The Effect of Transport Heterogeneity on Redox Reaction Rates at the Pore and Continuum Scale

Objectives
• To evaluate the effects of subgrid heterogeneity on the modeling of redox reactions in natural materials with complex pore structures.

Approach and Results
• A micromodel, representing a numerical grid in a continuum model, was fabricated in EMSL with pore features similar to natural porous media.
• Pore surfaces were coated with Fe(III) oxide, a common electron acceptor for biogeochemical reactions.
• A biogenic reactant (flavin) was run through the system and spatially distributed reaction progress over time was followed by optical measurements and spectroscopy.
• Complex reaction patterns and spatially variable kinetic rates were observed that were controlled by the distribution of advective and diffusive transport pathways.

Significance and Impact
• Results supported the development of a general, domain-based scaling approach to predict redox reaction rates in heterogeneous natural porous materials over a large range in spatial scales.