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Density structure of the lithosphere from joint inversion of different data sets

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Lateral density variations in the upper mantle are one of the main signs of tectonic processes, which have led to formation of the lithosphere. To understand these processes it is especially important to estimate the input of different factors, which contribute to entire density anomaly within the upper mantle and to determine their depth. This problem closely relates to a definition of the lithosphere. In the previous analysis we have made a general discrimination between thermally and compositionally induced upper mantle density anomalies, however their distribution with depth remains to a large extent uncertain. To resolve this problem we use a joint inversion of different data sets. The main parameters are the 'crust-free' gravity anomalies and residual topography. The contribution of mantle density anomalies located at different depths to these fields is remarkably different, which provides a possibility to define their location. We also use seismic tomography data calibrated by a heat-flow interpretation but instead of a 'strong' velocity-density relationship, a 'weak' condition, which requires only a similarity of variations of these parameters, is used. As a result we obtained density distribution within several layers from the lower crust down to the depth of 250 km. The resulting model is global however for North America a high resolution model is also constructed. We found that the depth distribution of thermal and compositional density anomalies is remarkably different. Normally the 'compositional' lithosphere is thinner than the 'thermal' one: compositional anomalies are located at lesser depths than the temperature anomalies. However in some specific cases, in particularly in the vicinity of plate collision zones, we have found very deep positive compositional density anomalies, which may be associated with remnants of the lithosphere.