Geophysical Research Abstracts
Vol. 13, EGU2011-256, 2011
EGU General Assembly 2011

Lithosphere structure of the Black Sea from 3D gravity analysis and seismic tomography

Tamara Yegorova (1), Tatiana Yanovskaya (2), Valentina Gobarenko (1), and Ekaterina Baranova (1)

(1) National Academy of Sciences, Institute of geophysics, Kiev, Ukraine (egorova@igph.kiev.ua), (2) St. Petersburg State University, St. Petersburg, Russia

A back-arc Black Sea (BS) basin was formed in the Late Cretaceous at the hinterland of the Pontide magmatic arc due to subduction of Neotethys Ocean below the southern Eurasian continental margin. At present the BS consists of two large sedimentary subbasins: the West- and East-Black Sea (WBS and EBS) basins filled with thick (up to 12-14 km) Cenozoic and younger sediments. The latter mask poorly investigated basement and crystalline crust that are assumed to represent a mosaic of accreted fragments of microplates and terranes of different affinities. Seismic refraction studies have shown that the WBS and EBS are underlain by high-velocity (6.6-7.0 km/s) thin oceanic and semi-oceanic crust of 5-7 km thickness underlain by the Moho shallowing up to 20 km depth. In comparison to the crust, little is known about the structure of the mantle lithosphere below the BS. This information, together with distribution of recent seismicity, is of crucial importance for understanding the geodynamic situation and governed tectonic processes in the region. In order to investigate the lithospheric structure below the BS we performed 3D gravity analysis and seismic tomography study. In addition we used these two independent approaches to derive the gravity signal from mantle lithosphere.

3D gravity analysis using the backstripping technique results in residual anomalies derived by removing from the initial field the gravity effect of constrained layers. The sediment-free anomalies are interpreted to reflect Moho relief and density heterogeneities in the crystalline crust and uppermost mantle. The final residual anomalies (after stripping off the sediments, Moho topography and large-scale crustal heterogeneities) reveal no significant long wavelength anomalies attributed to density variations in the upper mantle. These slight positive mantle anomalies might be indicative of isostatic equilibrium of the Black Sea deep structure, namely that negative gravity effect of sediments is substantially compensated by strong positive gravity impact of the Moho shallowing. The short wavelength pattern of the final residuals shows significant features that could be explained by crustal features that ere not taken into account by modelling. A chain of local gravity anomalies along the southern margin of the BS, showing good correlation with stripes of magnetic anomalies, are good expressions of Pontide (or Rhodope-Pontide) magmatic arc, which consists of western offshore branch along the Western Pontides and eastern, along the coastline, branch in Eastern Pontides.

Velocity structure of the BS lithosphere (down to the depth of 90 km) has been studied by P-wave seismic tomography using the data from the earthquakes occurred inside the study region and recorded by seismic stations located around the BS. Velocity distribution in the upper mantle was calculated using the seismic tomography method, which encompasses partitioning the medium on cells and defining in them velocity corrections. Initial data were corrected for the crust impact. Derived velocity distribution represents the BS not as single velocity domain, but rather heterogeneous one with two distinct areas of increased velocities within the western and eastern part of the BS, which are separated by lower velocities in the central part of the sea. Gravity signal from the lithospheric mantle, calculated from the density equivalent of this velocity model, outlines two areas of positive gravity (up to 50-70 mGal) in western and eastern parts of the BS. In general this mantle impact agrees with that derived by 3D gravity analysis. Both approaches reveal slight positive mantle gravity signal that could be indicative of lack of the asthenosphere or mantle diapir at the depth less 100 km below the BS. This corresponds with very low surface heat flow (30-40 mW m2) and low deep calculated temperatures (500-600° C at 30 km depth) in the BS.