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中国大陆及邻区Rayleigh面波相速度分布特征

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摘要　本文根据102个数字化台站记录的长周期垂直向面波资料，利用双台互相关方法测量了538条独立路径的基阶Rayleigh面波相速度频散资料，反演获得了中国大陆及边邻地区（70°E～140°E，18°N～55°N）20～120 s（周期间隔为5 s） 共21个周期的Rayleigh波相速度空间分布图像. 检测板测试结果显示中国大陆中东部地区横向分辨率可达3°，而西部及边邻地区大约5°. 研究表明，中国大陆地区的Rayleigh波相速度分布横向差异显著，大致以104°E为界，可分成具有不同速度结构特征的东、西两部分. 一般较短周期（20～35 s）的相速度分布受地形和地壳厚度的影响较大，总体表现为东部速度高，西部速度低；塔里木盆地、青藏地块及其东缘的松潘-甘孜地块形成整个研究区内最为突出的低速异常体，蒙古西部低速特征也较清晰；东部的四川盆地、扬子地块、华南地块、松辽盆地、日本海及蒙古东部高速特征明显. 随着周期的增大，青藏地块中部的低速异常体横向尺度逐渐缩小，而喜马拉雅冲断带、塔里木盆地相速度不断升高，意味着青藏低速区受到南、西北、东三个方向的高速区夹击，可能导致高原中部软弱的低速物质向东南方向迁移；同时，东部地区由高速逐渐转变为大面积的低速分布，反映东部地区岩石圈较薄而软流圈发育. 随着青藏地块低速特征的减弱，印支地块北部及相邻海域、东海、东北吉林深震区、日本海、中-朝地块至蒙古东部成为120 s周期上突出的低速异常体，而上扬子地块包括四川盆地高速特征依然明显，显示出稳定的古板块特征. 南北地震带始终呈现出相对较低的速度特征，并成为划分中国大陆具有不同岩石圈相速度特征的东部与西部的天然分界.

关键词　Rayleigh面波,相速度分布,双台法,中国大陆

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Rayleigh-wave phase velocity distribution in China continent and its adjacent regions

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Abstract Using a two-station analysis and vertical component records of Rayleigh waves from 102 seismograph stations in China and adjacent areas, we measured inter-station fundamental mode Rayleigh-wave phase velocity dispersion in the period band 20～120s for 538 independent paths. Dispersion data were then used to invert for 21 phase velocity maps from 20s to 120s with 5s interval in the continental China and its adjacent regions (70°E～140°E, 18°N～55°N). Checkerboard tests show that the lateral resolution is about 3° in central　eastern China and about 5° in western China and adjacent regions. The spatial distribution of phase velocities in the study area is significantly different for the parts of China to the west and east of approximately 104°E. The phase velocity maps at shorter periods (20～35s) are influenced by topography and crustal thickness. On these maps, the western part is characterized by low phase velocities and the eastern part shows relatively high phase velocities. The Tarim basin, the Qinghai-Tibet plateau, and its eastern margin (the Songpan　Garze block) form the most prominent low velocity structures in the study region. A large-scale low velocity anomaly also appears in western Mongolia. The Sichuan basin, the Yangtze block, the south-China block, the Songliao basin, the Sea of Japan, and eastern Mongolia are marked by relatively high phase velocities. At larger periods, the lateral size of the low velocity anomaly beneath central Qinghai-Tibet becomes smaller whereas the phase velocities increase beneath the Himalayan thrust and Tarim Basin. This implies that the Qinghai-Tibet low velocity area is surrounded by seismically fast structures to the south, northwest, and east, which may control a southeastern migration of mechanically weak, seismically slow material away from the central plateau. Meanwhile, a large area in the eastern part which appears fast at shorter periods shows relatively low phase velocity, suggesting a relatively
thin lithosphere and a pronounced asthenosphere. As the low velocity anomaly beneath Qinghai-Tibet plateau becomes weaker, the northern Indo-China block and its adjacent off-

shore areas, East China Sea, Northeast China's deep-earthquake region in Jilin Province, Sea of Japan, and the Sino-Korean block to eastern Mongolia are marked by prominent low phase velocity anomalies at the period 120s. However, high phase velocities appear in the upper Yangtze block (including the Sichuan Basin), which means that the ancient block is relatively stable. The North-South Seismic Belt in China has relatively low phase velocity from periods 20s to 120s, and becomes a natural boundary separating the continental China into the eastern and western parts with different lithospheric phase velocity features.

Key words Rayleigh wave Phase velocity distribution Two-station method Continental China

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