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深地震反射剖面揭示的渭河盆地西安坳陷的地壳精细结构

任隽[1,2], 冯希杰[1], 王夫运[3], 彭建兵[2], 刘晨[1], 戴王强[1], 李高阳[1], 张艺[1], 马冀[1]*

1. 陕西省地震局, 西安 710068;
2. 长安大学地质工程与测绘学院, 西安 710064;
3. 中国地震局地球物理勘探中心, 郑州 450002

Fine crust structures of Xi'an sag in the Weihe basin revealed by a deep seismic reflection profile

REN Jun[1,2], FENG Xi-Jie[1], WANG Fu-Yun[3], PENG Jian-Bing[2], LIU Chen[1], DAI Wang-Qiang[1], LI Gao-Yang[1], ZHANG Yi[1], MA Ji[1]*

1. Earthquake Administration of Shaanxi Province, Xi'an, 710068, China;
2. School of Geological Engineering and Geomatics, Chang'an University, Xi'an 710064, China;
3. Geophysical Prospecting Center, China Earthquake Administration, Zhengzhou 450002, China

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摘要

2005年,跨西安坳陷完成一条NW方向,69 km长的深地震反射剖面,首次获得该区域的地壳精细结构、主要断裂展布和深、浅构造关系图像.地震反射CMP叠加时间剖面显示,以反射事件C为界,地壳被分成上下两部分.上地壳由多组近水平反射带组成,具有分段连续性好、局部存在反射带明显错断或形态突变等特征,清晰地刻画出西安坳陷新生代沉积分层、坳陷底界、渭河断裂带、临潼-长安断裂带和秦岭山前断裂带的几何形态和关系.反射事件C是结晶地壳内宽度约0.5 s的反射带,最深处位于桩号30 km,底界约6.5 s,向西北缓慢抬升至5.5 s,向南东迅速抬升至5.5 s.下地壳有两个明显的反射事件RA、RB: RB是位于桩号40~47 km之间的局部反射团, 而RA为宽度约2 s、向坳陷倾斜的反射带.以桩号38 km为界,反射Moho形态截然不同,而且出现了显著的错断:大桩号方向,反射Moho为位于双程走时11~14 s水平的反射分段连续的过渡带,宽度约3 s;小桩号方向,反射Moho为一宽度约2 s、并向大桩号倾斜的反射分段连续的过渡带,其形态和反射事件RA相同.根据地震波速度资料,求得这几个反射带顶界的深度分别为:10.5~13.5 km(反射带C)、20.3~21.5 km(反射带RB)、16.8~34.3 km(反射带RA)和32~36.7 km(反射带Moho)左右.作者认为形态一致的反射事件RA和反射Moho很可能是古秦岭洋向华北地台俯冲的遗迹.此外,西安坳陷内错断新生界深达反射事件C的渭河和临潼-长安断裂带和莫霍错断的存在,表明该地区地壳现今活动性很强,是未来强震发生值得注意的地区.

关键词 西安坳陷, 深地震反射剖面, 地壳结细结构, 渭河盆地, 大陆动力学, 秦岭造山带

Abstract:

In 2005, a cross the Xi'an sag, a NW-direction and 69 km-long deep seismic reflection profile was completed. It is first time to get the fine structures of the crust, the distribution of main faults and image of tectonics relation between deep and shallow structure in this region. CMP time-stack section of seismic reflection shows the crust is divided into two parts by a reflection event C as the boundary. Upper crust consists of multiple nearly horizontal reflection belts, with good segmental continuity, local existence the fault offset reflection belts or the characteristics of morphological mutations that clearly depict Xi'an sag Cenozoic sedimentary layers, the bottom boundary of sag, and the geometry and relationships of the Weihe Fault, Lintong-Chang'an fault zone and piedmont of Qinling fault zone. C is the reflection event in the crystallization crust, with the reflection band width of about 0.5s, the deepest of the bottom boundary of about 6.5s at stake No. 30 km, slow uplift to the northwest to the 5.5 s, rapid uplift to the south east to the 5.5 s. There are two distinct lower crustal reflection events RA and RB: RB is the local reflect group at stake No. 40~47 km; RA is the band width of about 2 s, which inclines to sag. RA is a strong reflection under C and above Moho south of the stake 34 km. Arguably, the upper crust is above the C interface in the whole profile, but from south of stake 34 km, crust under C interface is divided into middle crust and lower crust by RA interface. From north of stake 34 km, RB is weak, unclear reflection group, so it cannot be a distinct interface to divide middle and lower crust. On both sides of stake No. 38 km. Moho

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reflection is of different forms, but there is also a significant fault to offset in big stake number direction. Moho reflection in the two-way travel time (TWT) for the 11~14 s is a level piecewise continuous reflection transition zone, with width of about 3 s in small stake number direction. Moho reflection is a about 2 s wide, piecewise continuous transition zone and tilts to the big stake number direction. Its shape is almost same as reflection event RA. According to seismic velocity data, these depth of top boundaries of reflective belts are:10.5~13.5 km (reflective belt C), 20.3~21.5 km (reflective belt RB), 16.8~34.3 km (reflective belt RA) and 32~36.7 km (reflective belt Moho) or so. The authors think the same shape of reflection events of RA and Moho is likely the relic of ancient Qinling ocean to dive to the North China platform. The fracture tectonic in this district developed, according to the reflection wave group characteristics of CMP stack-time section of deep reflection profile and total 11 faults (F1~F11) explained by the obvious characteristics of fracture. In addition, the depth Weihe fault and Lintong-Chang'an fault to the reflective belt C in Xi'an Cenozoic sag and the presence of Moho fault indicates that the region has strong present crustal activity, being worth noted as the future strong earthquake area.

Keywords Xi'an sag, Deep seismic reflection profile, Crustal fine structure, Weihe basin, Continental dynamics, Qinling orogenic belt

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About author: 任隽,男,1971年生,博士,2012年毕业于长安大学,主要从事地球物理和地震工程等方面的研究工作.E-mail:hi8341@sina.com

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