A combined near-surface geophysical approach to delineate hydrostratigraphic boundaries in a fractured aquifer in the Laramie Range, Wyoming.

Brady A. Flinchum, W. Steven Holbrook, Dario Grana, James St. Clair, and Bradley Carr

Understanding how groundwater is transported and stored in fractured environments using traditional hydrologic measurements presents a unique challenge because groundwater is channeled into narrow zones that are difficult to detect and characterize. Non-invasive geophysical methods provide a way to image the subsurface over large spatial scales, providing the necessary insight to guide more traditional hydrologic investigations in fractured systems. We collected approximately 3.3 line kilometers of electrical resistivity and seismic refraction data, plus three nuclear magnetic resonance (NMR) soundings, in a small catchment located in the Laramie Range, WY. Using a Bayesian inversion based on fundamental rock physics equations we estimate porosity from seismic velocities, then identify areas of saturation using the resistivity values. Using geostatistics we generate a three-dimensional model of porosity and resistivity over the entire catchment. The data show that porosity decreases rapidly beneath the valley but porosity remains higher beneath the ridge. The resistivity volume shows a possible groundwater connection from the stream through the highly porous ridge into an adjacent valley. The hydrostratigraphic insights from geophysical data are being used to strategically place traditional hydrological measurements to quantify groundwater flow within this small catchment.