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Active tectonics and seismic hazards in slowly deforming orogens: the case of the Western Kunlun mountain range (Xinjiang, China)

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The Western Kunlun mountain range is a slowly deforming intra-continental orogen where deformation rates are too low to be quantified from geodetic techniques. Despite an apparent lack of historical recorded seismicity, it is still the loci of rare but destructive earthquakes, such as the Mw 6.4 2015 Pishan earthquake, showing that this mountain range remains active.

To get further insights into the structural and seismotectonic background of this earthquake and to better quantify the rate of active deformation and the potential for major earthquakes in this region, we combine a structural and quantitative morphological analysis of the topographic mountain front in the epicentral area. Using field observations and a seismic profile, we derive a structural cross-section. This allows us to identify the fault that broke during the 2015 Pishan earthquake, an 8-12 km deep blind ramp beneath the Yecheng Pishan fold, branching into a shallow decollement that emerges at the surface 150-180 km further north within the Tarim Basin. Combining analysis of satellite images and DEMs, we obtain a detailed morphological analysis of the Yecheng-Pishan fold nearby the 2015 Mw 6.4 Pishan earthquake epicenter and found nine levels of incised fluvial terraces and alluvial fans. From their incision pattern and using age constraints available on some of these terraces, we are able to quantify the slip rate on the underlying blind frontal ramp to 0.5 to 2.5 mm/yr over the last $\sim$400 kyr, with a most probable long-term value of $\sim$2.0-2.5 mm/yr.

The evolution of the Yecheng-Pishan fold is then proposed by combining all structural, morphological and chronological observations. Finally, we compare the seismotectonic context of the Western Kunlun to what has been proposed for the Himalayas of Central Nepal. This allows for discussing the possibility of major M $\geq$ 8-8.5 earthquakes in the case that the whole decollement is presently seismically locked and fully ruptures in one single seismic event.