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Hydraulic properties of fractured crystalline rocks with internal fault zones: examples from the Upper and Lower Austro-Alpine (Austria)

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The hydraulic properties of fractured aquifers and the hydrogeological assessment of rock mass are significantly influenced by the hydraulic properties of faults and fault zones within the rock mass. Fault zones can be a water barrier, a preferred zone for water flow or a combined system of both. For hydrogeological investigations of fault zones in crystalline rocks we chose the Semmering area in the Eastern Alps (Austria). The area includes crystalline rocks of the Grauwackenzone (Upper Austro-Alpine) and the Semmering-Wechsel complex (Lower Austro-Alpine) characterized by a complex tectonic structure with many fault zones. The lithological units show a contrasting deformational behaviour from brittle fault structure over different types of cataclasites to fault gouges. Hydraulic packer tests in open boreholes are a proper investigation method to quantify in situ the hydraulic properties of a lithological/tectonic unit at discrete borehole sections like fault zones or highly fractured sections. Within hydrogeological investigations numerous packer tests with interval lengths between 30 m to 130 m were processed in boreholes with a maximum depth of 300 m below surface. The percentage of the cataclasite within the test intervals ranges from 0 % up to 80%. The packer tests result hydraulic conductivities from 6,7E-05 m/s to 1,1E-10 m/s showing a slight decrease of hydraulic conductivity with increasing depth. Considering the percentage of the cataclasite there is marked a critical value about 15 % over which the hydraulic conductivity is constantly lower than 2E-07 m/s. The median hydraulic conductivities range between 9,2E-08 m/s and 1,2E-09 m/s. Additionally, oriented samples of a fault core were taken with steel pipes at an exposure to analyse

the samples with respect to the grain size distribution and hydraulic conductivity. The hydraulic conductivities were determined by the application of tri-axial cells in the laboratory resulting values between 1,7E-07 m/s and 4,2Ee-11 m/s being significant for low to very low hydraulic conductivity. The median hydraulic conductivity is app. 3E-08 m/s. The hydraulic conductivity depends on the muscovite content, the content of fine grained particles (clay fraction about 15 %) and the orientation of the samples. These results are in accordance to the packer tests considering that the taken samples represent only the hydraulic properties of a fault core and are representative for a different scale. Combining the data of the packer tests with the results of the exposure a slight decrease of hydraulic conductivity with increasing depth can be seen.