Geophysical Research Abstracts,
Vol. 11, EGU2009-5950, 2009
EGU General Assembly 2009

Magnetic mineralogy and its correspondence with SEM observations on FZB1136 fault gouge of the Chi-Chi earthquake, Chelungpu fault, Taiwan

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During earthquake rupture, physical and chemical alterations occurred within tens centimetres of the fault rock. Four years after the 1999 Chi-Chi (Mw 7.6), TCDP hole B provided core from the Chi-Chi fault zone at 1136 m depth (FZB1136) . SEM observations revealed several layers corresponding to past earthquakes and a particular 2mm-thick isotropic layer, which is interpreted to be the Chi-Chi principal slip zone (Boullier et al., G-Cubed, accepted). We sampled U-channel along the FZB1136 and measured magnetic susceptibility, isothermal remanent magnetization and S-ratio, anhysteretic remanent magnetization. In addition, we investigated low-temperature magnetic properties (10K-400K) of 11 samples to identify the magnetic minerals. The fault zone is characterized by a well known susceptibility and IRM peaks where hardening of magnetization is also observed. We identified a S-ratio peak (softer coercivity) , at 5 cm distance from the K and IRM peak, and within the isotropic layer identified from SEM observations. Thanks to low temperature magnetic transitions, we identified goethite, magnetite, pyrrhotite and some unknown magnetic mineral. The wall rocks contain an assemblage of magnetite and pyrrhotite. The gray gouge, which framed the fault zone also contains an assemblage of pyrrhotite and magnetite. The black gouge, where IRM, K, and S-ratio peaks are observed is characterized by an assemblage of goethite, magnetite, and pyrrhotite. When comparing low-temperature properties of S-ratio peak and IRM-peak, we observed a larger content of magnetite along the isotropic layer. Goethite occurrence suggests that fluid circulation took place within the 17 cm-thick black gouge during or after the earthquake. The preservation of pyrrhotite and magnetite suggests that the environment was probably oxygen-free. As a whole, the magnetic approach permits to identify slip plane characterized by a S-ratio peak that is not related to the K or IRM peaks.