Starostenko V. I., Kazansky V. I., Drogitskaya G. M., Makivchuk O. F., Popov N. I., Tarasov N. N., Tripolsky A. A., Sharov N. V. Relationships of surface structures of the Kirovograd ore district (Ukrainian shield) with local heterogeneities of the crust and the Moho discontinuity relief // Geophys. J. — 2007. — **29**, № 1. — P. 3—21 (in Russian).

Starostenko V. I., Kazansky V. I., Popov N. I., Drogitskaya G. M., Zayats V. B., Makivchuk O. F., Tripolsky A. A., Chicherov M. V. From surface structures to the integrated deep model of the Kirovograd ore district (Ukrainian shield), I // Geophys. J. — 2010. — **32**, № 1. — P. 3—33 (in Russian).

Variations in the crustal types of the Dnieper-Donets Basin and surrounding areas from 3D gravity modelling

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There are two reasons for constructing a new three-dimensional density model of the Dnieper-Donets Basin (DDB) and surrounding areas. 1) A lack of reliable data on the structure of the deep horizons in the sedimentary cover and crystalline crust. 2) Recently fresh geological and geophysical data have been obtained for the upper sedimentary layers (up to depths of 5—6 km) from seismic data (DSS and MCSP) along the DOBRE1 and DOBRE2 profiles [Grad et al., 2003, Maystrenko et al., 2003].

In this study modern software has been applied [Starostenko et al., 1997; 2004]. It has a principal advantage over standard approaches because density maps of individual layers are automatically input into a PC, enabling geological environments to be approximated very accurately. A technique of constructing a 3D model and converting it into a schematic map of layers types are described in detail elsewhere [Kuprienko et al., 2007].

3D modelling has resulted in a new pattern of the density for the whole crust of the DDB and surrounding areas. It has been used to compile schematic maps for a thickness of the "granitic, "dioritic" and "basaltic" layers (the upper, middle and lower crust). Earlier based on the generalization of relationships of velocity vs. depth and density vs. velocity for different types of the crust, it has been put forward a conditional subdivision of the whole crust into three stages without sharp boundaries between them. They have been defined as the upper, middle and lower crust. Due to traditions they have been named as "granitic, "dioritic" and "basaltic" layers. Their parameters are as follows: 1) ρ<2.75 gcm^{-3}, V_P<6.30 kms^{-1}; 2) ρ=2.75÷2.90 gcm^{-3}, V_P=6,30÷÷6,80 kms^{-1}; 3) ρ>2.90 gcm^{-3}, V_P>6.80 kms^{-1} respectively. Petrologically the first range of the parameters is a mixture of acid and intermediate rocks. The second series is composed of a mixture of intermediate and basic rocks (granodiorites, diorites, charnokites, many gneisses, shists, metabasic rocks, and gabbroids). The third row consists of intrusive rocks of basic and ultrabasic composition and metamorphic rocks (granulites, amphibolites) [Lithospheric …, 1993].

A relationship of a thickness of each layer to a total thickness of the crust demonstrates the contribution of each layer into a total thickness of the crust. The name of the crustal type corresponds to prevailing portion of any layer.

The portion of "granitic" layer (Fig. 1, *a*) within the DDB iz characterized by a ratio of 0—0.4. The highest values correspond to the southern flank of Poltavskii megabloc (0.4), the northern side and the southern preflank zone of the Lokhvitskii and Poltavskii megablocs, as well as most of the northern flank, where the percent ratio is 0,3. The smallest proportion of the layer belongs to the central zone of megablocs (0.0—0.1). On the rest of the areas layer portion is 0.0—0.2.

The portion of "dioritic" layer (Fig. 1, *b*) is the largest in the south of the DDB, in south-east of the northern flank, in the central zone and southern preflank zone of the Chernigovskii, and Poltavskii and Lokhvitskii megablocs (0.4—0.5). A small portion of this layer occurres in the southeastern part of the central zone of the Iziumskii megabloc and in the north-western Donbass (0.0—0.1). The rest of the area is characterized by the values of 0.2—0.3.

The maximum portion of the "basalt" layer (Fig. 1, *c*) is associated with the north-western Chernigovskii megablock and the north-western part of the central zone in the Lokhvitskii megabloc, the south-eastern Iziumskii megablock and the whole Donbass (0.5—

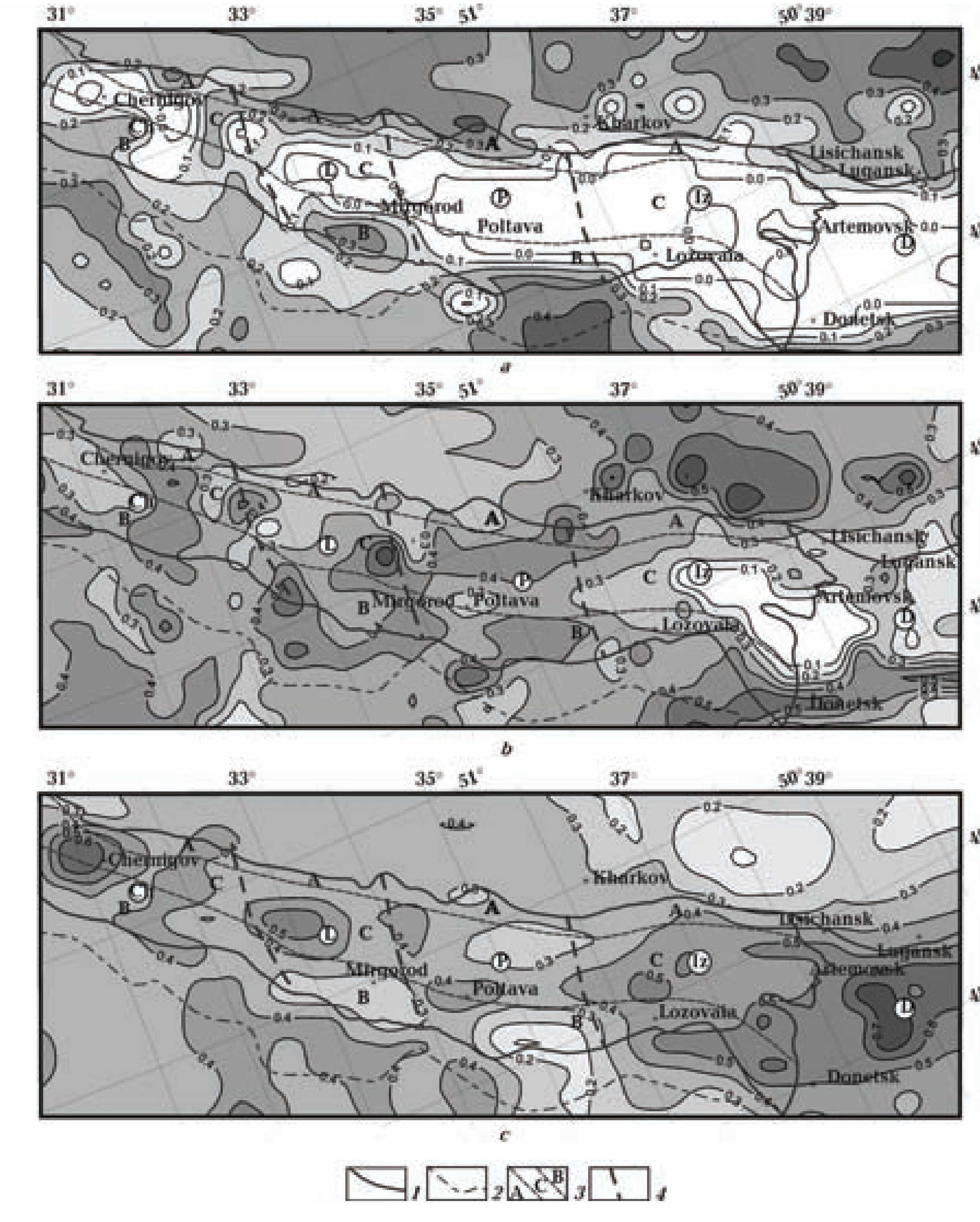

Fig. 1. Contribution of the "granitic" (*a*), "dioritic" (*b*) and "basaltic" (*c*) layers to a whole thicness of the crust in the Dnieper-Donets Basin and Donbass: *1* — the boundary of the DDB; *2* — the boundary of the northern flank of the DDB; *3* — the longitudinal division of the DDB (after Arsiriy et al., 1984) *zones*: A — northern flank, B — sothern flank, C — Central; *4* — the transversal division of the DDB (after Dolenko and Varich, 1989) *megablocks:* Ch — Chernigovskii, L — Lokhitskii, P — Poltavskii, Iz — Iziumskii, D — Donbass.

0.7). The smallest ratio of the layer (0.2) is related to the southern preflank zone of the Poltavskii megabloc and the northern edge of the Iziumskii megablock. In the rest of area the ratio is 0.3—0.4.

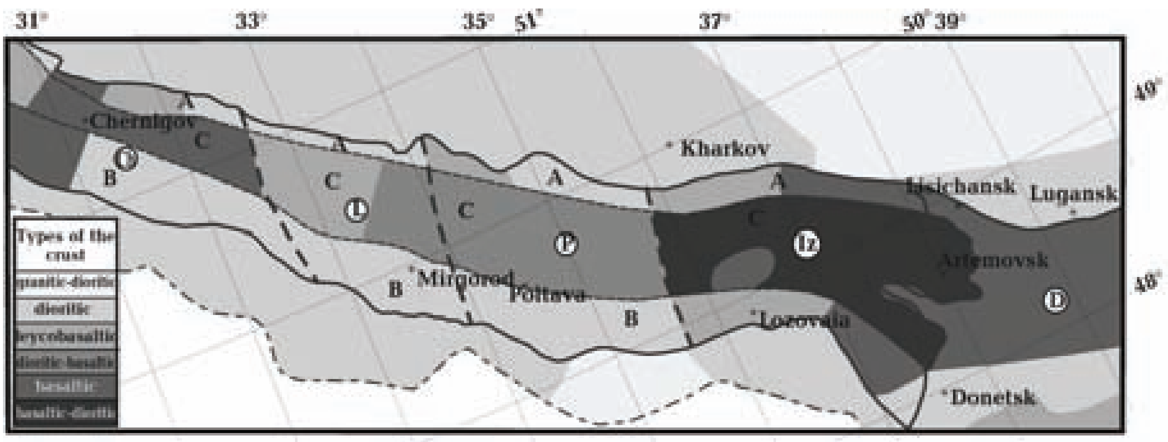

Fig. 2. Schemetic map of prognostic composition of the Earth's crust in the DDB and Donbass from 3D gravity modelling. See Fig. 1 for conventions.

Based on this information, six types of the crust are determined for the DDB and Donbass (Fig. 2).

The granitic-dioritic crustal type has the smallest distribution which mainly occurs on the southern flank of VCM (the Svatovo-Troitskii, Rossoshanskyii blocks). Its small massif occurs on the northern flank of the Ush (the southern flank of the Poltavskii megablock).

The dioritic type of the crust is distributed in the northwest and central parts of the southern slope of VCM, in the southeast of the northern flank zone of the Chernigovskii and Poltavaskii megablocs, in the northern flank zone of the Lokhvitskii block, in almost whole southern flank zone, on the southern edge, as well as in northern and southern Donbass.

Leykobazaltic type of the crust is characteristic of the north-western Chernigovskii and Lokhvitskii megablocs, north-western parts of the northern flank zone in the Chernigovskii, Poltavskii, Iziumskii megablocs, as well as the north-western portion of the southern flank zone of the Iziumskii megabloc.

Dioritic-basaltic type dominates in the central region of Poltavskii and the south-east of the central zone of the Lokhvitskii megablocs.

Basaltic type of the crust is spread in the southeast of the northern and southern flank zones of the Iziumskii megabloc, the most part of Donbass, in the central zone and in the north-western part of the southern preflank in the Chernigovskii megabloc. An isometric area is present in the southern part of the central zone in the Iziumskii megabloc.

Basaltic-dioritic type of the crust occurs only in the central zone of the Iziumskiy megabloc. Its parameters are intermediate between basaltic type, which is distributed in the central part of the Donbass, and diorititic — basaltic, typical for the central zone of DDB. *A question arises whether the belt of the basalt-diorite type of the crust is the transitional zone between the DDB and Donbass?* We should like to give a positive answer to this question.

In conclusion, the granitic-dioritic type of the crust dominates in the flank zones while the basaltic and basaltic-dioritic types are spread in the central belt of the DDB and Donbass. It demonstrates the increase in basicity of the rocks from the flanks to the centre of the depression that proves an axial compaction.

References

Grad Y., Gryn' D., Guterch A., Janik T., Veller R., Lang R., Lyngsie S. B., Omelchenko V. D., Starostenko V. I., Stephenson R. A., Stovba S. N., Thybo H., Tolkunov A. DPBRE-fraction'99—velocity model of the crust and upper mantle beneath the Donbas Foldbelt (East Ukraine) // Tectonophysics. — 2003. — **371**, № 1—4. — P. 81—110.

Maystrenko Y., Stovba S., Stephenson R., Bayer U., Menyoli E., Gajewski D., Huebscher C., Rabbel W., Saintot A., Starostenko V., Thybo H., Tolkunov A. Crustal-scale pop-up structure in cratonic lithosphere: DOBRE deep seismic reflection study of the Donbas fold belt, Ukraine // Geology. — 2003. — **31**, № 8. — P. 733—736.

Starostenko V. I., Legostaeva O. V., Makarenko I. B., Pavlyuk E. V., Sharypanov V. M. On automated computering geologic-geophysical maps images with the first type ruptures and interactive regime visualization of three-dimensional geophysical models and their fields // Geophys. J. — 2004. — **26**, № 1. — P. 3—13 (in Russian).

Starostenko V. I., Matsello V. V., Aksak I. N., Kulesh V. A., Legostaeva O. V., Yegorova T. P. Automation of the computer input of images of geophysical maps and their digital modeling // Geophys. J. — 1997. — **19**, № 1. — P. 3—13 (in Russian).

Kuprienko P. Ya., Makarenko I. B., Starostenko V. I., Legostaeva O. V. 3-D density model of the Earth's crust and upper mantle of the Ukrainian Shield // Geophys. J. — 2007. — **29**, № 5. — P. 3—27 (in Russian).

Lithospheric of the Central and East Europe . Generalization of the researches results / Ed. A. V. Chekunov. — Kiev: Nauk. dumka, 1993. — 258 p. (in Russian).

Lithospheric inhomogeneity in the Black Sea from geophysical data

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The international interest in the Black Sea geology is based on its key role in understanding the tectonic evolution of the middle Tethyan Realm and its hydrocarbon potential. The present-day tectonic setting of the Black Sea has been mainly derived from multi-channel surveys and sparse DSS data. The available information is however insufficient to produce a coherent geodynamic model for the region.

The purpose of this study is aimed at examining the lithospheric structure and relationship between near-surface and deep features using jointly the magnetic, gravity, heat flow, seismic and tomographic data (Figure).

A first integrated analysis has resulted in a new and mutually consistent image of lithospheric density, magnetic, thermal and velocity inhomogeneities. A most detailed map of faults systems has been compiled for the consolidated crust. A substantial and important difference in the crustal and mantle structure and geophysical parameters of the Western and Eastern Black Sea basins has been revealed. The "non-granitic" crust occurs only in the central portion of the Eastern Black Sea basin whereas it spreads practically within the whole Western Black Sea basin. Heat flow is more intensive and differentiated in the Eastern Black Sea basin than in the Western Black Sea basin. The topography of the thermal lithospheric lower boundary is dome-like beneath the Eastern Black Sea basin and it is flat in the Western Black Sea basin. Different mantle seismic velocities as well as the fabric of the crustal magnetic and gravity anomalies are characteristic of the two sub-basins. Over the rift zone a distinct local heat flow anomaly is observed in the Eastern Black Sea basin. On the contrary, in the Western Black Sea Basin the rift zone is not individually manifested itself in thermal field. The low density mantle exists beneath the rift zone in the Eastern Black Sea basin whereas any distortions of a density distribution are related to similar zone in the Western Black Sea basin.

The large mantle fault zones have been delineated in the Black Sea with the prominent Odessa-Sinop fault zone, which has mostly predetermined the dissimilarities mentioned because it has divided the old continental crust into two large blocks. Orthogonality of the rifts in the Western and Eastern Black Sea basins clearly demonstrates that they have been sequentially formed as two separate tectonic units. The Western Black lithosphere has rifted earlier than that of the Eastern Black and their post-rift histories have been autonomous and individual.