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Experimental and numerical demonstrations for development of composite planar fabrics in fault zones

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Many experimental works have previously performed to understand frictional properties of various kinds of rocks and minerals by using friction apparatus at various orders of sliding velocities ranging from nm/s to m/s together with microscopic observation. However, friction experiments at wide range of velocities on a single type of rock or mineral have been rarely reported. Here we conducted friction experiments using powdered pyroclastic samples at velocities ranging from 0.0002 m/s to 1 m/s, 1.5–3.0 MPa normal stress, 10 m slip distance and dry and wet conditions. We also performed numerical simulation by using discrete element method (DEM) that focused on the changes of distances to adjacent particles (referred as CAP) and forces particles experiencing during frictional slip. At higher velocities, the sample showed relatively drastic decrease of friction coefficient and boundary-parallel Y shears. In contrast, R1 shears, oblique to shear direction, were observed in the samples at lower velocities. Numerical simulations at higher velocities of 0.1 and 1 m/s resulted in slip weakening and development of larger CAP lines parallel to boundary. At lower velocities, larger forces and CAPs were concentrated locally. These results could imply that the development of composite planar fabrics has a dependency on slip velocity. Now we are investigating the relationship using synthetic quartz powders, and will show the preliminary results of re-experiments, numerical simulations, and microscopic observations.