Geophysical Research Abstracts,
Vol. 11, EGU2009-3443, 2009
EGU General Assembly 2009

Flow dimensions in dolomite aquifers - correlations with lithological, geochemical and fracture network properties

T. Verbovšek

University of Ljubljana, Faculty of Natural Sciences and Engineering, Department of geology, Ljubljana, Slovenia (timotej.verbovsek@ntf.uni-lj.si, +386 1 4704 560)

Flow dimension, introduced in the Barker's GRF model (WRR 24(10), 1998), is an important parameter in the research of flow and transport in fractured rocks. It describes the flow geometry and can be viewed as a measure of the connectivity of the fractures. There exist very few studies of flow dimensions in carbonate aquifers, and to this date no systematical analyses of correlation with lithological or geochemical properties are known. By the reinterpretation of 72 pumping tests with the Barker's GRF model, extended for double-porosity effects, flow dimensions were calculated for different dolomite aquifers in Slovenia (results concerning the research of these dolomites are available at the URL address www.geo.ntf.uni-lj.si/tverbovsek/bibliografija.html). Flow dimensions were consequently compared to the hydraulic conductivities, to the modeled quantities of major dissolved minerals in the ground water and to the fractal dimensions of the fracture networks. The average value of flow dimensions is 2.16 for all dolomites, representing radial flow tending toward spherical. Flow dimension is distributed normally by Kolmogorov–Smirnov test. The bulk of observations (76 %) is larger than 2.00 and only 8 % of observations support the approximate radial flow. A study of flow dimensions in aquifers separated by their lithological properties and age shows that higher dimensions occur in massive Cordevolian and Anisian dolomites compared with bedded Main, Bača and especially Lower Triassic dolomites, which contain a greater proportion of non-carbonate minerals. Partially penetrating wells exhibit higher flow dimensions than the fully penetrating wells and the differences are statistically significant. Differences also exist between the massive and bedded aquifers, with higher values of flow dimensions in the massive rocks, although the majority of the latter belong to the same aquifer. Flow dimensions are poorly correlated to hydraulic conductivities of fractures. Some correlations were found when comparing flow dimensions with modeled quantities of dissolved dolomite, which were calculated by a simple inverse modeling. The Cordevolian and Anisian dolomites exhibit the highest values of both dissolved dolomite and flow dimension, indicating a greater dissolution at higher flow dimensions. For other aquifers, data points are more scattered and the correlations are mostly poor. Finally, flow dimensions were compared to the fractal dimensions of the fracture networks. The latter were analyzed by a box-counting technique in two dimensions and the obtained values have been extrapolated to three dimensions. There is no correlation between these dimensions, as the latter are remarkably independent of rock type, with an average value of D = 2.77. However, almost all the values of flow dimensions are lower than the corresponding fractal dimensions, indicating the channeling of flow within the available space of the fracture networks and consequently reducing the flow dimensions.