Reactions of soil organic matter with iron and iron-oxides on its sorption, transport and degradation

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Climate change is expected to have significant impact on the rate and extent of soil organic matter (SOM) degradation, releasing greenhouse gases over the sensitive permafrost of the Arctic. However, the extent to which molecular-scale interactions between SOM and minerals (e.g. OM-iron complexation) control the partitioning, stabilization, and respiration of SOM remains unclear. SOM is a complex mixture of polyfunctional organic compounds with varying pK_a values, redox potenitals, aromaticities, and functional groups. Laboratory studies indicate that these organic compounds exhibit varying reactivities with iron and iron oxide minerals, resulting in sorption-desorption hysteresis, preferential transport and preservation over time. These findings have important implications to the availability and functionality of different carbon pools influencing microbial degradation of SOM at the Barrow Environmental Observatory, Alaska, where dissolved organic matter and ferrous iron are the dominant ionic species in the active layer soil pore-water. We employ advanced analytical techniques, including X-ray absorption spectroscopy and high-resolution mass spectrometry, to characterize SOM and its interactions with minerals. Results of these investigations provide better understanding on microbial degradation of SOM and may thus lead to improved computational models in predicting feedbacks to climate warming.