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Spatial relationship between asperities and fluid flow during sliding of a simulated fault

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We present results of laboratory experiments simulating frictinal sliding of a single fault/fracture undergoing fluid supply. Our objective is to clarify spatial relationship between asperities(contact area) of faults/fractures and fluid flow during sliding. Our experiments were conducted using granite specimens (60 mm in diameter, 140 mm in axial length) containing a single tensile fracture under constant confining pressure of 5 MPa. Sliding velocity applied to the fault was 0.001 mm/s. Sliding displacement was applied up to 2 mm approximately. Deionized water was supplied into the fracture by applying a constant differential fluid pressure of 0.1 MPa through boreholes of 3mm diameter drilled in the specimen. Fracture permeability were evaluated at every 0.5 mm in axial displacement by measuring differential fluid pressure between inlet and outlet of the fluid and mass flow in outflow. Our results showed the following features.

1. Before a breakout of the fracture at normal stress and shear stress of 50 [MPa] and 63 [MPa], fracture permeability showed a gradual decrease with increasing axial displacement from 5.1*10^-14 [m^2] to 1.9*10^-14 [m^2] associated with increase in normal stress and shear stress acting on the fracture.

2. Fracture permeability increased from the order of 10^-14 to 10^-12 [m^2] after the breakout. Normal stress and shear stress on the fracture during sliding were approximately 10 [MPa] and 7 [MPa].

3. Much of gouge were generated in the fracture after the experiments, which indicates that contact area(aspeities) were worn associated with the breakout and sliding.

We plan, in our presentation, to report mainly on a spatial relationship between worn area on fracture surefaces, which is estimated through a comparison of fracture surface topographies measured before and after the experiments, and fluid flow paths which are evaluated through the flow simulation based on fracture surface measurements.