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Microbial necromass in soil organic matter (SOM) and its impact on soil processes and properties

Matthias Kaestner (1), Anja Miltner (1), and Chao Liang (2)

(1) Helmholtz-Centre for Environmental Research - UFZ, Dpt. of Environmental Biotechnology - UFZ, Leipzig, Germany (matthias.kaestner@ufz.de), (2) Institute of Applied Ecology, Chinese Academy of Sciences, Shenyang 110016, China

Methodical advances have allowed significant progress in understanding SOM formation and turnover. Microbial necromass (= residue mixtures of initially intracellular and extracellular biomolecules/aggregations) is increasingly evidenced to play important roles in SOM formation and turnover. SOM is now considered to be a continuum of plant and microbial necromass at various stages of decay.

Microbial necromass has important implications for understanding soil processes. For example, transformation of plant residues into microbial biomass and its residues (necromass) retains carbon in soil but changes the molecular composition (C:N:P) and energy contents of the matter. This central process of the energy flux from plant carbon to CO_2, determines maximum microbial growth, carbon use efficiency, substrate use and recycling of building blocks and thus biomass contents and CO_2 formation. Hence this process needs to be included in turnover modelling.

Necromass materials have much longer half-lives than separate biomolecules such as proteins, peptidoglycanes, or even the monomers. Post mortem modification may increase their persistency in soil, in particular by spatial organisation as well as interaction with inorganic molecules and minerals. Residual electron-shuttle biomolecules (e.g. oxidoreductases, Fe-S cluster, quinoid complexes from respiratory chains) may retain activity and contribute to redox reactions of SOM.

In addition, necromass covers everything in soils and thus determines surface properties of mineral particles. In particular, these materials have high water storage potentials, shrink and swell depending on the soil water potential. They affect water retention and nutrient diffusion as well as microbial motility. Adaption of microbes to water stress changes their cell surface properties and molecular composition and thus may determine the overall wettability.

The implications will be reviewed in this presentation. Altogether, these concepts will have significant impact on our understanding of carbon turnover in soils and finally improve the modelling of SOM formation and turnover and the management of SOM.