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Carbon speciation in soil: Effects on carbon turnover and carbon sequestration

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Carbon storage in soil is essential for soil productivity while being directly linked to climate change. Mapping microaggregate-associated forms of soil organic carbon can help understanding the mechanisms of carbon stabilization in soil, revealing molecular organization, physical protection in soil particles and co-localization of carbon sources with microbial processes.
Spatially-resolved analyses of carbon distribution in microaggregates (<200 µm diameter) was conducted using FTIR microspectroscopy (Infrared Microspectroscopy beamline, Australian Synchrotron). Two soil types (Ferrosol and Vertosol) were collected from undisturbed areas and from locations immediately adjacent which have a long history of agricultural use. Soils were gently screened (250 µm) to obtain intact microaggregates which were humidified and frozen at -20℃, and sectioned (200 µm thickness) using a diamond knife and a cryo-ultramicrotome. The sections were placed between CaF2 windows and the spectra were acquired in transmission mode.
The maps obtained (5 µm step-size over ca. 150 × 150 µm) revealed for the first time carbon distribution in microaggregates from soils under contrasting land management. Accumulation of aromatic and carboxylic functions on specific spots and marginal co-localization with clays was observed, which suggests processes other than organo-mineral associations being responsible for carbon stabilization. A substantial decrease in carboxylic compounds was observed for agricultural soils. Clays were mostly co-localized with alkenes and polysaccharides, particularly in agricultural soils, likely due to enhanced microbial activity in those spots.
Results will be linked to currently ongoing analysis of enzymatic activities and dissolved organic carbon for further interpretation.

Keywords or phrases (comma separated)

Infrared Microspectroscopy; soil microaggregates; soil organic carbon; carbon sequestration;

Summary

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