Geophysical Research Abstracts
Vol. 16, EGU2014-1475, 2014
EGU General Assembly 2014

Geophysical data on the cratonic lithosphere structure and composition in the Northern Eurasia

Ninel Pavlenkova (1), Galina Pavlenkova (1), and Tamara Yegorova (2)
(1) Institute of Physics of the Earth RAS, Moscow, Russian Federation, (2) Geophysical Institute of NAS, Kiev, Ukraine

The seismic profiles made in Russia with Peaceful Nuclear Explosions (PNE), were interpreted with the purpose of constructing the upper mantle velocity models of the Northern Eurasia. The profiles show that the horizontal inhomogeneity of the upper mantle correlates with tectonics and geophysical fields. Higher velocities (8.2-8.4 km/s) are characteristic of the uppermost mantle of the cold East European and Siberian cratons, the velocities of 8.0-8.1 km/s are observed in the young plates with higher heat flows. The PNE data show a clear velocity and rheology stratification of the craton lithospheres. The asthenosphere is not traced as a low velocity layer, on the contrary, the 10-20 km thick velocity inversion zone is revealed at a depth of around 100 km. Several seismic boundaries are traced along all the profiles at depths of 100, 150, 200 and 300 km. The boundaries are not simple discontinuities. The reflections from these boundaries are complicated many-phase groups which may be explained by the reflective zones with alternation of the high- and low-velocity layers. The most important boundaries are the N boundary (depth of 80-120 km) which underlies the lithosphere brittle part, and the L boundary (depth of 200-250 km) which is the lithosphere bottom.
The 2D gravity modelling for the PNE profiles shows differences in the lithosphere composition of the East European and of the Siberian cratons. The Siberian Craton is characterized by the decreased densities which may be a result of the lithosphere material depletion. These data are in good agreement with the petrophysical modelling based on the xsenolite and thermal data. The higher densities are characteristic of the fertile matter of the primitive mantle, the lower densities – of the depleted mantle represented mainly by the garnet peridotites. The seismic boundary L may be a transition from the depleted to the fertile upper mantle.
The obtained data show that an important role in the mantle dynamics belongs to the deep fluids advection. This assumption is based on the high content of hydrogen and helium in the Earth's core. The fluids create the low velocity and high electrical conductivity layers at a depth of around 100 km, and the reflection boundaries (multi-layers zones) in the mantle. They modify the cratonic lithosphere composition by melting and extraction of comatites and basaltic components. The latter leads to depletion of the upper mantle and to its density decrease. The fluid flows have also a great importance for the formation of the thick continental lithosphere: the long process of the removal of silica, alkalis, fluids and incompatible elements in the crust should lead to the lithosphere crystallization. The longer this process continues, the thicker the crust and the mantle lithosphere become. Further gradual cooling makes the upper mantle more stable, promoting the formation of the less permeable cratonic lithosphere.