

川滇地区横波 Q 值动态变化

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Dynamic variation of S-wave Q value beneath Sichuan-Yunnan, China

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摘要

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摘要 Q 值的动态变化能够反映地壳应力、裂隙、地下流体等的变化趋势,为进一步理解地震的孕育发生提供证据.文中尝试将选自中国地震年报、四川省地震台网观测报告及云南省地震台网观测报告的数据分成6个时间段,分别对每个时间段的数据进行成像,来获得 Q 值的动态变化图像.首先选择一个具有超过14000条射线数据的时间段,通过原始数据加噪音的方法和Bootstrap方法对 M_L 振幅成像的结果进行误差和可信度分析,然后在误差可接受的基础上,再对每个时间段的数据进行成像.研究结果发现:(1)原始数据的观测误差和忽略震源辐射花样对成像结果的影响比较小,40%的噪音所造成的结果误差最大不超过6%.(2)用Bootstrap方法获得的结果最大误差不超过平均 Q 值的8%,说明振幅层析成像方法在川滇地区的应用因采用大量数据所获得的结果是稳定可靠的,误差是比较小的.(3)分辨率测试发现,川滇地区在射线超过50条的区域,分辨率能够达到20'.(4)分别对每个时间段进行成像,从而获得 Q 值变化的动态图像.每个时段的区域平均 Q 值与中强地震的个数有明显的正相关关系,即地震个数越多,则区域平均 Q 值越大,这可能是区域整体应力变化的结果.通过分析地震的分布和 Q 值动态变化的关系还发现,大多数中强地震不是分布在 Q 值变化最大的区域,而是分布在 Q 增加和降低最大区域之间的过渡区域,这可能是由于差应力变化在过渡区最大,更容易触发地震造成的.

关键词: 四川云南地区 S波 振幅层析成像 Q 值动态变化

Abstract: Variation of Q value can provide the information of crustal stress, rock cracks, and fluid variation, and evidence to understand preparation and generation of earthquake. In this study, the amplitude data from the Annual Bulletin of Chinese Earthquake and the provincial earthquake bulletins of Sichuan and Yunnan were tentatively divided into 6 time segments. Tomographic M_L amplitude method has been applied for each time segment to obtain temporal Q value variations. Firstly, a representative time segment with more than 14000 ray paths was selected to estimate the resolution and error of tomographic attenuation structure by adding random noise to original data and bootstrap method. Then, based on the detailed analysis of reliability, the same tomographic method with the same parameters was applied for all time segments. The research result shows that (1) the imaging error is small from the observation error of original data and ignoring radiation pattern of earthquake source. The error is less than 6% if 40% random noise is added to the original data. (2) The bootstrap method shows that the maximal error is less than 8% of average Q value, that means the tomographic results are stable and reliable because of huge data set in Sichuan and Yunnan region. (3) In checkerboard test, the resolution can reach 20' for the region with more than 50 ray paths in each cell. (4) The Q value variations were obtained after imaging for each time segment. A clear positive relation was found between the average Q value for each time segment and the number of middle and large earthquakes, in other words, the more earthquakes, the larger average Q , that may be resulted from the changes of regional stress. The relation between earthquake distribution and Q value variation was analyzed and we found that most of the large earthquakes did not occur in the maximal variation region of Q , but in the transition zone between maximal increase and drop of Q value. Maybe the differential stress has a maximal change in transition zone and the earthquake is easier to trigger.

Keywords: Sichuan and Yunnan S-wave Amplitude tomography Q value variation

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