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GPS结果揭示的龙门山断裂带现今形变与受力——与川滇地区其他断裂带的对比研究

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Present-day deformation and stress state of Longmenshan fault from GPS results—comparative research on active faults in Sichuan-Yunnan region

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摘要

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摘要

本文构建川滇地区二维有限元接触模型, 采用“块体加载”方法和1999—2007年GPS数据, 模拟计算该区主要断裂带的形变运动, 对比、分析其运动、受力特征和应力积累差异. 结合区域强震研究汶川地震、芦山地震的力学背景. 结果显示强震前龙门山断裂带保持低变形, 右旋错动不超过 $1 \text{ mm} \cdot \text{a}^{-1}$, 挤压不超过 $0.5 \text{ mm} \cdot \text{a}^{-1}$, 明显低于其他断裂带, 但其两侧应力值与其他断裂带相当, 主压应力轴与断裂带走向垂直, 形成很宽的挤压带, 断层面法向挤压应力积累为 $-333.74 \text{ Pa} \cdot \text{a}^{-1}$, 为全区最高, 揭示1999年以来, 龙门山断裂带及巴颜喀拉块体东部的挤压应力快速增加, 致使实际应力可能处于高水平并诱发地震活跃, 期间强震呈丛集性, 出现汶川、芦山地震接连发生的现象.

关键词 川滇地区, 龙门山断裂带, 芦山地震, GPS, 有限元分析

Abstract:

The 2D finite element model of Sichuan-Yunnan Region was established in this paper. The deformation movement of the main faults in this region is simulated by using the ‘block loading’ method and GPS data from 1999 to 2007. The simulated slip rate and stress accumulating rate along Longmenshan Fault is compared with those of other faults to determine the particular geodynamic condition which may have caused Wenchuan Earthquake and Lushan Earthquake. The results show that before Wenchuan Earthquake the right-lateral slip rate and the thrusting rate along Longmenshan Fault were respectively $\sim 1 \text{ mm} \cdot \text{a}^{-1}$ and $\sim 0.5 \text{ mm} \cdot \text{a}^{-1}$, which were fairly lower than other faults while the stress was relatively high and of the same magnitude compared with other faults. In addition, the axis of principal compressive stress is perpendicular to the fault strike with a wide compressive zone. The accumulating rate of compressive pressure on the fault surface was $-333.74 \text{ Pa} \cdot \text{a}^{-1}$, which was the highest among the faults in the region. The results above indicate that the compressive stress in the east of Bayan Har block and Longmanshan Fault had been increasing rapidly which lead to the local real stress being at high level and accordingly seismic activities. During this seismic active period, strong earthquakes should occur in clustering fashion. As a result, Wenchuan 8.0 earthquake and Lushan 7.0 earthquake successively occurred in less than 5 years.

Keywords [Sichuan-Yunnan Region](#), [Longmenshan Fault](#), [LuShan Earthquake](#), [GPS](#), [FEA](#)

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