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汶川 M_S 8.0地震余震序列重新定位及其地震构造研究

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Seismotectonic study by relocation of the Wenchuan M_S 8.0 earthquake sequence

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摘要

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摘要 综合利用川西流动地震台阵观测数据和震后应急地震观测站台的震相数据,采用双差地震定位方法对汶川地震的余震序列进行了精确重新定位,并对汶川地震的地震构造进行了深入研究.其结果显示,汶川地震序列从彭灌杂岩南缘开始破裂,主震及其余震破裂带长约350 km,在大部分区域宽约20~30 km,其宽度和空间形态沿破裂带显示了强烈的分段和非均匀特征.坚硬的彭灌杂岩对余震的非均匀性分布和汶川地震复杂的破裂过程起到了重要的控制作用.以松潘—甘孜地块中地壳低速层顶部为底边界,余震主要分布在4~24 km深度范围内的龙门山东缘上地壳高速层内.余震深度分布剖面清晰地显示了映秀—北川断裂和灌县—江油断裂以及汶川—茂汶断裂在20~22 km深度合并为剪切带的特征.小鱼洞到理县方向存在一条长度超过60 km的垂直于龙门山走向的余震分布条带,综合震源机制解和地震破裂过程的研究结果,我们推测,这是坚硬的彭灌杂岩体底部在长期应力积累作用下发生破裂的反映,并成为汶川地震释放出巨大能量的主要原因.

关键词 汶川 M_S 8.0地震, 余震序列重新定位, 地震构造, 龙门山断裂带, 地震台阵

Abstract: Accurate relocation of the Wenchuan earthquake sequence is obtained by using the double difference relocation algorithm from the integrated travel time data recorded at the Western Sichuan movable seismic array and the earthquake emergency response stations. In this presentation, the seismotectonic deformation and rupture process is also investigated. The results show that the Wenchuan earthquake sequence begins from the south margin of the Pengguan Massif and extends northeastward for about 350 km within a width of 20~30 km. The spatial distribution of the aftershocks exhibits obvious inhomogeneity which can be divided into small sectors. The rigid Pengguan Massif controls the distribution of the earthquake sequence and the complex rupture process. The aftershocks occurred mainly in the depth ranging from 4 to 24 km inside the high velocity layer of the upper crust in the eastern border of the Longmen Shan and above the low velocity zone in the middle crust. Depth distributions of the aftershocks across the sections show clearly that the Yingxiu-Beichuan, Guanxian-Jiangyou and the Wenchuan-Maowen faults merge into a shear belt at the depth of 20~22 km. There exists an aftershock distribution belt from Xiaoyudong to the direction of Lixian, which is perpendicular to the strike of the Longmen Shan and longer than 60 km. Consulting with the results of the focal mechanism of strong aftershocks and the rupture process of the main shock, it could be inferred that the lower part of the Pengguan Massif has been broken up during the earthquake after long term stress accumulation, which would be the main reason why such a great earthquake occurred.

Keywords Wenchuan earthquake, Relocation of earthquake sequence, Seismotectonics, Longmenshan fault belt, Portable seismic array

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