How does the redox reactivity of iron minerals affect carbon mineralization in floodplains?

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Floodplains are active sites for transport, transformation, and storage of carbon and therefore play a critical role in the carbon cycle. Under oxygen-limited conditions, organic matter mineralization is often coupled to reduction of ferric iron in minerals. The reactivity of these minerals toward accepting electrons from the microbial oxidation of organic carbon potentially limits the extent of organic matter mineralization.

Here, we discuss effects of iron mineral reactivity on carbon mineralization in the East River floodplain in Colorado, U.S.A. We examined soils from three sites that differ in redox conditions: a permanently saturated oxbow pond, a fine-grained river meander, and a coarse-grained river meander. To characterize the reactivity of iron minerals in the soils, we used a mediated electrochemical approach that has previously been used on synthetic iron oxides. We combined this approach with X-ray diffraction for mineral phase identification and X-ray fluorescence for element analysis. Anoxic soil incubations showed that iron mineral reactivity decreased over time and along soil depth; the decrease was accompanied by a parallel decrease in carbon dioxide production. Organic matter mineralization in the incubations was therefore likely limited by decreased redox reactivity of the iron minerals.