



## New evidence that the 1999 Mw=7.6 Chi-Chi earthquake is a characteristic earthquake: Deciphering long-term (30 ka) fault slip vectors on the northern Chelungpu fault from fold scarps on alluvial terraces

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In convergent tectonic setting, fold scarps on alluvial terraces provide a quantitative long-term record of the amount of slip through an underlying fault bend since abandonment of the terraces. Cumulative slip can be computed in 3 independent ways, based on the terrace height in the hanging-wall relative to base level, the fold-scarp relief, and the width of the fold-scarp limb. We use these techniques to invert for fault-slip magnitude and azimuth from fold scarps on dated alluvial terraces in the hanging wall of the northern Chelungpu thrust, located at the piedmont of the Taiwan fold-and-thrust belt. Three main levels of alluvial terraces show progressive folding by kink-band migration in relation to the underlying fault geometry, forming a main N-S fold scarp up to  $\sim$ 193 m high and secondary E-W scarps. Based on scarp relief, the 3D deformation of the highest terrace T1, OSL-dated at  $\sim$ 30 ka, leads to  $523 \pm 81$  m cumulative slip oriented  $N338^\circ \pm 6^\circ$ , which is parallel to the 1999 Mw=7.6 Chi-Chi coseismic displacements in this area ( $N333^\circ$  to  $N341^\circ$ ), but strongly different from the azimuth of interseismic deformation ( $N285^\circ$ ). In a similar direction, scarp reliefs on terraces T2 and T3, OSL-dated at  $\sim$ 22 ka and  $\sim$ 17 ka respectively, yield slip values of  $432 \pm 78$  m and  $271 \pm 62$  m, respectively. The slip and age results indicate a constant fault slip rate of  $17.7 \pm 2.2$  mm/a along  $N338^\circ \pm 6^\circ$ . Late Quaternary shortening rates observed at 4 sites along the fault vary in similar proportion to Chi-Chi coseismic displacements. Together with the colinearity of long-term and coseismic slip vectors at our study site, this suggests that Chi-Chi earthquake is a characteristic earthquake for the Chelungpu thrust with an average recurrence of  $\sim$ 440 years for the last  $\sim$ 30 ka.