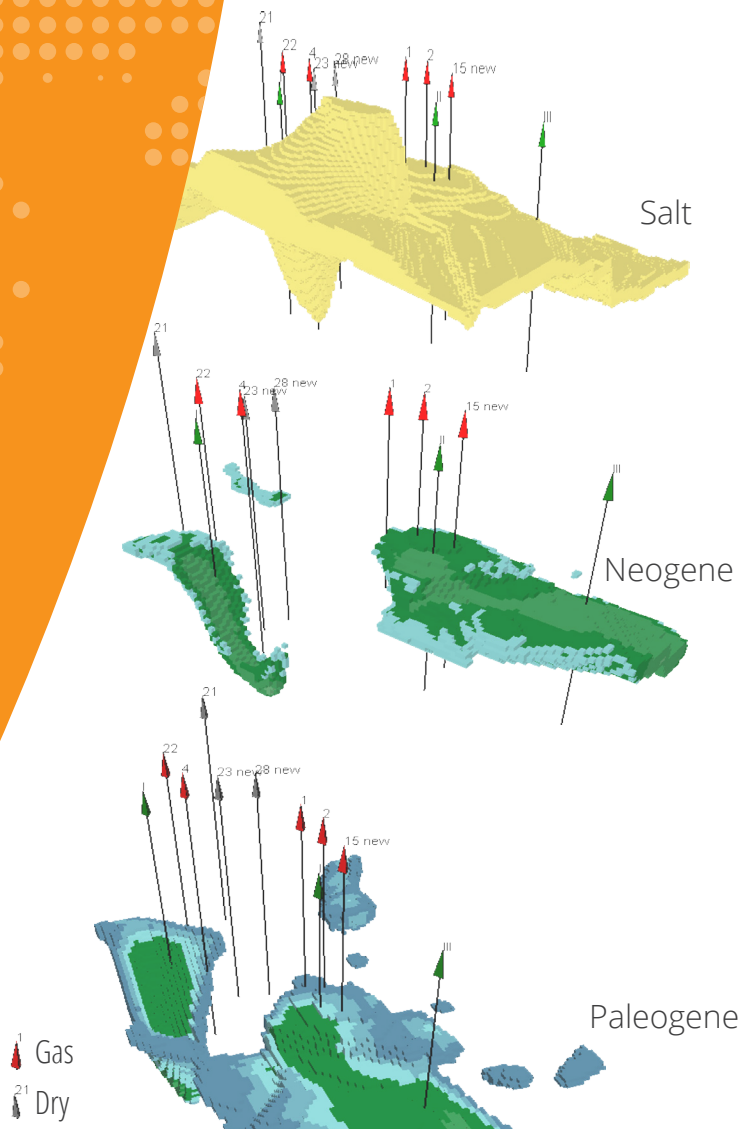
DEPROIL

DETAILED OIL & GAS PROSPECTING

- Two gas fields
- Appraisal of two commercial pools
- One commercial well drilled within the mapped gas pool
- Commercial success rate within gas pools: 100%
- Two dry holes drilled outside mapped gas pools
- Dry hole prediction probability: 100%



THE ACCURATE SHAPE OF SALT DIAPIR AND NEAR-SALT COMMERCIAL HYDROCARBON POOLS AS A RESULT OF GEOLOGICALLY MEANINFULL REGULARIZATION FREE JOINT 3D INVERSION OF GRAVITY, WELL-LOG, AND SEISMIC DATA

SOLOTVYNSKE AND DIBRIVSKE GAS FIELDS

MAPPING THE SHAPE OF THE SOLOTVINO SALT DIAPIR AND SUBSALT COMMERCIAL HYDROCARBON POOLS

Dibrivka and Solotvino gas fields, Solotvino trough, Transcarpathian region, Ukraine, 2005

STUDY OBJECTIVES

The study area is located within the Miocene molasse basin of the Transcarpathian trough which is underlain by Paleogene-Mesozoic basement. In the south-eastern part of the study area salt pierces Neogene clastic sequence and forms the Solotvyno salt diapir. Due to the alteration of salty and clastic beds, the top and the bottom of salt are not distinguished by seismic method.

Solotvyno gas field is situated in the eastern part of the study area. A gas pool in the Lower Badenian tuffs of Novoselytsya formation N_1nv was discovered by wells #1 and #2. Dibrivka gas field is situated in the central part of the study area. Gas pool in Grushivka formation of Paleogene P_3gr was discovered by wells #4 and #22. Both fields are located near the Solotvyno salt diapir and are overlaid by salt beds of Tereblya formation.

Based on 2D seismic data, Solotvyno and Dibrivka gas pools were considered to be trapped in anticlines. Wells #4 and #22 of Dibrivka field were placed in the southern pericline of Dibrivka anticline; while wells #1 and #2, in the western pericline of Solotvyno anticline.

The main objective of the study was to delineate distribition of commercial hydrocarbon pools, discovered by producing wells of Solotvyno and Dibrivka fields, as well as to refine the shape of the Solotvyno salt diapir.

3D MODELLING WORKFLOW

A 3D structural framework was built using 20 2D seismic lines as well as stratigraphic well tops from different wells including wells #4 and #22 of Dibrivka field, wells #1 and #2 of Solotvyno field. Structural model consisted of 7 surfaces, featuring the structure of Neogene and Paleogene. An initial 3D density model (Figure I-2a) was built using generalized petrophysical relations down to 7km depth. Dimensions of the 3D density model were 14.4x10 km with discretization (cell size) - 100x100x50 m. 3D model consisted out of 2 million cells. The misfit between observed and modelled gravity from the initial 3D density model was 3.792 mGal (Figure I-1d).

At the first stage we refined the shape of salt diapir with non-linear structural inverse gravity problem, which reduced deviation between observed and calculated gravity down to 1.5 mGal. Thus initial 3D density model was improved by 2.5 times. At the next stage we refined the 3D density model with 3D linear gravity inversion, which reduced deviation between observed and calculated gravity to 0.316 mGal. Relatively the gravity field, the initial 3D density model was 12 times improved (Figure I-1e).

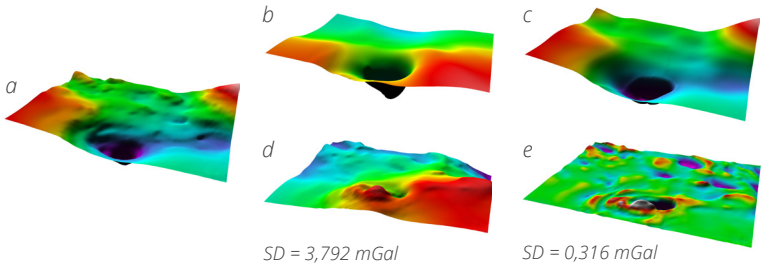


Figure I-1. Observed (a) and calculated gravity fields from initial (b) and final (c) 3D density models, and gravity misfits respectively (d, e)

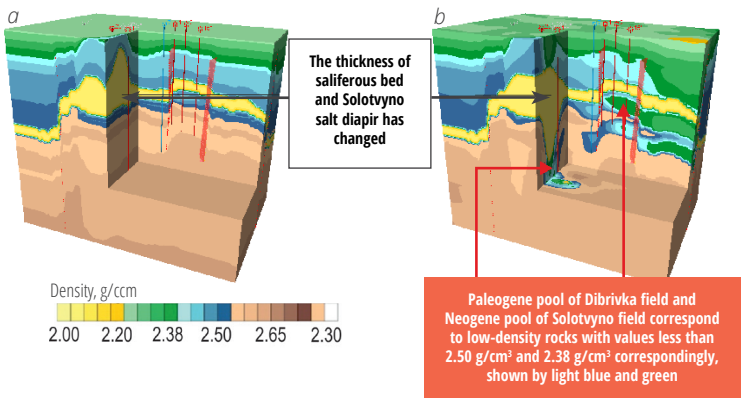


Figure I-2. Initial (a) and final (b) 3D density models. Salt is shown in yellow

GEOLOGICAL RESULTS

Compared to the initial model, the bottom of the Solotvino salt diapir has deepened to 2.5 km (from an initial depth of only 1.3 km) (Figure I-2).

Paleogene gas pool of Dibrivka field shows up as a low-density area outlined by a cut-off value of 2.50 g/ccm. The low-density anomaly embraces wells #4 and #22 (Figure I-3) and extends southward underneath the diapir. The apical and northern parts of the anticline are represented by tight rocks with densities of 2.52 g/ccm and higher. Absence of commercial hydrocarbons in this part of the anticline was confirmed by dry wells #23 (drilled in 2005) and #28 (2011) (Table I-1).

The Neogene gas pool of the Solotvyno field is revealed in the 3D density model as a low-density area outlined by a cut-off density of 2.38 g/ccm (Figure I-4). According to the density distribution the Solotvino gas pool extends to the east and south-east from producing wells around the salt diapir. Predicted gas saturation of the eastern apical part of Solotvino anticline was confirmed in 2012 by new well #15, which obtained gas inflow of 62 thou. m³/day.

All three wells 100% proved the accuracy of created 3D model of Solotvino diapir and outlines of mapped commercial gas pools.

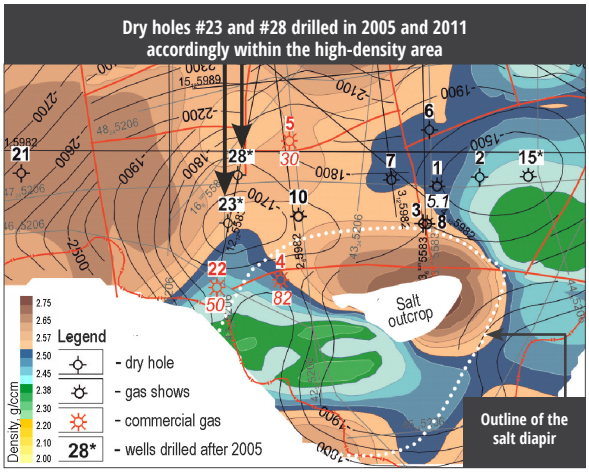


Figure I-3. Top of Paleogene superimposed with mapped commercial gas pool showed up as low-density anomaly with the cut-off value of 2.5 g/ccm. Dry holes #23 and #28 penetrated tight rocks within the apical part of the Solotvino anticline outside the commercial gas pool.

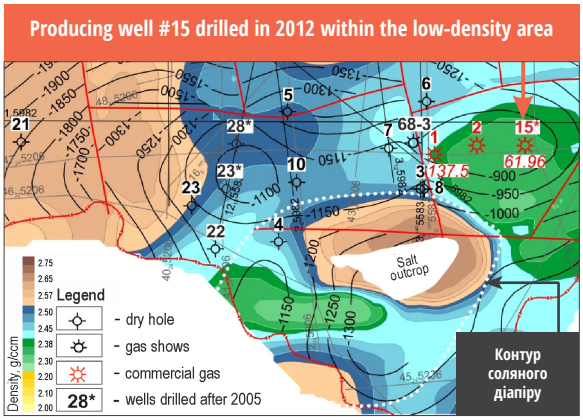


Figure I-4. Top of Novoselytsia formation of Neogene superimposed with mapped commercial gas pools of Solotvino and Dibrivka anticlines outlined by the cut-off density value of 2.32 g/ccm and new commercial well #15 in the crest of the Solotvino anticline

Table I-1. Drilling results

Year	Well number	Age	Prediction	Well test
2005	23	P_3gr	dry	dry
2011	28	P_3gr	dry	dry
2012	15	N_1nv	gas	gas