

Frictional strength of fault gouge in Taiwan Chelungpu fault obtained from TCDP Hole B

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Three fault zones (FZB1136, FZB1194 and FZB1243) are found in core samples in Hole B borehole penetrating through the Chelungpu fault, central Taiwan that activated at the 1999 Taiwan Chi-Chi earthquake. Each fault zone is composed of a black gouge zone (BGZ) and a gray gouge zone (GGZ) surrounded by a fault breccia zone (BZ) and/or fracture-damaged zone (FZ). We conducted tri-axial friction experiments on samples collected from subzones of the above three fault zones under the 1 km depth ambient condition with axial shortening rates of 0.1 - 10 micron m/s to investigate frictional strength and its velocity dependence. We found that the coefficient of friction is 0.3 for the BGZ at FZB1136 (1136BGZ), which is lower than those at other fault zones. This result indicates that fault slip at the Chi-Chi earthquake occurred at the 1136BGZ. However the samples exhibit only velocity strengthening behavior (frictionally stable slip), which does not support the hypothesis that this zone slipped during the Chi-Chi earthquake. The frictional strength profile across FZB1136 was that the frictional strength was the lowest (the coefficient of friction is 0.3) for the BGZ and increased up to 0.5 for undeformed host rock with increasing distance from the BGZ. Presence of the intermediate frictional strength zone consisting of the GGZ and the BZ suggests a development of off-fault damage zone where deformation occurred not only in the BGZ but also in the intermediate zone. This feature should be important to estimate total fracture energy released during earthquakes.