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2010年 M_S 7.1级玉树地震同震库仑应力变化以及对2011年 M_S 5.2级囊谦地震的影响

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Coseismic Coulomb stress change caused by 2010 $M_S=7.1$ Yushu earthquake and its influence to 2011 $M_S=5.2$ Nangqên earthquake

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摘要

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摘要 2010年4月14日青海省玉树藏族自治州发生 M_S 7.1级地震. 和传统的板内地震相比, 玉树 M_S 7.1级地震的余震具有数量少、震级大的特点. 研究玉树地震主震与余震之间的关系, 对于我们了解余震的发震机理具有十分重要的参考价值. 本文利用弹性位错理论和分层岩石圈模型, 计算玉树地震引起的同震及震后黏弹松弛应力场变化, 讨论 M_S 7.1级玉树地震对余震分布的影响以及与2011年囊谦 M_S 5.2级地震之间的触发关系. 结果显示, 玉树地震导致了四处明显的库仑应力增强的扇区, 2010年4月13日至6月17日的870次 $M_L>1.0$ 级余震主要分布于主震破裂面附近区域以及破裂面东北端的应力增强扇区. 分析玉树地震对余震分布的影响时, 有效摩擦系数以及计算深度的选取对计算结果的影响较小, 是否考虑区域构造应力场的影响较大. 考虑区域构造应力场时, 占总数86.7%的余震位于库仑应力增强区, 地震应力触发理论较好地解释了余震的分布. 选取囊谦地震震源机制解的两个节面作为库仑应力计算中的接收断层参数, 并且考虑不同黏滞系数下的玉树地震同震及震后黏弹松弛效应, 模型计算结果均表明囊谦地震位于玉树地震所导致应力影区, 仅依靠地震的静态、震后黏弹松弛应力触发理论, 无法解释囊谦地震的发生, 说明该次地震可能是一次独立的事件.

关键词 玉树地震, 囊谦地震, 地震应力触发, 库仑破裂应力

Abstract: A moderate and widely felt earthquake of M_S 7.1 occurred on April 14, 2010 in Yushu district of Qinghai province, China. Comparing with typical intraplate earthquakes, the exceptional characteristic of aftershock sequence of Yushu earthquake is that the aftershocks are exceptionally sparse and strong for such a moderate earthquake. Thus, the relationship between the M_S 7.1 mainshock and its aftershocks should provide us a good opportunity to investigate the mechanism of aftershock occurrences. Based on the elastic dislocation theory and multilayer lithospheric model, we calculate the coseismic static and postseismic viscoelastic relaxation stress changes induced by the Yushu earthquake, analyze its influence on aftershocks distribution, and discuss the interaction between M_S 7.1 Yushu earthquake and 2011 M_S 5.2 Nangqên earthquake. The results show that the coseismic stress changes induced by Yushu earthquake obviously raised the stress accumulation in four regions. Analyzing the relationship between Coulomb stress changes and aftershocks distribution, the numerical result is insensitive to the effective coefficient of friction and calculated depth, but more sensitive to the effect of regional stress. Taking the regional stress into account, 86.7% of total aftershocks located in the regions with increased Coulomb stress. The aftershock distribution of Yushu earthquake could be well explained by the earthquake stress triggering theory. Taking the two nodal planes of the focal mechanism of Nangqên earthquake as the receiver fault, we calculate the coseismic and postseismic stress changes with different viscosities. The numerical results indicate that the hypocenter of Nangqên earthquake always locates in the stress shadow, which means the theories of static and viscoelastic relaxation stress triggering can not explain the occurrence of Nangqên earthquake. So, we propose that the Nangqên earthquake could be an independent event.

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Keywords [Yushu earthquake](#), [Nangqên earthquake](#), [Earthquake stress triggering](#), [Coulomb failure stress](#)

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