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Inverse and forward gravity modeling for revealing the crustal structure of Volga-Uralian subcraton

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A new crustal model of the Volga-Uralian subcraton was built. The compilation of the model was subdivided in two steps: (1) inverse gravity modeling followed by (2) thorough forward gravity modeling.

For inverse gravity modeling GOCE gravity gradients were used. The effect of the Earth sphericity was taken into account by using tesseroids. Density contrasts between crust and mantle were varied laterally according to the tectonic units present in the region. The model is constrained by the available seismic data including receiver function studies, and deep reflection and refraction profiles.

The Moho discontinuity obtained during the gravity inversion was consequently modified, and complemented by the sedimentary cover, upper crust, lower crust, and lithospheric mantle layers in the process of forward gravity modeling. Obtained model showed crustal thickness variation from 34 to more than 55 km in some areas. The thinnest crust with the thickness below 40 km appeared on the Pericaspian basin with the thickest sedimentary column. A relatively thin crust was found along the central Russia rift system, while the thickest crust is located underneath Ural Mountains as well as in the center of the Volga-Uralian subcraton. In both areas the crustal thickness exceeds 50 km. At the same time, the gravity misfit of ca. 95 mGal between the measured Bouguer gravity anomaly and forward calculated gravity field was revealed in the central area of the Volga-Uralian subcraton. This misfit was interpreted and modeled as high-density lower crust which can possibly represent an underplated material.

In the end, the new crustal model of Volga-Uralian subcraton respects the gravity and seismic constraints, and reflects the main geological features of the region. This model will be used for further geothermal analysis of the area.