Evaluation of FLUTe FACTTM as a Screening Tool for Vertical Distribution of Contaminant Mass Flux in Fractured Rock Boreholes

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Abstract

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Contaminant delineation in fractured bedrock boreholes is a data intensive and expensive endeavor due to strong heterogeneity in both fracture and matrix properties. In porous fractured rock, groundwater flow occurs primarily in the interconnected fractures, while solute transport occurs due to advection in fractures, but also due to diffusion into and out of the low permeability rock matrix, where sorption also occurs. Contaminant concentration profiles derived from high-resolution rock core sampling is the most rigorous measure of contaminant distribution in fractured rock. This project evaluates a new borehole technology, referred to as the FLUTe FACT™ (FLUTe Activated Carbon Technique) for mapping the contaminant distribution, comprised of a continuous strip of activated carbon felt embedded in a NAPL sensitive cover, deployed on the outside of a blank FLUTe™ liner and pressed against the borehole wall as the liner seals the borehole. The FACT™ wicks contaminants by diffusion from the rock matrix and from groundwater flow in fractures and sorbs the contaminants to the carbon strip. The FACT™ is removed after a deployment period of days to a few weeks, depending on levels of groundwater contamination expected, and subsampled in 0.5 to 2.5 ft lengths to create a vertical profile of time-integrated flux-based concentrations. This project seeks to evaluate the FACT™ technology in multiple hydrogeologic settings to determine its effectiveness as both a screening level tool and to evaluate whether it can also be used to quantify the vertical distribution of mass flux in bedrock boreholes. Performance assessment will be conducted at sites with varying hydrogeologic properties and contaminant conditions to assess how the results are affected by natural flow system and borehole conditions. Laboratory analyses will be completed to assess the uptake and extraction capabilities of the activated carbon material to determine the consistency at which the FACT™ provides quantitative contaminant mass concentrations. If the FACT™ results are shown to provide a reliable measure of in-situ contaminant mass flux distributions, this tool can be used to improve the quality and cost-effectiveness of site characterization needed to inform conceptual site models for risk-assessment and remediation performance.