
Assessing the potential for mega-earthquakes rupturing the largest known active thrust sheet: the Mazar Tagh (Western Kunlun, Xinjiang, China).

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Résumé

The Western Kunlun Range (WKR) is a slowly converging orogen located along the northwestern edge of the Tibetan Plateau, facing the Tarim Basin. The recent Mw 6.4 2015 Pishan earthquake along the mountain front recalls that this region remains seismically active, despite little or moderate historical seismicity. Its low deformation rates can be hardly retrieved from current geodetic data, placing limited constraints on the potential interseismic loading of the region. This is particularly critical as structural investigations report the existence of an extremely wide (~150-180 km) frontal thrust sheet, whose dimensions would imply the possibility of major $M \geq 8$ earthquakes in the case that it is locked and slips during one single seismic event.

To place further constraints on the seismic hazards of this region, we have conducted morphological and structural analyses of active faults to unravel the geomorphic record of active deformation cumulated over multiple seismic events at specific sites. To do so, field observations, seismic profiles and high-resolution Pléiades images and DEMs were combined

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together with the dating of fluvial terraces. We find that shortening and fault slip rates have been of ~ 2 mm/yr over the last ~ 300 -500 kyr. Our detailed morphological investigations further indicate that this shortening is variably partitioned on one or several blind ramps along the mountain front, and from there that it is transmitted forward all the way to the deformation front, ~ 150 -180 km further north. As such, this extremely wide single frontal thrust sheet stands most probably as the largest known active thrust sheet in the world! Finally, a re-analysis of previously published GPS velocities highlights a 2-3 mm/yr gradient in horizontal velocities across the WKR and southwestern Tarim basin when combined and expressed in a stable Tarim reference. Such gradient is consistent with our morpho-tectonic results on shortening rates. Most importantly, this spatial gradient in velocities may suggest that the frontal thrust sheet is presently locked. Combined with field observations of the frontal thrust zone, this finding clearly questions the possibility of mega-earthquakes in the region.

Mots-Clés: active tectonics, morphology, GPS, interseismic coupling, fault zone