DEPROIL

DETAILED OIL & GAS PROSPECTING

- Mature field
- Two new commercial wells drilled within mapped gas pool
- Commercial success rate within gas pools: 100%
- New geological structures identified

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

ROZPASHNIVSKE GAS FIELD

MAPPING OF COMMERCIAL HYDROCARBON POOLS IN PRODUCING AND PROSPECTIVE DEEP FORMATIONS OF ROZPASHNIVSKE GAS-CONDENSATE FIELD

Dnipro–Donets Basin, Ukraine, 2020

STUDY OBJECTIVES

Rozpashnivske field, with estimated gas reserves of 55 BCM, is located in the central part of the Dnipro–Donets basin. Gas pools are associated wit Permian and Carboniferous reservoirs. Gas accumulations are trapped within a monoclinal block sealed by tectonic faults and Rozpashna salt diapir. The field is at a mature stage of development. To enhance hydrocarbon production, a study was undertaken to refine the areal extent of commercial gas pools and to delineate accumulations within deep reservoirs. To achieve this objective, high-resolution detailed gravity survey was carried out, followed by joint invertion of gravity, seismic, well log and geological data.

3D MODELLING WORKFLOW

The structural 3D model comprised 20 horizons interpreted from 2D seismic and well data, extending from the surface to the Archean–Proterozoic basement and incorporating the Devonian salt sequence and associated salt wing.

Density distribution of the initial inhomogeneous 3D model was derived from acoustic log using modified Gardner relationship. For deeper stratigraphic intervals, density was estimated as a function of burial depth, geological age, and lithology. Density estimates for well logs were calibrated by core.

The model dimensions were 25.5 × 21.5 km laterally and 25.14 km vertically. The model consisted of 68.5 million cells with a cell size of 100×100×20 m. Misfit between observed and calculated gravity fields for the initial density model was 5.62 mGal.

The gravity inversion workflow included refinement of basement and mother-salt geometries, delineation of Rozpashna salt stem morphology, and determination of inhomogeneous density distribution within surrounding sedimentary rocks (Fig. III-1).

Misfit between the observed and calculated gravity fields for the final 3D model was reduced to 0.065 mGal. Consequently, relatively to the gravity field the model was improved by a factor of 86.

To delineate the spatial distribution of commercial hydrocarbon pools, closed low-density bodies were identified within the final 3D model. For these bodies, reservoir properties, including porosity and hydrocarbon saturation, were estimated, and both gas initially in place (GIIP) and recoverable gas reserves were calculated.

GEOLOGICAL RESULTS

The geometry of the salt stem was determined. Commercial hydrocarbon pools were delineated within producing Permian and Carboniferous reservoirs, including accumulations associated with newly identified geological features – displaced blocks of salt diapirs' overburden (Fig. III-2). These geological structures are considered as analogous to carpaces of the Gulf of America.

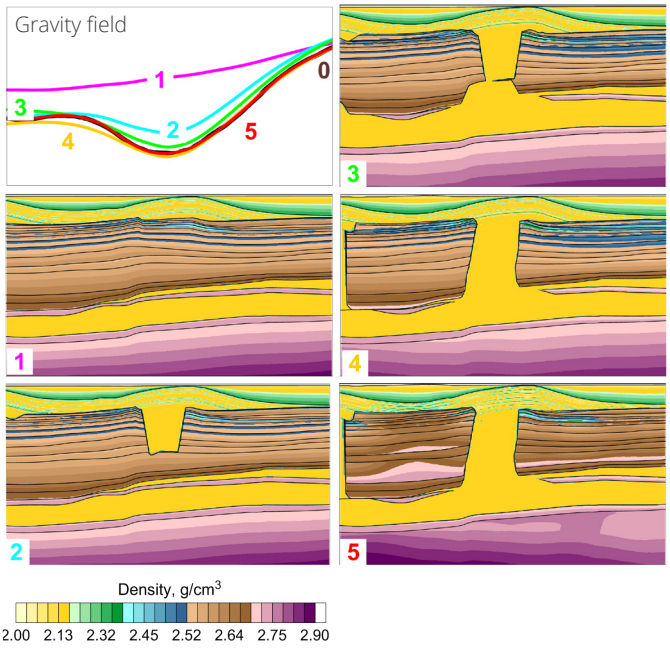

Figure III-1. Observed (0) and calculated (1-5) gravity fields and 3D density models at successive stages of the gravity inversion workflow: 1 – initial density model; 2–4 – refinement of the salt stem geometry and density distribution within the sedimentary succession; 5 – refinement properties of basement and sedimentary succession – final 3D model.

Total gas resources within the license were estimated at 34.6 BCM. Locations for 11 development and appraisal wells were proposed to evaluate and produce mapped commercial pools.

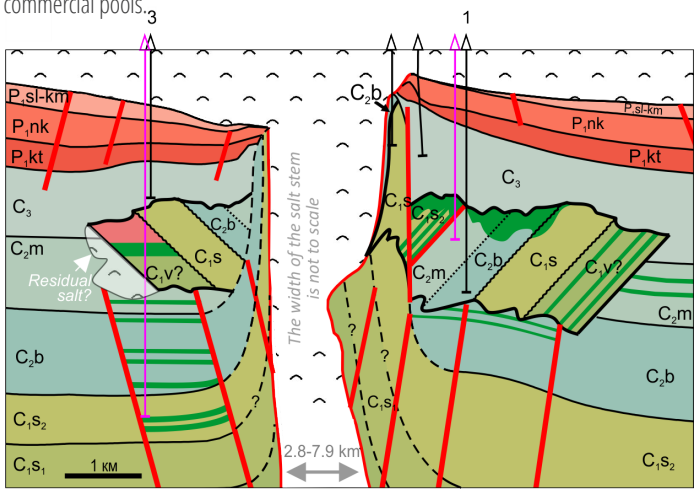

Figure III-2. Conceptual model of displaced blocks of salt diapirs' overburden and associated hydrocarbon pools.

MODEL VALIDATION BY DRILLING

In accordance with provided recommendations, production wells 104 and 105 were drilled in 2022–2023 at a distance of approximately 100 m from the locations of proposed wells R-3 and R-9 (Figs. III-3, III-4).

According to the drilling outcomes:

- the base of salt wing was determined with an error of 60–80 m under the average depth of 3,250 m;
- porosity estimation error was 2–3% under the average value of 19%;
- gas saturation estimation error was 10% under the average value of 85%.

Well 104, drilled within the area of lower density, yielded a gas production rate of 64 thou m³/day, whereas well 105 produced 63 thou m³/day.

The commercial success rate is 100%.

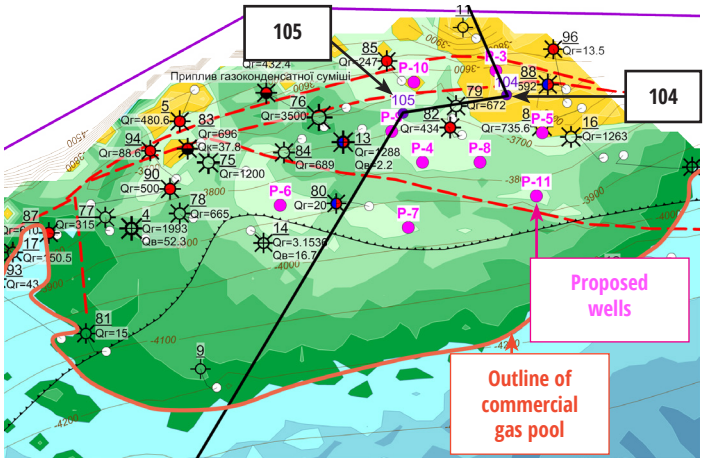

Figure III-3. Density distribution in Upper Carboniferous.

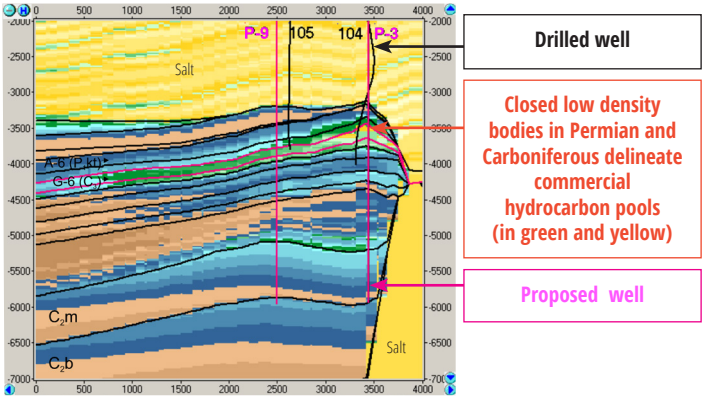

Figure III-4. Density cross-section through proposed and newly drilled production wells 104 and 105.