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

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INTRODUCTION AND GEOLOGICAL SETTING

As the highest, largest and most active plate on Earth, the Qinghai-Tibet Plateau has a complex crust-mantle structure, especially in its eastern part. In response to the subduction of the Indian plate, large-scale crustal motion occurs in this area. 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 large-scale crustal motion occurs in this area. 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 large-scale crustal motion occurs in this area.

Our research confirmed that GOCE (Gravity field and steady-state Ocean Circulation Explorer) mission products with high precision and a spatial resolution better than 50 km can be used to constrain the crust-mantle density distribution.

In the eastern part of the Tibetan Plateau, there are five major crustal blocks as:

- A Lhasa
- B Qiangtang
- C Songpan-Ganzi
- D Kunlun–Qaidam
- E Qilian Shan terranes

To the east of Tibetan Plateau, there are four major crustal blocks as:

- F Yangtze Craton
- G Sichuan Basin
- H Qinling Dabie Fold System

DATA PRESENTATION: GRAVITY GRADIENT MEASUREMENTS AND MODELING CONSTRAINTS BY TOMOGRAPHIC DATA

Gravity Gradient Anomaly (spherical harmonic expansion)

Tomographic Data
(Peng 2012) Tibet Vs Model + LUCI-GRIDDY Model)

The density of the crust changes with depth. The density changes are temperature, pressure dependent. The relationship with P, S wave velocity:

\[ \rho = \rho_0 \left(1 + \frac{2}{3} \psi \right) \]

Density changes with depth in ordinary deposits should not be ignored.

DISCUSSION AND CONCLUSION

DISCUSSION

1) Accomplished preliminary inversion of GOCE gradients. Method was tested on synthetic crustal model.
2) Inversion Voigtan is constrained down to 300 km depth, below, Voigt assumption is not valid.
3) Strong constraint gives starting density model
4) Gradient isostatic residuals are inverted. Starting density model is modified through inversion.
5) Density contrasts are converted to absolute densities referring to starting tomography values.

RESULTS

1) Crustal thickness of China and India plate below the density below 300 km depth.
2) Thickness of Tibet is lower. Main crust of Qiangtang block and part of China block have reduced density.
3) Combination with data due to cross checks results and test influence of starting model on final result.

REFERENCES


Feng et al. 1986. The seismic wave velocity of the Eastern Tibetan Plateau (1° x 1°).