DISTRIBUTION OF TEMPERATURE AND DENSITY IN LITOSPHERE MANTLE OF SIBERIAN CRATON ACCORDING TO DATA OF REGIONAL SIESMIC MODELS

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Key words: *lithosphere, composition, temperature, density, Siberian Craton*

Objectives of this study are to restore thermal fields and density in accordance with seismic velocities data and to estimate the thickness of thermal lithosphere of Siberian Craton. Studying the Siberian Craton on long-range lines was accomplished by GEON Centre using nuclear and chemical explosions. Seismic probing permitted to gain detailed data of the seismic structure of the lithospheric mantle of the Siberian Craton. This data were processed by different Russian and international science groups [1, 2, 3, 4, 5]. Published models differ by methods of wave fields processing and different volume of received data, that leads to considerable difference of these seismic models.

In our research we use the method of the upper mantle temperature estimation by seismic data. This method is based on thermodynamic modeling, and using the geochemical limits of xenolith compositions we can create more reliable thermal and density models of the mantle [6]. According to [7, 8], there is a transition zone from garnet peridotite (GP) to primary mantle material (PM) under ancient cratons on depth near 170-200 km. The composition of the Siberian Craton lithosphere was set on GP model till the depth of 170 km and set as PM model on bigger depths.

Results of restoration for thermal fields, compared with seismic and thermobarometry data are produced on figs. 1-2.

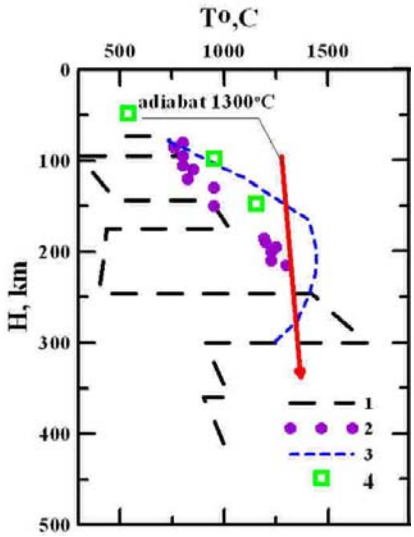

Fig.1. Temperature distribution under Siberian Craton. Line Craton.
1 – restored temperature from regional model [9]; 2 – restored temperature from [11]; 3 – temperature restored from IASP91 model; 4 – temperature from near-surface thermal streams [10].

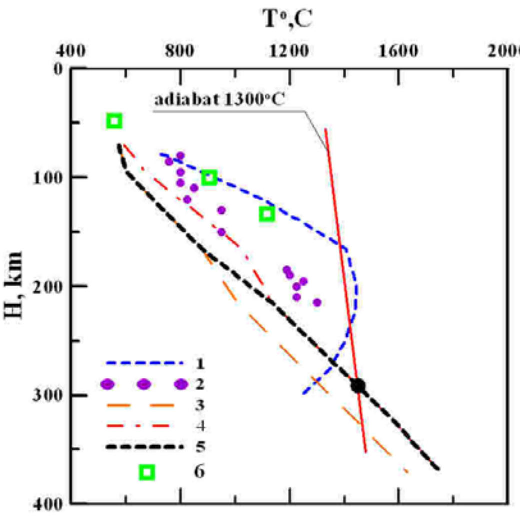

Fig.2. Temperature distribution under Siberian Craton. Line Craton.
1 – temperature restored from IASP91 model;
2 – restored temperature from [11];
3, 4, 5 – restored temperature from regional model [3]: 3 – GP-model; 4 – PM model; 5 – combined model (GP to 170 km, PM o bigger depths); 6 – temperature from near-surface thermal streams [10]

Restored temperature profiles from the regional models of Egorkin [9], Pavlenkova [3] and IASP91-model allow to draw conclusions about applicability of these seismic models for solution of different thermal objectives. On fig.1 we can see restored profile of Egorkin's model [9]. Velocities variations are so large that they reduce to baseless temperature variations that greatly differ from other models [10, 11].

Profile from Pavlenkova's model [3] on fig. 2 allows to restore temperature with acceptable reliability and to estimate lower bound of thermic lithosphere. 2D fields for Craton and Kimberlite lines (fig. 3-4) displays a considerable temperature decrease under Siberian Craton in comparison with mean temperature in continental lithosphere estimated from IASP91 model. Depth of thermic lithosphere, determined from intersection of temperature lines (fig 2) with adiabat 1300°C, matches the isotherm 1450 °C (fig 3-4) and we can say that the lower bound of thermic lithosphere is situated on depth 330-350 km for Craton line (fig 3) and 310-320 km for Kimberlite line(fig 4). These results correspond to estimation from different models [1,5,10,12] but research of surface waves gives another depth – about 220 km. Also we restored the density under Siberian Craton (fig 5)

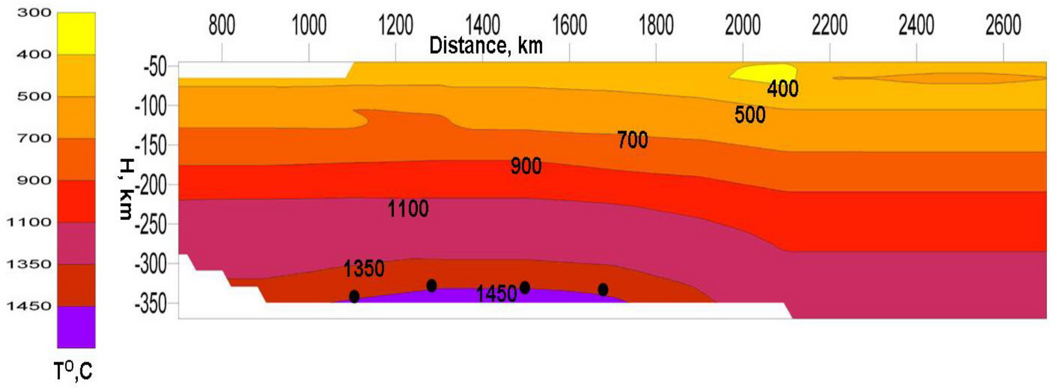

Fig.3. Distribution of temperature under Siberian Craton. Craton line. Black dots show intersection of restored lines with adiabat 1300°C

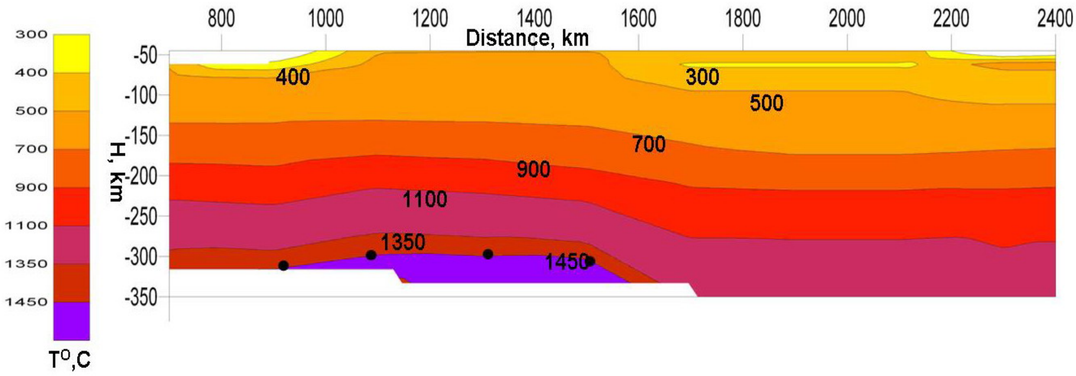

Fig.4. Distribution of temperature under Siberian Craton. Kimberlite line. Black dots show intersection of restored lines with adiabat 1300°C

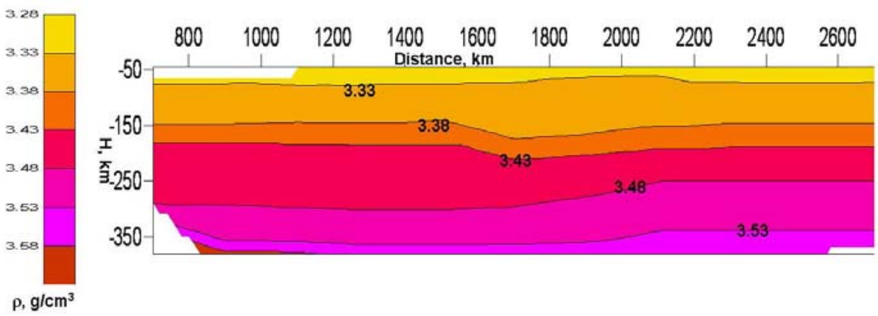

Fig.5. Distribution of density under Siberian Craton. Craton line

Conclusions

1. We received 2D distribution of temperature under Siberian Craton according to seismic data and petrological models. Temperature under Craton is lower than mean temperature in continental lithosphere.
2. Depht of thermic lithosphere is 310-350 km that corresponds with other researches.
3. Depht of thermic lithosphere matches the isotherm 1450°C.
4. We restored the density under Siberian Craton.

Grant: RFBR 09-05-00115

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Electronic Scientific Information Journal "Vestnik Otdelenia nauk o Zemle RAN" № 1(27)'2009
ISSN 1819 – 6586
Informational Bulletin of the Annual Seminar of Experimental Mineralogy, Petrology and Geochemistry – 2009
URL: http://www.scgis.ru/russian/cp1251/h_dgggms/1-2009/informbul-1_2009/planet-20e.pdf

Published on July, 1, 2009