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基于GPS同震位移场约束反演2008年5.12汶川大地震破裂空间分布

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Coseismic slip distribution of the 2008 Wenchuan great earthquake constrained using GPS coseismic displacement field

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摘要

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摘要 2008年5月12日发生在四川汶川的大地震造成映秀—北川断裂和灌县—江油断裂同时破裂, 分别形成了240多公里和70多公里的地表破裂带. 本文以GPS观测获得的同震位移场为约束, 反演地震破裂的空间分布. 反演结果显示映秀—北川主破裂带倾向北西, 沿破裂带的走向从南到北倾角逐渐变大, 破裂断层的平均宽度在10~18 km左右. 破裂断层的错动在南段以逆冲为主, 在北段走滑分量逐步加大, 右旋走滑成为断层破裂的主要特征. 断层破裂最大段落错动量分别达到了7.8 m和7.4 m, 恰好对应这次地震中地表破坏最为严重的映秀和北川地区. 本次地震释放地震矩 $6.70 \times 10^{20} \text{ N} \cdot \text{m}$, 相应矩震级 $M_w = 7.9$.

关键词 汶川地震, GPS, 同震位移, 破裂空间分布

Abstract: The May 12, 2008 Wenchuan earthquake ruptured the Yingxiu-Beichuan and Guanxian-Jiangyou faults, and produced surface ruptures of ~240 km and ~70 km in length along the two faults, respectively. In this study, the coseismic displacement field derived from GPS observations collected before and after the quake is used to invert for the fault geometry and slip distribution of the rupture. The result shows that the Yingxiu-Beichuan fault dips to the northwest at a moderate angle of ~41° at the southwest end, and the fault plane gets progressively steeper northeastward along strike, reaching a dip angle of ~73° at Qingchuan. The averaged width of fault plane is 10~18 km. Slip caused by the earthquake is characterized mainly by thrust motion with a modest right-lateral strike slip component at the south segment of the fault. As the rupture travelled farther northeastward, the thrust component tapers down gradually, and the dextral component becomes dominant at the northeast end of the rupture. The slip distribution on the Yingxiu-Beichuan fault shows two high-slip concentrations of up to 7.8 m and 7.4 m, respectively. The two high-slip concentrations are just near the Yingxiu town and Beichuan city, which suffered the greatest fatalities and structure damages during the quake. The seismic moment release is estimated to be $6.70 \times 10^{20} \text{ N} \cdot \text{m}$, corresponding to an $M_w 7.9$ earthquake.

Keywords Wenchuan earthquake, GPS, Coseismic displacement, Slip distribution

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