Role of Microenvironments and Transition Zones in Subsurface Reactive Contaminant Transport: The PNRL SFA


CONCEPT

The PNRL SFA will significantly advance understanding of microscale and macroscopic systems that control contaminant transport (e.g., coupled geochemical, biological, and transport processes) at the pore and grain scale. Experimental and theoretical investigations of coupled geochemical, biological, and transport processes that occur at different or overlapping scales will be conducted in these systems. Microenvironments are submicron to meter scale domains that exert significant influence on and are fundamentally shaped by biogeochemical processes. The research program is supported by collaboration between researchers at the Pacific Northwest National Laboratory (PNL), Idaho National Laboratory (INL), and University of Wisconsin (UW) scientists to address fundamental and applied research of coupled geochemical, biological, and transport processes at the pore and grain scale. Research is conducted by collaborative teams of PNNL and University of Wisconsin investigators. The research will be informed by collaborative efforts to improve models and methods for understanding the coupled processes that occur at different spatial scales and the complex functioning of the unconfined aquifer system. Findings will have relevance to site-specific sites and provide a scientific basis for site-specific and site-independent predictive models and decision making.

EMPHASIS

- Holistic-inspired sub-surface science issues with biogeochemical implications
- High-throughput (HT) and artificial intelligence (AI) methods to create complex biogeochemical and significant insights (HTS and HT-AI methods)
- River systems and wetlands complex biogeochemistry and significant year (HTS and HT-AI methods)
- River systems and wetlands complex biogeochemistry and significant year (HTS and HT-AI methods)
- River systems and wetlands complex biogeochemistry and significant year (HTS and HT-AI methods)
- River systems and wetlands complex biogeochemistry and significant year (HTS and HT-AI methods)

SCIENCE THEME 1: BIOGEOCHEMICAL ELECTRON TRANSFER REACTIONS

Scope and Research Examples:

- Microbial community structure
- Electronic properties
- Electron transport
- Microbial community structure
- Electronic properties
- Electron transport

SCIENCE THEME 2: FOR SCALE REACTIVE TRANSPORT AND UPSCALING

Scope and Research Examples:

- Experimental and theoretical investigations of coupled geochemical, biological, and transport processes at the pore and grain scale
- Microorganisms and their interactions with redox-active mineral surfaces
- Microorganisms and their interactions with redox-active mineral surfaces
- Microorganisms and their interactions with redox-active mineral surfaces

SCIENCE THEME 3: BIOGEOCHEMICAL/MICROBIAL COMMUNITY SPATIAL & TEMPORAL DYNAMICS

Scope and Research Examples:

- Microbial community structure
- Electronic properties
- Electron transport
- Microbial community structure
- Electronic properties
- Electron transport

ACKNOWLEDGEMENTS

Research performed through PNNL’s Scientific Focus Area (SFA) is supported by DOE Office of Science, Office of Biological and Environmental Research (BER), Climate and Environmental Sciences Division (CESD).