

Seventy Years of Deep Structure Studies in Russia (main results & progress)

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The first Deep Seismic Sounding (DSS) profile was acquired in the Soviet Union under the leadership of Academician G.A. Gamburtsev (method initiator) in 1949. The system of onshore and offshore deep seismic refraction profiles was acquired in the early seventies of the last century. It was the first stage of systematic deep structural studies of Russia.

The results of the second stage (1971-1994) are well known all over the world: seismic data of the super-long transects with peaceful nuclear explosions. The network of onshore trans-regional discrete and point data DSS transects with 3-component recording supplemented with receiver function (RF) data having total length more than 55,000 km was acquired during this stage. The focus of the stage was the mantle. The Program of Deep and Super-deep boreholes has been started and successfully implemented. Six Deep Boreholes including the Kola Super-deep Borehole (12,261 m) were drilled (Fig. 1).

The Russian Program «Network of Geotransects and Deep Boreholes» is the third stage of deep structural studies in Russia. The stage started in 1995 and continues till today. The Program has a strong focus on the crustal architecture and evolution of regional tectonic structures. A multichannel seismic (MCS) reflection survey has begun at this stage. The Program combines deep seismic (MCS and DSS) and magnetotelluric (MT) observations, a wide spectrum of geophysical data (including gravity) processing; Deep Boreholes linked with transects drilling, acquired data compilation in the shape of deep structural maps and geotransects. The total length of the stage transects is nearly 32,000 km, including nearly 12,500 km of offshore and more than 19,000 km of onshore profiles. Seven Deep Boreholes from 3,500 m to 8,000 m deep were drilled.

In the last decade, the focus of the Program is on the east of Russia, including adjacent seas of the Arctic and Pacific Oceans. The transects network makes it possible to obtain crustal images including velocity, density and conductance parameters of the Siberian Craton (southern part), two of its adjacent Fold Systems – the Central Asian Fold Belt and the Verkhoyansk-Kolyma Fold Region, the Chukchi Fold Belt, shelf and deep-water structures of the Arctic passive continental margin, shelf and deep-water structures of the Pacific active continental margin including the South-Okhotsk back-arc basin and the Kuril volcanic islands.

Processing and interpretation of deep seismic data, potential field anomalies, geological and tectonic data allow acquiring 3D models of the tectonic structures and their joint zones. Combining geophysical data from several transects provides acquiring super-long geotransects such as «Central Asian Fold Belt—Siberian Craton—Verkhoyansk-Kolyma Fold Region» (4,000 km) and «Deep-water Arctic Rises—Arctic Shelf—Chukchi Fold Belt—Yano-Kolyma Fold Region—Okhotsk region—Pacific Ocean plate» (5,000 km).

Seismic data of the three stages are the base to a set of deep structural maps. Sets of deep structure maps as the frame of the Tectonic Maps are compiled under two International Cooperative Projects circumscribing the Circum-Arctic and Northern-Central-Eastern Asia areas. The sets are presented by digital maps reflecting the Earth's Crust, Sediments, Consolidated Crustal thickness, Earth's Crust Zoning, Earth's Crustal Types and are supplemented with maps of magnetic and gravity anomalies. More than 400 published seismic models and published regional maps were selected and used for map compilation as well as data of more than 240 Russia profiles.

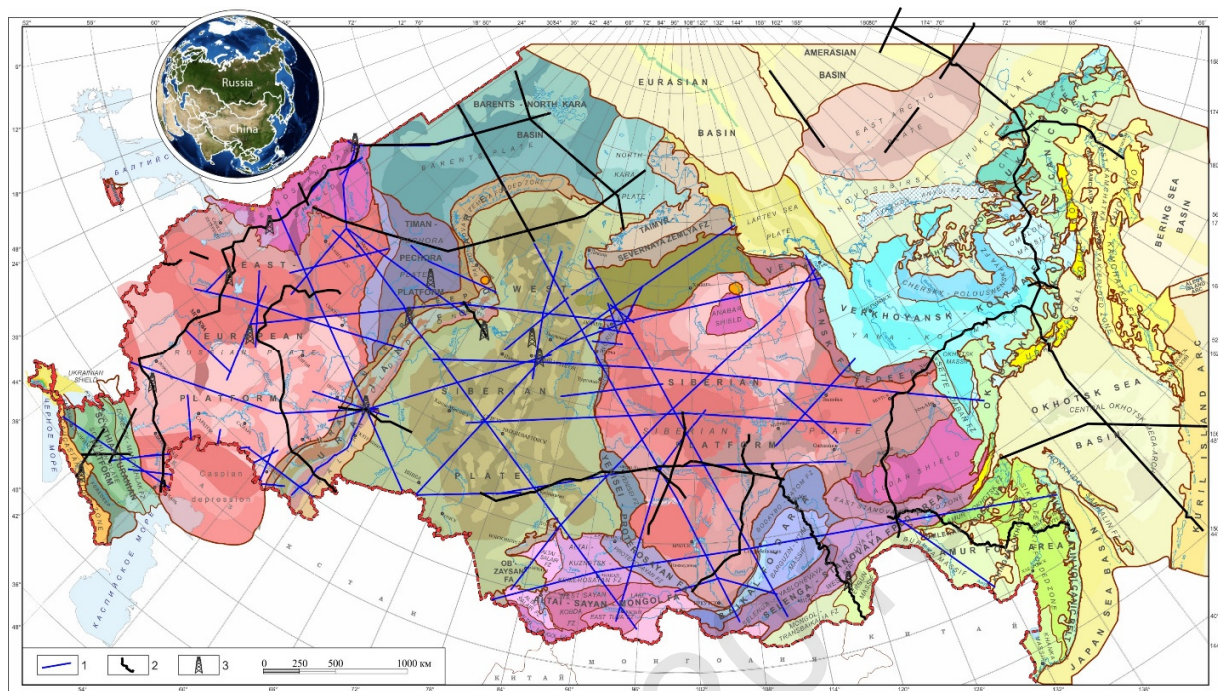


Figure 1. Network of Russian Geotransects and Deep Boreholes tectonic setting: 1 - transects of the second stage (1971-1994), 2 - transects of the third stage (1995- till today), 3 - -Deep Boreholes