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チャート中の断層におけるシリカゲル層の形成過程
Formation process of a silica gel layer along a fault in chert

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Previous experimental studies have demonstrated that fault weakening in siliceous material occurred at relatively low slip velocities (V >0.01 mm/s) [Goldsby and Tullis, 2002; Di Toro et al., 2004; Hayashi and Tsutsumi, 2010], under which conditions transformation reactions (e.g., melting, decomposition, etc) are unable to proceed because of low temperatures. Formation of a silica gel (hydrated amorphous silica) layer within a siliceous rock has been suggested for a possible cause of the weakening behavior [Goldsby and Tullis, 2002]. However, there exists only limited information on the frictionally generated material on faults in quartz-rocks. To get a better understanding of fault zone process in siliceous material, we have performed intermediate-velocity friction experiments on chert samples and have performed transmission electron microscope (TEM) studies of the fault surface material.

Friction experiments were performed on chert at intermediate velocity (V = 104 mm/s) and at low normal stress of 1.5 MPa. As has been reported preliminary in Hayashi and Tsutsumi (2010), fault weakening in chert samples occurred in association with the formation of a 0.1-mm-thick fault gouge layer. SEM observations on the fault surfaces revealed that the fault surfaces consisted of smooth and rough parts, with the smooth parts probably corresponding to the area with vitreous luster. On the smooth part of the surfaces, rod-shaped particles (1 to 5 μm long with a diameter of ~0.5 μm), aligned perpendicular to the sliding direction, probably indicating that they were rolled during the experiment [Hayashi and Tsutsumi, 2010]. These particles have been termed “rolls” .

The samples for TEM studies were prepared with an application of a focused ion beam (FIB) system. Cross-sections of the fault surface were prepared so that rolls and the substrata interface could be observed using TEM. During the preparation, we paid attention to the cutting direction; rolls were cut perpendicular to their long axes. TEM observations revealed the following characteristics of the experimentally generated fault surface material in chert: (1) the smooth fault surface consist of several hundred-nm-thick amorphous silica layer. (2) Rolls exist on the smooth fault surface and are in contact with the amorphous silica layer. (3) Rolls are made of amorphous silica. The result from TEM observation implies that the rolls observed on the smooth fault surface are formed via a process of consuming the thin amorphous silica layer.

Hayashi and Tsutsumi (2010) showed that the fault gouge consists of a mixture of hydrated amorphous silica and quartz grains. The thin, several hundred-nm-thick amorphous silica layer formed on the fault surface would be a likely candidate for the source of the hydrated amorphous gouge material (silica gel layer).

References

Goldsby and Tullis, 2002, Geophys. Res. Lett., 29(17), 1844, doi:10.1029/2002GL015240.
Di Toro et al., 2004, Nature, 427, 436?439, doi:10.1038/nature02249.
Hayashi and Tsutsumi, 2010, Geophys. Res. Lett., 37, L12305, doi:10.1029/2010GL042943, 2010.

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