/ PROJET DE MASTER
SECTION DE GÉNIE CIVIL

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

Experimentation on hydraulic fracturing of Barre granite: from hydrofracturing to hydroshearing

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MOTIVATION AND GOALS

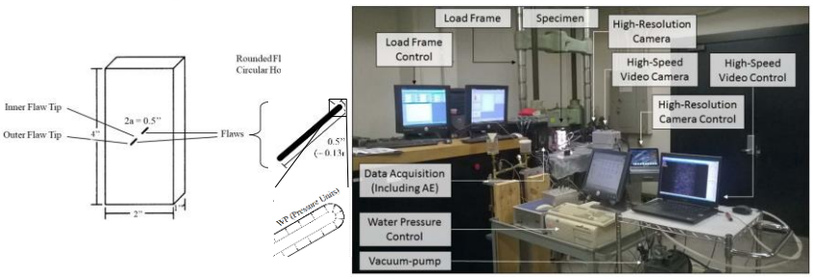
Enhanced Geothermal Systems (EGS) constitute a large renewable energy source for electricity production.
→ Hydraulic stimulation in deep dry rock to reactivate existing fractures by injecting pressurized water
→ Understand better the mechanisms of hydraulic fracturing for EGS: induce shear failure in Barre granite

APPROACH

Interaction between hydraulic fractures and pre-existing, non-pressurized flaws
Identification of shearing under different flaw geometries and loading conditions

EXPERIMENTAL SETUP

Prismatic specimens containing two pre-cut flaws

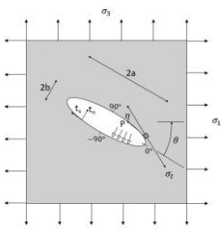


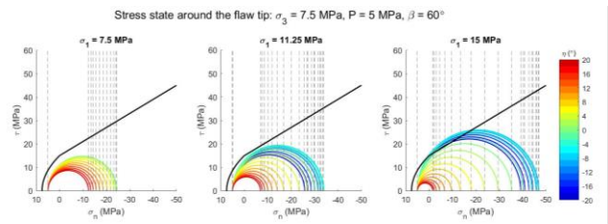
- Inputs: flaw geometries, uniaxial or biaxial external load
- Results: pressure and volume data, visualization of crack development with high-speed and high-resolution imagery

ANALYTICAL INVESTIGATION

Stress state evolution around a pressurized opening

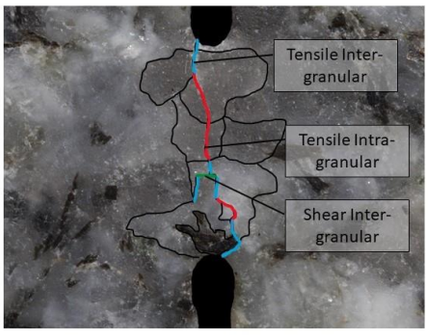
- Type of failure induced by stress and pressure evolution
- Model to develop a biaxial experimental procedure to induce shear failure

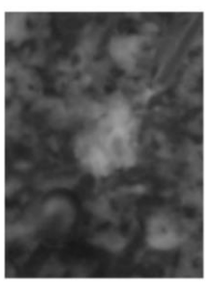




CRACKS AND GRAIN STRUCTURE

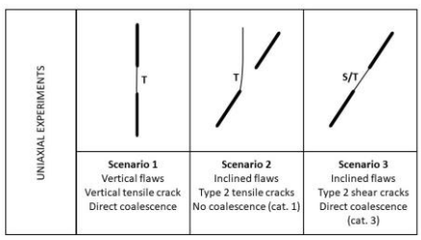
→ Visible crack propagation is highly influenced by the large grains in Barre Granite
→ Micro-cracks develop in the form of white areas in shear fracture process zone



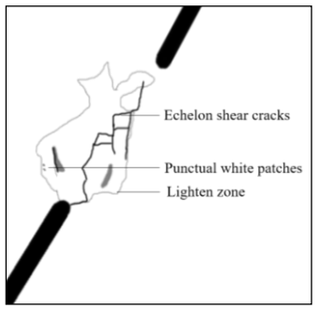


FROM HYDROFRACTURING TO HYDROSHEARING

→ Identification of crack scenarios



→ Shear failure under a combination of biaxial external stress and hydraulic pressure: dilatancy, en echelon crack patterns and sliding



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Morgan, S. P., Johnson, C. A., & Einstein, H. H. (2013). Cracking processes in Barre granite: fracture process zones and crack coalescence. *International journal of fracture*, *180*(2), 177-204.

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