1. Introduction

- Hydraulic fracturing of intact granite samples
  - Compared to continuous injection, cyclic injection can help to reduce breakdown pressure, induced seismicity and to create more complex fractures
- Injection induced shear slip on an existing fracture or fault generates retainable permeability enhancement, and on the other hand could cause larger seismic events in field
- Preliminary experimental study on cyclic injection to an artificial fractured sample with rough surface fracture

2. Experimental setup

Sketch of the triaxial shear-flow experiment

Four steps of continuous and cyclic injections on the same ONE sample
  - Step ① & ② Pressurization rate control 0.01 MPa/s
  - Step ③ & ④ Injection rate control 0.2 mL/min

Normal stress 11 MPa, Initial pore pressure 1 MPa
Shear stress level: 90% shear strength
Maximum pore pressure: 95% of monotonic failure

3. Experimental result analysis

Evolutions of injected volume, shear displacement and injection pressure

Before and after the experiments
  - Root mean square asperity height: 1.79 mm → 1.71 mm
  - Frictional coefficient: 1.25 → 1.26

4. Summary & Next plan

Under the specified test conditions applied in this study:
- For the quasi-static shear slip, the maximum slip rate can be reduced by cyclic injection, compared to continuous injection
- Slip rate could increase during a shut-in stage, accompanying (or can be predicted by) larger/faster fluid pressure drop. This indicates that fracture permeability is enhanced by the shear slip
- Continue injection after the unstable shut-in stage has the potential to induce rapid fracture slip with larger slip rate

Next plan
- Use CT data and 3D carving to prepare fractures with similar surface roughness
- Apply modified injection schemes