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青藏高原东北部岩石圈有效弹性厚度及其各向异性

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Lithospheric effective elastic thickness and its anisotropy in the northeast Qinghai-Tibet plateau

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摘要

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摘要

青藏高原东北部是中国大陆构造环境特殊的主要构造域, 毗邻青藏高原羌塘地块、塔里木盆地、四川盆地和华北克拉通, 属于不同构造类型块体俯冲、碰撞及陆内汇聚的结合部, 在中国大陆形成与演化的历史中扮演着重要角色. 岩石圈有效弹性厚度(T_e)及其各向异性与岩石圈流变性、力学结构紧密相连, 研究青藏高原东北部的岩石圈 T_e 及其各向异性将为我们认识大陆岩石圈的流变性及其动力学过程提供重要信息. 本文基于 F_{an} 小波相关性分析法, 运用布格重力和地形资料获得了青藏高原东北部岩石圈 T_e 及其各向异性二维分布的详细信息. 研究表明研究区域内 T_e 的分布范围在5~100 km之间; 松潘—甘孜地块、祁连山造山带和龙门山地区的 T_e 较薄(5 km < T_e < 40 km)、各向异性较强; 而周缘的断裂带、缝合带的 T_e 值都较低, 其中龙门山断裂带 T_e 只有5~20 km, 且南、北两段各向异性存在明显差异. 内部的若尔盖盆地 T_e 值略显高值, 说明其是仍保留有刚性的块体; 北缘的柴达木盆地地下伏为古生代的地壳, 被认为是古老的克拉通碎片, T_e 较大(50 km < T_e < 90 km), 显示为轮廓分明的刚性块体. 并且我们发现研究区域内 T_e 的各向异性轴垂直于大的块体边界. 通过比较 T_e 各向异性与SKS波的快波偏振方向、Rayleigh面波方位角各向异性的相互关系我们推测阿拉善地块各向异性源自地幔橄榄岩晶格的优势取向, 岩石圈变形趋于垂直连贯变形模式; 柴达木盆地各向异性源于历史构造事件残留在岩石圈中的“化石”各向异性; 松潘—甘孜地块各向异性源自物质的侧向流动.

关键词 小波分析, 有效弹性厚度, 各向异性, 青藏高原东北部

Abstract:

Adjacent to Qiangtang terrane, Tarim basin, Sichuan basin and North China block, the northeast Qinghai-Tibet plateau is one of the major tectonic provinces in mainland China, which is a combinative region with subduction, collision and intracontinental gathering and plays an important role in the deformation and evolution process of continental China. The lithospheric effective elastic thickness (T_e) and its correspondent mechanical anisotropy are tightly related to the rheologic properties and the mechanic structures. Thus, studying on these characteristics in the northeast Qinghai-Tibet plateau will provide important information for understanding the rheologic structure and the dynamic process of continental lithosphere. In this work, Fan wavelet analysis on coherence between Bouguer anomaly and topography is applied to obtain a more detailed two dimensional lithospheric T_e structure as well as its anisotropic properties in the Songpan-Garzê terrane. The results show that the effective elastic thickness of the lithosphere varies significantly from 5 km to 100 km. In general, in the east margin of the northeast Qinghai-Tibet plateau, the Songpan-Garzê terrane is a weak tectonic zone with a low T_e (5 km < T_e < 40 km) and strong anisotropy. Low T_e anomalies are also distributed in the marginal zones of the tectonic blocks, such as the fault zones and the suture zones. In Longmenshan mountain the strength is extremely weak, where the T_e only ranges 5~20 km, and the anisotropic structure can be divided into north and south segments. T_e in the Zoigê basin is a little higher than surrounding area, which implies that the Zoigê basin is still capable of strong rigidity. The distribution of T_e shows that the Qaidam basin is a rigid block, the magnitude

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of T_e ranges 50~90 km, with a well-defined edge which is underlain by Paleozoic crust. Therefore, we believe that the Qaidam basin should be underlain by fragments of old cratonic blocks. Compared with the geological surveys and the seismological studies, our results show that the weak mechanical axes are perpendicular to the main tectonic boundaries. By comparing our results with SKS and the seismic azimuthal anisotropy axes, we suggest that the source of our observed anisotropy in Alxa massif is likely to be vertically coherent "frozen" deformation of the lithosphere due to alignment of olivine crystals. In Qaidam basin, the T_e anisotropy therein most likely reflects the fossil strain field from past tectonic events. Anisotropy in Songpan-Garzê terrane is maybe developed by lateral flow.

Keywords [Wavelet analysis](#), [Effective elastic thickness](#), [Anisotropy](#), [Northeast Qinghai-Tibet plateau](#)

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