

川滇地区强震序列库仑破裂应力加卸载效应的数值模拟

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收稿日期 2007-12-26 修回日期 2008-5-22 网络版发布日期 2008-9-17 接受日期

摘要 通过建立较精细的川滇地区三维有限元模型, 数值模拟了川滇地区主要活动断裂的强震活动对于其他活动断裂潜在强震孕育进程的库仑破裂应力加卸载效应. 模拟结果显示在川滇地区主要活动断裂带的几何学展布形态和运动学性质的构造背景之上, 川滇地区强震活动相互影响的主要特征是活动断裂面库仑破裂应力变化大多处于增大状态. 其中, 金沙江断裂带、小江断裂带、楚雄—建水断裂带、鲜水河断裂带和安宁河断裂带上的强震所产生的加载作用比较强, 而丽江—小金河断裂带和腾冲—澜沧断裂带则较弱. 1981~2000年川滇地区 $M \geq 6.5$ 地震序列的模拟结果显示, 后续地震全部位于已发生地震所引起的库仑破裂应力增大区之内. 数值模拟结果显示, 在川滇地区, 一个强震发生之后, 发震断层本身强烈卸载的同时, 库仑破裂应力的加载效应在其他主要活动断裂带潜在强震孕育进程中占据了主导地位, 强震活动之间相互作用的主要效应是应力加载, 已发生的强震加速了下一个强震的孕育进程, 进而导致一系列地震的发生, 直至整个区域所积累的应变能处于较低水平之后, 区域地震活动进入一个新的平静期.

关键词 [川滇地区](#) [三维有限元模拟](#) [强震活动](#) [库仑破裂应力](#) [加卸载效应](#)

分类号 [P541,P315](#)

DOI:

Numerical simulation of loading/unloading effect on Coulomb failure stress among strong earthquakes in Sichuan-Yunnan area

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Received 2007-12-26 Revised 2008-5-22 Online 2008-9-17 Accepted

Abstract Using a fine three dimensional (3-D) finite element model of Sichuan-Yunnan area, we simulate the loading/unloading effects of strong earthquakes to following events on the other active faults in the region. The results of simulation show that in light of the geometric and kinematic patterns of major active faults the strong earthquakes in the region cause the Coulomb failure stress to increase on most active fault planes in Sichuan-Yunnan area. Since the interactions among events are mainly loading, an event usually may advance the occurring of the following one. The loading effects of Jinshajiang fault, Xiaojiang fault, Chuxiong-Jianshui fault, Xianshuihe fault and Anninghe fault are strong, but that of Lijiang-Xiaojinhe fault and Tengchong-Lancang fault are relatively weak. The simulation of $M \geq 6.5$ earthquake sequence from 1981 to 2000 indicates that the later events all occurred in regions of increased Coulomb failure stress. In Sichuan-Yunnan area, after a strong earthquake, accompanying the strong unloading on the rupture segment itself, the Coulomb failure stress loading effects dominate the evolution process of future events on the other major active faults. So a group of events will occur until most of the accumulated energy is released and a new peaceful period comes.

Key words [Sichuan-Yunnan area](#); [3-D finite element simulation](#); [Seismic activity](#); [Coulomb failure stress](#); [Loading/unloading effect](#)

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