The distribution and formation mechanism of lower-crust channel flows in the Qinghai-Tibet Plateau

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Abstract:

The Qinghai-Tibet Plateau is characterized by the following features: 1) located at a depth of between 43 and 72 km with very high thickness; 2) containing a lot of salt water from the Tethys Ocean; 3) with temperatures of between 800 and 1100°C, which are 300°C higher than the common temperatures in the lower crust in craton areas. These features cause large-scale thermal expansion and deformation. Previous study from P-wave tomography and Magnetotelluric (MT) have supported the hypothesis of the presence of the large lower crust channel flows. In this study, we inverted the crustal density perturbations from high-resolution ground gravity data, to study the distribution and formation mechanism of the lower-crust channel flows in the Qinghai-Tibet Plateau. Moreover, thermal expansion and deformation in continuum mechanics were applied to derive the relationship between the low-density anomalies and the thermal strains, hence to get the thermal strain maps. In the lower crust, the lowest density anomaly (highest thermal strain) is located in the convergence zone where the Karakoram Fault (KF), Bangong-Nujiang Suture (BNS) and Yalung-Zangpo Suture (YZS) meet. Another area where the density anomaly is low (thermal strain is high) is in the north part of the YZS. These two low-density zones may indicate the source areas of the lower-crust channel flows. Some low-density branches are extending outside from the source areas. Comparing with the density distributions in the upper, middle and lower crust, the channel flow squeezes upward like dental cream to the middle crust, leading to crustal thickening and uplift of the plateau. Our study is in consistent with the previous researches from P-wave tomography and MT and provide future constraints for the distribution and formation mechanism of the lower-crust channel flows in the plateau.

Keywords:

geodynamics; Qinghai-Tibet Plateau; lower crustal channel flows; density perturbations; thermal expansion

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