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Recent upper mantle structure beneath Siberia and surrounding areas according to a seismic tomography and numerical thermogravitational convection modeling data

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We investigate the interaction between the recent lithosphere structure and dynamics of the upper mantle beneath a big segment of Asia. This study is based on the results of seismic tomography using travel times from the ISC catalog (1964-2007) and numerical thermogravitational modeling. The model contains thick lithosphere blocks of the Siberian Craton, the Tarim plate, and remnant parts of the Mongol-Tuva microcontinent. These blocks are alternated with weaker younger lithosphere corresponding to the West-Siberian plate, orogenic belts in southern Siberia and the Arctic shelves to the north.

In the tomography part, we have updated a previously published model by Koulakov and Bushenkova (2010) based on a larger dataset including reflected PP and teleseismic P travel times from global catalogues. The lithosphere thickness has been estimated based on seismic anomalies at 250 km depth according to a technique described in (Bushenkova et al., 2008). These estimates were used to define the lithosphere thickness which is then implemented for setting the boundary conditions in numerical modeling and for joint interpretation of the final results.

When computing the mantle dynamics, we consider the viscosity which is depends from temperature and pressure. Calculations are performed in the spherical coordinates. To minimize the boundary effects and to take into account the effect of the outside features, we considerably enlarged the calculation area by including the Russian, North- and South China Cratons and the Indian Plate. The modeling results demonstrate formation of steady ascending flows caused by overheating under the cratons (the average temperature of the upper mantle under a craton increases to $\sim 100°$) and descending flows on their periphery. The ascending flows spread along the bottom of the cratonic lithosphere and propagate towards its edges which cause smaller-scale convection cells nearly the borders of the cratons.

The computed temperature distribution is compared with seismic anomalies derived from the tomographic inversion and with the heat flow measured on the surface. These fields appear to be consistent for most regions. For example, ascending flows beneath Sayan and Mongolia fit to negative seismic anomalies and elevated heat flow. Same features are observed in N-W and central parts of the Siberian craton (Putoran Plateau and Tura region).