CNC - SNC

Groupe de recherche interuniversitaire sur les eaux souterraines

Réseau québécois sur les eaux souterraines

SÉRIE DE CONFÉRENCES EN HYDROGÉOLOGIE

2 AVRIL 2014, 12H15

High-resolution Characterization of Hydraulic Conductivity Using Direct-Push Tools

GEOFFREY C. BOHLING, **Associate Scientist in the Geohydrology Section of the Kansas Geological Survey, a research division of the University of Kansas**

Abstract

Spatial variations in hydraulic conductivity (K) provide critical controls on solute transport in the subsurface. Direct-push tools have been developed for high-resolution characterization of K variations in unconsolidated settings. The direct-push injection logger (DPIL) provides an indicator (flux/pressure, Q/P) of relative variations in K at a very high vertical resolution. The more recently developed HRK (High-Resolution K) tool combines the DPIL with a direct-push permeameter (DPP), providing a means to transform the DPIL Q/P profiles into high-resolution K profiles. These tools were applied to obtain 58 K profiles with a vertical sample spacing of 1.5 cm from the heavily studied macrodispersion experiment (MADE) site. We have compared the data from these 58 profiles with those from the 67 flowmeter profiles that have served as the primary basis for characterizing the heterogeneous aquifer at the site. Overall, the patterns of variation displayed by the two data sets are quite similar, in terms of both large-scale structure and autocorrelation characteristics, although the two datasets exhibit distinct differences in geometric mean K and lnK variance.

The DPIL calibration approach used in the foregoing work has some drawbacks. There is an upper limit on accurate Q/P values due to a lower limit on measureable DPIL pressure responses in high-K zones. Our previous DPIL calibration approach assumed a linear relationship between lnK and ln(Q/P); consequently, the Q/P limit was translated into an upper threshold on accurate DPIL-based K estimates. Current work aims to improve the calibration by incorporating an adaptive, nonlinear ln(Q/P) vs. lnK relationship into the inversion process, allowing the estimated K profiles to more accurately reflect the very high K's indicated by some of the DPP tests.

Authors: Geoffrey C. Bohling, Gaisheng Liu, James J. Butler, Jr., Steven J. Knobbe, and Edward C. Reboulet

Biography

Geoff Bohling is an Associate Scientist in the Geohydrology Section of the Kansas Geological Survey, a research division of the University of Kansas. His work focuses on statistical and geostatistical subsurface characterization and inverse problems. His research projects have included aquifer characterization with hydraulic tomography, statistical modeling and geostatistical analysis of data from a giant gas field in southwest Kansas, development of software for interactive instruction in interpretation of petrophysical well logs, geostatistical analysis of high-resolution direct-push hydraulic data from the MADE Site alluvial aquifer, and development of geostatistical procedures for building 3D aquifer property models from drillers' logs. Bohling earned a B.A. in English and a B.S. in Physics-Geophysics from the University of Kansas, an M.S. in Geology from the University of Wisconsin-Madison, and a Ph.D. in Geology from the University of Kansas, with the latter two degrees focused on hydrogeology. Prior to taking his current position in the Geohydrology Section, Bohling worked for 15 years in the Kansas Geological Survey's Mathematical Geology Section, participating in a wide variety of projects involving statistical and mathematical analysis of earth science data.