Building Robust LCSM for Remediation Decision-Making: Next-Generation Tools

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Objectives: We will present an LNAPL-Conceptual Site Model (LCSM) in development that integrates microbial community traits and degradative capacity with quantification of compositional weathering, cumulative degradation rates, LNAPL mobility, and vertical and horizontal gradients in overburden and bedrock facies.

Advanced Analytical and Machine Learning Approach: the LCSM integrates multiple advanced techniques, including unsupervised learning, to interpret generated datasets:

- Natural Source Zone Depletion Rates: calculated using soil gas gradients.
- LNAPL Compositional Change and Cumulative LNAPL Mass Loss: use of high-resolution GC-MS compositional analysis with Principal Component Analysis to identify patterns and extent of weathering. We will share how we estimated Cumulative LNAPL Mass Loss when no single compound could serve as a biomarker.
- Probing PHC biodegradation: Coupling Compound-Specific Isotope Analysis (CSIA) with microbial community composition and functional potential to support a mechanistic understanding of the observed changes in PHC composition.
- Transmissivity Testing: used to identify those hydrogeological units from which hydraulic LNAPL recovery may be viable.

Results/Lessons Learned. This multi-faceted approach identified data gaps and the LCSM development has been iterative. We will discuss how we are applying the LCSM to inform exposure control (seep management) and evaluation of remedial alternatives. We will share lessons learned and highlight the value of high-resolution methods in advancing LCSM practice.

This presentation expands on a RemTech 2021 talk (E. Haack presented) focused on the compositional analysis approach within LCSM. We now can demonstrate (local) field application and benefits of compositional analysis in LCSM development.

Paul Furbacher

Paul Furbacher, Ph.D., is an Environmental Consultant with Ecometrix, located in Mississauga, Ontario. Paul's professional experience and research work have focused on applying high-resolution analytical tools to demonstrate the progression of PHC degradation during remediation (e.g, biodegradation and chemical oxidation). Together, Ecometrix, AECOM, and the University of Guelph demonstrate leadership in implementing innovative new approaches and technologies for contaminated site remediation, and in evaluating how these approaches might benefit industry.