Viscous behavior of chert during frictional melting

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Pelagic chert is one of the major lithology in accretionary complexes. Thus, frictional properties of chert at seismic slip rates are important for understanding of earthquake faulting in subduction zones. Here, we conducted high-velocity friction experiments on chert collected from the Jurassic accretionary complex in central Japan at a slip rate of 1.3 m/s and normal stresses of 5–13 MPa under room humidity conditions. The results show that initial slip weakening was followed by slip strengthening and subsequent second slip weakening toward a steady-state shear strength. Slip strengthening resulted from the formation of a silica-rich melt layer (experimentally generated pseudotachylyte) at lower melting temperatures than expected. The chemical composition of the pseudotachylyte matrix suggests the frictional melting of quartz with a small amount of illite, which may contribute to reduce melting temperatures. The second slip weakening occurred despite an increasing shear strain rate because of the thinning of the melt layer, implying that the viscosity of the melt layer decreased with slip. The estimated temperatures before and after the second slip weakening and microstructural and chemical features of experimentally generated pseudotachylytes suggest that the viscosity decrease during the second slip weakening is not due to a change in the chemical composition of melt layer, but rather a temperature increase in the melt layer.

Keywords: frictional melting , chert, high-velocity friction experiments

