Deep structure and geodynamics of the euro-arctic region

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The Euro-Arctic region includes the Barents Plate, the northern Baltic Shield, the northern Timan-Pechera Plate and the northeastern Russian Plate. In the west, the study region is bounded by the Svalbard Archipelago, in the east by the Novaya Zemlya Archipelago and in the north extends as far as the latitude of the Franz Josef Land Archipelago. In the region, the Kola Superdeep Borehole was drilled to a depth of 12 km and over 450 000 linear kilometres of seismic profiles were worked out, about 1/3 of which as a part of regional studies. Deep horizons were mapped, two- and three-dimensional models of geological structures were developed and deep faults were traced using the seismic method [Lithospheric …, 2005]. Seismic data provided a basis for interpretation by other geophysical methods.

The basic characteristics of the lithospheric structure in the domain of transition from the passive continental margin to the oceanic depression were revealed by integrated interpretation of the data that show the main pattern of the deep structure of the Euro-Arctic region at its different levels. The continental parts of the platforms have an average crustal thickness of 40—50 km, the upper and lower crustal storeys having a commensurate thickness. The plasticity level is at a depth of 20—25 km, and usually corresponds to the lower crust surface. Upper crust heterogeneities are compensated by the mantle, in which either one layer with a velocity of about 8.0—8.2 km/s or two complementary layers with velocities of 8.0—8.1 and 8.4 km/s are distinguished above the compensation level. Locally, in palaeosuture zones the layering of the substrate increases, and lenses with velocities of 7.6 km/s or over 8.5 km/s appear in it. The consolidated crust of the shelf is as thin as 15—25 km, in contrast to oceans, where the maximum thickness of the consolidated crust is not more than10 km. Another characteristic of the shelf plate is a greater contribution of the lower ("basaltic") layer to the consolidated crust column up to the almost complete disappearance of the upper crustal ("granitic") layer.

Available technical facilities and marine and ground monitoring methods were used to form a system of hodographs of refracted and deep reflected waves to examine the wave field structure over a wide distance range and to study in detail the geological structure of the earth crust and the upper mantle in the transition zone between the Baltic Sea and the Barents Sea depression. At the Baltic Shield-Barents Plate jointing the basement plunges in stepwise manner. The sedimentary cover increases in thickness to 15—20 km, and crustal thickness decreases to 28—30 km. A layer with a velocity of 7.0 km/s was revealed in the thickest sedimentary cover zone in the crystalline basement of the plate. A lower-crustal layer with a velocity of 7.0—7.4 km/s was detected locally on the Baltic Shield in rifting zones. Therefore, its crust-mantle mixture, formed in tectono-magmatic activation zones, can be interpreted.

New seismological data on the deep structure of the eastern Baltic Shield have confirmed the correctness of the reconstruction of the deep structure in which the earth crust of the modern continent and shelf was chiefly formed in Archaean time, and Proterozoic structural facies complexes played a minor role. The structure of large Precambrian crustal blocks has largely preserved to the present time, and has only been modified in tectono-magmatic activation zones of limited size.

Geological-geophysical interpretation of seismic data on the Euro-Arctic region has revealed quite a number of discrepancies in geohistorical models and palaeoreconstructions, showing again that tectonics and geodynamics are now at a crucial stage: scientists search for a new paradigm to fit "plate-tectonic" and "oscillation" concepts into a general-purpose scheme.

In one group of models emphasis is placed on the stability of continental lithospheric blocks over billions of years, which does not prevent the permanent manifestation of high-amplitude intracontinental movements in aulacogens and "isolated depressions" without transformation of the continental crust into oceanic. This group of models is based on conventional methods for interpretation of geological and geophysical data and is consistent with the concepts of an essential contribution of raid tectonics to the platform history developed in the past few years. In an alternative model of the destructive-accretionary history of the Barents-Pechera basin crust a distinctive methodology, used to reveal an old oceanic-type spreading belt buried at great depth under a young plate cover, is especially valuable. If these bold geophysical palaeoreconstructions are supported by geochemical and petrological data, then an integrated geological-geophysical methodology of analysis of the evolution of continents will be at a new, advanced level.

References

Lithospheric structure of the Russian part of the Barents region / Eds. N. V. Sharov, F. P. Mitrofanov, M. L. Verba, C. Gillen — Petrozavodsk: Karelian Res. Centre, RAS, 2005. — 318 p.

Earth's tidal tilt jumps and their relationship to earthquake source's physics

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Institute of Geology and Seismology and Poltava Gravimetric Observatory of Institute of Geophysics of National Academy of Sciences of Moldova and Ukraine researched earth's crust tilt deforma-

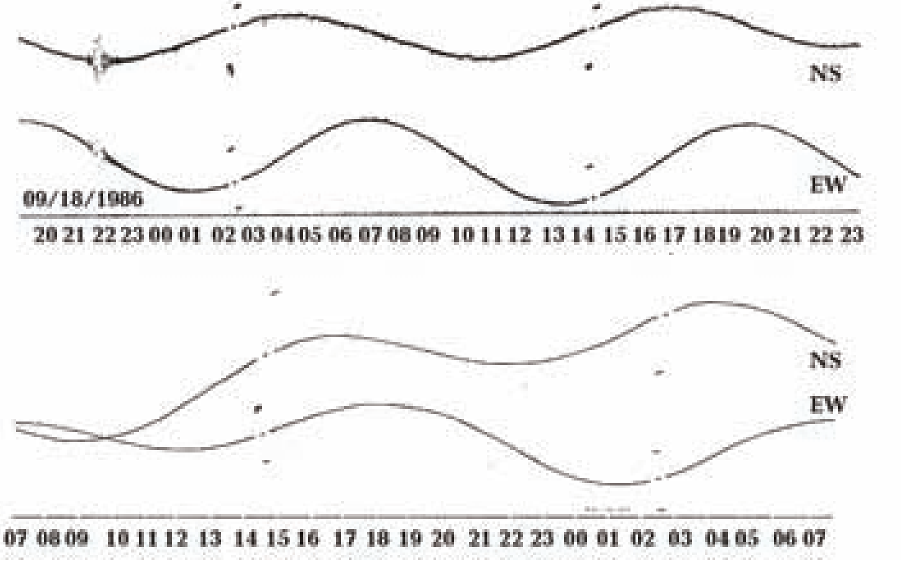

Fig. 1. Usual record of earth- tidal tilts at station "Chisinau". Top — with presence of seasonal microseisms and bottom — without.