ドレライトおよび花崗岩の中速摩擦特性に対する背景温度の効果
Frictional properties of dolerite and granite at intermediate slip rates and controlled ambient temperatures

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High velocity friction experiments (up to several m/s) on many types of rocks have revealed that frictional strength decreases with increasing slip rate at seismic slip rates (e.g., Tsutsumi and Shimamoto, 1997; Di Toro et al., 2011). Coseismic weakening has been attributed to temperature rise including flash heating, melt lubrication or thermal pressurization (e.g., Rice, 2006; Hirose and Shimamoto, 2005). Although the importance of temperature during fault motion are widely recognized, the effects of temperature on frictional properties at intermediate to high slip rates remain unknown. We therefore conducted friction experiments at a wide range of temperatures and investigated the effects of temperature on the friction coefficient (μ).

Experiments were performed on dolerite (Belfast, Northern Ireland) and granite (Aji, Japan) using a rotary shear deformation apparatus at Chiba University. Samples were displaced up to 10 - 20 m at a normal stress of 1 MPa, slip rates of 1 to 300 mm/s, and ambient temperatures of 20 - 500°C in an argon atmosphere with an oxygen concentration of 0.2 %.

At 20°C and 100°C, dolerite showed velocity weakening at slip rates ranging from 1 to 30 mm/s with μ of 0.81 - 0.83 at 1 mm/s and of 0.73 at 30 mm/s. Whereas at high temperatures >300°C, friction is almost constant (μ = 0.81 - 0.85) at < 30 mm/s. At 100 mm/s, the behavior is slight velocity strengthening at 20 °C and 100°C with μ = 0.75 - 0.79 and clear velocity-weakening at more than 300°C with μ = 0.67 - 0.76. At 300 mm/s, the dolerite showed strong velocity weakening at all temperatures investigated. The amount of weakening (i.e., the drop in friction, $\Delta\mu$) increases with increasing temperature ($\Delta\mu$ = 0.1 - 0.38). Thus, the frictional properties of dolerite are affected not only by slip rate but also by ambient temperature.
Experiments using granite to decipher the effect of materials on temperature dependence are in progress. Our preliminary results are summarized as follows. At <30 mm/s, the behavior is slight velocity strengthening at room temperature and velocity-weakening at temperatures of 100-300°C. At >300°C, friction is almost constant. Friction coefficient decreases with increasing temperature of 20-300°C and increase again at >400°C. At >100 mm/s, clear velocity-weakening did not occur except at temperatures of 20°C. More results especially on granite will be reported at the meeting.

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