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华北克拉通中部地区背景噪声成像

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Ambient noise tomography in north China craton

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摘要

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摘要 利用华北地区的流动与固定地震观测台阵在2007年1月~12月期间的垂直分量记录,采用背景噪声层析成像方法获得了华北克拉通中部地区6~40 s的相速度和群速度分布图像.成像结果显示研究区地壳以及上地幔的速度结构存在很大的横向不均匀性.8~16 s的相速度以及8~20 s的群速度分布图像清晰地勾绘出华北地区盆地和隆起之间的边界.华北盆地以及山西断陷带呈明显的低速异常,表明相应区域存在较厚的沉积层并且在中、上地壳内存在低速带;而太行山隆起以及鄂尔多斯高原则呈现高速异常.相速度16~25 s以及群速度20~30 s的图像显示华北盆地由低速异常变为高速异常,表明华北盆地的地壳较薄.长周期(30~35 s)相速度图像表明华北盆地的上地幔顶部存在低速异常.华北盆地较薄的地壳和低速异常(明显低于全球平均水平),可能与该地区岩石圈减薄,软流圈物质上涌有关.8~35 s的群速度和相速度图像都显示,大同火山区是一个低速异常区,可能是由目前仍在活动的岩浆的加热而引起地壳升温造成的.

关键词: 背景噪声层析成像 华北盆地 鄂尔多斯 山西断陷带 群速度 相速度

Abstract: Peking University deployed two linear arrays (140 km apart) of 45 portable broadband seismometers across the southern part of Shanxi Rift during August 2006 to March 2008. Using the ambient noise records at these two arrays and some stations from North China Seismic Array (NCSA) of the Institute of Geophysics, China Earthquake Administration (CEA), permanent stations from Hebei Seismological Bureau and Shanxi Seismological Bureau, CEA, China, we obtained empirical Green's function of Rayleigh wave employing the cross-correlation technique. Then we measured group velocity and phase velocity at periods from 6 s to 40 s for all possible station pairs. The results of tomography show that substantial lateral variations exist between Ordos and North China Basin (NCB). Sedimentary basins of NCB and Shanxi Rift are clearly imaged as low velocity anomalies at periods of 8 s. Low group velocities at 12~20 s and phase velocities at 12~16 s may indicate a low velocity layer in the upper and middle crust beneath NCB. However, Ordos and Taihang uplift are imaged as high velocities in the same period range. The rapid change from low velocity anomaly to high anomaly between 16 s and 25 s in phase velocity maps and between 20 s and 30 s in group velocity maps suggests that the Moho depth beneath NCB is much shallower than that beneath Ordos. At longer periods (30~40 s), phase velocity maps show that the velocity beneath NCB is lower than that of Ordos, which could be related to the thinning of lithosphere and the upwelling of asthenosphere beneath NCB. Datong volcanic region is revealed as low velocity anomaly in group and phase velocity maps from 8 to 35 s, which could be caused either by high temperature or partial melt in the crust resulting from active magmatism.

Keywords: Ambient noise Tomography North China Basin Ordos Shanxi rift Group velocity Phase velocity

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