Geophysical Research Abstracts
Vol. 12, EGU2010-10908, 2010
EGU General Assembly 2010

Hydrochemical case study of the poorly productive Irish bedrock aquifer.

Katarina Pilatova and Ulrcih Ofterdinger

Queen's University Belfast, School of Planning Architecture and Civil Engineering, Groundwater Research Group, United Kingdom (kpilatova01@qub.ac.uk)

Poorly productive bedrock aquifers (PPBA) are characteristic of low porosity and small specific well yield. Not even they underlay a considerable area of Ireland (up to 70%) and worldwide, the heterogeneity of these low porosity aquifers with fractured dominated groundwater flow regime makes it increasingly important to comprehend the conceptual model of flow in such systems in order for further groundwater exploitation and being aware of preferential flow paths. Also, recent worldwide studies suggest noteworthy groundwater contribution towards stream flow and thus contradict an older rule of thumb perception of a simple mechanism of a storm runoff generation in upland PPBA catchments. This groundwater-surface water interaction requires further attention in order to meet the water quality targets set by EU Water Framework Directive. Given the significance of these bedrock aquifers, they are, particularly in Ireland, under-researched and groundwater flow is poorly constrained.

To investigate the groundwater flow and stream flow generation processes, a catchment (Gortinlieve, Co. Donegal, Ireland) was instrumented with nested and depth specific monitoring wells, targeting different fracture zones in schist bedrock and superficial deposit i.e. transition zone.

Major ion and trace element hydrochemistry is used to charcterise the flow processes in the fractured aquifer. Between June and September 2009 the groundwater chemistry as well as surface water chemistry was analysed during low flow and high flow conditions in order to determine groundwater contributions towards a streamflow.

Hydraulic heads in each well were monitored over the entire period, also additional data for rainfall and stream flow were collected. In terms of groundwater quality, the sampling program is carried out at the well locations on a quarterly basis. To gather further data to characterise the vertical distribution of hydrogeological parameters, pumping tests were completed within each nested well concomitant, with groundwater sampling and monitoring of in-situ water quality parameters also taking place.

The preliminary results suggest significant vertical groundwater stratification reflecting different residence times of groundwater masses. In addition, hydrochemical groundwater composition in some shallow and transition wells resemble the stream water composition. Hydrograph separation also confirmed a considerable role of groundwater in maintaining a stream flow during low flows and surprisingly during the storm flows as well.

The outcome from pumping, as far as physicochemical parameters are concerned, demonstrates the great variability in groundwater quality across the catchment as well as in the vertical profile. This reflects the heterogeneity in the bedrock aquifer and the different residence times due to variable fracturing across the whole area of each of the catchments.

Nevertheless, there is an apparent trend in physicochemical parameters that distinguishs the shallow groundwater from the deeper parts of the aquifer. The groundwater samples obtained from the deep wells are of significantly more mature composition with notably higher pH values, dissolved solids, alkalinity and with the absence of dissolved oxygen. This trend of stratification, as a result of significant mixing processes, is however, observed to be reversed in one particular cluster situated in the valley floor, at the vicinity of the stream. Further, tracer based approaches are required to successfully explain the mixing and recharge processes.