Investigation of friction velocity dependence under the change of pore fluid pressure

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Pore fluid pressure plays an important role in controlling the mode of fault slip, and friction parameter and fault stability change with pore fluid pressure (Scuderi and Collettini 2016). But, there have been only a few experimental studies focused on role of pore fluid pressure. Scuderi and Collettini (2016) conducted experiments on marble gouge and limestone gouge under pore fluid pressure condition. These experiments revealed significant effect of pore pressure on critical slip distance Dc and the friction velocity parameter (a-b). In this study, we conducted friction experiment on silicic to calcareous ooze under the change of pore fluid pressure continuously, and investigated rate-dependence of steady-state friction.

We conducted friction experiment using a rotary-shear intermediate- to high-velocity friction-testing machine. Samples were sediment on the Cocos plate offshore Peninsula, at U1381, during IODP Exp.334. The samples were dried at 60 ˚C and disaggregated gently using pestle. Sample was placed between a simple gabbro cylinder and cylindrical sandstone mounted on a gabbro cylinder. Pore pressure was controlled by a syringe pump. At the start of experiment, normal stress was 6 MPa, pore fluid pressure was 1 MPa. We raised pore fluid pressure from 1 MPa to 5 MPa continuously after friction coefficient attained a roughly steady-state. The additional shear stresses from PTFE O-rings in experiments were calibrated. In this experiment, slip rate was 0.003-0.028 mm/s, displacement was 0.6 m.

As a result, the frictional velocity dependence was negative when pore pressure was from 1 MPa to 2 MPa. But when pore pressure was from 4 MPa to 5 MPa, the frictional velocity dependence was positive. Namiki et al 2014 conducted friction experiment under the drain condition using same sample, and show that friction velocity dependence was negative through experiment. Our results may suggest that friction velocity dependence change with pore fluid pressure.

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