地震性すべり時におけるチャートの摩擦特性
Frictional properties of chert at seismic slip rates

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Pelagic chert is one of the main components of accretionary complexes. Frictional properties of chert are important for understanding faulting processes in subduction zones. Previous friction experiments on quartzite or chert at slip rates of 0.1-100 mm/s suggested that fault weakening was caused by a thixotropic behavior of silica gel (Di Toro et al., 2004; Hayashi and Tsutsumi, 2010). However, frictional properties of chert at higher slip rates have not been examined. Here, we conducted friction experiments on chert at a slip rate of 1.3 m/s and normal stresses of 5-13 MPa under room humidity conditions. During the experiments, temperature was measured using a high-resolution infrared thermal-imaging camera, and the process of rotary shear was monitored by a digital video camera. After the experiments, the resultant microstructures and chemical composition of experimental shear zones were examined under optical microscope and field emission scanning electron microscope. The samples for experiments were collected from the host rock (gray chert) of the thrust fault in the Jurassic accretionary complex, central Japan. Experimental data indicated that slip strengthening occurred after first slip weakening. This was followed by second slip weakening toward a steady-state shear strength, with maximum temperature being less than 1200 °C, which was considerably lower than the melting temperature of quartz at 1730 °C. Microstructural observation, video, and axial displacement data confirmed that the formation of continuous melt layer (experimentally generated pseudotachylyte) and melt squeezing occurred before and after second slip weakening. The chert outside of the pseudotachylyte layer was changed to dark and optically isotropic, possibly due to thermal alteration of chert associated with heat diffusion from the molten layer. The chemical composition of the pseudotachylyte matrix represents the frictional melting of quartz with a small amount of illite, which may contribute to reduce melting temperature. Our results suggest that the melt layer developed during slip strengthening may lead to viscous braking on faults. However, once this viscous braking was overcome, slip weakening was likely to occur, which could result in melt lubrication and earthquake rupture propagation.

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References

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