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Analysis of efficiency of sidetracking at the late stage of development of one field of Mubarek group based on the geological and hydrodynamic model

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ABSTRACT: In this article, the authors investigate the effectiveness of using a horizontal sidetrack for two sections of the field with different residual reserves in the late stage of gas condensate field development.

KEY WORDS: Geological and hydrodynamic model; sidetracking; field development forecasting, hydrodynamic simulator, geological and hydrodynamic model adaptation.

I. INTRODUCTION

In recent years, due to the development of computer technology and mathematical methods for solving complex problems, geological and hydrodynamic modeling has become one of the effective tools of analysis and design of oil and gas field development. [1]

II. METHODOLOGY

Geological and hydrodynamic model of the field makes it possible to monitor the dynamics of depletion of residual reserves, to make a more accurate forecast of oil and gas production, to model geological and technical measures to improve gas and oil recovery and efficiency of the enterprise, to calculate the most rational and cost-effective options for the development of productive formations.

III. CALCULATION RESULTS

The purpose of this work is to evaluate the effectiveness of sidetracking of a given length for two different areas of the gas field using an adapted geological and hydrodynamic model. The field model reliably describes filtration-capacitance properties, which is evident from the results of the field development history tuning (figure 1).

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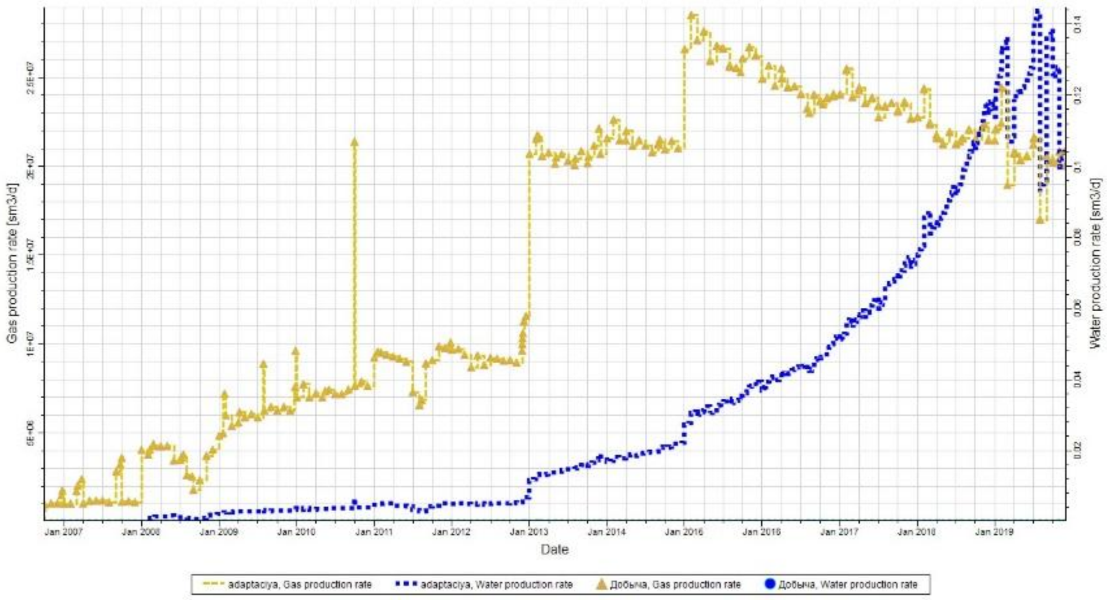

Figure 1: Results of adapting the hydrodynamic model of the field

Sidetracking technology helps increase gas production, engages previously untapped reservoir sections that could not be produced before and actually replaces well compaction. Appropriate technology helps to save the well and the cost of drilling a vertical wellbore. [2]

Efficiency calculation is based on the difference of cumulative gas production values for the forecast without the geological and engineering operations (production is performed by a vertical well) and the forecast with the geological and engineering operations (production is performed by a sidetracked horizontal borehole). The resulting difference is the effect of the event.

The results of calculation of forecasting without the use of well interventions are shown in Table 1.

Table 1. Calculation results without geological and technical measures

Well number	Simulation results		
	First month		Cumulative gas production for 5 years, mln. m^3
	Gas flow rate, thous. m^3/day	Water flow rate, m^3/day	
7	45,3	17,3	42,3
3	51,4	28,5	62,1

Starting parameters and dynamics of technological indicators drop for the first section of the field selected for sidetracking are shown in table 2 and figure 2.

Table 2. Results of calculation of well 7 geological and engineering operations efficiency estimation

Wellnumber	Simulationresults			Efficiency of geological and engineering operations, %
	First month		Cumulative gas production for 5 years, mln. m^3	
	Gas flow rate, thous. m^3/day	Water flow rate, m^3/day		
7	221,4	47,8	91,07	215,3

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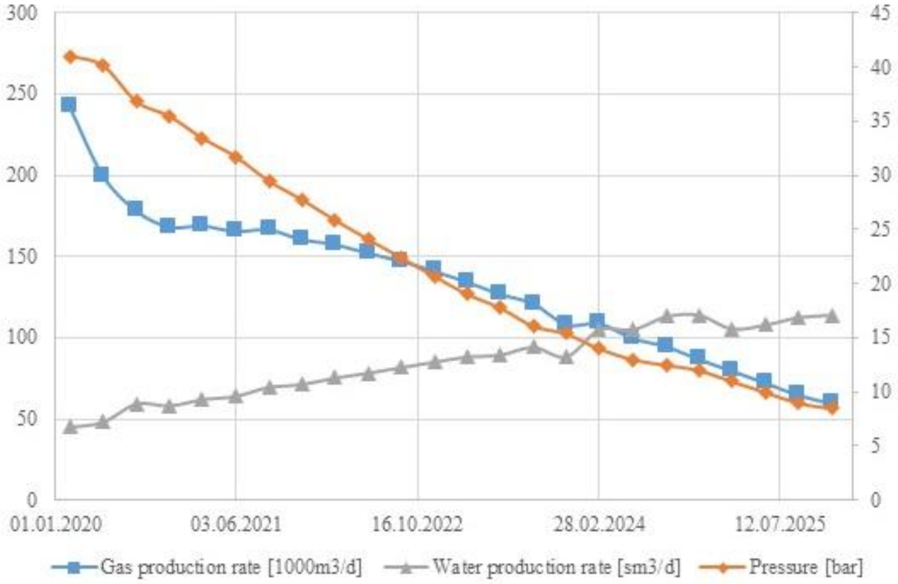

Figure 2. Dynamics of technological parameters drop of well 7 during sidetracking

Residual reserves map and estimated reservoir pressure map before forecasting are plotted in Figure 3.

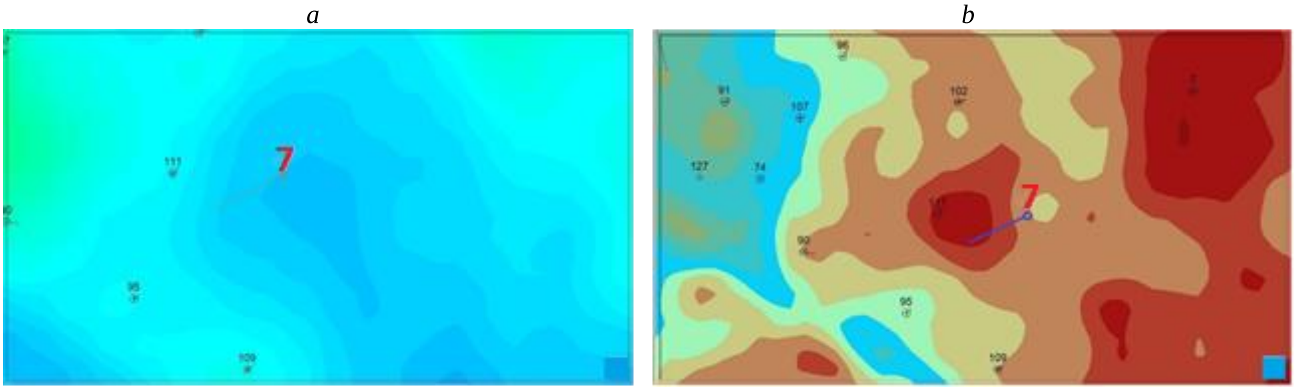

Figure 3. *a* - Residual reserves map, *b* - Current pressure map

According to the calculation results for the first section of conducting well interventions in the chosen direction of the horizontal table with the help of residual reserves and current pressure maps, led to an increase in cumulative production. However, the technical and economic results, despite the obtained increase in gas production (215.3%), it is economically unprofitable to conduct sidetracking of a given length in this area of the field.

Similar calculations were done for the second selected area of the field, the results of which are shown in table 3 and figure 4.

Table 3: Results of calculation of well 3 geological and engineering operations efficiency estimation

Well number	Simulation results			Efficiency of geological and engineering operations, %
	First month		Cumulative gas production for 5 years, mln. m^3	
	Gas flow rate, thous. m^3/day	Water flow rate, m^3/day		
3	307,2	10,4	196,98	317,2

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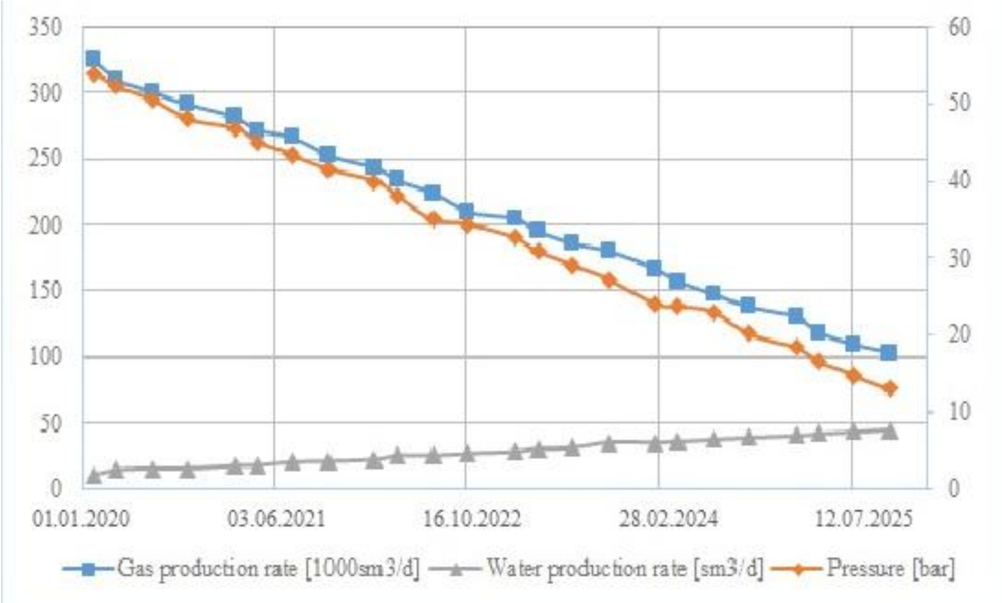

Figure 4. Dynamics of technological parameters drop of well 7 during sidetracking

The maps of current residual reserves and the map of estimated reservoir pressure for the second section of the field before forecasting, selected for sidetracking, are shown in Figure 5.

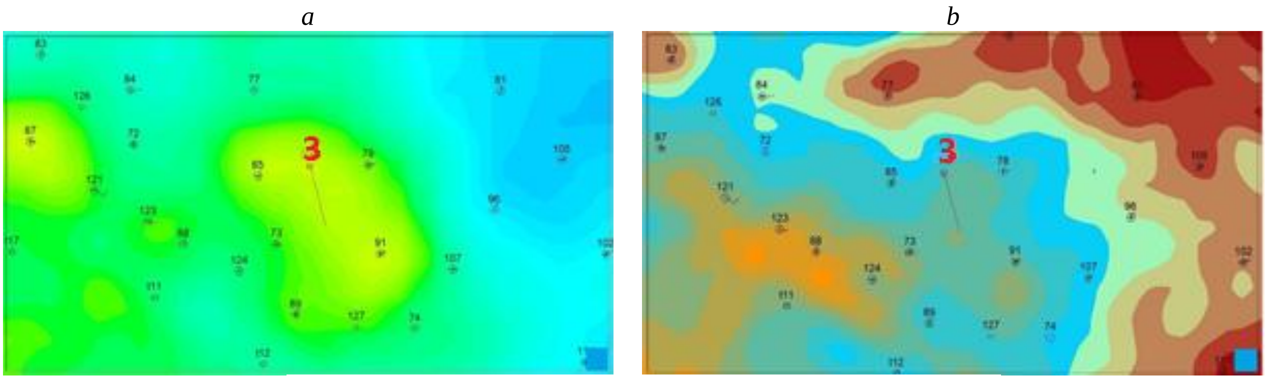

Figure 5. *a* - Residual reserves map, *b* - Current pressure map

In this case, the increase in gas production (317.2%) justifies the capital investment for sidetracking of a given length.

The technical and economic analysis of additional various options for sidetracking showed that the economic feasibility of sidetracking arises when the increase in gas production from geological and technological measures is not less than 250%.

IV. CONCLUSION

The geological and technical measure of sidetracking was considered, the forecast indicators of this measure were calculated on the basis of the hydrodynamic simulator, which is a 3D model of the field. This reservoir model allowed forecasting, estimating the effect and tracing the dynamics of production indicators of the project wells with the given length of the horizontal wellbore. Calculations for two variants of horizontal sidetracking technology in different parts of the field were performed. The results showed a high success rate of horizontal wellbore drilling in the area with large residual gas reserves.

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