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CONCERNING FORECASTING OF THE RESERVOIR TYPES OF DEEP SEATED OIL DEPOSIT

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Abstract. *It's recommended to utilize the proposed classification of reservoir types selection for the fields conditions of Fergana depression in the well drilling and site development. For increasing field development efficiency in depth of "bad" and "ugly" reservoirs it's required more advanced specialized technologies that keep stability and wall-building properties of container rocks during filtration of formation fluids.*

Well drilling in more depth and their operation require significant investments and they are related to a high risk. The complications during drilling and operation process to a certain degree are related to uncertainty of the reservoirs that are met in a well section.

Published practical data and research results allow in the opinion of US researchers to select three types of reservoirs: "good", "bad" and "nasty" /1/.

Above types of reservoirs have been selected under following parameters: producing depth; position of abnormalhigh formation pressure (AHFP) upper limit, actual temperature and normal design temperature in the depth to top of reservoir; earth pressure gradient; economic index of drilling and production (table 1).

"Good" reservoirs are oil and gas formations the development of which is commercially profitable.

"Bad" reservoir doesn't have some positive features of "good" one. However, it still keeps a commercially profitable quality, and it will be operated if the well has been duly drilled, completed by drilling and managed.

Drilling for "bad" reservoirs and their further operation are related to raised risk, significant costs as well as getting over technical and process difficulties.

"Nasty" reservoir doesn't have major features of "good" one and it never provides inflow to well of products in commercial sizes.

As the main parameter for oil and gas reservoirs' classification in works /1,2/ there has been used a depth of AHFP zone. In accordance with this classification the reservoirs of productive formations may be considered as follows:

- "good" – in depth up to approximately 600 m below upper limit of AHFP zone;
- "bad" – in depth up to 600-1500 m below upper limit of AHFP zone;
- "nasty" – in depth more than 1500 m below upper limit of AHFP zone.

For classification of reservoirs of Fergana area with hydrocarbon potential we have plotted the formation pressure related to producing depth for all productive formations. (Figure 1-4). The diagram shows that the upper limit of AHFP zone for all productive formations is the depth of approximately 2000 m. Given the above we can conclude that probability of discovery within Fergana Valley of oil and gas deposits with "good" reservoirs is limited to depth of 2600 m, "bad" – 2600-3500 m, and "nasty" – more than 3500 m.

Analysis and generalization of available expertise for development of oil and gas fields within Fergana depression shows that the classification of reservoir types mainly is confirmed.

It's necessary to note that if for reservoir types classification there will be used just a plot of formation pressure related to depth of site, it's possible to find some exceptions from established limits. Thus, these exceptions are connected with not only non-standard performance of container rocks of deep seated oil deposits in AHFP conditions but also with successful development of some sites located in depth where "bad" and "nasty" reservoirs are available.

As an example we will address to development expertise of oil deposit of horizon VII in Ravat field. The specified oil deposit located in the top of alay layers of Paleogene (depth of 3500 m) consists of light grey and grey pelitomorphic, as well as arenaceous lime stones with light grey sandstone band and grey green shale streak.

Development well spacing density is on the average 8.5 ac per well. Field drilling out period proceeding for 10 years has been accompanied by increasing of annual oil extraction, as well as significant rate of formation pressure drop (Figure 5.). Further, notwithstanding producing well stock extension at 30% the annual oil production sharp reduction is available. After 14 years of development an observed decreasing of the rate of annual oil production drop has been related to introduction of a water flooding system. Despite of the producing well stock decreasing at almost 40% this trend has been available over the past years of development.

An efficiency of inside profile water flooding is clearly shown in the dynamics of formation pressure that by the commence of water injection has been decreased from virgin pressure of 30.2 MPa (abnormality rate is 0.86) to 13.6 MPa. Over 10 years of water flooding there have been achieved 100% compensation of fluid extraction by water injection that in turn has resulted in formation pressure increasing up to 22.6 MPa. After that the rate of annual production considerably has been decreased.

An execution of the project document main statements during development of oil deposit of horizon VII in Ravat field has allowed to achieve current extraction rate of 0.15. An anticipated design value of oil extraction final rate is 0.222. It's more higher than in the sites with "bad" reservoirs developed in a natural mode and with more rare infrequent well pattern.

At the same time in a depth with "bad" and "nasty" reservoirs location there are available more than 10 fields the development efficiency of which is too low (expected oil extraction final rate doesn't increase 0.10) or their development in production quantities can not be implemented through existing technology.

Gumkhanaoil field is one of these sites. Its discovered oil deposits are related to deposition of light pink suit of Neogene presented mainly as sand-shale incompetent differences with sufficient salt content. Since 1968 there have been drilled 12 wildcats in the fields with average producing depth of 4750m and a rate of formation pressure abnormality is approximately 2.

Among them seven wells (# 2, 3, 4, 6, 7, 9, 10) have been producing ones. However, just well #2 has been passed for operation, as well as with insufficient rate of flow of both oil and fluid. The purpose of abandonment of other wells is emergency particularly connected with carry up of much sand from productive depositions.

Table 1. Parameters value range for various reservoirs

Parameters	Reservoir Type		
	Good	**Bad**	**Ugly**
Depth to top of reservoir, m	0-4580	2100-6100	3050-9150
AHFP upper limit position, m	910-3050	910-3660	2440-*
Reservoir temperature, °C	21-121	121-149	149-*
Normal temperature in the depth to top of reservoir, °C	21-91	93-138	138-*
Depth earth pressure gradient, MPa/m	0,0181-0,0226	0,0204-0,0226	0,0204-0,0271
Estimation of capitalized value of well drilling, completion and commissioning (C)	low	High	really high
Estimation of net capitalized profit during production (K)	high	low or average	really low
Commercial factor	really high	average or low	Catastrophic

* - Parameters range that are subject to definition are not available

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