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Visualization of organic matter binding on poorly-crystalline mineral phases in soil submicron organo-mineral matrix

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Soil organic matter (SOM) accounts for a major portion of terrestrial C and is considered to be stabilized against microbial degradation due partly to its interaction with soil minerals. Significant control of poorly-crystalline mineral phases on soil organic matter turnover as well as its storage has been shown based on field correlation studies and incubation experiments. Yet how organic compounds of microbial and plant origins interact with poorly-crystalline and other mineral phases within soil aggregate structure at the spatial scale relevant to microbial extracellular enzymes (tens of nanometers) remain unclear. Here we focused on the sonication-resistant particles that are enriched in organic matter (OM) from an Andisol, the soil order characterized by high contents of OM and poorly-crystalline minerals and high aggregate stability, and tested the hypothesis that submicron-scale OM distribution within a soil particle is controlled by poorly-crystalline minerals using scanning transmission X-ray microscopy (STXM) and near-edge X-ray absorption fine structure (NEXAFS) as well as scanning and transmission electron microscopy (SEM, TEM). We will demonstrate that the combination of synchrotron and other spectroscopic techniques used here is a powerful approach to directly examine soil organo-mineral associations occurring at submicron scale, which can contribute to enhance our mechanistic understanding of SOM stabilization processes.

Keywords: soil organic matter, aggregate, poorly-crystalline minerals, Andisols, scanning transmission X-ray microscopy