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A new generation 3D density model of the lithosphere and upper mantle of Asia and surroundings

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We construct a 3D density model of the lithosphere and upper mantle of Asia based on integration of various data sets. A recent model of the crust based on nearly all available seismic data [1] is employed to calculate the impact of the crust to the gravity anomalies and observed topography. As a result, the residual mantle anomalies and residual topography are calculated. These fields are jointly inverted to calculate density variations in the lithosphere and upper mantle down to 325 km. As initial approximation seismic velocity variations [2] are converted into temperatures and then to density variations based on mineral physics constraints. In the Occam type inversion we fit both the residual mantle gravity anomalies and residual topography by finding deviations from the initial model. Using both fields gives a possibility to resolve vertical stratification of the density structure [3]. The obtained corrections are significant and reach $\pm 50 \text{ kg/m}^3$. They not only improve resolution of the initial model, but also reveal many principal features of the upper mantle, e.g. those related to composition, which are not resolved in seismic tomography. Generally, the obtained density variations reflect the tectonic fragmentation of Asia and ongoing tectonic processes. The most significant negative corrections of the upper mantle density are found in the East Siberian and East European cratons and can be associated with depleted mantle material. However, their amplitude reaches only $\sim 1.35 \%$, which is somewhat less than suggested before. The most significant positive density anomalies are found beneath the Tarim basin, South Caspian, Barents Sea and Bay of Bengal. We attribute these anomalies to eclogites in the uppermost mantle, which substantially affect formation of the basins. Furthermore, the obtained results provide evidence for a presence of eclogites in the mantle lithosphere of subducting oceanic slabs.

References:

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