Geophysical Research Abstracts
Vol. 16, EGU2014-11206-1, 2014
EGU General Assembly 2014

Frictional properties of mylonite from Longmenshan fault zone under hydrothermal conditions

Lei Zhang and Changrong He

State Key Laboratory of Earthquake Dynamics, Institute of Geology, China Earthquake Administration, Beijing, China (ballycumt@hotmail.com)

To investigate the frictional sliding behavior of typical fault rocks as related to dynamics of faulting under different temperature and pressure conditions, we collected phyllosilicate-rich mylonite ($\sim$60wt.% phyllosilicates which are mainly chlorite and muscovite) from a ductile thrust zone along Gengda-Wenmao fault of Longmenshan fault zone and conducted frictional sliding experiments under hydrothermal conditions. The experiments were conducted under elevated temperatures in the range of 100^{o}C-600^{o}C and effective normal stress of 200MPa and 300MPa to represent the deep portion conditions (elevated temperature and pressure) of the fault zone. In order to obtain velocity dependence of friction, shearing rates were stepped up and down in the range of 0.0488μm/s-6.1μm/s.

In our experiments, the frictional coefficient of mylonite exhibits systematic increase with increasing temperature (100^{o}C-600^{o}C). The frictional behavior of mylonite shows a transition from initial velocity-strengthening behavior to velocity-weakening behavior at about 300^{o}C, and then transitions back to velocity-strengthening behavior as temperature is elevated. The velocity dependence of mylonite also shows strong pressure sensitivity. When the effective normal stress is increased to 300MPa, the stable frictional behavior is significantly enhanced with larger $(a - b)$ compared to that under the lower pressure condition. The transition from velocity weakening to velocity strengthening frictional behavior may be controlled by competition between pressure-solution healing and dilation weakening processes in the mylonite gouge.

In the framework of rate and state friction constitutive law, the effects of frictional properties of mylonite on faulting dynamics are discussed. From our experimental results of mylonite, unstable slip events may nucleate in mylonite gouge under 250^{o}C -550^{o}C temperature conditions at 200MPa effective normal stress, and transitional behavior is found at 600^{o}C which is rate dependent. At 300MPa effective normal stress, the temperature condition for the nucleation of unstable slip events is constrained to 260^{o}C -320^{o}C (corresponding to 15-19km depth of Longmenshan fault zone), and rate dependent, transitional behavior is found at 400^{o}C. For velocity-strengthening cases, a large loading disturbance from neighbouring area may cause triggered slip events at the corresponding depth.