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腾冲地区地壳速度结构的有限差分成像

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Finite difference tomography of the crustal velocity structure in Tengchong, Yunnan province

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摘要

利用流动台网和固定台站的地震观测数据,采用有限差分层析成像方法反演了腾冲及邻近地区的地壳P波速度结构,分析了腾冲火山区的岩浆活动和龙陵七级地震的深部构造成因.研究结果表明,腾冲火山区的地壳结构具有明显的非均匀性,浅表层偏低的速度主要为盆地内部的松散沉积层、新生代火山堆积及断裂附近的流体裂隙和热泉活动所致;5～15 km之间的高速体可能代表了早期火山通道内冷却固结的岩浆侵入体或难挥发的超铁镁质残留体;地壳深部的低速体则反映了熔融或半熔融的岩浆体,推断火山区下方的岩浆活动与龙陵七级地震震源区地壳深部的岩浆侵入来自同一源区——现今壳内岩浆活动的主要区域.龙陵震源区的地壳速度结构横向变化较大,怒江断裂东侧和龙陵断裂西侧为高速特征,介质应变强度较大,为应力积累的主要载体;两断裂之间的低速区向下延伸至下地壳,可能与地壳深部的岩浆侵入有关;龙陵断裂和怒江断裂明显控制了这一区域的岩浆活动,七级地震正是发生在断裂下方的速度边界附近.地壳介质强度的横向变化导致了震源区应力积累的不均一性,深部岩浆的聚集和动力作用是龙陵地区发生强震的主要原因.

关键词 P波成像, 岩浆作用, 龙陵地震, 腾冲火山区

Abstract:

This paper applies the finite difference tomography method to invert for the P-wave velocity structure in the Tengchong area using earthquake data from a temporary network and other permanent stations, and analyzes the magmatic activity of the Tengchong volcanoes and the deep tectonic genesis of Longling *M*7.3/*M*7.4 earthquakes. The results show the mean velocity in the crust with clear heterogeneity is a little lower. The lower velocities in the shallow layers are caused by unconsolidated basin deposits, Cenozoic volcanic deposits, fluid fractures and hot springs. The high-velocity zone at 5～15 km depth probably represents the cooled and solidified magmatic intrusions or the less volatile ultramafic remnants. The low-velocity structure in the deep indicates the molten or semi-molten magma. It is probable that the magmatic activity beneath the volcanoes and heat flow intrusions in the deep crust of Longling earthquake zone are from the same magmatic hearth area, which is the main area of the present magmatic activities. A strong lateral heterogeneity is observed in Longling earthquake zone. The east of the Nujiang fault belt and the west of the Longling fault belt have the characters of high-velocity with the high strength of rock, which are the main bearing body of stress accumulation. However, the low-velocity anomaly between the two faults extends to lower crust, probably caused by magmatic intrusions in the deep crust. The magmatic activity in this area is controlled clearly by the Longling fault and the Nujiang fault. The Longling *M*7.3 and *M*7.4 earthquakes occurred near the velocity boundary beneath the faults. The main reasons of the strong earthquakes in the Longling area contain the heterogeneity of stress accumulation caused by the lateral variation of the crustal medium strength, the deep magmatic aggregation and dynamic effects.

Keywords P wave tomography, Magmatism, Longling earthquakes, Tengchong volcanic area

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