

High velocity frictional tests and an attempt to reproduce fault materials using TCDP Hole-B samples

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Abstract

Taiwan Chelungpu-fault Drilling Project (TCDP) was started from 2002 to investigate the faulting mechanism of the 1999 Chi-Chi earthquake. Micro-textural observation, rock magnetic analyses, and mineralogical analysis for carbonate of fault zones in Hole-B implied the evidence of heat generation (Hirono et al., 2006), though the temperature did not reach the melting point. Mishima et al. (2006) carried out thermomagnetic analyses and also investigated frequency dependence of magnetic susceptibility. Their results indicate that high magnetic susceptibility at the center of fault zone can be explained by the decomposition of thermally unstable paramagnetic minerals into magnetite or maghemite at the time of slip event. However it is still uncertain that instantaneous heat generation during slip events can really produce such anomaly. Therefore we tried to reproduce the frictional products from the high velocity frictional tests, and various analyses are conducted to compare between original and frictional samples to investigate transformation of the fault rock due to frictional heating. We used crushed sedimentary rocks at the 3 m distance from the center of the fault zone in 1136m (Hole-B) for our tests. All high-velocity experiments were conducted by dry samples at a slip rate of 1.03 m/s and a normal stress of 0.5 MPa and 1.0 MPa. All tests showed similarity in frictional behaviors, and the friction continues to weaken from a peak frictional coefficient of 0.7 to 1.1 towards a steady state with a frictional coefficient of 0.1 to 0.3. After experiments, frictional samples are used for thermomagnetic, XRD, XRF and grain size analyses to compare the difference between original and frictional samples. In thermomagnetic analyses, original samples were characterized by “humps” above 400°C which the induced magnetization on the heating branches began to increase at about 400°C, reached a maximum at about 480°C, and decreased from 480 to 600°C. On the other hand “humps” were disappeared for frictional samples. The results suggest that decomposed magnetized mineral was newly deformed by frictional heating. Frictional samples show slight peak reduction in calcite for XRD analysis, though no difference

between original and frictional samples in most peaks. In grain size analyses, grain size is slightly decreased for frictional samples.