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俯冲带上特大地震静态库仑应力变化对后续余震触发效果的研究

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A study of the impact of static Coulomb stress changes of megathrust earthquakes along subduction zone on the following aftershocks

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摘要 参考文献 相关文章

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摘要 地震静态触发研究在全世界范围内广泛开展,并取得显著成效;但是否所有的大地震,地震静态触发都有很好的效果,对此目前还不甚清楚.本文通过计算最近发生在俯冲带上的三次特大地震(2011年日本东北地震(M_W=9.1)、2010年智利地震(M_W=8.8)与2004年苏门答腊—安达曼地震(M_W=9.0))所产生的静态库仑应力变化,考察主震库仑应力变化对其后续余震空间分布的影响,从而研究俯冲带上特大地震对地震的触发效果.计算结果显示:对于2011年日本东北地震,仅有47%的后续余震发生在库仑应力增加的区域;2010年智利地震也只有47.6%的余震位置处于库仑应力变化的正值区;2004年苏门答腊地震触发了49.8%的后续余震.文中通过进一步改变模型参数(如:采用不同的有效摩擦系数,使用不同作者给出的震源模型等)进行计算,结果表明这三大地震对后续余震的触发比例仍然不高(最好情况下,触发比例也不超过60%).但对于板内地震(如:2008年汶川地震,1999年集集地震),主震对后续余震的触发比例超过85%.由此可以推知,对于俯冲带上的特大地震,地震静态触发效果不显著.因此,对于俯冲带上大地震的触发问题,还需深入研究.

关键词 地震静态触发, 库仑应力变化, 俯冲带, 余震分布

Abstract: Research on static earthquake triggering has been carried out widely in the world, and achieved remarkable results. But it is still unclear whether this model is effective to all large earthquakes. In this paper, we investigated Coulomb stress changes of the 3 megathrust earthquakes along subduction zone (the 2011 M_W9.1 Tohoku earthquake, the 2010 M_W8.8 Chile earthquake and the 2004 M_W9.0 Sumatra-Andaman earthquake) which occurred in this century to test the triggering effects by examining the correlation between Coulomb stress increases and spatial distribution of the following aftershocks. The calculated results suggest that there is no obvious evidence that the Coulomb stress changes caused by the 3 megathrust earthquakes promoted the occurrence of the aftershocks. There are only 47% of the encouraged aftershocks following the Tohoku earthquake. And there are 47.6% and 49.8% for the Sumatra-Andaman and the Chile earthquake, respectively. We also calculated the Coulomb stress changes with different focal models and parameters. It is still less than 60% of the promoted aftershocks in the optimal case. However, the static triggering model is good for the Wenchuan earthquake and the Chi-Chi earthquake which have enhanced more than 85% of the subsequent aftershocks. This model may be not reasonable for large subduction earthquakes. Therefore, other model should be introduced in studying earthquake triggering in subduction zone and further studies will be performed.

Keywords Static earthquake triggering, Coulomb failure stress change, Subduction zone, Aftershocks distribution

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