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水和化非晶質シリカの力学挙動と変形組織について
Deformation textures and mechanical behavior of hydrated amorphous silica

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Previous experiments have discussed the possibility that fault weakening at rapid slip velocities is caused by faulting processes such as frictional melting, thermal decomposition of the fault material, or silica-gel formation. Among these processes, silica-gel formation may be distinguished from the others because the weakening has occurred even at relatively low slip velocities (V $>$ 0.01 mm/s) [Goldsby and Tullis, 2002; Di Toro et al., 2004], under which conditions transformation reactions (e.g., melting, decomposition, etc) are unable to proceed because of low temperatures. Goldsby and Tullis [2002] and Di Toro et al. [2004] have suggested that the weakening is caused by formation and thixotropic behavior of a silica gel (hydrated amorphous silica) layer within a siliceous rock sample. Despite the general acceptance that frictionally generated silica gel plays an important role in the weakening process of siliceous materials, there exists little information on the frictionally generated material (described as fine grained amorphous silica by Di Toro et al. [2004]) on a fault of quartz-rocks; consequently it remains unclear whether the material could behave as a fluid, and whether flow processes contribute to fault weakening. In this study, to better understand the mechanical properties of frictionally generated fault material within quartz-rock, we conducted a series of friction experiments on chert and a synthetic quartz crystal at intermediate to high slip velocities.

We conducted a series of friction experiments on chert at intermediate to high slip velocities (V = 0.87 - 104 mm/s) and at low normal stress of 1.5 MPa to better understand the process of fault weakening by silica-gel formation, as identified in previous friction experiments on quartz-rocks. Fault weakening in chert samples occurred in association with the formation of a 0.1-mm-thick fault gouge layer that contains a thin, foliated layer of fine-grained material and a cataclastically fragmented zone characterized by clast?matrix texture. MFT-IR and XRD analyses reveal that the fault gouge consists of a mixture of hydrated amorphous silica and quartz grains. The mechanical behavior of the fault gouge at a small magnitude of strain (shear strain = 0.008), as examined independently of the friction experiments using a rheometer, is characterized by a negative dependence of shear stress on strain rate with a notable hysteresis behavior.

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