Geophysical Research Abstracts
Vol. 21, EGU2019-13233, 2019
EGU General Assembly 2019

Developing Geological Parameters for a 3D Reservoir Model of a Fractured and Faulted Karstic Aquifer

Mariella Penz-Wolfmayr, Leon Antretter, Helene Bauer, and Kurt Decker
Department od Geodynamics and Sedimentology, University of Vienna, Austria

Most of the drinking water supply for the city of Vienna derives from fractured and faulted karstified aquifers in the Northern Calcareous Alps. The catchment area for some of the most important tapped springs, the massif of the Zeller Staritzen, has been selected as a study to develop a 3D reservoir model that should serve as a basis for further hydrogeological modelling. The model includes the following basic geological and hydrogeological parameters:

(1) A spatial model of rock units with different hydrogeological properties. Volumes are constructed from GIS-based geological data and cross sections grouping lithostratigraphic units with similar properties. The model discerns between dolomite of the Triassic Wetterstein Fm. (reef and lagoon), limestone of this formation, limestones of other lithostratigraphic units, and marl formations forming aquicludes. Volume construction uses 3D Move software.

(2) 3D fault surfaces derived from detailed structural mapping. Faults are classified according to fault-zone architecture and rock content, which is different for dolostone and limestone. Four types of faults are discerned: faults with single-stranded minor fault cores, faults with single-stranded permeable fault cores, and faults with multiple-stranded fault cores are seen as conduits. Faults with single-stranded impermeable fault cores are seen as conduit-barrier systems. On a regional scale, faults have to be viewed as forming a network of flow conduits directing recharge more or less rapidly towards the water table and the springs.

(3) Porosity and permeability data from the different lithostratigraphic units derived from benchtop measurements and in-situ tests. Representative data were collected from carbonates with different fracture densities. On a small scale, porosities of all samples were first measured with the immersion method delivering average porosities from almost 4 % for Wetterstein dolostone indicating a standard deviation of 1.5, 2.2 % for Wetterstein limestone indicating a standard deviation of 1.3 and around 1 % for other limestone formations showing various standard deviations. Subsequently benchtop mesurements were carried out to evaluate porosities and permeabilities. Also reduction of porosity/permeability of the rock mass under the plateau below the massif was determined by increasing confining pressure up to 6500 psi. Measurements show that the effect of increasing normal stress leads to a very significant reduction of pore volume and therefore permeability to about 30 – 40 % compared to surface values. In-situ, newly developed injection tests followed to generate permeability values on a larger scale. The in-situ derived values where partially validated by the results of the benchtop measurements for hardly fractured fault rocks, or larger for intensly and extremely fractured rocks of the damage zone. Permeabilities for Wetterstein dolostone range from 0.1 to many hundreds mD, limestone permeabilities from less than 0.01 up to 100 mD.