From lab to field: Multi-scale spatiotemporal redox dynamics of geochemical phases

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In aquatic systems, redoxclines form at the boundary between oxic surface waters and anoxic bottom waters. They exhibit strong vertical gradients in redox potential and speciation of dissolved substances as well as in microbial diversity and ecosystem functioning. Redoxclines may move across aquatic-terrestrial or benthic-pelagic interfaces, and hence affect the redox state of both solid and dissolved phases. Over the last few years, several studies highlighted the importance of particulate (solid) geochemical phases in soils and sediments including iron and manganese bearing minerals and natural organic matter [1].

In this contribution, we briefly explore how recent results obtained in lab-based studies on redox-active solid phases can be used to advance understanding of redox dynamics in aquatic systems. Those dynamics can be diverse: e.g., diurnal to seasonal shifts in pelagic oxygen availability in lakes and water-level changes in wetlands result in redoxcline oscillations across wide temporal and spatial scales. Using several examples, we will show that solid phases react readily on these changes in redox conditions. The phases participate in microbially mediated as well as abiotic electron transfer reactions and can hence control the chemical speciation, bioavailability, toxicity, and mobility of both natural and anthropogenic compounds. Implications of electron transfer to and from solid phases in sediments for oxygen regimes in aquatic systems, carbon cycling and greenhouse gas emissions will be discussed.

[1] Lau MP, Sander M, Gelbrecht J, Hupfer M (2015), *Biogeochemistry* **123** (1-2), 49-61.