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Coupled iron cycling and organic matter transformation across redox interfaces

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A large fraction of organic matter (OM) in soils and sediments is associated with minerals to form mineral-OM associations (MOAs), which is known to decelerate OM decomposition because of protection against microbial use. However, redox cycling of Fe minerals represents an important mechanism to transform OM, yet specific pathways of coupled Fe redox cycling and OM transformation are only partly understood. In this talk, we focus on processes and mechanisms of coupled iron-carbon (Fe-C) cycles [1]. Specifically, oxygenation of structural Fe(II) in minerals generates reactive oxygen species (ROS), which directly transform OM [2-4]. ROS also affect extracellular enzyme activity and decomposing microbial activity, thus indirectly transforming OM [5-6]. Fe(III) reduction contributes to OM oxidation through anaerobic respiration. OM plays an important role in Fe redox cycling by serving as electron donor, acceptor, shuttle, buffer, and conductor, as well as via adsorption/coprecipitation with Fe minerals and complexation with Fe [1]. Coupled Fe-C redox cycles have major implications for greenhouse gas emission, biogeochemical cycles of elements, soil fertility and food security, biodiversity and ecosystem functions, and environmental behavior of contaminants.

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