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HYH-07 Groundwater flow and water?rock interaction in compact fractured rocks: Storage of nuclear waste, field evidence and mathematical models

Distribution of hydraulic conductivity in fractured compact granite defined by hydraulic tests and geophysical logging

Lenka Rukavickova, *Czech geological survey (Czech Republic)*
Jiri Lukes, *Aquatest a.s. (Czech Republic)*

Hydraulic properties of granites were investigated in the Bohemian massif, Czech Republic. Closely spaced drillings penetrated three types of granite to a maximum depth of 350 m.Hydraulic conductivity was low and it decreased with depth. The decrease was not linear. Hydraulic properties were constant in granite blocks of the size of several tenths of meters. A distinct boundary, where the hydraulic conductivity changes, is the bottom of the surface zone of disintegration. The boundary occurs at a depth of 100 to 150 m. The hydraulic conductivity decreases here abruptly by at least one order of magnitude. A large heterogeneity of the fractured granites is manifested by a wide range of determined coefficients of hydraulic conductivity from 10-11 to 10-5 m.s-1. The highest conductivities were determined in sections of drill holes with a single opened fracture. Fluid-resistivity logging indicated the exact positions of the conductive fractures. The fractures had mostly sub-horizontal position.

They conducted water between drill holes situated several tens meters apart.The correlations between number of fractures and hydraulic conductivities are different in granites with the conductivities higher respectively lower than 10-8 m. s-1. The correlation between the two parameters is positive and sometimes it is statistically insignificant in granites with the conductivity below 10-8 m. s-1. The correlation is negative in the sections with the conductivity above 10-8 m. s-1. The less fractures are in the sections, the higher probability is that there is present a single fracture with high conductivity. Most of the tested fracture zones were sealed with secondary minerals. The hydraulic properties of the sealed fracture zones were similar to the properties of the compact unbroken granite.The hydraulic conductivity is significantly different at comparable depth levels depending on the type of granite.

The hydraulic conductivity of the "Melechov" granite is one to two orders of magnitude higher and the density of fractures is twice or three times lower that in other types of tested granites. While the surface

geological and geophysical data obtained in the "Melechov" granite indicated an unbroken, homogenous rock, the hydrological testing in the drill holes found a rock with increased hydraulic conductivity. Continuous fluid resistivity logging determined a very slow vertical flow of ground water in the drill holes in hydraulically undisturbed state.

The logging precisely indicated points of inflow and outflow of ground water to and from the drill holes. The temporal shifts in the resistance profiles indicate piezometric heads and hydraulic conductivities of individual fractures. The evaluation of the shifts of the fluid-resistivity logs in half a year intervals showed that the flow capacity in the drill holes decreased with depth from 3.1 L.day-1 at depth around 100 m to 0.2 L.day-1 at depth of 330 m.

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