Geophysical Research Abstracts,
Vol. 11, EGU2009-7892, 2009
EGU General Assembly 2009

Anisotropy and microstructure of fine-grained material in Hole B of the Taiwan Chelungpu Fault Drilling Project (TCDP)

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The Taiwan Chelungpu-fault Drilling Project (TCDP) was initiated in 2002 to locate the slip zone and investigate the faulting mechanism of the Mw 7.6 1999 Taiwan Chi-Chi earthquake. In 2005, core sampling of Hole B was completed along depth range 950-1350 meters. We collected samples from this hole at various locations in order to analyze the effect of long term deformation and fault activity on the rocks cm-scale physical properties and microstructure. Three different facies were sampled: coarse sandstone, fine sandstone and siltstone. Fine sandstone and siltstone were retrieved in FZB1136 and FZB1194 damaged zones, and away from the fault zones. Coarse sandstone was found only outside the fault zones. We measured in all samples the anisotropy of P-wave velocity perpendicular to the bedding strike, the anisotropy of magnetic susceptibility (AMS) and the anisotropy of anhysteretic remanent magnetization (AARM). Magnetic mineralogy investigation revealed the presence of fine grain pyrrothite and magnetite.

AMS and APV data in all samples suggest that the organization of the microstructure is primarily controlled by sedimentary processes and horizontal shortening under remotely applied stresses. In the coarse sandstone, horizontal shortening resulted in the formation of microcracks with normal orientation parallel to the bedding strike. The presence of these microcracks at depth is confirmed by the AARM data, as remanent magnetic minerals (magnetite) appear to mimic their preferred orientation.

Within the footwall of FZB1136, which is the zone that is thought to have ruptured during the 1999 earthquake, samples show significant differences as compared to the rest of our set: anisotropy of magnetic susceptibility and anisotropy of P-wave velocity are larger, and the analysis of the microstructure indicates intense bed parallel fracturing, and possible indications of shear with a displacement consistent with the Chelungpu fault kinematics.