地球物理学报 » 2012, Vol. 55 » Issue (12) :4106-4115 doi:10.6038/j.issn.0001-5733.2012.12.023

引用本文(Citation):
郭飚, 刘启元, 陈九辉, 贺日政, 李顺成.中国大陆及邻区上地幔P波各向异性结构. 地球物理学报, 2012,55(12): 4106-4115,doi: 10.6038/j.issn.0001-5733.2012.12.023

GUO Biao, LIU Qi-Yuan, CHEN Jiu-Hui, HE Ri-Zheng, LI Shun-Cheng.P-wave anisotropy of upper-mantle beneath China mainland and adjacent areas.Chinese J.Geophys. (in Chinese),2012,55(12): 4106-4115,doi: 10.6038/j.issn.0001-5733.2012.12.023

中国大陆及邻区上地幔P波各向异性结构

郭飚[1], 刘启元[1], 陈九辉[1], 贺日政[2], 李顺成[1]*

1. 地震动力学国家重点实验室,中国地震局地质研究所,北京 100029;
2. 中国地质科学院地质研究所,北京 100037

P-wave anisotropy of upper-mantle beneath China mainland and adjacent areas

GUO Biao[1], LIU Qi-Yuan[1], CHEN Jiu-Hui[1], HE Ri-Zheng[2], LI Shun-Cheng[1]*

1. State Key Laboratory of Earthquake Dynamics, Institute of Geology, China Earthquake Administration, Beijing 100029, China;
2. Institute of Geology, Chinese Academy of Geological Sciences, Beijing 100037, China

摘要

利用分布在中国大陆及邻近地区的213个地震台站记录到的远震P波走时数据和弱各向异性条件下P波速度扰动调和分析方法,研究了中国大陆上地幔P波各向异性结构.研究结果表明中国大陆西部上地幔变形主要受印度大陆俯冲的影响.印度大陆的P波快波方向总体为NNE方向,与绝对板块运动方向一致,这表明印度大陆上地幔流动方向与板块运动方向一致.青藏高原内部、东天山的P波快波方向与主压应力方向接近,而在青藏高原南缘、北缘及东北缘等块体边界地区P波快波方向与主压应力方向垂直.中国大陆东部上地幔变形主要受菲律宾板块和太平洋板块俯冲的影响.在扬子板块内部P波快波方向为SE方向,这与绝对板块的运动方向一致.华北地区的各向异性结构较为复杂,可能与华北克拉通裂解有关.中国大陆东北的东部平均方向为SE,而在兴安岭一侧为SSW方向,即平行于构造线方向.根据各向异性的倾角,中国大陆及邻区上地幔各向异性结构大体可分为三块:1)青藏新疆地区的各向异性倾角接近水平,推测该区形变力源主要为上地幔物质水平流动.2)南北带地区的各向异性倾角较大,特别是在青藏东缘地区的倾角约为40°,这可能是由于青藏向东挤出过程中受华南地块和鄂尔多斯地块的阻挡,在板块边界地区产生了垂直变形.3)中国东部地区各向异性结构较为复杂,在中国大陆东北部各向异性倾角接近水平,这可能是该区上地幔变形主要受太平洋板块俯冲的影响,而在太行山、大别—苏鲁地区各向异性倾角较大,这表明该区上地幔以垂直变形为主.

关键词 远震P波走时, 地震各向异性, 中国大陆, 上地幔形变

Abstract:

The P-wave anisotropic structures of upper-mantle beneath China mainland and adjacent areas are obtained by using teleseismic P-wave traveltime data recorded by 213 permanent seismic stations and the harmonic decomposition analysis of qP velocity perturbation under the condition of weak anisotropy. The results show that the deformation of upper-mantle in China mainland is mainly controlled by the subduction of Indian, Philippine Sea and Pacific plates. In the Indian plate, the fast P-wave directions are roughly in NNE, which is consistent with the absolute plate motion. This implies that the direction of the mantle flow is consistent with the absolute plate motion. The fast P-wave directions are parallel to the direction of the principal stress in central Tibet, eastern Tianshan, while perpendicular to the direction of the principal stress in southern, northern and northeast margins of Tibet. In the Yangtze block, the fast P-wave direction trends SE, parallel to the absolute plate motion and perpendicular to the main tectonic lines. In North China, the anisotropic pattern is complex, which is perhaps associated with the decomposition of the ancient craton. In Northeast China, the average fast P-wave direction trends SE, and SSW in the Xinganling area which is parallel to the tectonic line. According to the dipping angle of fast P-wave, the anisotropic structure in China mainland and adjacent areas can be roughly divided into three regions: 1) The dip angle of fast P-wave in Tibet and Xinjiang regions are nearly horizontal, which implies that the upper-mantle deformation is mainly affected by horizontal drag. 2) In the north-south tectonic zone, especially in eastern Tibet, the dip angles turn to steep. These indicate that the Yangtze block and Ordos obstruct the escape

flow of Tibet, and produce vertical deformation in boundary areas. 3) In Northeast China, the dip angles of fast P-wave are nearly horizontal. It means that the deformation style is mainly affected by the horizontal mantle flow caused by subduction of the Pacific plate. The dip angles of fast P-wave are very large beneath the Taihang and Dabie Mountain, which implies that the vertical deformation is predominant in these regions.

Keywords Teleseismic P-wave traveltimes, Seismic anisotropy, China mainland, Upper-mantle deformation

Received 2012-04-10;