Geophysical Research Abstracts
Vol. 13, EGU2011-12440, 2011
EGU General Assembly 2011

Towards conceptual models of flow and transport for Irish hard-rock aquifers: a multidisciplinary approach.

Rachel Cassidy, Jean-Christophe Comte, Janka Nitsche, Katarina Pilatova, Raymond Flynn, and Ulrich Ofterdinger

Queen's University Belfast, School of Planning Architecture and Civil Engineering, Belfast, United Kingdom (rachel.cassidy@qub.ac.uk)

Conceptual modelling of hard rock aquifer systems is dependent upon an understanding of the geological heterogeneity of the bedrock. The complexity of structure, controlling both flow and transport properties, means that any interpretation of hydraulic or hydrochemical data must be based on a comprehensive knowledge of the structure of the aquifer, both laterally and with depth. Although providing accurate information at point locations in an aquifer, traditional borehole (hydraulic, geophysical or hydrochemical) investigations are often insufficient to account for the 3D variability in fractured rock. Both surface and airborne geophysics, however, have particular potential as the range of scales over which geophysical methods can be applied provides a means of identifying relevant structural features across the scale of the aquifer.

Much of the landmass of Ireland is underlain by igneous and metasedimentary rock in which groundwater movement is dominated by fracture flow. The uppermost weathered bedrock zone and overlying superficial cover in this region also exhibits significant spatial variability due to near-surface processes and deposition. Management and protection of these aquifers is required under the Water Framework Directive, yet there have been few studies to date and conceptual models have not been developed specifically for an Irish context.

As part of ongoing work which aims to address this, a multidisciplinary approach is applied to characterise a hard rock aquifer situated in the Silurian greywacke of NE Ireland. We develop an approach of 3D characterization integrating traditional borehole hydrogeological investigations with multiscale geophysical surveys. Borehole geophysics and multi-level hydraulic testing are applied at wells distributed across the site, providing high resolution data on structure with depth around the boreholes and indicating the bulk hydraulic parameters in the rock mass. Surface geophysical methodologies, including 2D and 3D electrical resistivity tomography, seismics and ground penetrating radar, are applied to characterise the structure of the aquifer, each providing complementary information on structure at different scales. EM and magnetic survey data from both fieldscale and airborne surveys are also incorporated; the latter indicating a number of dykes intersecting the study area. Results to date are revealing strong lithological variations associated with the folded turbidite successions, which vary from coarse sands to shales in composition. Large contrasts in the overburden thickness across the study area are also apparent with up to 30m of till cover in drumlins alternating with large areas of sparse cover and outcropping that are likely to significantly impact recharge to the aquifer. Such information is not indicated from borehole and outcrop studies alone and as such the refined integrated conceptual model provides a stronger basis for groundwater numerical modelling.