Contribution ID: **21** Type: **60s-Pitch + Scientific Poster**

Investigating Permeability Evolution in Shear, Tensile, and Saw-Cut Fractures under Injection-Induced Slip in Odenwald Granodiorite

Enhanced Geothermal Systems (EGS) rely on engineered fracture networks to facilitate fluid circulation and heat exchange in low-permeability, high-temperature rock formations. Unlike the conventional gel-proppant hydraulic fracturing techniques used in hydrocarbon extraction, many EGS projects employ hydraulic shear stimulation to enhance permeability. This method leverages the self-propping effect, where rough fracture surfaces remain open due to injection-induced slip. However, the effectiveness and sustainability of self-propping remain unclear, particularly for different rock and fracture types under varying stress conditions. To address this, we conducted laboratory experiments on Odenwald Granodiorite samples to compare the permeability evolution of shear fractures with tensile and saw-cut fractures. Cylindrical specimens containing pre-existing fractures were subjected to critical stress states and increasing injection pressures, while their hydromechanical responses were monitored. Our findings indicate that shear fractures initially exhibit significantly higher permeability than tensile and saw-cut fractures, yet experience a notable permeability reduction due to shear-induced asperity degradation and clogging by fine particles. In contrast, tensile and saw-cut fractures display lower initial permeability but show a modest increase prior to slip, attributed to elastic opening. During injection-induced slip, both fracture types undergo a substantial permeability enhancement, suggesting self-propping effects. Post-slip permeability, however, declines with decreasing injection pressure, primarily due to elastic fracture closure. These results emphasize the key roles of fracture type, rock properties, in-situ stress conditions, and injection pressure in governing permeability evolution and self-propping behavior in EGS applications.

Author: KALANTAR, Alireza

Co-authors: HOFMANN, Hannes (GFZ Potsdam); Prof. JI, Yinlin (3School of Earth 11 Sciences and Engineering, Nanjing University, Nanjing 210023, China); BLOCHER, Guido; MUHL, Lena; Prof. ZANG, Arno (5Institute of Geosciences, University of Potsdam, Germany); DEON, Fiorenza (GFZ Helmholtz Zentrum für Geoforschung)

Presenter: KALANTAR, Alireza