THE STRUCTURE OF CONSOLIDATED CRUST OF THE YAKUTIAN DIAMONDIFEROUS PROVINCE - NORTHERN PART: EVIDENCE FROM GEOPHYSICAL INVESTIGATIONS

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Investigations occupied the northern Yakutian province, Anabar and Olenyok River basins. Within this area fifteen Middle Paleozoic and Mesozoic kimberlite fields are found. Deep seismic sounding and volume gravitational modelling were used to study the lower crustal horizons and upper consolidated crust, respectively. The compilation of a gravitational model implied:

1. Calculation of the depth of occurrence of top and bottom interfaces, their angle and excess density by assuming that any object of abnormal gravity can be considered as a block limited by oblique steps.
2. Construction of the map for volume distribution of density heterogeneities.
3. Testing of the model by comparing of calculated gravitational effect and observed gravitational field.

These investigations allowed to reveal that the earth crust thickness of the region ranges from 37 to 42 km. The thickness of its consolidated part decreases from 38-34 km within the Anabar anteclise to 33-30 km in the Lena-Khatanga trough. In the center part of the studied territory the mantle relief is exhibited by a low-amplitude trough that extends submeridionally across the whole area. Its width is 150 km, amplitude - 2 km. The trough coincides with the suture zone that separates the Anabar and Olenyok megablocks. Trough boundaries are indicated by a change of "basaltic" layer thickness. Round the trough there are local (up to 200 km) rises of the Moho's interface to which the manifestations of kimberlite magmatism relate. For the whole geological period this most ancient and deep lithospheric suture controlled the movement of megablocks. Along the trough the Udzha-Khastakh rift has formed in the Riphean and was repeatedly activated in the Phanerozoic (Shpunt, 1992). The rift's spatial position and history are clearly recorded by sedimentary and magmatic rocks of different age. Their thickness and areas of distribution were determined after seismic and magnetic data. Unlike the stable plots of cratons that are characterized by thin platform sedimentary sequences, the plots of strong tectonic activity are exhibited by multi-kilometer sedimentary sequences which thickness varies spatially and temporally. Clifford's rule, that excludes the localization of diamondiferous kimberlite in tectonically active zones, was supported by fulfilled investigations. Kimberlite fields are situated at a distance of 100 km from intracontinental paleorift zone.

According to the compiled model the territory is characterized by the contrasting change of the depth of crystalline basement occurrence. The latter is exposed within the Anabar shield and submerges to 6-8 km depth in the Lena-Khatanga trough. By the structure of consolidated crust several giant blocks are recognized: Anabar- and Olenyok rises, Lena-Anabar trough, Udzha depression, and Muna block. The boundaries between blocks are represented as extended steps of crystalline basement surface of 1-3 km amplitude.

Depths to the lower interfaces of density heterogeneities are identified with the bottom of the upper "fragile" part of consolidated crust and range from 2 to 20 km, decreasing towards the Laptev Sea.

Thickness of the upper crust changes in the same manner. The plots of lowered thickness are of 50-100 km size and often join into linear and arc-like zones that control the boundaries of basement blocks. About 80 % of available kimberlite bodies relate to such plots.

Based on the studied density characteristics we succeeded to distinguish and map three units of crystalline basement rocks:

- granulite substratum rocks weakly subjected to ultra-metamorphism processes – $(2.8\text{-}3.0)\cdot10^3$ kg/m^3 density;
- the rocks undergone the I stage of ultra-metamorphism (charnokite-enderbite assemblage) – $(2.7\text{-}2.8)\cdot10^3$ kg/m^3 density;
- strongly altered by ultra-metamorphism rocks of granite-gneiss and granite assemblages – $(2.6\text{-}2.8)\cdot10^3$ kg/m^3 density.

The depth of occurrence of high-dense granulite complexes reaches 20-30 km. The bottom depth of the occurrence of low-dense assemblages is 7-15 km.

The zones of strongly altered rocks are manifested distinctly. The zones of folding (diaphthoresis) are distinguished according to density minimum and extend for 60-300 km at 20-40 km width and smooth to steep dip angles. Somewhere, the linearity of zones is disturbed by across elements. Kimberlites traditionally occur at the exocontacts of intense diaphthoresis zones tending to the plots of their linearity disturbances inside blocks of $(2.7\text{-}2.8)\cdot10^3$ kg/m^3 density.

Conclusions:

- kimberlite magmatism is typical for stable earth crust blocks and localize 100 km remotely from intracontinental paleorifts, at the plots not undergone a strong tectono-magmatic activization;
- kimberlite fields locate near the slopes of mantle rises - along its trench-like trough;
- kimberlite occurrences relate to the plots of abrupt decrease of upper "fragile" crust thickness up to 7-12 km;
- kimberlites are localized at the exocontacts of intense diaphthoresis zones, near the plots of those zones disturbance, inside the blocks of basements rocks undergone ultra-metamorphism of $(2.7\text{-}2.8)\cdot10^3$ kg/m^3 density.