

The seismogenic characteristics of the 2022 Mw6.7 Menyuan earthquake and its implications for tectonic deformation in the northeastern margin of the Tibetan Plateau

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On January 8, 2022 (local time), an Mw6.7 earthquake occurred in the Menyuan County, Qinghai Province, China (37.77°N; 101.26°E), with a focal depth of 10 km. The focal mechanisms and regional active faults indicate that this earthquake is a typical sinistral strike-slip event and the seismogenic faults are the Lenglongling fault and Tuolai Shan fault in the middle segment of the Haiyuan fault zone, northeastern margin of the Tibetan Plateau. The offset topography and InSAR coseismic deformation field confirmed that the Menyuan earthquake is characterized by the sinistral strike-slip. The field surveys discovered a 20-km-long surface rupture zone, as well as a succession of offset landforms that demonstrated evident left-lateral strike-slip motion with a maximum horizontal displacement of ~ 2.1 m [1]. The InSAR 3-D surface deformation field suggested that the maximum horizontal and vertical coseismic displacements are 1.7 m and 0.6 m, respectively [2].

The 2016 Mw6.0 Menyuan earthquake contrasts sharply to the 2022 Menyuan earthquake, because the 2016 event is dominated by compression, and its seismogenic fault is a secondary thrust fault located at the north side of the Lenglongling fault [3]. It is very rare in the historical record that two strikingly diverse earthquakes occurred in the same area within a short period of time. Therefore, we further collected the regional active faults and historical seismic data in the northeastern margin of the Tibetan Plateau and found that there are two different tectonic deformation patterns in the Qilian Mountains: the north-south compression shortening and the block eastward extrusion. The tectonic deformation and seismic activity in the western and eastern Qilian Mountains are obviously different. The western Qilian Mountains are generally characterized by the crustal compression shortening from north to south, manifested in the widespread distribution of thrust faults and compressional earthquakes. However, the eastern Qilian Mountains are characterized by the block eastward extrusion, manifested by the rapid sinistral strike-slip, strong seismic activity at the block boundaries and weak seismic activity inside the blocks. The seismogenic characteristics of the two Menyuan earthquakes in 2022 and 2016 are in accord with this tectonic deformation background.

References

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