Supporting Information for

3D density model of the upper mantle of Asia based on inversion of gravity and seismic tomography data

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Introduction

This supporting information explains calculation of the **gravity field and dynamic topography induced by deep density heterogeneity of the mantle** and provides maps of these fields for Asia and surrounding area.

Text S1.

This study focuses on the uppermost mantle down to ~325 km (lower limit of the model). Therefore, it is important to remove beforehand from the residual mantle gravity field and residual topography the effect of deep density variations located below. This can be done based on global dynamic models of the mantle, which were massively developed last decades [e.g. *Steinberger and Calderwood*, 2006]. In this study we use the same fields (gravity and dynamic topography), which were previously employed in *Kaban et al.* [2015a, 2016]. A model of *Kaban and Trubitsyn* [2012] was used as a basis for the calculations. Compared to most existing models it includes the transition zone boundaries (410 and 660 km), which are determined in a joint inversion with S-wave velocities in the tomography model of *Gu et al.* [2003]. In addition, lateral viscosity variations (LVV) have been introduced based on the results of *Kaban et al.* [2014]. The numerical code ProSpher [*Petrunin et al.*, 2013] was used to calculate instantaneous flow velocities in the mantle and dynamic topography induced by density variations below a depth of 325 km. This code combines the advantages of both spectral-based and FD/FE numerical methods and can handle with strong LVV (up to 5 orders of magnitude in each layer), self-gravitation and compressibility. For more details see *Kaban et al.* [2015a, supplementary materials].

The gravity field and dynamic topography induced by the mantle density variations located below a depth of 325 km are shown in Fig. S1. The main amplitude of this fields is associated with a very long-wavelength trend and reflect deep density heterogeneity of the mantle as provided by seismic tomography. The amplitude of the dynamic topography is relatively insignificant (ca. ± 0.8 km), which is less than most previous estimations giving the values up to about ± 2 km [*Flament et al.* [2013]. However, the dynamic topography estimated in the present study represents only a part of the total mantle field: it reflects the effect of the mantle density heterogeneity below 325 km, while the contribution of the upper mantle is significant. Therefore, it is not correct to compare this result directly with other estimations based on the whole mantle models. The computed fields have been removed from the residual mantle gravity field and residual topography to refine the effect of the uppermost mantle.

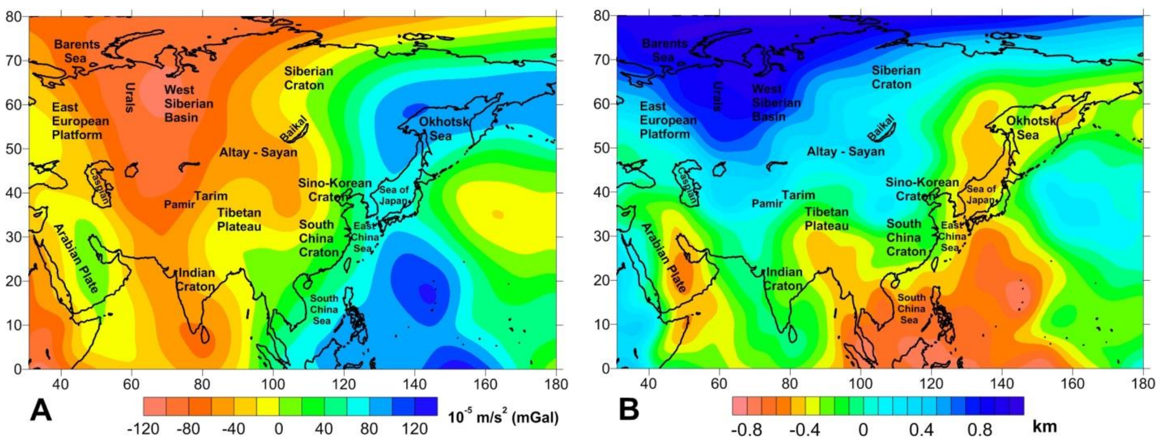

Figure S1. Gravity field (A) and dynamic topography (B) induced by the mantle density variations located below a depth of 325 km. The dynamic topography corresponds to the density 2670 kg/m^3.