Sorption Temperature and the Stability of Iron-Bound Soil Organic Matter

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Iron oxide surfaces can preserve soil organic matter (SOM) through the formation of organo-mineral associations (OMAs). We hypothesized that climatic changes, like warming, can affect SOM dynamics by altering the formation and stability of OMAs. To test these hypotheses, we measured equilibrium sorption of soil humic and fulvic acids to hematite at experimental temperatures of 15, 20, 25, 30, and 35°C. The stability of OMAs formed at each temperature was then assessed using laboratory incubations and thermal analysis. Isotopic depletion consistent with selective sorption of lignin- and lipid-derived carbon from humic acid during adsorption was observed, but the fractionation was not temperature-dependent. No fractionation was observed during the adsorption of fulvic acid. The 45-day microbial incubation experiment showed that the percentage of potentially mineralizable carbon (Co) was generally <2% for fulvic acid and <1 % for humic acid, suggesting a high degree of carbon stabilization by OMAs. The biological decomposition rate constant (k) were similar for humic and fulvic acids. No relationships were found between Co or k and sorption temperature to suggest sorption temperature affected the biological stability of OMAs. Analysis of the thermal stability experiments is ongoing. Our initial findings suggest that sorption temperature may not affect the biological or thermal stability of iron oxide OMAs.