Rupture segmentation and process of the 2001 Mw 7.8 Central Kunlun Earthquake,China

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The magnitude (Mw) 7.8 Central Kunlun earthquake occurred on 14 November 2001 in the central Kunlun mountain area, northwest China (Lin et al., 2002). Field observations show that a 425-km-long strike-slip surface rupture zone with a lateral offset up to 16.3 m occurred along the pre-existing strike-slip Kunlun fault (Lin et al., 2002, 2003). Both the rupture length and maximum displacement are the largest among the co-seismic surface rupture zones ever reported in intracontinental earthquakes. The large displacement and rupture length are of great importance as key parameters in estimating maximum earthquakes and earthquake moments and assessing individual seismogenic structures for large fault. Furthermore, the Central Kunlun earthquake was well recorded by the worldwide broadband seismograph stations, which provided good seismic data to determine the fault rupture behavior and the displacement distributions on the fault plane. The Central Kunlun earthquake, therefore, provides us an unusual opportunity to understand the rupture mechanism and process along a large continental strike-slip fault.

The purpose of this study is to understand the relationship between the displacement distributions, rupture structures and pre-existing geological structures, and to assess the kinematics of rupturing process during the Central Kunlun earthquake by using the field observations, Landsat and SPOT images and inversions from teleseismic data.

The 425-km-long rupture zone may be divided into four segments based on the geological structures, tectonic landform features, spatial displacement distributions obtained from field observation, and analysis of teleseismc waveform. The deformational characteristics of the surface ruptures and focal mechanism solutions reveal that the earthquake had a nearly pure strike-slip mechanism. The inversion results from seismic data show that the rupture started from the west near the epicentral area bilaterally and rapidly extended to the east in an unilateral manner for 380 km, and that the large slip region was limited in the segment 150-280 km east of the epicenter, consistent with field observations. The average stress drop is estimated to be 7 MPa in the area where the large displacements occurred, a value typical of intraplate earthquakes.

The geologic and topographic evidence and the inversion results from seismic data clearly show that temporal and spatial displacement distributions and the rupture process are controlled by the pre-existing geological structures of the Kunlun fault.

References:

1. Lin et al. (2002). Co-seismic strike-slip and rupture length produced by the 2001 Ms 8.1 Central Kunlun earthquake. Science, 296, 1917-2088.

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