HIGH-RESOLUTION GEOPHYSICAL CHARACTERIZATION OF THE GRANITE GRAVEL AQUIFER OF BURNET COUNTY TEXAS

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Hydrogeologists regularly incorporate geophysical methods into aquifer-delineation studies because of their sensitivities to the electrical and mechanical contrasts between different pore fluids and hydro-stratigraphic layers. In most practical situations, useful interpretations of the geophysical data are only possible when several different techniques are used, because one or more techniques are typically required to resolve missing information from one or more of the others. A multi-method geophysical approach to aquifer delineation is demonstrated in this work by a high-resolution survey of the unconfined, weathered Granite-Gravel aquifer in southwest Burnet County, Texas. The following observations were made within a 100 m time-domain electromagnetic (EM) induction loop: (1) EM sounding data show strong electrical contrast between the aquifer and granite bedrock but indistinguishable contrast between the unsaturated and saturated aquifer, allowing for the delineation of the bedrock depth but not the water-table depth; (2) seismic refraction tomograms show strong mechanical contrast between the aquifer and the bedrock but indistinguishable contrast between the unsaturated and saturated aquifer, also allowing for delineation of the bedrock depth but not the water-table depth; (3) bedrock surface picks from seismic refraction tomograms aid in interpretation of self-potential (SP) data measured on a 5 m grid, which are correlated to the surface topography and inversely correlated to bedrock topography, respectively, yet misleading with respect to groundwater flow directions without seismic refraction data; and (4) electric resistivity tomograms aid in the interpretation of seismic refraction tomograms as well as flow directions interpreted from SP data but are incapable of distinguishing bedrock depths or flow directions in isolation. Collectively, the variety of geophysical methods incorporated into this study provides a more reliable delineation of the Granite-Gravel aquifer using the full geophysical data set as compared to using any one method alone, which is confirmed by drillers' logs from an on-site well.