

Hydraulic Testing in Low Permeability Rock: Method for Tests Conducted using Westbay Multilevel Systems and Analysis with nSIGHTS Software

Christopher A. Morgan

Nuclear Waste Management Organization

Summary

Obtaining accurate estimates of hydraulic properties for low-permeability rock is crucial for numerous hydrogeological applications including aquifer vulnerability studies, gas storage projects, caprock integrity studies, and long-term storage of radioactive waste. Traditional testing and data analysis methods, including core plug analysis and straddle packer testing, have limitations that can adversely affect hydraulic property estimates. Without proper consideration, such limitations can result in uncertainty regarding the confining capabilities of low-permeability rocks.

Results from a recent study by the Nuclear Waste Management Organization (NWMO) at a field site in northwestern Ontario show that hydraulic testing in granodiorite-tonalite, a low permeability ($< 10^{-4}$ mD or 10^{-12} m/s) crystalline rock, can be successfully conducted using Westbay Multilevel systems installed in deep boreholes (1000 m). Numerical modelling of the test data using nSIGHTS, a commercially available well test software, provided improved estimates for a suite of hydraulic parameters (hydraulic conductivity, specific storage, flow dimension) and enabled uncertainty analysis for the estimated parameters. Results from the study show that challenges with conventional testing and analysis in low permeability rock, including estimation of test zone compressibility and static formation pressure, can be overcome with proper testing tools and analytical software choices.

Acknowledgments

This study was supported by several staff at the NWMO, including Erica Sykes, Kim Falkenstein, Adrian Kowalchuk, and Brayden Moore. Westbay Instruments provided technical contributions to support development of the field-testing workflow.