Geophysical Research Abstracts
Vol. 15, EGU2013-1386, 2013
EGU General Assembly 2013

Repeated folding during Late Holocene earthquakes on the La Cal thrust fault near Mendoza City (Argentina)

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In 1861, one of the most destructive earthquakes in the history of Argentina destroyed the city of Mendoza (currently 1 million inhabitants). The magnitude M_s ~7.0 earthquake is inferred to have occurred on the 31-km-long La Cal thrust fault, which extends from Mendoza to the north, where it offsets an alluvial fan and small inset terraces along a well preserved fault scarp.

A trench excavated on a terrace that is vertically offset by ~2.5 m exposes two main stratigraphic units separated by an erosional unconformity. The coarse-grained upper unit is deformed by three east-vergent folds (F1–F3). Retrodeformation of these folds yields total displacements of ~2.0 m, ~2.4 m, and ~0.5 m on the underlying fault splays, respectively. The displacement of ~2.0 m recorded by fold F1 is interpreted as the result of the fault rupture that caused the 1861 earthquake (Salomon et al., 2013). F2 and F3 were presumably generated during the penultimate event with an inferred magnitude of M_w ~7.0, although formation during two distinctruptures cannot be excluded. Finite-element modeling shows that coseismic foldingabove the tip of a blind thrust fault is a physically plausible mechanism to generate these folds. A published luminescence age of 770 ± 76 years, which is interpreted to date the formation of the deformed terrace (Schmidt et al., 2012), indicates that the two (or possibly three) scarp-forming events occurred during the last ~800 years. The fine-grained sediments below the erosional unconformity – that contain evidence for at least one older earthquake – are dated at ~12 kyr.

Our results indicate that elastic strain energy, which is accumulating at the front of the Precordillera today as shown by GPS data (Brooks et al., 2003), was repeatedly released during earthquakes on the La Cal fault in the past. Hence, the La Cal thrust fault poses a serious threat to the city of Mendoza.

References:

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