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Recurrent morphogenic earthquakes in the past millennium along the strike-slip Yushu Fault, central Tibetan Plateau

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The magnitude (M_w) 6.9 (M_s 7.1) Yushu earthquake occurred on 14 April 2010 in a high mountain region in the Yushu area of the central Tibetan Plateau, resulting in approximately 3000 fatalities (including 270 missing) and widespread damage. Field investigations reveal that the earthquake produced a ~33-km-long surface rupture zone along the pre-existing Yushu Fault of the strike-slip Ganzi-Yushu Fault Zone (Lin et al., 2011a). The Yushu earthquake provides us with a rare opportunity to understand the rupture mechanism and process of a large-scale strike-slip fault related to eastward extrusion of the Tibetan Plateau. The primary features of the seismogenic fault upon which the 2010 Yushu earthquake occurred are now understood, but details of its seismotectonic behavior, e.g., recurrence interval, slip rate, and maximum magnitude of morphogenic earthquakes, are largely unknown despite their importance in terms of assessing the seismic hazard in high mountain regions around the Yushu area on the central Tibetan Plateau.

Here, we present geological evidence regarding the occurrence of paleo- and historical earthquakes that ruptured the strike-slip Yushu Fault of the Ganzi-Yushu Fault Zone during the past millennium, based on field work and observations of an excavated trench and outcrop in July 2010, after the 2010 Yushu earthquake (Lin et al., 2011b). Field surveys and analyses of an excavated trench and outcrop reveal that three morphogenic earthquakes have occurred on the Yushu Fault in the past millennium. Paleoseismic evidence, historical records, and radiocarbon age data show that (i) the penultimate large-magnitude earthquake occurred during the past 400 yrs, corresponding to the 1738 M 7.1 earthquake; and (ii) the third most recent event occurred between AD 650 and AD 1100, suggesting a recurrence interval of 300-400 yrs for morphogenic earthquakes on the Yushu Fault in the past millennium. An average slip rate of ~4-5 mm/yr is estimated for the Yushu Fault. These results are consistent with those obtained from long-term geological evidence and GPS observations. Our findings reveal that most of the strain energy on the Ganzi-Yushu Fault Zone, caused by northeastward motion of the Tibetan Plateau to accommodate north-south shortening of the plateau due to ongoing northward penetration of the Indian Plate into the Eurasian Plate, is released as seismic slip.

References:

- 1) Lin, A., G. Rao, D. Jia, X. Wu, B. Yan, Z. Ren (2011a). Co-seismic strike-slip surface rupture and displacement produced by the 2010 M_w 6.9 Yushu earthquake. *Journal of Geodynamics*, doi:10.16/j.jog.2011.01.001.
- 2) Lin, A., G. Rao, D. Jia, X. Wu, B. Yan, Z. Ren (2011b). Recurrent morphogenic earthquakes occurred in the past millennial along the strike-slip Yushu Fault, central Tibetan Plateau. *Bulletin of Seismological Society of America*, in press.

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