# Temperature and redox effects on iron reduction kinetics and organic carbon transport in wetland soils

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Wetlands cover less than 10% of Earth's land surface area, but contain about one third of the planet's soil carbon (C). The residence times of water through wetlands influence their redox conditions and thus biogeochemical reaction rates and the supply and removal of C and nutrients. In these environments, transformation and movement of C and iron (Fe) are closely linked due to the sequestration of organic C by solid Fe(III) phases. We investigated how temperature influences microbial Fe(III) reduction kinetics and the consequences on the mobilization and retention of dissolved organic carbon (DOC) in subalpine wetland soils.

We studied a slope wetland and a depressional wetland (USDA Fraser Experimental Forest, CO, USA) that each provides a redox gradient from constantly reducing soils to soils undergoing redox fluctuations. We investigated the effects of temperature on potential Fe(III) reduction rates and DOC release rates, as well as on the kinetics of Fe(III) reduction (maximum rate, $R_{max}$, and affinity constant, $K_m$) in soils from different depths using flow-through reactor experiments run with synthetic porewater and at three temperatures (6, 12, and 18°C) mimicking field conditions.

We showed that the potential for Fe(III) reduction and Fe(III) reduction kinetics in subalpine wetland soils varied with wetland type, soil depth and with location along the redox gradient. $R_{max}$ values ranged from 23.7 to 449.4 nmol $cm^3$ $h^{-1}$, with the highest values observed for the highest temperatures ($Q_{10}$ of 1.1-2.6), the constantly reducing soils, and the more C-rich, shallower soil depths. $K_m$ values ranged from 0.3 to 3.7 mM and indicated a higher affinity for Fe(III) at ~12°C, which corresponds to the mean annual soil temperature. In addition, our results showed a positive correlation between Fe(III) reduction rates and DOC release rates, both for Fe supplied to the soil as Fe-NTA, and for autochthonous Fe-oxides. Such findings suggest there is a local adaptation of microbial kinetics to temperature and that soil warming could lead to decreasing water quality in subalpine wetlands, as a result of increased Fe(III) reduction-mediated DOC release.