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松潘-甘孜块体东北端强震间相互作用及地震危险性研究

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Earthquake stress interaction in the northeastern Songpan-Garzi block and its implication for earthquake hazard

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摘要

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摘要 松潘-甘孜块体位于中国大陆西南部、南北地震带的中段,其东段与扬子块体相接,拥有多条活动断裂带,是青藏高原北部的主要构造单元。该地区地震活动性强烈,历史上曾发生过多次灾难性地震。本文基于地震触发原理和黏弹松弛分层地壳模型,计算了松潘-甘孜块体东北端历史强震之间应力传输和相互作用的过程。模型结果显示,受之前地震导致的库仑应力场变化的影响,1879年武都地震和1976年8月23日松潘M7.2级地震震中库仑应力积累提升,将促进这些地震提前发生;1933年M7.5叠溪地震和1973年M6.5松潘地震震中库仑应力降低,前续地震的影响可能使得这两次地震的发震时间推迟;在研究历史地震对1960年漳腊M6.7级地震、1976年8月16日M7.2级和1976年8月22日M6.7级松潘地震的作用时,有效摩擦系数的取值十分重要,当有效摩擦系数取0.8时,前续地震导致的应力场变化将促进以上三次地震的发生。松潘-甘孜块体东北端的强震活动有效地增强了西秦岭北缘断裂、东昆仑断裂玛沁-玛曲段、鲜水河断裂康定-道孚段和岷江断裂中段上的库仑应力积累,将提升这些断裂今后发生地震的概率;有效降低了龙日坝断裂上库仑应力的积累,降低了该断层上发生地震的概率。松潘-甘孜块体的地震活动降低了汶川地震震中位置的库仑破裂应力,但提升了破裂面东北段的应力积累,有助于汶川地震向东北端破裂。

关键词 松潘-甘孜块体, 库仑破裂应力, 地震相互作用, 地震危险性

Abstract: The Songpan-Garzi block, located in Southwest China and the central segments of north-south seismic belt, lies to the west of the Yangtze block. It is one of most important tectonic units in the northern Tibet Plateau with several active faults in and around it. The seismic activity is highly active in this region, and several devastating earthquakes were recorded in this area. Based on earthquake stress triggering theory, we calculated the stress transfer and earthquake interaction process of the sequence of historical strong earthquakes in the northeastern Songpan-Garzi block with elastic dislocation theory and the viscoelastic multilayered crustal model. The results show that Coulomb failure stress increases significantly in the epicenter of the Wudu earthquake, 1879 and the M7.2 Songpan earthquake, August 23, 1976. The increased stress encourages the occurrences of these two earthquakes. The accumulated stress is released on the epicenters of the M7.5 Diexi earthquake, 1933 and the M6.5 Songpan earthquake, 1973, whose occurrences are mainly delayed by previous earthquakes. The effective friction coefficient is very important in the study of the M6.7 Zhangla earthquake, 1960, the M7.2, August 16 and the M6.7, August 22 Songpan earthquake, 1976. If the value of 0.8 is chosen, the occurrences of three events are encouraged by previous earthquakes. The strong seismic activity in the northeastern Songpan-Ganzi block raises the stress accumulations on the West Qinling fault, the Maqin-Maqu segment of East Kunlun fault, the Kangding-Daofu segment of the Xianshuihe fault and the mid-segment of the Minjiang fault, and will encourage the occurrence of earthquakes on these faults. The historical earthquakes released the accumulated stress on the Longriba fault, on which the seismic activity will be depressed. Although the accumulated stress in the epicenter of the Wenchuan earthquake is released, the strong earthquakes in the northeastern Songpan-Ganzi block enhances the stress loading on the northeastern segment of the rupture plane of the Wenchuan earthquake, and will encourage it to rupture northeastwards.

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