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NATURAL GAS RESOURCES
AND RESERVES ESTIMATION STUDY
FOR THE COMMERCIAL FIELD B

1. WORK TARGETS

The work targets are as follows:
- the fulfillment of the first natural gas resources and reserves study for the commercial field B,
- optimum production scenarios,
- Discounted Cash Flow analysis.

2. RESERVOIRS PARAMETERS AND PRODUCTION STATUS

Field B belongs to the Moldavian Platform from the geological point of view.

The natural gas B field was discovered in the period 2004–2005, through seismic survey and drilling of the wells #1 and #2. The wells intercepted the producing Sarmatian at 550–600 m depth. Sarmatian is characterized by lens shape reservoirs. The production started with initial flow rates of 30 000–34 000 scm/d.

The initial reservoir pressures for both natural gas accumulations from B field are 40 bar for B 1 and of 45 bar for B 2.

The calculated gradient temperature is 30°C/km.

The natural gas is sweet with the following content:

methane – 99.469%,
ethane   – 0.1119%,
nitrogen – 0.3799%.

Till now the well #1 did not produce reservoir water and well #2 produced very small quantities. The reservoir water is calcic, chloride type, chloride group, sodium subgroup.

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The porosity values are between 20–21% and those of the initial gas saturation are 60–50% (they were determined based on well logs interpretation).

The physical parameters of the reservoir rock and of the rock-fluids system calculated for the wells B 1 and B 2 are as follows (Tab. 1).

Table 1

Reservoir parameters

Reservoir parameter	B 1	B 2
Top sand, m	550	600
Base sand, m	560	610
Saturation limit, m	560	605
Gross thickness, m	8	9
Net pay, m	7.5	5
Net pay / Gross thickness	0.9375	0.555
Porosity, %	20	21
Gas saturation, %	60	50
Initial pressure, bar	40	45
Initial temperature, ^{o}C	26	27
Formation volume factor (b_g)	0.02232	0.02232

In the B field there were discovered two natural gas accumulations as following:

– a reservoir in Sarmatian, Eastern block, underlined by the well #1;
– a reservoir in Sarmatian, Western block, underlined by the well #2.

The accepted hydrocarbon displacement mechanism is elastic gas drive.

In the present, after one year of production, both wells drilled in B field are in production with the subsequent flow rates: 15 000 scm/d (well #2) – 75 000 scm/d (well #1) and the total field flow rate is 90 000 scm/d.

Till the reference date of the study, 01.01.2007, it was extracted a cumulative of 10 millions scm of natural gas, representing 10% from OGIP, estimated at 100 millions scm.

The main production parameters from B field are presented in Table 2.

Table 2

Production parameters at 01.01.2007

Reservoirt	Cumulative extracted at 01.01.2007, MMscm	Production wells	Gas rate, scm/d	Pressures tubing/casing, bar	Water, cm/d
B East (well #1)	6	#1	75 000	25/25	0
B West (well #2)	4	#2	15 000	20/20	0
Total B field	10		90 000		0

3. ANALYSIS AND EVALUATION METHODS

The petrophysical analysis was performed, based on the well logs acquired, together with mud logging and lithological data collected by well site geologists.

After the seismic data were acquired and the seismic profiles (Fig. 1) were interpreted, there were accomplished the following top sand maps:

– time: Top Gas Sand TWT,
– depth (300 m under sea level): Top Gas Sand Depth,
– amplitude: Top Gas Sand Amplitude (Fig. 2),
– Top Gas Sand AVO – Amplitude versus Offset – (RO*G) (Fig. 3),
– Amplitude of Sand Reservoir.
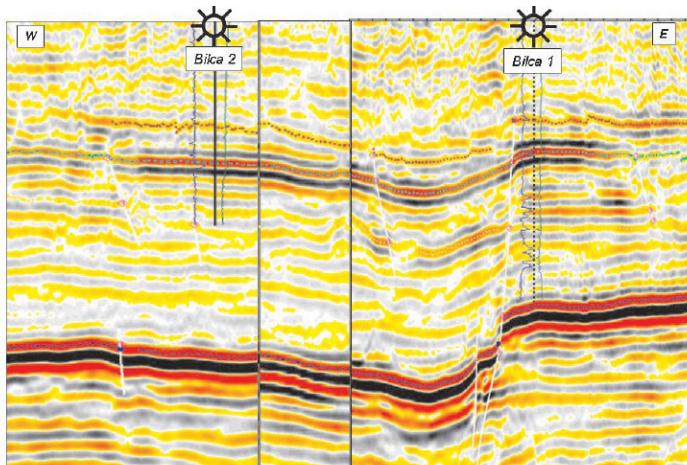
Fig. 1. Seismic profile
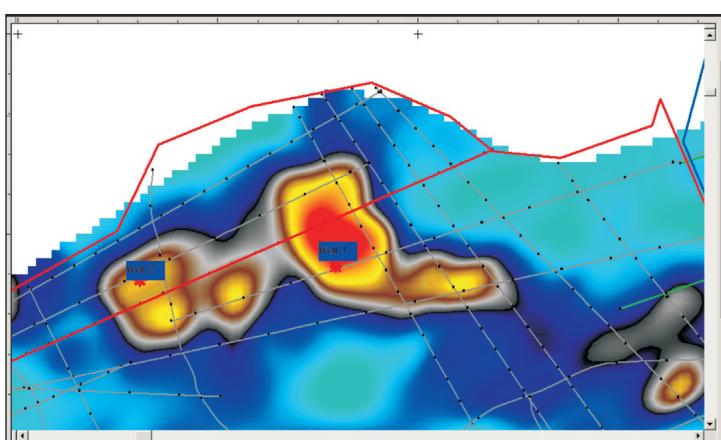
Fig. 2. Top Gas Sand Amplitude
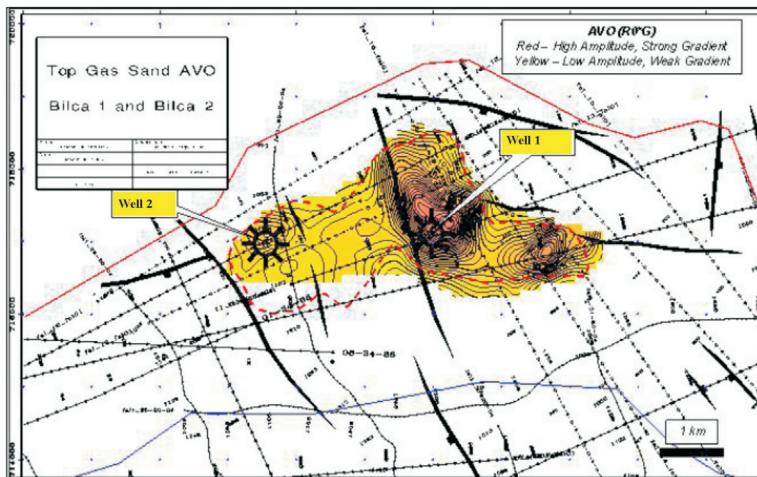
Fig. 3. Top Gas Sand AVO

Based on these maps, it was completed the top Sarmatian producing sand structural map.

In accordance with the results from the production tests, seismic interpretation and physical parameters, it can be considered that in the present are two non-associated gas accumulations, separated from the hydrodynamic point of view by faults: B East (intercepted by the well #1) and B West (intercepted by the well #2).

In the present work OGIP was calculated using the volumetric method, based on the physical parameters determined and the isopachyte maps. The producing areas were determined in accordance with: sealed faults, the initial gas-water contact (in the Western block), fluids saturation limit (in the Eastern block), a limit with high reflector amplitude (area considered to have the highest thickness of the producing layer) and a limit with low reflector amplitude (pinch out producing layer area).

In order to verify the resources calculated using the volumetric method, it was applied the material balance method and the results showed that the present estimated resources are lower than the volumetric ones.

With the purpose of determination of the natural gas reserves, there were carried out production predictions for each well.

The production prediction was analyzed in two options:
1) with the present wells and the current production mode, till a line collecting pressure of 20 bar, depending of the pressure drop;
2) with the present wells and decreasing the collecting pressure by a field compressor with suction pressure of 5 bar and discharge pressure over 25 bar. The investment is about 2 000 000 Euro.

The conception of the production prediction is based on natural gas radial flow equation from the horizon to the well, function of flow resistance coefficients.

Each option was economically analyzed using Discounted Cash Flow method.

4. STUDY RESULTS

The initial geological resources estimated through the volumetric method are 100 millions scm of natural gas.

The initial geological resources estimated through the material balance method were calculated as 90 millions scm of natural gas (with the remark that the production time was very short), which are nearer to the initial geological resources estimated in this work using the volumetric method.

The natural gas reserves were evaluated through the Discounted Cash-Flow method, applied on the results got from the production predictions.

In the study there were not estimated probable or possible reserves, because the existent resources can be completely drained by the present producing wells.

5. CONCLUSIONS AND PROPOSALS

The Sarmatian non-associated gas from B field was discovered in the year 2004 through the wells #1 and #2.

There were distinguished two accumulations separated from the hydrodynamic point of view: Eastern block (B 1) and Western block (B 2).

The exploitation of the B field started in the year 2006 by the wells #1 and #2.

The gas cumulative extracted till now is about 10 millions scm.

The initial geological resources estimated in the study using the volumetric method are 100 millions scm.

In the study there were not estimated probable or possible reserves because the existent reserves can be completely drained by the present producing wells.

It is proposed to continue the field production accordingly to the option 2 (with the present wells and decreasing the collecting pressure by a field compressor.

The economical limit is reached in the year 2012.

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