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中国东北地区地壳、上地幔速度结构及其对矿产能源形成的控制作用

田有, 刘财, 冯晖*

吉林大学地球探测科学与技术学院, 长春 130026

P-wave velocity structure of crust and upper mantle in Northeast China and its control on the formation of mineral and energy

TIAN You, LIU Cai, FENG Xuan*

College of Geo-exploration Science and Technology, Jilin University, Changchun 130026, China

摘要

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摘要 中国东北地区处于古亚亚洲洋和滨太平洋构造域叠合部位, 地质构造极其复杂. 利用东北及华北地区部分台网所接收的近震及远震走时资料获得东北地区地壳与上地幔三维P波速度结构, 成像分辨率在80 km左右. 成像结果表明东北地区地壳与上地幔具有较强的横向不均匀性. P波速度异常走向大体呈北东向, 与该区地表构造走向一致. 5 km深度的速度异常与地表起伏形态有很好的对应关系: 阴山、燕山与大兴安岭造山带表现为高速异常; 渤海湾盆地, 松辽盆地表现为低速异常, 渤海湾低速异常一直延伸至 >200 km深度. 东北地区呈现两个明显的低速异常条带, 分别是沿着长白山一线与松辽盆地地区, 其中长白山低速异常延伸至400 km深度附近. 地幔转换带 (410~660 km) 表现为显著高速异常体, 这与西向俯冲的高速太平洋板块在地幔转换带中的滞留相对应. 较高分辨率的三维速度成像结果表明东北地区构造演化 (如岩浆活动、岩石圈演化、深震与火山活动等) 与东北亚地区大地幔楔内软流圈上涌与西太平洋板块在地幔转换带中的滞留密切相关. 东北地区的岩浆活动在矿产与油气资源的形成过程中起着提供物源和深层控制作用.

关键词: 中国东北地区 地震层析成像 地壳与上地幔 P波速度 岩浆活动

Abstract: Northeast China, which is located at the composite part of Paleo-Asian ocean and Pacific ocean domains, has undergone multi-stage tectonism. The activity of crust and upper mantle is strong and geological structure is complicated. In this paper, we obtain the three-dimensional P-wave velocity model of northeast China by using P-wave travel times from local and teleseismic events in North and Northeast China. The tomographic resolution is about 80 km. The tomographic images show a very heterogeneous structure in the crust and upper mantle under Northeast China. The velocity structure in the shallow depth (5 km depth) correlates well with the surface geological features: Yanshan and Da Hinggan Ling orogens show high-velocity anomalies and the Bohai Bay and Songliao basin show prominent low-velocity anomalies which extend down to more than 200 km depth. Two low-velocity anomaly belts exist in Northeast China, which are along the Changbai Mountain and Songliao Basin, respectively. Changbai Mountain low-velocity anomaly extends down to about 400 km depth. Mantle Transitional Zone (MTZ) represents high-velocity anomaly which correlates well with the high-velocity Pacific subducted slab stagnating in the MTZ. High resolution tomographic images represent that structural evolution of Northeast China (e.g., magmatism, lithosphere evolution, deep seismicity and volcanism) is related to the upwelling of hot and wet asthenospheric materials in the big mantle wedge above the stagnant Pacific slab. The magmatism of Northeast China provided the source in formation of the minerals and took deep control effect on energy source formation.

Keywords: Northeast China Seismic tomography Crust and upper mantle P-wave velocity structure Magmatic activity

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About author: 田有, 男, 1979年生, 吉林大学地球探测科学与技术学院, 副教授, 主要从事地球内部结构成像研究工作. E-

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