

Study on earthquake potential and GPS deformation of the middle-southern segment of the Liupanshan fault zone

Du Fang (1), Wen Xue-Ze (1,2), Liang Ming-Jian (1,2), Long Feng (1), and Wu Jiang (1)

(1) Earthquake Administration of Sichuan Province, Chengdu, China (1289991429@qq.com), (2) State Key Laboratory of Earthquake Dynamics, Institute of Geology, China Earthquake Administration, Beijing 100029, China

The Liupanshan fault zone is a border-type and active thrust zone between the Qinghai-Tibet block and the North China block. The fault zone trends nearly N-S direction north of Guyuan and NNW-direction south of Guyuan. The middle segment of the fault zone consists of several branches, including the western and eastern branches, as well as the Xiaoguanshan fault. They are all belonging to active thrust faults in the late Quaternary. The southern segment of the fault zone also consists of several branches, such as the Taoyuan-Guichuansi fault, the Guguan-Baoji fault and the Longxian-Zhishan-Mazhao fault. They exhibit mainly sinistral strike-slip faulting.

We have identified a seismic gap of major earthquakes which exists in the middle segment of the Liupanshan fault zone, south of Guyuan. Several historical earthquakes occurred on the fault zone at and north of Guyuan, among them are the 1219 M=7 event, the 1306 M=7 event, and the 1622 M=7 event. The southern segment of the Liupanshan fault zone could be the seismogenic one of the Tianshui-Longxian earthquake of 600 AD. This early historical event might have a greater magnitude than 6^{1/2} that is given in the current earthquake catalog. No strong earthquake occurred on the southern segment of the Liupanshan fault zone between Longde and Longxian in the documentedly recorded history. So, the time period without major earthquake rupture in the seismic gap on the middle segment of the fault zone is at least 1415 years. The seismic gap has a length of about 70 km.

The GPS velocity profile across middle-southern segment of the Liupanshan fault zone suggests that inter-seismic locking is happening there. An analysis of the GPS velocity profiles mainly shows that, horizontal shortening is occurring from west to east in the fault-perpendicular direction and horizontal left-lateral shearing parallel to the fault's strike is occurring in the area from the middle segment of the fault zone to tens of kilometers away west of the fault zone. The shortening rate is estimated to be 3 mm/a from 100 to 250 km on the west side of the Liupanshan fault zone. It reduces to approximately 0.5 mm/a on the area about 100 km west of the fault zone. However, almost no deformation exists on the east side of the Liupanshan fault zone. The distortion rate is estimated to be 4.0×10^{-9} /a on the west side of the Liupanshan fault zone. But there is almost no distortion on the east side of the fault zone. The GPS deformation pattern across middle segment of the Liupanshan fault zone is similar to that GPS deformation pattern across middle segment of the Longmenshan fault zone before the 2008 M=8.0 Wenchuan, China, earthquake. Therefore, we believe that the middle-southern segment of the Liupanshan fault zone has had high strain building-up, and thus relatively high seismic potential of major earthquake exists there on this fault segment.

Keywords: Liupanshan fault zone, Inter-seismic locking, GPS deformation, Earthquake potential