



DEPROIL

DETAILED OIL & GAS PROSPECTING

85% -
SUCCESS RATE
25 fields
81 wells
166 well tests

- ✔ High-resolution 3D model of rock density
- ✔ Refined shape of the salt dome
- ✔ Multilayer commercial gas-bearing reservoirs below and near salt
- ✔ Free-form shape and origin of hydrocarbon-bearing reservoir
- ✔ Estimated hydrocarbon reserves
- ✔ Initial production rate for new wells



SUBSALT HYDROCARBON EXPLORATION

OVER TWO DECADES OF
RELIABLE HYDROCARBON-BEARING
RESERVOIR EXPLORATION

CRITICAL FACTORS FOR EXPLORATION & PRODUCTION SUCCESS, WHEN APPLYING GRAVITY DATA 3D:

- 3D joint inversion of gravity, well log, seismic, petrophysical and geological information is the only way to obtain meaningful information from gravimetric data 3D.
- Implication of additional geological and geophysical data into gravity inversion allows to impose geologically reasonable restrictions on the variations of parameters within the model (rock density, bedding depth) and to parametrize the inversion algorithm for obtaining a unique geologically meaningful 3D model out of the multiple possible solutions which correspond to the observed gravity.
- Gravity inversion comprises 3D density model of the entire geological section - from the land surface to the crystalline basement or mantle (in case of regional exploration).
- Using full Bouguer gravity for inversion does not require to separate it into single components or extract gravity anomalies which correspond to studied geological structures. 3D gravity inversion provides compensation of obtain gravity by changing the entire 3D density model.
- Using actual rock density allows to calculate 3D models of petrophysical parameters such as porosity, hydrocarbon (HC) saturation, hydrocarbons in-place per rock volume and predicted total amount of hydrocarbon resources and reserves.

A THREE-TIMES INCREASE OF THE GAS PROSPECT AREA AS A RESULT OF REFINING THE SHAPE OF BUDUSHCHANY SALT DOME

Dnieper-Donets Basin, Ukraine, 2012

GEOLOGICAL PROBLEM

The central part of Dnieper-Donets Basin is characterized by active salt tectonics. Hydrocarbon accumulations are confined to Carboniferous sediments, which are pierced by Devonian salt. Budushchany salt dome is located within the investigated area. The problem is caused by inability to map salt dome walls by 3D seismic due to absence of seismic reflections in proximity to the salt dome as well as difficult terrain. High-precision gravity data were used for delineating the shape of Budushchany salt dome.

3D GRAVITY INVERSION WORKFLOW

The initial 3D structural model of target horizons in Carboniferous was built using 3D seismic interpretation results. Underlying Devonian sequence (including mother salt) and the basement were built using regional 2D seismic lines. The initial 3D density model of target Carboniferous interval was built using log data from wells of nearby Matviivka field. Structural features of the salt dome and mother-salt were refined by 3D non-linear inversion of gravity data for 17 structural surfaces. 3D density model was refined by full-depth 3D linear inversion of gravity data for 11.2 million cells (cell dimension 100x100x50 m).

Standard deviation (SD) between observed gravity and gravity calculated from the initial 3D density model was 4.639 mGal (Figure 1, d); between observed gravity and gravity calculated from the resulting 3D density model was 0.048 mGal (Figure 1, e) (relative to the gravity field, the initial 3D density model was improved by 97 times).

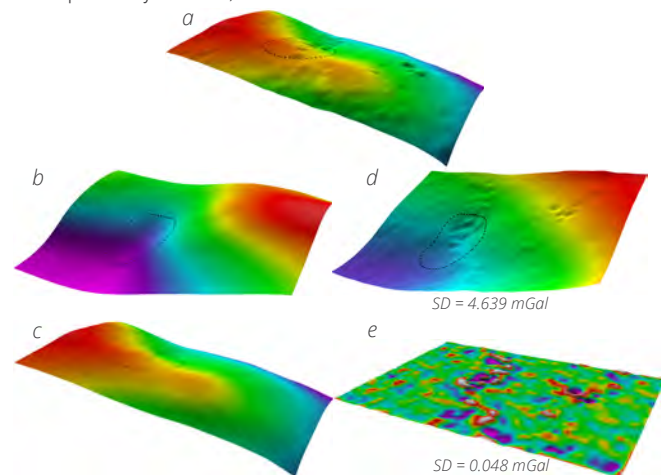


Figure 1. Observed (a) and calculated gravity fields in case of initial (b) and resulting (c) 3D density models and gravity misfit in case of initial (d) and resulting (e) 3D density models

GEOLOGICAL RESULTS

The results of joint inversion of gravimetric and seismic data showed that the lateral size of Budushchany salt dome is three times smaller than it was initially interpreted by 3D seismic data (Figure 2). Low-density areas near the salt wall identify presence of gas saturated reservoirs. New hydrocarbon trap occupies the area where the salt dome had been mapped by 3D seismic (Figure 3).

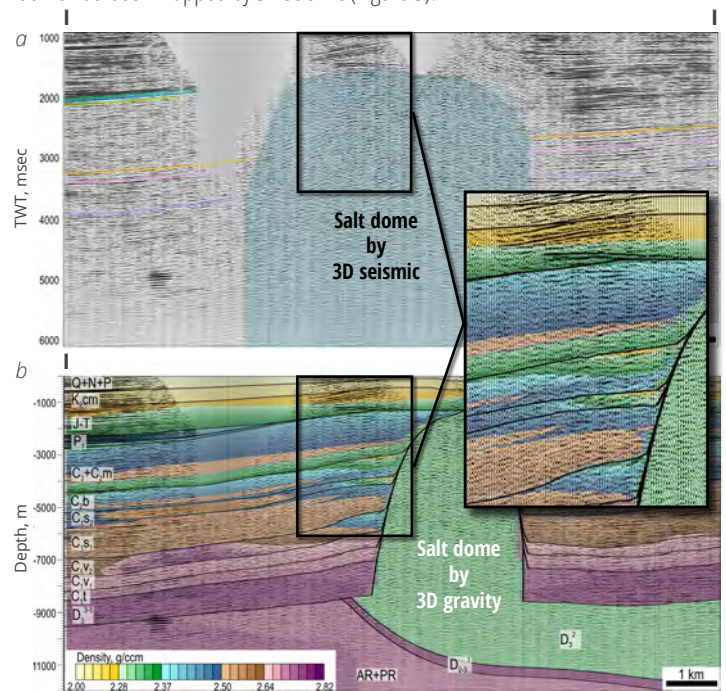


Figure 2. Salt dome by 3D seismic data interpretation (a) and 3D gravity inversion (b). The new hydrocarbon trap is adjacent to the south-western wall of the salt dome, in 3D density model it was delineated by density values 2.28-2.37 g/ccm

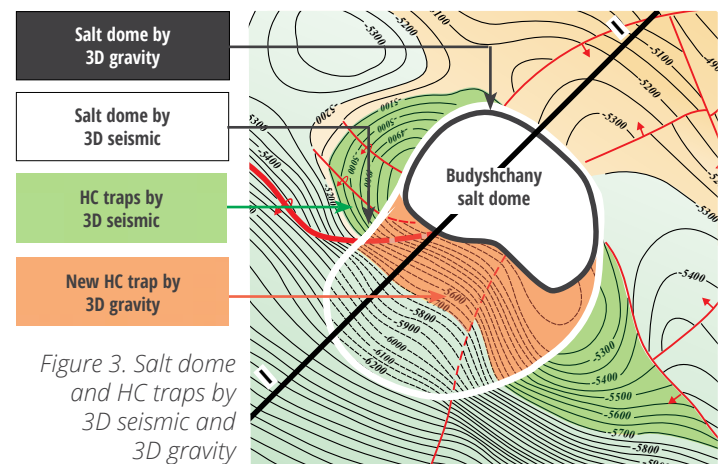


Figure 3. Salt dome and HC traps by 3D seismic and 3D gravity