VOLUME 2, 2011

GEOLOGICAL RISKS DURING CONDUCTION OF EXPLORATION WORKS IN THE UZBEKISTAN PART OF ARAL SEA

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ABSTRACT

Oil and Gas industry in general and geological exploration process particularly is characterized by a number of specific peculiarities, which differ it from other sectors of economy. We focused on search and identification of geological risks associated with oil drilling. During regional level risk evaluation a significant role was played by the fact that based on results of special processing of seismic materials abnormalities were discovered and these abnormalities propose the presence of hydrocarbon deposit (deposits) in the trap. Eventually, success ratio exceeded the threshold limit value more than 20 folds, i.e. the risk of deposit absence was not high. Subsequent exploration of the deposit will show industrial significance of identified deposits. It is possible that during drilling of exploration wells in Jurassic section other deposits are possible to be discovered as it occurred in Surgil deposit located in the adjacent tectonic zone (Sudochiy depression).

UDC CODE & KEYWORDS

■ UDC: 553.9 ■ Oil exploration ■ Geological risk

INTRODUCTION

Oil and Gas industry in general and geological exploration process particularly is characterized by a number of specific peculiarities, which differ it from other sectors of economy. The most essential includes dependency of indicators and criteria of expenses efficiency from environment conditions, territory level of knowledge, our knowledge of geological structure of examination area in general and on specific prospective object, time variability of environment factors, probabilistic character of majority of techno-economic rates during exploration works conduction and even on oil and gas deposits development, long duration of oil and gas projects implementation, high level of capital intensity of geological exploration and production processes, long period of initial capital reimbursement (Shepard, 1972).

These peculiarities form risks environment and the most critical (for exploration works stage) risks are the risks of non-discovery of deposit, inaccurate construction of geological deposit model and estimation parameters identification (fluid separating contacts, reservoir properties, saturation and others), incorrect estimation of amount of initial and extractable hydrocarbon reserves.

Geological risks identification

On the stage of exploration drilling geological risks are identified as possibility of non-confirmation of presence of exploration object (trap) or in case of its availability - absence of forecasted deposits of hydrocarbon reserves.

During the exploration stage geological risks depend on drilling of non-producing wells and stipulated by inaccuracy of our consideration on geological model of examined object as the result of complex allocation of geological environments parameters because of the lack of the knowledge regarding the allocation.

At present time in the Republic of Uzbekistan alongside with state companies exploration activities are being performed by foreign investors as well. More than 60 % of prospective for oil and gas areas are assigned to investors. It is obvious that investors are interested in minimization of investment risks related to the development of new areas with insufficient level of knowledge.

One of such companies is "Aral Sea Operating Company" which was established by Consortium of Investors from 5 companies and conducts geological operations in Uzbekistan part of Aral Sea. As the result of CDP 2D seismic works, which were performed in Uzbekistan part of Aral Sea during the exploration program implementation a number of structures for deep exploration drilling was prepared. First of these structures was Western Aral structure which is located at the east border of the Kosbulak depression. No industrial accumulations of hydrocarbons were discovered so far in the range of this tectonic element on the territory of the Republic of Uzbekistan and Kazakhstan. Considering this circumstance the risk that drilled well might turn out to be dry was very high. In addition to it, the matter of profitability of exploration works conduction throughout the investment block territory also raised doubts. For more reliable evaluation of the risk it was decided to conduct special examinations for the conduction of such assessment on the quantitative level.

At present time in order to solve such kind of problems there are many mathematical approaches and appropriate programs (Monte Carlo method, decision tree, etc.). The reliability and authenticity of any of these methods directly depends on quantity, completeness and significance of initial parameters which characterize the evaluation subject.

In our case, geological risk assessment during implementation of exploration works in Uzbekistan part of Aral Sea could be implemented rather conditionally as preconditioned by the following circumstances.

First of all, complete absence of wells in the vicinity of investment block that penetrated proposed producing formations of Jurassic and Paleozoic sediments. Secondly, the existence of different opinions about the block prospectivity, particularly its eastern part; difficulties in selection of reference for geological analogy. Thirdly, extremely limited scope of geological works, especially deep-hole drilling works, determined by five year program period(two wells), which will not ensure the entire examination of the block and transfer of prognosis hydrocarbons resources into industrial category reserves.

With regard to the above matter, hierarchy approach implemented by "Algoritm-engineering" research institute specialists (G.K. Ishanhodjaev) was used as a work tool for quantitative risk assessment. This method uses processing of expert opinions for each stated question (Thurston, 1927). In this case solution quality significantly depends on the level of experts' knowledge level, risks coverage level and its statement.

ISSN 1804-4158
ISSN 1804-4158
SOCIAL and NATURAL SCIENCES Journal
SOCIAL and NATURAL SCIENCES Journal

Based on analysis of geological materials, block exploration degree, work staging by "IGIRNIGM" specialists (A.V. Kirshin, G.S. Solopov, A.N. Bogdanov) and "Aral Sea Operating Company" specialists (V.N. Yakovlev, J.B. Urazaliev) most important regional, zonal and local risk indicators were identified and grouped.

The first group (regional risks) includes indicators, characterized by favorable regional prerequisites of oil-and-gas contentperspectives of examined tectonic element. These are - oil-and-gas source rock availability in a section, favorable thermobaric conditionsfor the transformation of organic substance contained in it into oil and gas hydrocarbons, hydrocarbons migration routes from oil and gas formation zones into oil and gas accumulation zones, preservation conditions of hydrocarbon accumulation. Only if these conditions are met, it is possible to move to the next stage - risk evaluation on local level.

The second group (local risks) includes criteria, characterizing the favorable conditions for independent object: trap presence, its positive prognosis of oil-and-gas productivity, expected perspective hydrocarbon resources, etc. In this case, as in the previous one, the transfer to the next stage (subjective risks) is possible under positive success ratio of all indicators of the second stage.

Third group (subjective risks) includes conditions, characterizing the expected degree of conformity of regulated drilling technology, coring, completeness and quality of well logging complex, well testing, etc.

The success ratio evaluation (opposite to the risk) of exploration works was done for Western Aral structure. . For analysis we based our research on methods of Mirzadjanzade et al (2004) and Altunin et Semuhin (2004).

Processing of expert evaluation criteria of the first stage resulted in identification that success ratio exceeds limit value for more than 10 folds and this fact allowed to proceed to the second stage. During regional level risk evaluation a significant role was played by the fact that based on results of special processing of seismic materials abnormalities were discovered and these abnormalities propose the presence of hydrocarbon deposit (deposits) in the trap. Eventually, success ratio exceeded the threshold limit value more than 20 folds, i.e. the risk of deposit absence was not high.

Conclusion

High predicted success ratio during conduction of exploration works in Aral Sea basin allowed to make a decision to drill the well at Western Aral structure. Western Aral 1 well was drilled with a depth of 3300 meters in Permian Triassic sediments with complete penetration of prospective Jurassic sediments. During testing using production casing commercial inflows of gas were obtained in four intervals of Middle Jurassic with maximum flow rate of 309,0 thousand m3/day. Thus, Western Aral 1 well was the pioneer of this deposit. The meaning of this well can't be overestimated. Firstly, it proved producing capacity of Kosbulak depression. Secondly, it confirm correct choice of methods and reliability of geological risk assessment. Thirdly, it gives confidence in success of subsequent exploration works within this investment block.

Subsequent exploration of the deposit will show industrial significance of identified deposits. It is possible that during drilling of exploration wells in Jurassic section other deposits are possible to be discovered as it occurred in Surgil deposit located in the adjacent tectonic zone (Sudochiy depression).

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