up of persistent SOM.