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银川盆地深地震断层的三维透射成像

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Tomographic determination of the deep earthquake faults in Yinchuan basin by using three-dimensional seismic transmission technology

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摘要

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摘要 为了获得三维地震透射成像技术在活断层探测中的有效性和应用价值的评价,在银川盆地中北部布设了一个三维地震透射台阵,利用该台阵获得的基底初至折射波和莫霍界面反射波资料,采用有限差分反演、时间项反演和连续速度模型反演方法,对台阵区域基底及上地壳结构进行了分析.结果表明:研究区基底呈东西浅、中部深的界面形态,且西陡东缓,最深处大致位于芦花台至西大滩一带,埋深达7 km.芦花台断层、银川—平罗断层、黄河断层在研究区内均表现为北北东走向的速度差异条带,且断层两侧基底及沉积界面埋深存在显著变化.芦花台断层东倾,倾角较陡,延伸至研究区基底之下;银川—平罗断层倾向西,是一条超基底的隐伏断层;黄河断层西倾,延伸深度超过研究区基底.本探测结果证明,初至折射波与莫霍面反射波探测相结合的三维地震透射台阵技术能够给出研究区上地壳三维细结构图像,不仅可以揭示主要断裂的展布位置、浅部空间形态和特征,而且可以揭示断裂向基底之下的延伸状况.

关键词 活断层探测, 银川盆地, 地震透射台阵, 上地壳三维细结构

Abstract: In order to prove the validity and application value of three-dimensional seismic transmission technology in active fault detection, a three-dimensional seismic transmission array was deployed in the middle north of Yinchuan basin. The basement and upper crust structure under the seismic array were reconstructed based on first-arrival refraction traveltimes and reflection traveltimes from Moho at critical distances by using finite difference method, time-term method and the inversion method without model blocks. The results show that the basement of the studied area is shallow in the east and west and deep in the centre and it is steeper in the west than in the east. The greatest depth of the basement occurs between Luhuatai to Xidatan, and its depth reaches 7 km there. Luhuatai fault, Yinchuan-Pingluo fault and Huanghe fault all behave as velocity difference strip of NNE direction and there is significant variation in the depth of the sediment interface. The east-dipping, high-angle Luhuatai fault extends under the basement. The west-dipping Yinchuan-Pingluo fault is a buried fault penetrating the basement. Huanghe fault dips toward the west and penetrates the basement as well. These exploration results prove that the three-dimensional seismic transmission technology, which combines first-arrival refraction wave exploration with Moho reflection wave exploration, is applicable in the reconstruction of fine upper crustal image of the studied area. With this technology, we can not only reveal distribution and shallow features of the major faults, but also their extension under the basement.

Keywords Active fault detection, Yinchuan basin, Seismic transmission array, Three-dimensional fine structure of the upper crust

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