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青藏高原东北缘上地幔地震各向异性:来自SKS、PKS和SKKS震相分裂的证据

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Seismic anisotropy in the uppermost mantle beneath the northeastern margin of Qinghai-Tibet plateau: evidence from shear wave splitting of SKS, PKS and SKKS

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摘要

基于青藏高原东北缘甘肃区域台网41个宽频带地震台站的远震记录资料,通过PKS、SKS和SKKS震相的剪切波分裂分析,获取了台站下方介质的各向异性分裂参数,得到该地区上地幔各向异性分布图像,并结合GPS速度场和地壳剪切波各向异性分析青藏高原东北缘各向异性形成机制及壳幔各向异性特征.分析结果认为,在阿尔金断裂带西侧,各向异性快波偏振呈NWW-SEE方向,与断裂带走向有一定夹角,与塔里木盆地向柴达木盆地俯冲方向一致,说明该地区上地幔物质变形主要受古构造运动的影响,属于"化石"各向异性.在祁连山-河西走廊构造区,XKS快波偏振呈NW-SE方向,一致性较好,与区域断层走向方向相同;由区域小震的地壳剪切波分裂分析得到的地壳剪切波快波偏振在该区域呈NE-SW方向,与相对于稳定欧亚大陆GPS运动速率一致,地壳和地幔快波偏振方向的差异表明壳幔变形可能有不同的形变机制.在陇中盆地及其周缘,由于处于活跃青藏地块与稳定鄂尔多斯地块之间的过渡带,相对于其他区域具有更加复杂的构造背景,地壳快波偏振和地幔快波偏振总体上呈NWW-SEE方向,说明壳幔变形机制可能相同;但不同台站结果之间存在一定离散性,推测是由于受局部构造特征差异性造成.

关键词 青藏高原东北缘, 上地幔, 地壳, 各向异性, 剪切波分裂

Abstract:

Based on teleseismic PKS,SKS and SKKS phases (XKS) recorded by 41 permanent broadband stations in Gansu province in northeastern margin of Qinghai-Tibet plateau,this study obtains the splitting parameters of fast polarization direction and delay time between the fast and slow shear waves at each station using the minimum transverse energy method,and then,plots the distribution map of upper mantle anisotropy around this area. Furthermore,combined with GPS velocity field and crustal anisotropy from near-field shear-wave splitting using SAM method,we discuss the characteristics and formation mechanism of the crust-mantle anisotropy in the northeastern margin of Qinghai-Tibet plateau. The results can be summarized as follows. In the west part of Altun fault,the fast wave polarization trends NWW-SEE,siting at a certain degree angle to the strike of regional structures,while coinciding with the subduction direction from Tarim Basin to Qaidam Basin,which reveals that in this region,the upper mantle deformation is mainly affected by ancient tectonic movement so that it belongs to "fossil" anisotropy. In Qilian-Hexi Corridor tectonic region,the XKS fast direction is NW-SE,consistent with strike direction of the main fault in this area. while the fast direction obtained from near-field shear-wave splitting is NE-SW,consistent with GPS velocity relative to stable Eurasian Continent. The different direction between crust and mantle suggests that the deformation mechanism of them may be different in this area. Crust anisotropy represents the direction of regional principal compressive stress, and XKS anisotropy may reflect the direction where materials flow. In Longzhong Basin and adjacent regions,which located in the transition zone between the active Qinghai-Tibet block and comparatively stable Ordos block,with more complex tectonic background,the fast directions in the crust and in the upper mantle are consistent by and large,which means that the crust and the upper mantle possibly have the same deformation,but owing to local feature's influence,the results vary obviously with these stations.

Keywords Northeastern margin of Qinghai-Tibet plateau, Upper mantle, Crust, Anisotropy, Shear-wave splitting

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