Geophysical Research Abstracts
Vol. 17, EGU2015-4964-1, 2015
EGU General Assembly 2015

Crust-mantle density distribution in the eastern Qinghai-Tibet Plateau revealed by satellite-derived gravity gradients

Honglei LI (1,2,3), Jian Fang (1), Carla Braitenberg (3), and Xinsheng Wang (4)

(1) State Key Laboratory of Geodesy and Earth's Dynamics, Institute of Geodesy and Geophysics, Chinese Academy of Sciences, Wuhan, 430077, China (hlli@whigg.ac.cn), (2) University of Chinese Academy of Sciences, Beijing, 100049, China, (3) Department of Mathematics and Geosciences, University of Trieste, Trieste, 34100 Italy, (4) National Earthquake Infrastructure Service, Beijing, 100045, China

As the highest, largest and most active plateau on Earth, the Qinghai-Tibet Plateau has a complex crust-mantle structure, especially in its eastern part. In response to the subduction of the lithospheric mantle of the Indian plate, large-scale crustal motion occurs in this area. Despite the many previous studies, geodynamic processes at depth remain unclear. Knowledge of crust and upper mantle density distribution allows a better definition of the deeper geological structure and thus provides critically needed information for understanding of the underlying geodynamic processes.

With an unprecedented precision of 1-2 mGal and a spatial resolution better than 100 km, GOCE (Gravity field and steady-state Ocean Circulation Explorer) mission products can be used to constrain the crust-mantle density distribution. Here we used GOCE gravitational gradients at an altitude of 10km after reducing the effects of terrain, sediment thickness variations, and Moho undulations to image the density structures of eastern Tibet up to 200 km depths. We inverted the residual satellite gravitational gradients using a least square approach. The initial density model for the inversion is based on seismic velocities from the tomography. The model is composed of rectangular blocks, having a uniform density, with widths of about 100 km and variable thickness and depths. The thickness of the rectangular cells changes from10 to 60km in accordance with the seismic model.

Our results reveal some large-scale, structurally controlled density variations at depths. The lithospheric root defined by higher-density contrast features from southwest to northeast, with shallowing in the central part: base of lithosphere reaches a depth of180 km, less than 100km, and 200 km underneath the Lhasa, Songpan-Ganzi, and Ordos crustal blocks, respectively. However, these depth values only represent a first-order parameterization because they depend on model discretization inherited from the original seismic tomography model. For example, the thickness of the uniform density blocks centered at140 km depth is as large as 60 km. Low-density crustal anomalies beneath the southern Lhasa and Songpan-Ganzi blocks in our model support the idea of weak lower crust and possible crustal flow, as a result of the thermal anomalies caused by the upwelling of hot deep materials. The weak lower crust may cause the decoupling of the upper crust and the mantle. These results are consistent with many other geophysical studies, confirming the effectiveness of the GOCE gravitational gradient data. Using these data in combination with other geodynamic constraints (e.g., gravity and seismic structure and preliminary reference Earth model), an improved dynamic model can be derived.