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An Attempt of Hydrogeological Classification of Fault Zones in Karst Areas

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Around 60% of Vienna‘s drinking water originates in the Hochschwab plateau (Eastern Alps, Austria). The hydrogeology (groundwater storage and flow) of the Hochschwab is essentially governed by karstified, large-scale faults. Previous work has shown that faults that formed during the Oligocene/L. Miocene lateral extrusion of the Eastern Alps act as groundwater pathways draining the karst massif preferably in E-W-direction. However, further analysis of flow processes in karstified aquifers requires hydrogeological relevant data from natural fault zones.
We investigated E- to ENE- striking strike-slip faults in limestones and dolomites of the Wetterstein Fm. in terms of potential permeability properties that result from structural composition and fault rock content. Using the standard fault core-damage zone model, we analyzed fault rock characteristics and volumes at the fault cores and connective fracture networks surrounding faults in the damage zones. Special attention has been drawn to fracture densities and the spatial extent of fracture networks. Small-scale fractures are generally assumed to carry most of the effective porosity and have a great influence on the permeability of a fault zone. Therefore, we established a classification scheme and measuring method that provides semi-quantitative estimates of the density and abundance of small-scale fractures by using scanning line techniques to quantify the total joint surface in a volume of rock (m^2 joint surfaces per m^3 rock). This easily applicable method allows to generate fracture density data for the entire damage zones (over tens of meters) and thus to enhance the understanding of permeability properties of damage zones. The field based data is supported by effective porosity and permeability measurements of fractured wall rock and fault rock samples. Different fault rock categories turned out to have complex poro/perm properties due to differences in grain sizes, matrix content, cementation and fracturing.
In summary, the volume of fault rocks seems to be a function of size and displacement of the faults. Fracture densities in damage zones shows gradual increase from fault zone margins towards fault cores and significant asymmetries. Highest fracture densities with nearly isotropic fracture networks are often located adjacent to the fault core boundary and seem to be depending again on fault size/displacement. More research has to be done, but the presented results provide a useful base for further applications in hydrogeological modelling.