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昆仑山M_S 8.1级地震震后变形场数值模拟 与成因机理探讨

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摘要 2001年11月14日，在青海和新疆交界处发生了昆仑山M_S8.1级强烈地震，GPS后观测显示，此次地震震后形变不仅在断裂南北两侧存在很大的差异，而且在短时间调整后断裂南北两侧表现为同向运动.本文以观测的地震形变为约束，通过有限元数值模拟分析昆仑山地震震后形变的物理机制.建立有关的有限元虚功方程，通过有限元数值方法模拟震后形变，从理论上分析介质的非均匀性、黏滞性松弛、流体调整对震后形变的影响.采用网格搜索确定昆仑断裂南北两侧下地壳的黏滞系数分别为5.0×10^{17}Pa·s, 9.0×10^{18}Pa·s左右，正是这十余倍的差异引起了断裂两侧震后形变的非对称性和同向运动，这一差异既是长期地质作用的结果，又是现代地球动力学环境的决定因素之一.通过数值模拟定性讨论了断裂北侧地表形变在震后短期内的调整，对于靠近断裂附近的测点可能是黏弹性松弛和孔隙流体调整共同作用的结果，所以在分析短期震后形变时综合考虑黏弹松弛和孔隙流体调整是很有必要的.

关键词 昆仑山M_S 8.1级地震 震后形变 黏弹介质 孔隙介质 有限元模拟

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The numerical simulation and discussion on mechanism of postseismic deformation after Kunlun M_S 8.1 earthquake

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Abstract On November 14th 2001 an earthquake with magnitude of M_S 8.1 occurred at the Qinghai-Xizang Plateau in China. The deformation observed by GPS shows that there are many differences between the deformations of south and north sides of the Kunlun fault. And after a short span of about three months, the deformations at all GPS stations are eastward. In this paper, the postseismic deformation observed by GPS is used as constraints and we analyze the possible mechanism of postseismic deformation after Kunlun earthquake. Firstly, this paper constructs the virtual work equation and theoretically analyzes the effects of heterogeneous, viscoelastic, poroelastic characters on the postseismic deformation. Then this paper uses grid-search procedure to determine the viscosity for different models. The best fitting viscosities of lower crust is 5.0×10^{17}Pa·s and 9.0×10^{18}Pa·s for the south and north sides of Kunlun fault, respectively. The difference of viscosities brought on the special postseismic deformation. And this difference is not only the result of long-term geological action but also one of the crucial factors of modern geodynamic environment. On the other hand, the simulation shows that the postseismic deformation after 2001 Kunlun M_S8.1 earthquake is caused not only by the viscoelastic relaxation but also by poroelastic relaxation. So it is necessary that the viscoelastic relaxation and poroelastic rebound be combinedly considered during process of analysis of postseismic deformation.

Key words Kunlun earthquake Postseismic deformation Viscoelastic medium Poroelastic medium FEM

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