Mechanical amorphization of synthetic fault gouges during rotary-shear friction experiments

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Although mechanical amorphization of fault rocks and its effects on frictional properties were reported in various faults, the relationship between slip processes and generation rate of amorphous materials remains unclear. In this study, we performed rotary-shear friction experiments on quartz and kaolinite gouges under normal stresses of 1 or 3 MPa, at slip velocities of 0.001 or 1 m s^{-1}, with displacements of 1–100 m under room temperature and humidity. XRD measurements revealed that the amorphous content in some products after experiments increased compared to that in the intact powder, and depends on mineralogy and total frictional work, not on the velocity. Therefore, the mechanical amorphization occurs during not only coseismic slip, but also aseismic slip. Only less than 1 % of the frictional work was used for the mechanical amorphization, and thus it plays a minor role in energetics. However, estimated high amorphous content indicates that mechanical amorphization may be important in dynamic fault-weakening mechanisms, such as thermo-chemical pressurization and fault lubrication by amorphous silica, in natural faults.

Keywords: Mechanical amorphization, Friction experiment, Fault gouge

