Pore-pressure dependence of frictional properties of opal gouge at low-temperature hydrothermal conditions

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In order to investigate the pore-pressure dependence of frictional properties at low-temperature hydrothermal conditions, we conducted triaxial friction experiments on opal gouge at a confining pressure of 150 MPa, pore water pressures P_p of 50–130 MPa, a temperature of 100˚C, and axial displacement rates V_{axial} changed stepwise among 0.1, 1 and 10 μm/s.

Slip-hardening with steady-state friction coefficient μ_{ss} up to 0.66 was observed at P_p = 50 MPa, while steady-state sliding with μ_{ss} ≈0.6 was observed at P_p = 130 MPa. Although rate-weakening as shown by an increase or decrease in μ_{ss} upon a stepwise decrease or increase in V_{axial} was observed in all experiments, the μ_{ss} changes after the V_{axial} changes were smaller at higher P_p. Thus both μ_{ss} and the degree of rate-weakening tend to decrease with increasing P_p. When fitted by the rate- and state-dependent friction constitutive law, the friction parameter *a* increases, while the friction parameter *b* does not change much, and resultantly (*a*–*b*) value increases with increasing P_p, although it is still negative at P_p = 130 MPa.

Our experimental results imply that at a seismogenic condition where $a-b < 0$, P_p increase would increase (*a*–*b*) value toward ≈0 and hence promote slow seismic faulting which is supposed to occur when (*a*–*b*) value is small and negative.

Keywords: frictional properties, opal gouge, pore-pressure dependence, low-temperature hydrothermal conditions

