N E W S
OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
SERIES OF GEOLOGY AND TECHNICAL SCIENCES
ISSN 2224-5278
Volume 4, Number 424 (2017), 270 – 275

UDC 622.323(574.1)

S. M. Ozdoyev, M. A. Mashrapova

Institute of Geological Sciences named after K. I. Satpayev, Almaty, Kazakhstan
E-mail: ozdoyevsultan@mail.ru, moldir_m_m@mail.ru

GEOLOGICAL STRUCTURE AND METHODS OF INCREASING OIL RECOVERY OF THE PRODUCTIVE HORIZONS OF THE ARYSTAN DEPOSIT

Abstract. There are the reservoirs of the deposit, which are presented in the form of laterally and layerwise heterogeneous in terms of their reservoir properties and productivity coefficients, permeability, efficiency of oil-saturated capacities in the article. The methods of using the optimal technologies in increasing the selection of oil in the productive wells of the wells of the Arystan deposit are selected.

Key words: deposit, oil, gas, flow rate, well, reservoir, core, bed thickness, permeability, porosity, reservoir, recovery factor, hydraulic fracturing, productivity, oil saturation.

Introduction. The extraction of high-viscosity heavy oil with a large percentage of paraffin for the extractive industries of the petroleum industry in Kazakhstan has always been a problem. Most of the deposits of the Mesozoic deposits of the sedimentary basins of Kazakhstan are explored comparatively at small depths up to 2500-3000 meters and many of which have long been exploited. The high depletion of Mesozoic stocks of oil deposits is an inevitable consequence of the watercut in the oil produced and decrease in well production rates. That is why the use of traditional technologies not only reduces the competitiveness of the country's economy, but also makes it impossible to use oil and gas reserves in the future.

Increasing the flow rate of wells in the conditions of feeding oil production is acute in old fisheries for the majority of oil companies in Kazakhstan. The use of enhanced oil recovery technologies to develop residual oil reserves in the Mangyshlak and Ustyurt deposits requires constant improvement and perfection.

Commercial success requires the use of an inexpensive, highly efficient oil recovery method. One of the most common and widely used methods is the technology of hydraulic fracturing to improve the oil recovery factor. Enhanced oil recovery at the deposits of Mangyshlak and North Ustyurt is associated with hard-to-recover reserves, the extraction of which requires the use of additional technologies for the performance of the adopted oil recovery factors.

The key issues related to the uncertainty of the Arystan deposit are well acceptance, operating method, paraffin and salt deposition, primary processing of extracted oil and growth of hydraulic fracturing during fluid injection, flooding coverage, heterogeneity of the lithological composition of the reservoir rocks.

In the concept of a calculated geological model, each oil deposit of the Arystan field is represented in the form of a set of reservoirs that are characterized by discontinuity in occurrence over the area and dissection in the thickness of the formation within the productive oil-saturated part of the reservoir. The capacitance-filtration properties of the oil reservoirs at the Arystan deposit differ significantly in the results of the analytical data of the core material [1, 2].

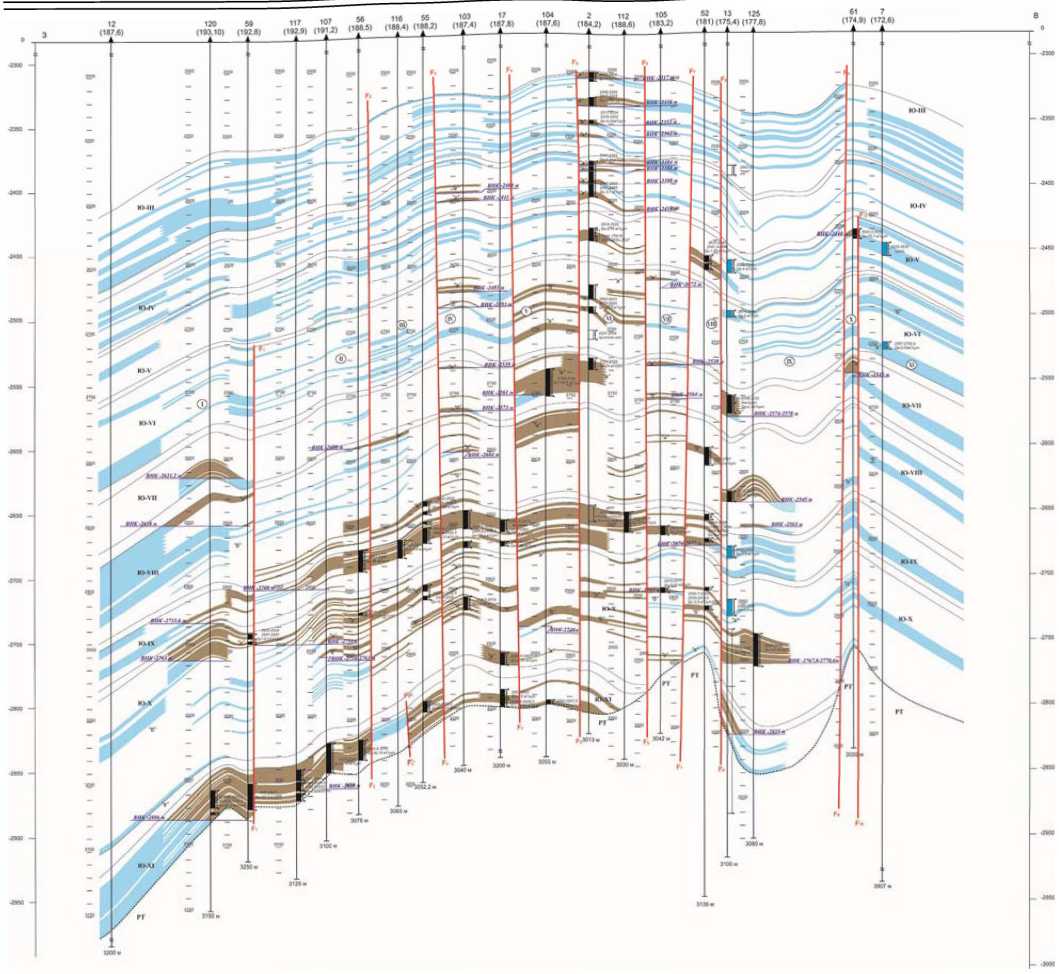

Figure 1 – Geological profile along the line of wells.
Scale: Horizontal 1:25 000, Vertical 1: 1 000

When developing a model, each segregated reservoir is characterized by reservoir properties as a difference from the others. The considered deposits are represented in the form of laterally and layerwise nonuniform reservoir properties according to the coefficients of productivity, permeability, effective oil-saturated capacities (Figure 1) [3].

The increase in recoverable reserves due to the growth of the oil recovery factor is characterized by the industrial application of modern integrated methods of enhanced oil recovery (EOR). As is known, the developed deposit Arystan has a complex geological structure, lithology of the cut rocks, due to the inconsistency of the occurrence of reservoirs, their frequent replacement by clayey differences. Its influence was rendered by the late Kimmeridgian tectonic activity, which divided the section by 11 faults, complicated the structure of oil-bearing horizons of the Jurassic deposits by 12 blocks.

The block structure of the deposit is clearly visible in the deep seismic section, shown along the well line (Figure 2) and on the well layout diagram on the area of the field with the external oil-bearing contours of productive horizons: J-XI, J-IX, J-VIIa (Figure 3).

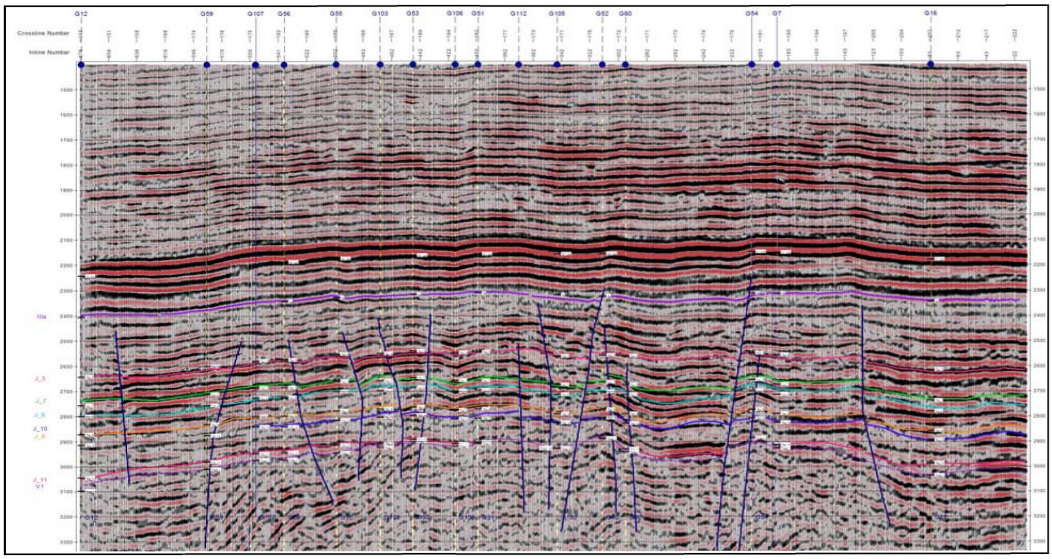

Figure 2 – Depth seismic section along the line of wells
G12, G59, G107, G56, G55, G103, G53, G106, G51, G112, G105, G52, G60, G54, G7, G16

The nine productive horizons are represented by terrigenous rocks – mainly sandstones, rarely siltstones, argillites, irregular interbedding of rock differences, forming lithological macro- and micro-lamination.

The horizons are separated between each other by clay clamping, the thickness of which varies from 1.52 to 27.43 m with an average thickness of 9.36 m. The screening capacity of clay clamping in the regional plan is fluid deterrent.

In the oil industry there are more than a hundred different types of relevant technologies, but the process of developing new solutions continues to gain momentum. At the same time, the primary and secondary generations of methods of increasing oil recovery came to replace the Tertiary ones, which became the main object of our study.

In our case, the traditional methods of applying modern technology to increase oil recovery have shown positive results in the Arystan deposit, primarily hydraulic fracturing of the reservoir, perforating and blasting operations, hot oil treatment, gas treatment of production wells. Despite the costs, at the initial stage, the introduction of an methods of increasing oil allows enhancing the oil recovery of the reservoir.

Based on the filtration-capacitive properties of reservoirs of productive horizons and the minimum production rates of some wells in the Arystan deposit, the article suggests an option of using modern technologies to increase the oil recovery of horizon deposits.

As a method of intensifying the inflow of fluids by influencing the bottomhole zone of wells in the Arystan deposit, it is recommended to apply hydraulic fracturing of the formation. For the purpose of forming new or expanding natural fractures already existing in the reservoir under the influence of the fracturing fluid injected into the formation. As a result of the impact on the rocks in the formation of the formation of cracks subvertical or subhorizontal direction. In order that the cracks do not close after the pressure is removed, a proppant must be introduced in them, often sorted quartz sand of 0.5–0.8 mm fraction is used, and larger fractions 1.2–2 mm are also used. The practice of application hydraulic fracturing shows that, in the case of a successful fracturing operation, well productivity may increase tens of times due to improved communication of the reservoir with the well with a large radius of influence on the propagation of cracks.

At the Arystan deposit, the deposits of the horizons given in the column 4, table 1 are particularly low-debit.

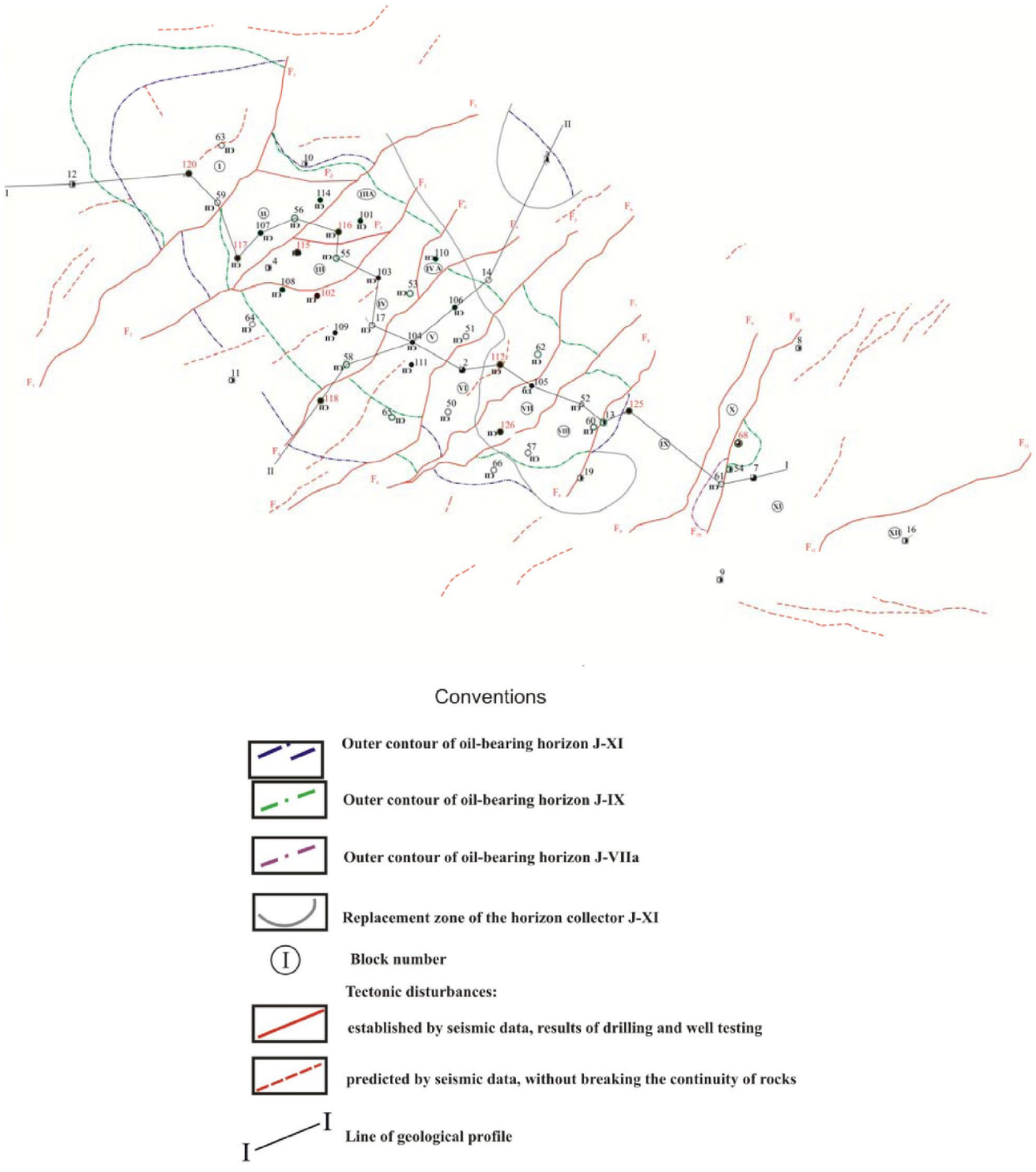

Figure 3 – Arrangement of wells in the Arystan area with external oil-bearing contours of the productive horizons J-XI, J-IX, J-VIIa

The total number of them is equal to nineteen wells, the sum of their debits during trial operation is about 70 m^3/day. It is sufficient to apply secondary methods of hydraulic fracturing or hot oil treatment to increase the volume of oil production, the productivity of these wells is minimally five to seven times and bring the selection to 750-800 m^3/day.

Indicators of oil flow rates of trial operation and hydraulic fracturing

#	Horizon	Reservoir	Oil flow rates		Block	№wells
			when tested, m^3/day	estimated debit after fracturing, m^3/ day		
1	J-III	«a»	1,8	12,6	VI	2
2		«b»	3,3	23,1		
3		«v»	5,5	38,5		
4	J-IV	«a»	2,32	16,24	VI	2
5		«v»	3,7	25,9		
6	J-V		3,12	21,84	VI	2
7			1,88	13,16	VIII	52
8	J-VI		6,19	43,33		62
9	J-VII	«a»	2,3	16,1	IX	13
10			10,5	73,5	VIII	66
11	J-VIII	«v»	1,06	7,42	III	55
12		«b»	1,4	9,8	IX	13
13		«b»	11,1	77,7	V	65
14	J-IX		1,4	9,8	III	116
15			4,94	34,58	IV	17
16			7,48	52,36		17
17			4,3	30,1	VI	112
18			3	21	VII	105
19			4	28	VIII	52
20	J-X	«a»	0,13	0,91	I	59
21		«a»	1,21	8,47	II	56
22		«a»	0,43	3,01	III	55
23		«a»	0,42	2,94	IV	58
24		«b»	3,6	25,2		58
25		«b»	0,85	5,95		103
26		«b»	5,9	41,3	VIII	52
27			7,9	55,3	I	63
28	J-XI		0,82	5,74	II	107
29			6,72	47,04	V	104
			≈∑107,27	≈∑750,89		

In this article, it is recommended that fracturing of the formation is carried out in the wells listed in Table with the aim of increasing the additional oil production. Preliminary calculations of the well production rates after the hydraulic fracturing of the well operation operation and the change in the daily subsistence increment from the minimum to the maximum oil production rates.

REFERENCES

[1] Dakhnov V. Geophysical methods for the determination of reservoir properties and oil and gas saturation of sediments. M.: Nedra, 1975. 343 p. (in Russ.).

[2] Kozhevnikov D., Kovalenko K. Modulation of granular reservoir based on petrophysical invariance // NTV «Karotazhnik». Tver. Publication. AJS, 2007. Education 161. P. 66-84 (in Russ.).

[3] Niyazova A., Borisenko G. Petrophysical model of well logging interpretation charts in Arystan field // Works book of the third international scientifically-practical conference «Status, problems and challenges of informatization in Kazakhstan», dedicated Almaty, 20-22 of November 2014. P. II. P. 331-335 (in Russ.).

С. М. Оздоев, М. Ә. Машрапова

Қ. И. Сәтбаев атындағы геологиялық ғылымдар институты, Алматы, Қазақстан

АРЫСТАН КЕНОРНЫНЫҢ ГЕОЛОГИЯЛЫҚ ҚҰРЫЛЫМЫ ЖӘНЕ ӨНІМДІ ҚАБАТТАРЫНЫҢ МҰНАЙБЕРГІШТІГІН АРТТЫРУ ӘДІСТЕРІ

Аннотация. Өнімділік, өткізгіштік коэффициенті, мұнайқанықтық қалыңдығының тиімділігі мен коллекторлық қасиеті бойынша латеральді және қатпарлы түрдегі бір текті емес кенорнының шоғырлары осы мақалада қарастырылған. Арыстан кенорны горизонттарының өнімді шоғырларындағы ұңғымалардан мұнай өндіруде тиімді технологияларды пайдалану әдістері таңдалынып алынған.

Түйін сөздер: кенорын, мұнай, газ, дебит, ұңғыма, коллектор, керн, қалыңдық, өткізгіштік, кеуектілік, шоғыр, айырып алу коэффициенті, қатты сумен жару, өнімділік, мұнайқанықтық.

С. М. Оздоев, М. А. Машрапова

Институт геологических наук им. К. И. Сатпаева, Алматы, Казахстан

ГЕОЛОГИЧЕСКОЕ СТРОЕНИЕ И МЕТОДЫ ПОВЫШЕНИЯ НЕФТЕОТДАЧИ ПРОДУКТИВНЫХ ГОРИЗОНТОВ АРЫСТАНОВСКОГО МЕСТОРОЖДЕНИЯ

Аннотация. В статье рассмотрены залежи месторождения представленные в виде латерально и послойно неоднородные по своим коллекторским свойствам и коэффициентам продуктивности, проницаемости, эффективности нефтенасыщенных мощностей. Подобраны методы применения оптимальных технологий в наращивании отбора нефти продуктивных залежей горизонтов скважин Арыстановского месторождения.

Ключевые слова: месторождение, нефть, газ, дебит, скважина, коллектор, керн, мощность, проницаемость, пористость, залежь, коэффициент извлечения, гидроразрыв пласта, продуктивность, нефтенасыщенность.