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# Experimental and numerical investigations into the hydro-mechanical behaviour of a single fracture - a benchmark experiment

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The brittle upper crust contains discontinuities on various scales, from microcracks over macroscopic fractures to large faults. Especially in fractured tight rocks, fluid flow and storage is governed by the transport properties of discontinuities. To fully understand transport in fractured media the hydro-mechanical coupling between the pressure distribution within the fracture and the mechanical deformation of the surrounding rock mass has to be taken into account. The hydraulically effective fracture width controls fluid flow in fractures according to the cubic law. The effective fracture width in turn depends on the fracture's normal stiffness. Hence varying normal stress (e.g. by fluid injection) has a strong impact on fracture transport properties. In this study we performed oscillatory injection measurements on cylindrical granite samples containing a single fracture oriented perpendicularly to the cylinder axis. Due to its simple radially symmetric geometry the dataset serves as a benchmark to test and fit numerical simulations schemes. The numerical investigation of hydro-mechanical coupling, e.g. in the framework of poroelasticity, is limited to low aspect ratio conduits due to problems associated with discretization of the fluid domain. To investigate fractures with aspect ratios occurring in natural systems ($>10^4$) the hybrid-dimensional modelling approach was previously introduced, which reduces the fluid volume to one dimension, reducing computational cost. To document the sensitivity of results to details of the fracture geometry (in particular effective width) we performed all measurements at various effective stresses on three fractures with varying roughness at hydrostatic triaxial conditions. Effective hydraulic parameters were derived from the phase shift and amplitude ratio between the fluid pressure and the corresponding fluid flow. We tracked the mechanical deformation of the fracture with displacement transducers. Ultrasonic transmission measurements were simultaneously made to gain further insights into the interrelation between mechanical and hydraulic fracture properties. Intended as a benchmark the dataset will be made available to any interested colleague.