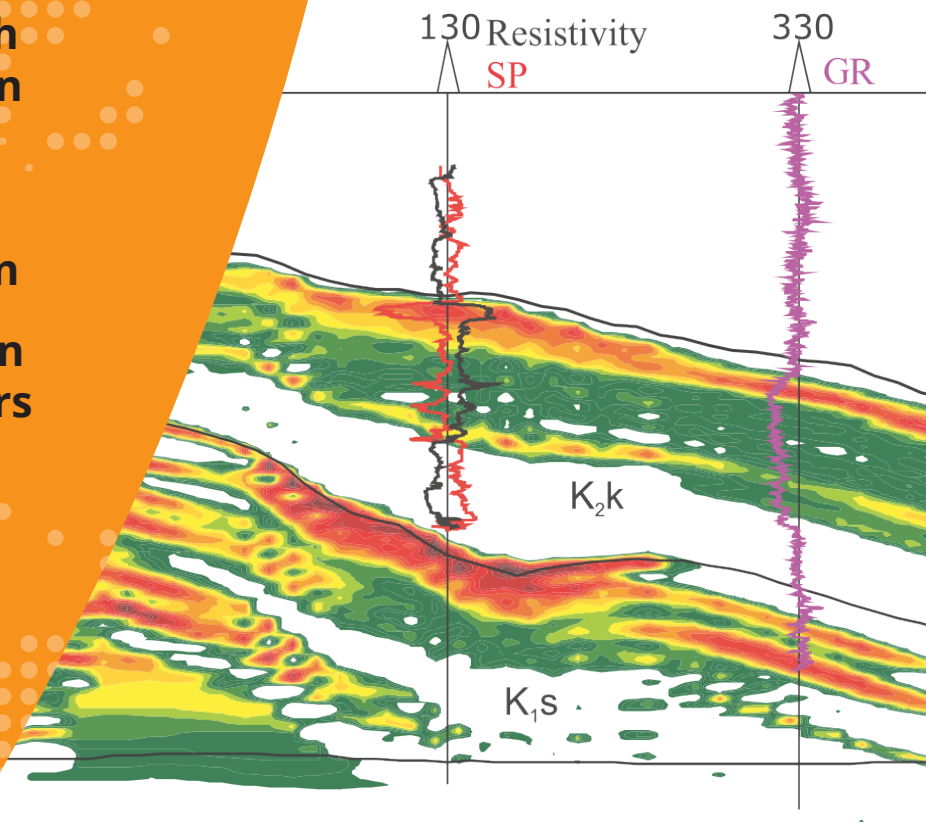
DEPROIL

DETAILED OIL & GAS PROSPECTING

- 4D on-land gravity & 1D gravity log observations
- 4D+1D joint inversion of surface and borehole gravity fields
- 3D density model with 1 m vertical resolution
- 3D model of gas saturation after 10 years of production
- 3D model of formation pressure after 10 years of production
- Discovery of new Senonian commercial gas pool



PRODUCTION MONITORING

PRESSURE DROP AND FLOODING AREAS BY TIME-LAPSE GRAVIMETRIC OBSERVATIONS AND BOREHOLE GRAVIMETRY, JAMSOVEY GAS FIELD, WESTERN SIBERIA

MAPPING PRESSURE DROP AND FLOODING AREAS BASED ON THE RESULTS OF TIME-LAPSE GRAVIMETRIC OBSERVATIONS AND BOREHOLE GRAVIMETRY (4D+1D)

Nadym-Pur, Western Siberia, Russian Federation
Time lapse gravity survey: 1998-2008

GEOLOGICAL PROBLEM

- Monitoring of waterflooding in the main gas pool - Cenomanian, Cretaceous, K_{1-2}pk
- Seismic monitoring not an option due to the absence of seismic signal above the structure
- Study of more shallow reservoir in Berezov Formation, Senonian, Upper Cretaceous, K_2br

3D GRAVITY INVERSION WORKFLOW

Structural framework of the model was built using 2D & 3D seismic data interpretation, including target Cenomanian and Senonian horizons of Upper Cretaceous. Wells were used to define the initial 3D density model of target Cenomanian intervals (Upper Cretaceous, K_2). 3D density model was refined by joint 3D linear inversion of surface gravity field and well log gravity data with one-meter resolution in depth (Figure 1). We used surface background measurements of 1998 and measurements after a decade of production of 2008. 3D model of gas saturation (Figure 3) was built using the dependency of Cenomanian rock density on porosity and saturation (Figure 5). The dependency of real gas density on pressure and temperature was derived (Figure 4) as well as the dependency of Cenomanian gas-saturated sandstone's density on porosity and gas saturation (Figure 5). Gas saturation decrease was detected in the marginal part of the gas pool which is associated with contour water flood within highly permeable beds (Figure 3). In the apical part of the structure, there is a zone of abnormal pressure drop (Figure 6). New gas-saturated pool was mapped in Cenonian formation of Upper Cretaceous (Figure 2).

GEOLOGICAL RESULTS

- Local areas of pressure drop by 5-6 MPa and gas-saturation change after 10 years of production were identified
- Predicted location of well clusters with gas-water contact rise and pressure drop
- Predicted gas-saturated reservoir in Senonian formation

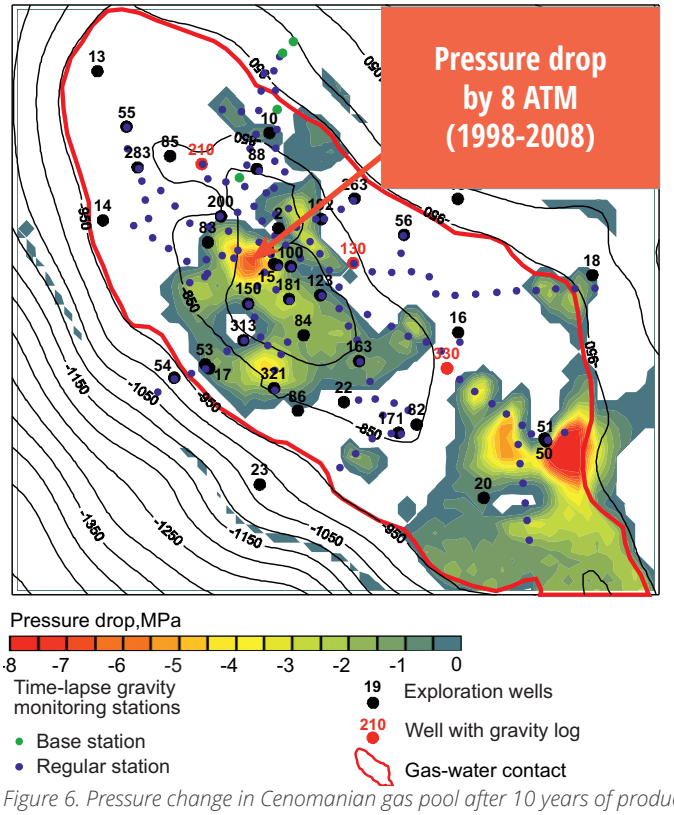


Figure 6. Pressure change in Cenomanian gas pool after 10 years of production

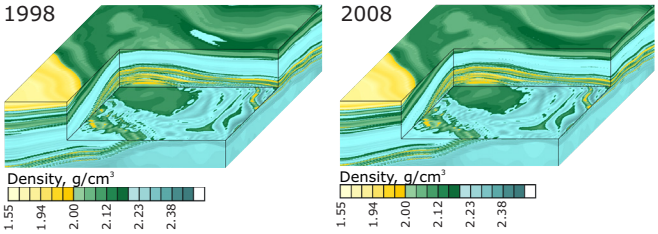


Figure 1. High-resolution (1m in depth) 3D density models of gas-saturated reservoir by joint gravity field and gravity log inversion: background model (1998, left) and model after 10 years of production (2008, right)

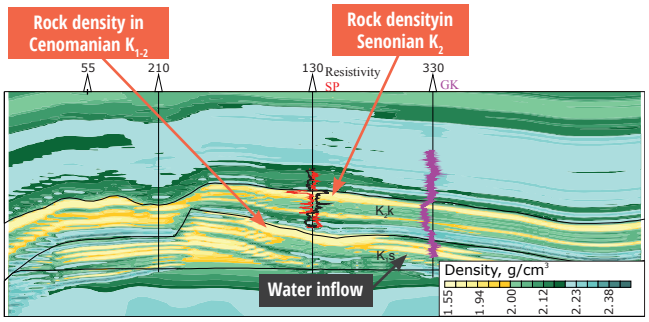


Figure 2. Cross-section of 3D density model through the wells with gravity log

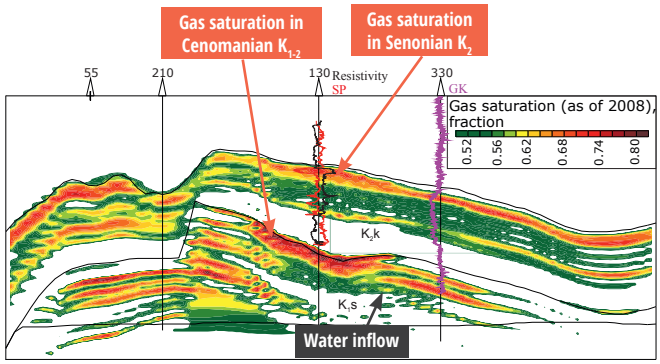


Figure 3. Cross-section of 3D gas-saturation model through the wells with gravity log

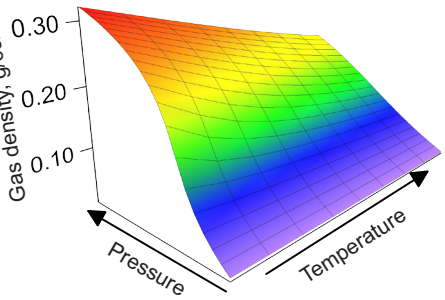


Figure 4. Dependency of gas density on pressure and temperature in Cenomanian gas-saturated sandstones

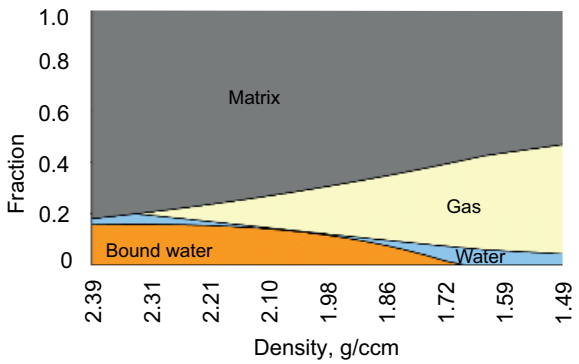


Figure 5. Dependency of Cenomanian rock density on porosity, water- and gas-saturation