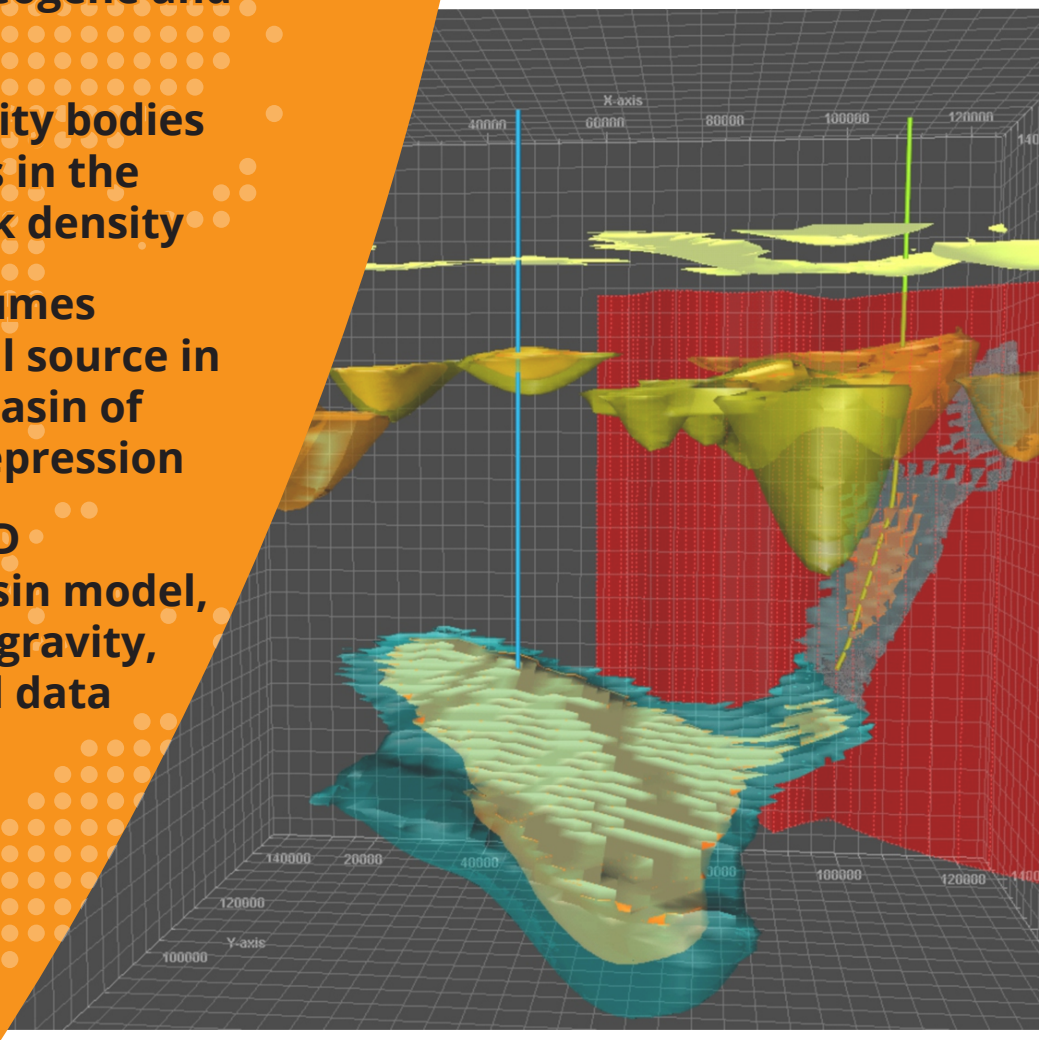
DEPROIL

DETAILED OIL & GAS PROSPECTING

- 2.1 TCM (P50) OGIP deep-water fan mapped at 8000 m depth
- New commercial gas pools in Neogene, Paleogene and Cretaceous
- Closed low-density bodies of existing fields in the 3D model of rock density
- Deep mantle plumes as a depositional source in a sedimentary basin of the Black Sea depression
- High accuracy 3D sedimentary basin model, consistent with gravity, seismic and well data



OFFSHORE EXPLORATION

IDENTIFICATION DEEP-WATER FAN WITH 2.1 TCM OGIP WITHIN THE ULTRA-DEEPWATER AND CONTINENTAL SLOPE OF THE BLACK SEA

North-Western Part of the Black Sea, Ukraine, 2007

GEOLOGICAL PROBLEM

The Black Sea is one of the last immature but closest to the European market hydrocarbon exploration frontiers with a rather high assessment of its petroleum potential. In spite of over 60 years of exploration, only 8 gas condensate fields and one Subbotino oil field were discovered within the Ukrainian shelf of the Black Sea. To date, a total of 25 deep-water wells have been drilled in water depths over 400 m, 11 of which were ultra-deep (water depth > 1500 m). In spite of multiple commercial discoveries in the shelf of Romania and Bulgaria, many new wells fail to discover quality reservoirs or do not encounter commercial hydrocarbon accumulations. The sole deep-water discovery in the Black Sea is the Sakaraya gas field, which is the second largest worldwide discovery of 2020. Well Tuna-1 discovered reservoir rocks associated with paleo-delta of Danube River.

Given that all Black Sea deep-water prospects discovered to date had all of the elements of an oil system, such as source rocks & reservoirs, seals and hydrocarbon movement channels, the negative drilling results suggest the need to revise current geological concepts and implement new methods of hydrocarbon exploration.

3D GRAVITY INVERSION WORKFLOW

Structural framework for the initial 3D density model was built using the Neogene-Cretaceous structural surfaces, a result of a 2D regional seismic data interpretation, bathymetry and Moho interface from a deep seismic survey. Generalized petrophysical data was used to define initial density properties of sedimentary cover. Interval seismic velocities were used to calculate density of pre-Cretaceous basement. The constructed 3D density model's dimensions were 250 km x 372 km laterally and 70 km vertically. Individual cell size of 2 km x 2 km x 5 m resulted in the total of over 32.5 million 3D cells. Standard deviation between the observed and the calculated gravity for the initial 3D density model was 19 mGal.

Depth of the Moho interface was refined by means of a 3D structural non-linear inversion of the gravity data. 3D property model was refined by 3D joint linear inversion of gravity with seismic and log data. Standard deviation between observed gravity and gravity calculated for resulting 3D density model by inversion results was 1.3 mGal (relative to the gravity field, the initial 3D density model was improved by 15 times).

GEOLOGICAL RESULTS

3D joint inversion results gave the possibility to validate and refine the basin model from the surface to the Moho interface, to delineate deep mantle plumes and associated with them sedimentary basins, to delineate tectonic sutures between major tectonic units and to outline the boundaries of sub-basins.

In sedimentary cover, 3D density model allowed to locate a set of multi-zone low-density areas in Neogen-Cretaceous and associated with them hydrocarbon accumulations. Some of them corresponded to known gas fields within Odessa shelf (for example Shmidt and Golitsina fields, Figure 1) others, indicated the location of new reservoirs. The major target was mapped in Cretaceous sediments within ultra-deepwater and continental slope (Figure 1, 2). It is represented by clastic fan, Albian or Valanginian in age, with a total area of 2,745 sq.km. For the most promising sweet spot area of 2,000 sq.km the gross reserves estimation was 2.1 TCM OGIP (P50).
The new prospect mapped in 2007 within the continental slope and deep part of the Black Sea is a geological analog of the prospects discovered by the Tuna-1 well in 2020, and can be associated with the delta of a paleo-river.
In 2012 – 2014 the Skifska block enclosing mapped deep-water prospect was licensed for PSA by consortium of Exxon Mobile & Shell (Figure 2).

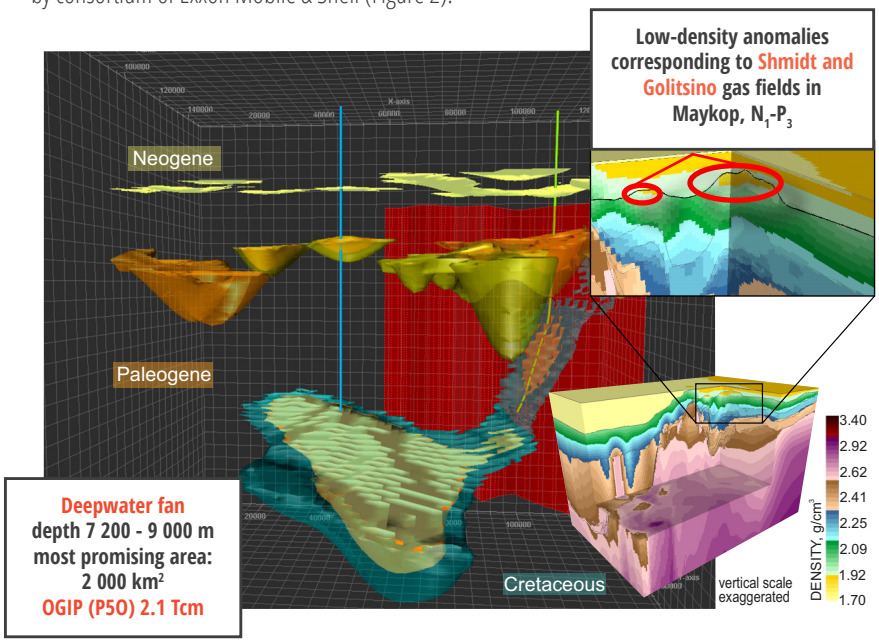


Figure 1. Multi-zonal HC prospects, including Cretaceous deep-water fan, extracted in the form of local bodies from the 3D density model by the results of 3D inversion of gravity, seismic and well data

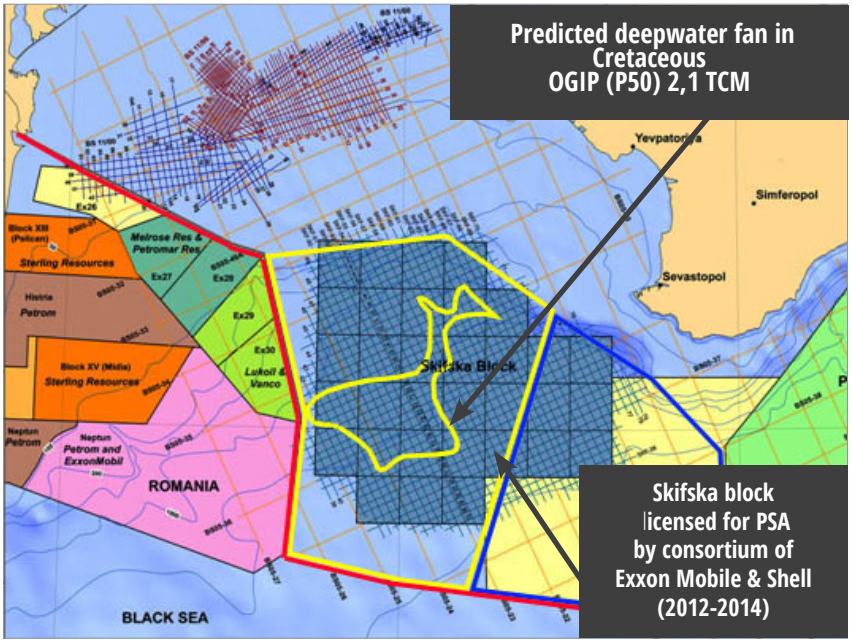


Figure 2. Exxon Mobil & Shell Skifska licence block with location of predicted deep-water fan