

Not all SOM is created equal

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Two-thirds of the carbon in the terrestrial biosphere is stored as soil organic matter (SOM). This vast pool of C is derived primarily from decomposed plant and microbial cell material, and the fluxes that control the size of this pool are critical to the global C cycle. However, the basic processes of SOM formation and turnover remain elusive and thus difficult to model and predict. Our perspective on OM persistence is evolving—stabilized carbon is no longer assumed to be chemically recalcitrant, and we now recognize that much mineral-associated OM has passed through a microbial lens, much of it as necromass or extracellular materials. Still, advancing our understanding of soil carbon organic-mineral interactions requires disentangling the complex interactions between soil mineral surfaces and decomposed organic compounds, root exudation and deposition, and soil microbial activity/biomass. By incubating ¹³C/¹⁵N labeled bacterial, fungal and root cells in soils and tracing the fate of the labeled components, it is possible to measure the fate of individual classes of organic materials under both controlled and environmentally relevant conditions. High resolution imaging techniques such as ‘STXM-SIMS’ when combined with bulk and microbial isotope tracing (‘Chip-SIP’), molecular microbiology, metabolomics and traditional geochemical extractions allow a comprehensive analysis of the fate of isotopically labelled rhizodeposits and plant tissues. The characteristics of the resulting plant and microbially derived organic compounds (lipids, phenolics, lignin, amino acids, polysaccharides) appear to interact differently with soils mineral phases, suggesting that the amount and types of carbon that are maintained in soil is based on the individual reactivity of component molecular groups (carboxylic acids, amines, aromatic rings).