

Does mineral surface chemistry influence soil organic matter properties?

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Interest in the influence of mineral chemistry on soil organic matter cycling has been steadily growing, with the role of iron and aluminum oxyhydroxide phases garnering a great deal of attention. Empirical evidence from both lab and field based studies suggest that the interactions of oxyhydroxide and colloidal mineral phases are unique from the interactions of the soil mineral matrix as a whole and may have a disproportionate influence on soil organic matter. However observations of naturally formed soils have yet to identify or define a consistent difference between interaction of soil organic matter with less crystalline oxyhydroxides and more crystalline phases. To explore the influence of mineral surface chemistry on soil organic matter properties, a suite of soils was subjected to selective dissolution, quantitative mineralogical analysis, and organic matter characterization. Stability of organic matter associated with different mineral types was estimated through radiocarbon abundance measurements. Selective dissolution data indicated that colloidal organo-mineral complexes comprise a significant pool of soil organic matter which cycles on a shorter-term basis across a variety of ecosystems types, while surface sorption, even on crystalline phases, confers a greater stability to the sorbed organics. Sequential density separation combined with x-ray diffraction imply concentration and long-term preservation of N-rich organics on Fe-bearing crystalline mineral surfaces, with Fe-bearing phases also conferring the greatest stability to associated organics in the majority of cases. Our results explore the unique and multifaceted roles of the mineral matrix in regulating organic matter transformation and preservation in a range of soil types.