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Main features of the lithosphere structure below the Black Sea area

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The Black Sea basin, located between two orogenic systems – Crimea-Caucasus in the north and Pontides in the south, consists of two deep subbasins – West-Black Sea (WBS) and East-Black Sea (EBS) basins filling with thick sediments (up to 12-14 km),which are separated by NW-SE oriented Mid-Black Sea Ridge (MBSR) with the uplift of the basement. It is widely accepted that Black Sea basin has been formed at the end of Cretaceous in a back-arc setting at the hinterland of Pontide Arc originated by closure of Neotethys Ocean. However, a lot of problems concerning the origin of the Black Sea basin and structure of the crust and upper mantle are still under question. In order to get new information on the lithosphere structure below the Black Sea region the following interpretation of gravity, old seismic (DSS) and seismology data have been undertaken.

3D gravity analysis using the back-stripping technique was implemented for the model consisted from sea-water layer and Cenozoic sedimentary strata including four sedimentary layers of Anthropogene, Neogene, Maikopian and Paleocene-Eocene age with average densities 2.0, 2.3, 2.6 and 2.65 g/cm^3. Removal of gravity effect of this model from the observed field reveals two strong positive sediment-free anomalies within the WBS and EBS with amplitudes 350 and 320 mGal, which are caused mainly by strong Moho uplift to the depth of 20 km, outlining in such a way the contours of thin high-density oceanic crust.

Reinterpretation of old seismic (DSS) data (worked out more than 30 years ago by organizations of former Soviet Union) using the ray-tracing methods was done on two N-S lines – along the profile 25 crossing the central part of the WBS and along the line, represented by two profiles - profile 28 in the Azov Sea and profile 29 in the central

part of the Black Sea. Velocity model along the profile 25 shows thin oceanic crust (thickness of sediments 12-14 km and that of crystalline crust – about 5 km) below the deep-water depression and continental domain as thick as 39 km on the Odessa shelf within the Scythian Plate and Ukrainian Shield. These domains are separated by a transitional crustal domain located within the continental slope, detached from continental domain by high-amplitude (7.5 km) fault on the basement surface. In the central part of the Black Sea, crossed by the profile 29, two crustal domains (from north to the south) can be seen also: oceanic crust of the EBS with the parameters similar to those of the WBS and continental domain of the MBSR with the Moho boundary at the depths of 29 km. The basement of the MBSR is represented by three steps elevated southwards from the depth of 10-11 km at the Andrusov Ridge up to 6 km on the Arkhangelsky Ridge. Oceanic crust of the EBS is detached from the continental domain of the MBSR by distinct reflector dipping south-westwards below the MBSR.

3D velocity model for the uppermost mantle has been constructed for the depths of 40, 45 and 50 km by seismic tomography using the data from not only the International Seismological Center (ISC), but mainly from national seismology networks of adjoining to the Black Sea countries (Ukraine, Russia, Georgia, Turkey and Moldova). Against the background of low velocity values (Vp=7.5=7.8 km/s) within the onshore areas, one can see high-velocity domains (Vp=7.9-8.1 km/s) below the WBS and EBS characterizing the upper mantle below the Black Sea. These two domains are separated by low velocity area beneath the central part of the sea, just to the south from Crimea. Its south-eastern limitation in the form of NW-oriented gradient zone corresponds with Odessa-Sinop fault, confirming in such a way its deep origin.

These new data, together with available data from other geophysical methods, clearly indicate that two sedimentary basins – WBS and EBS – differ in basin architecture, orientation of main tectonic units and structure of the lithosphere. Revealed distinctions are determined, first of all, by different affinity of the crustal domains, on which they were originated, and also by the peculiarities of their rift and postrift history. Available data suggest that the WBS was originated on the crust of Moesian Plate at the end of Cretaceous due to rifting occurred mainly along the sutures of the plate with adjoining accreted terrains (including Scythian plate on the north). That is clearly seen on the velocity model of profile 25, showing high-amplitude fault at the edge of the Scythian Plate. The EBS, most probably, was originated on the Transcaucasus domain, whose fragments – the Shatsky Ridge and the MBSR, located on both sides of the EBS, can be seen now in the utmost eastern and central parts of the Black Sea. Opening of the EBS was trigged by strike-slip movements along the MBSR initiated by moving northward the Arabian plate. Further approaching of Arabia has caused the

commencement of orogenic processes in the Caucasus and accretion of the oceanic lithosphere of the EBS to the continental domain of the Scythian Plate. This idea is supported by the presence of deep and narrow NE-SW Sorokin Trough just at the edge of the Crimea, which can be treated as an accretional basin filled with thick (up to 12 km) Cenozoic sediments, and by high recent seismicity observed along the south-eastern coastal line of the Crimea and within the Sorokin and Kerch-Taman Troughs.