

New Insight into the Oil and Gas Prospects and Geological Structure of the NW Black Sea Shelf by Integrated Seismic and Gravimetric 3D Geo-Modelling

Petrovskyy O.P.¹, Krupskyy B.L.², Gladun V.V.², Chepil P.M.², Melnichuk P.M.², Fedchenko T.O.³, Gablevskyy B.B.⁴, Kitchka O.A.⁴, Tsiokha O.G.⁵, Gerasimov M.E.⁵, Koltsov S.V.⁵, Chupryna I.S.⁶

¹STF «BIPEKS Ltd.»

²NJSC «Naftogaz of Ukraine»

³IFNTUOG

⁴CASRE NASU

⁵SGE «Ukrgeofizika»

⁶«Prychornomor SGE»

The problem of supplying Ukraine with own hydrocarbons requires study of immature and frontier areas. One of such less explored, however, rather large and quite promising areas is territory of the Black Sea northwestern shelf. Taking into account the need for intensive regional exploration deep analysis and generalization of all available geological and geophysical data about the region is extremely important for further effective exploration.

One of the ways for such generalization is 3D integral geo-modeling of the subsurface which allows to study deep geological structure on the base of geodynamics of the region together with sedimentary cover and its hydrocarbons potential. Such an integral density model of the Black Sea northwestern shelf was built as the result of joint seismic-and-gravity geologically constrained inversion (Technology of STF BIPEKS Ltd (Petrovskyy, 2005)).

For initial model construction a wide range of geological and geophysical information was used - 2D seismic structural interpretation, petrophysical summaries of core studies, seismic velocities for the property (density) 3D model, geological concepts and constraints. The dimensions of the territory under investigation were 250 x 372 km laterally and 70 km in depth for modeling the subsurface, with discretization of the model 2 km laterally and 50 m vertically (32.55 million of elementary bodies). During the spatial inverse seismic-and-gravity problem solution initial gravity field deviation of 96 mGal was reduced to 1.339 mGal.

Geological adequacy of the final geo-density model became apparent through its correspondence to basic geotectonic elements. New tectonic elements were delineated and confirmed by gravity lineaments (final gravity deviation analysis). Obtained principle correlation between peculiarities of geo-density model and modern geodynamical knowledge gave a possibility to analyze distribution of sedimentary rocks parameters.

Thus, within the sedimentary cover zones of decreased density were outlined which correspond to regional trends of reservoir behavior. In the top of Mid-Albian sedimentary package the dilation areas are controlled by deep fault zones striking along the northern flank of the Western Black Sea sub-basin. In the Cretaceous it is delineated weak contrast west-eastern zones of decreased density that are controlled by tectonics, wedging out and erosion zones. The top of Upper Cretaceous carbonates and chalks is characterized by significant heterogeneity of density properties. Four dilation zones with anomalously low values are traced in near-latitudinal direction. One of them is attributed to Schmidt gas field. A similar tendency can be observed for Lower Paleocene sedimentary rocks. Perspective low density zones can be recognized in transversal to the terrain direction, along internal shelf hinge, toe and continental slope.

Comparison with well production showed 78% prospect accuracy of the integral 3D geo-density model.