High Resolution Site Characterization for Bioremediation in Fractured Rock

Nathan Thacker (nthacker@astenv.com) (AST Environmental, Inc., Harrisonburg, VA, USA)
Bill Brab (bbrab@astenv.com) (AST Environmental, Inc., Midway, KY, USA)

Background/Objectives. Achieving remediation goals in fractured rock settings requires the application of specific techniques to accurately define the conceptual site model (CSM) and utilization of advanced tooling to place reagents in the appropriate fracture zones. This presentation will describe how to characterize a fractured bedrock site succinctly and successfully with the intention to design and inject pertinent reactants utilizing high-capacity pumps and narrow-interval straddle packers. The main difference between this approach and conventional bedrock characterization and injection is the deployment of multiple methods to evaluate lines of evidence during investigation; this process is not reliant on few techniques or tools to render a subsurface model and/or design.

Approach/Activities. These diverse practices include both conventional and novel means to evaluate the site geology, which includes noninvasive surface and borehole geophysical methods and intrusive geological and aquifer characterization procedures (i.e., lithology and hydrogeology). The characterization of the fractured rock consists of identification of fractures/weathered zones within the fractured rock using high resolution tools and techniques such as two-dimensional electrical resistivity imaging survey (2-D ERI), borehole geophysical logging to delineate the vertical extent, orientation, and aperture size of the bedding planes and fractures, downhole camera, and discrete groundwater sampling from identified fractures/bedding planes using small interval straddle packer assembly. Quantification of total mass and spatial location of the contamination is crucial in the precise delivery of the selected remedial technology and in return, achieving site remediation goals.

Results/Lessons Learned. The intention and planning throughout the investigation is to develop a remediation program with significantly increased distribution (radius of influence [ROI] can underserve the injection program and performance within the formation) via fractures, features, discontinuities, secondary porosities, and other subsurface pathways that are either typically under-characterized or overlooked for injection operations. By overlaying these unique data sets, representations, and video of geology and subsurface contaminant conditions (sorbed contaminant mass and mass flux), environmental practitioners can move forward in confidence with a BCIP injection design that uses actionable data. The design is therefore practical, efficient, and effective – completed in one mobilization or several sequenced events.