Iron-ing out the details of soil organic matter cycling: The unique role of Fe-bearing minerals in regulating organic matter transformation in soils

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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 specifically garnering a great deal of attention. Empirical evidence from both lab and field based studies suggest that the interactions of Fe-bearing minerals and colloidal Fe species are unique from the interactions of the soil mineral matrix as a whole and may have a disproportionate influence on soil organic matter. We present results from a suite of studies examining Fe-organic matter interactions which utilize a broad range of technical approaches and highlight the use of radiocarbon analysis in terrestrial carbon cycle studies. Data suggests that interaction of organics with Fe-bearing moieties induces consistent partitioning of organics between dissolved and surface bound organic matter pools, including significant consequences for N and P availability and biodegradability of soil organic matter. Selective dissolution techniques have revealed that Fe-humus complexes comprise a significant pool of soil organic matter which cycles on a shorter-term basis across a variety of ecosystems types, while sequential density separation combined with x-ray diffraction imply concentration and long-term preservation of N-rich organics on Fe-bearing crystalline mineral surfaces. Our results explore the unique and multifaceted roles of Fe in regulating organic matter transformation and preservation in a range of soil types.