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Effective elastic thickness of the continental lithosphere in China from heat flow: Implications for the lithospheric rheology and active tectonics

S. Liu (1) and L. Wang (2)

(1) School of Geographic and Oceanographic sciences, Nanjing University, Nanjing 210093,China (shaowliu@nju.edu.cn),
(2) School of Earth Science and Engineering, Nanjing University, Nanjing 210093, China (lswang@nju.edu.cn)

The effective elastic thickness (Te) of continental lithosphere is one important parameter that describes the response of the lithosphere to long-term loads. However, the estimation of Te is still controversial and various forward and inverse methods have been proposed since the last 20 years. Besides the general application of gravity-topography based inverse method, thermal aspect and related technique is more emphasized, since the mechanical behavior of lithosphere is obviously influenced by temperature. Here we present the effective elastic thickness of the continental lithosphere in China from heat flow data by the method proposed by Burov et al, *J. Geophys. Res.*, 1995, 100(B3):3905-3927.

Our results show that Te varies much in different areas of China due to diverse and complicated geological evolution and associated change in thermal regime. Te is much larger than the crustal thickness in the regions where the heat flow is really low (usually less than 50mW/m^2) and the lithosphere is relatively thick, indicating much more contribution from the upper mantle to the whole strength of lithosphere. Under this condition, the rheology of the mantle with olivine dominates the deformation manner and processes of the lithosphere and the typical cases in China are those blocks (Tarim, Junggar, Ordos and Sichuan) in central-western China. For instance, the Te of the Tarim basin is 66$\pm$7km, and is obviously larger than crustal thickness of 45km. Te is less than the crustal thickness in the areas where the heat flow is relatively high (usually larger than 65 mW/m^2), approximating to the depth of crustal brittle-ductile transition, which suggests more contribution from the crust and the dominative control of the felsic crust on the rheology and deformation of the lithosphere, and this model is available in the southeast coastal China, eastern North China and other young orogenic belts. Furthermore, we compared the estimated Te with the seismogenic layer thickness (Ts) available in China, and find that the Te is much greater than Ts in the rigid blocks with low heat flow, but is basically identical to Ts in the areas with high heat flow, which is inconsistent with the idea that Te of continental lithosphere is usually less than Ts as proposed by Maggi et al., *Geology*, 2000, 28 (6): 495-498. Accordingly, we conclude that two end-element modes for the rheology of continental lithosphere as the strong crust-weak mantle and the weak crust-strong mantle, respectively, are all available in China, considering differences in thermal regime, composition and geological evolution.

This rheological structure of continental lithosphere controls the seismicity and other active tectonics in China. It is found that all the seismicity and active faults are more diffuse in those areas with low Te but more localize at the boundaries of rigid blocks with large Te such as the Tarim and Ordos, and the boundaries where deformation is intensive coincide well with the Te transition imbedding different values. The Ms 8.0 Wenchuan earthquake occurred at the Longmenshan fault belt in 12 May 2008 in China is just the scenario of rheological contrast between the strong Sichuan block and the weak northeast margin of the Tibet Plateau.