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

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Taiwan Chelungpu-fault Drilling Project (TCDP) was started from 2002 to investigate the faulting mechanism of the 1999 Chi-Chi earthquake. TCDP was succeeded in penetrating the Chelungpu fault and recovered core samples from three holes, Hole A, Hole B and Hole C. In Hole B, three fault zones, FZB1136 (1134-1137 m), FZB1194 (1194-1197 m), and FZB1243 (1242-1244 m), were recognized in the core samples (Hirono et al.,2006). Micro-textual observation, rock magnetic analyses, and mineralogical analysis for carbonate of fault zones implied the evidence of heat generation, 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. We also don't know the importance of pore water for the reaction that is related to anomalous feature. 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 crashed sedimentary rocks at the 3 m distance from the center of the fault zone in 1136m (TCDP Hole-B) for our tests. The crashed sample was placed between a pair of solid-cylindrical sandstone specimens 24.8 mm in diameter. 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^{o}C which the induced magnetization on the heating branches began to increase at about 400^{o}C, reached a maximum at about 480^{o}C, and decreased from 480 to 600^{o}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.