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Crustal Deformation on the Longmenshan Fault Zone and its Northwestern Side before the Ms=8.0 Wenchuan Earthquake of 2008

Du Fang (1), Wen Xue-Ze (2), and Su You-Jin (3)

(1) Earthquake Administration of Sichuan Province, Chengdu, 61004 Sichuan, China (scdufang888@yahoo.com.cn) , (2) Institute of Earthquake Science, China Earthquake Administration, Beijing 100036, China (hhxs.easp@yahoo.com.cn) , (3) Earthquake Administration of Yunnan Province, Kunming 650224, China (suyoujin0818@sina.com)

Using data of regional GPS velocity field and leveling measurements,and making an analysis considering seisimotectonic background, we study the inter-seismic crustal deformation in the region across the NE-trending Longmenshan fault zone and the further northwest, Sichuan, China, before the Ms=8.0 Wenchuan earthquake of 2008, discuss the active tectonic and geodynamic model in which the inter-seismic deformation produced,and from these, speculate the process in which the Wenchuan earthquake prepared and yielded. Our study mainly shows the follows:

The GPS measurements suggest that during the period from 1997 to 2007, little horizontal shortening and shearing deformation appeared within the middle segment of the Longmenshan fault zone. However, about 3.0 mm/yr. of horizontal shortening in the direction perpendicular to the fault's strike occurred in the area from the middle segment of the fault zone to about 230km further northwest, and about 3.0 mm/yr. of horizontal right-lateral shearing in the direction parallel to the fault happened in the same area. Also during the same period, horizontal shortening and shearing rates in the NW-side of the northern segment of the fault zone were only about 0.9 mm/yr.

The leveling measurements suggest that during the period from 1975 to 1997, different rates of vertical uplifting happened in the belt across the middle segment of the Longmenshan fault zone and its further northwest. The uplifting was at a rate of 0.5 to 0.8mm/yr. within the fault zone, but it increased to 2 to 3mm/ yr. in the area 100km to 250 km further northwest from the fault zone.

Based on an analysis combining the deformation characteristics mentioned above with the structural geological feature revealed by acquired seismic profiles across the fault zone, we conclude that, before the Ms=8.0 Wenchuan earthquake of 2008, the middle segment of the Longmenshan fault zone had been locked for long time with high inter-seismic strain accumulation. But in the same time the northern segment of the fault zone had much lower strain accumulation. During the Ms=8.0 Wenchuan earthquake of 2008, large-scale rupture occurred, along with huge energy release, first along the highly locked middle segment of the fault zone, and then triggered that rupture on the northern segment of the fault zone, that had relatively low strain accumulation.

Keywords: Wenchuan earthquake of 2008, Inter-seismic deformation, Fault locking, Longmenshan fault zone