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REGULARITIES OF THE PLACEMENT OF HYDROCARBON DEPOSITS IN THE CRETACEOUS SEDIMENTS OF THE EASTERN SIDE OF THE BESHKENT TROUGH

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Abstract

The article clarifies the characteristic patterns of the placement of hydrocarbon deposits in Cretaceous deposits on the territory of Turkmenistan and Uzbekistan. The dependence of the productivity of structures in Cretaceous sediments on their location relative to deposits in Jurassic sediments is shown. Structural and tectonic features and their influence on the conditions of placement and formation of oil and gas deposits in the sediments of the Cretaceous formation of the eastern side of the Beshkent trough are considered.

Keywords

placement, deposit, Cretaceous deposits, tectonic disturbance, formation, migration, hydrogen sulfide

INTRODUCTION

In the Bukhara-Khiva oil and gas region (BKOGR), systematic geological exploration has been carried out for about 100 years, more than 200 hydrocarbon deposits have been discovered, mainly in the deposits of the carbonate formation. Year after year, the production level is decreasing, which indicates the need to open new large oil and gas fields. One of the highly promising areas of exploration is the Cretaceous deposits of the BKOGR, in particular on the territory of the eastern side of the Beshkent trough.

MATERIALS AND METHODS

In Western Uzbekistan, according to the conducted prospecting and exploration works on 134 structures, hydrocarbon deposits were discovered in Cretaceous deposits only on 29 structures (Bukhara stage) and on 1 structure (Chardzhou stage), the reserves of which are included in the State Balance of Mineral Reserves of the Republic of Uzbekistan. The main productive horizons of Cretaceous deposits in open fields were the VII-XIV horizons (Fig. 1).

Cretaceous deposits account for 16% of the total industrial gas reserves in Western Uzbekistan, and Jurassic deposits account for 84%. These data indicate that the Jurassic deposits are the main oil and gas complex in Western Uzbekistan. However, in neighboring Turkmenistan, the ratio of reserves in Jurassic and

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Cretaceous sediments is directly opposite to that observed in Uzbekistan. This phenomenon can be explained by the varying degree of study of these complexes in different parts of the oil and gas basin.

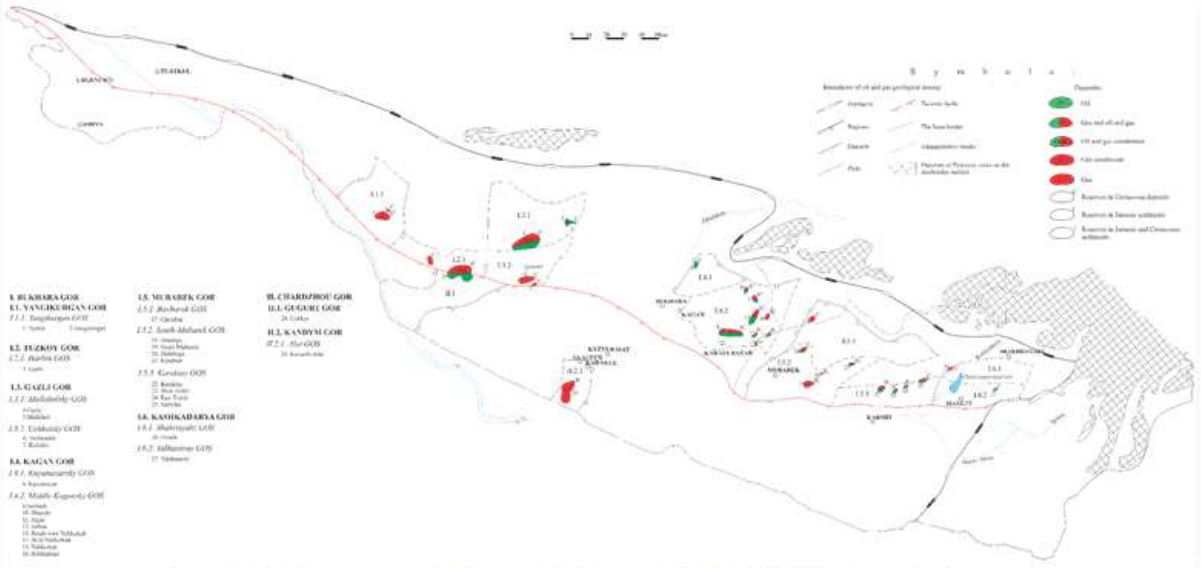

Figure 1. Map of the prospects of oil and gas potential of Cretaceous deposits of the Bukhara-Khiva oil and gas region

All of the above about the ratio of reserves in Cretaceous and Jurassic sediments gives rise to the assumption that in Western Uzbekistan, when purposefully searching for Cretaceous traps located above deposits in Jurassic sediments, industrial hydrocarbon reserves will be revealed in them, close in volume to reserves in Jurassic sediments or even exceeding them. And there are such traps, and for the most part they are located in the Chardzhou stage (Kandym, Urtabulak, Zevardy, Kultak, Kamashi, Beshkent, Shurtan, North Nishan, etc.) (Sitdikov B.B., 1998).

As for the Chardzhou stage, there is still little data for unambiguous conclusions, since only one deposit has been discovered there – Kuvachi-Alat.

An interesting pattern is observed in the productivity of local uplifts, depending on the age of their formation. This pattern can be used to forecast fields with large oil and gas reserves. Almost 90% of the identified reserves are concentrated in three structures (Gazli, Uchkir and South Mubarek) and were formed in recent times, with the presence of age-varying structures in Cretaceous sediments. This fact indicates that in Western Uzbekistan, the migration of hydrocarbons and the formation of deposits in Cretaceous sediments did not stop in the Neogene and post-Neogene time.

Everywhere in Western Uzbekistan, there is a dependence of the productivity of structures in Cretaceous sediments on their location relative to deposits in Jurassic sediments. If a structure in Cretaceous sediments is located directly above a

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deposit in Jurassic sediments, then it is productive. For example, Kuvachi-Alat in the Chardzhou stage, Yangikazgan, Southern Mubarek, Tashli group of structures, etc. in the Bukhara stage. Unfortunately, not all marine deposits in Cretaceous deposits in Western Uzbekistan have positive structures (for example, over the Umid, Northern Urtabulak, Northern Guzar, etc.).

There is no strict pattern in the placement of oil and gas deposits in individual stratigraphic horizons of the Cretaceous. Deposits have been identified in all horizons – from VII to XIV inclusive. More than half of the total industrial gas reserves in Western Uzbekistan are located in the Upper Cretaceous deposits of one field – Gazli.

The degree of filling of structures with hydrocarbons varies widely – from 0.4 to 1.0. The highest values of this indicator are observed in those structures that were formed in recent times and are located in close proximity to the fault, but their vault is not touched by the fault (Gazli, Uchkyr). Conversely, in structures of ancient foundation and with fractured arches, the degree of hydrocarbon occupancy is the lowest (Tashkuduk).

It was assumed that in the areas of development of the Upper Jurassic saline strata, only the subsalt Jurassic sediments are productive, and the overlying Cretaceous ones are not productive. This was due to the idea that salts are a good screen (tire) that does not allow vertical migration of hydrocarbons through themselves. Based on this view, Cretaceous deposits have not been tested for productivity in any area or well, not only in the Chardzhou stage, but also within the southwestern spurs of the Hissar Ridge.

Many researchers believed that within the Amudarya syneclise, where salts are present, there are no hydrocarbon deposits above them. However, within the Turan plate, which includes the Amudarya syneclise, large reserves of sulfur-free gas have been discovered in the Lower Cretaceous suprasalt deposits (XIV horizon) at the Davletabad-Donmez, Shekhitli-Jujukli, Farab (Turkmenistan) and Kuvachi-Alat (Uzbekistan) fields (Ibragimov A.G. et al., 2013). It is characteristic that these deposits are located near tectonic disturbances. For example, the Farab field is located in the southern part of the Gdynia Graben, and the Kuvachi-Alat field is located north of it.

Due to the absence of oil and gas mother deposits in the lower part of the Cretaceous section, it can be concluded that the gas came from Jurassic deposits and accumulated in the first permeable sandy XIV horizon. To prove this, we can cite a change in the hydrogen sulfide content in the gas by area. In the gas of the XIV horizon, located near the fault, the hydrogen sulfide content is high. As you move away from the fault, the percentage of hydrogen sulfide gradually decreases and disappears.

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In the same direction, there is a decrease in the pyrite content in the XIV horizon. This is a natural phenomenon typical for many oil and gas regions of the world, including the Amudarya syneclise.

The resulting gas always contains a certain amount of hydrogen sulfide in its composition. During the lateral migration of gas through terrigenous rocks, hydrogen sulfide combines with ferrous minerals to form pyrite.

$Fe + 2H2S \rightarrow FeS2 + 2H2\uparrow$

When gas migrates through carbonate rocks, such a reaction does not occur due to the absence of ferrous minerals. For this reason, many gas fields of the Amudarya syneclise associated with carbonate rocks contain hydrogen sulfide, while those associated with terrigenous rocks do not (Parpiev M.V., 2000).

The presence of large tectonic elements within the Amudarya syneclise, such as the Uchajin uplift, Bagajin, Chardzhou and Bukhara stages, extending from southwest to northeast and separated from each other by regional faults (Amudarya, Bukhara and Liangaro-Karail), served to locate and form deposits in Cretaceous and Jurassic sediments (Fig. 2). These positive large tectonic elements served as gas accumulation zones. At the same time, the presence of a powerful salt-anhydrite stratum of tithonum in the section, which is a reliable screen, contributing to the creation of conditions for the conservation of gas and oil deposits, played an important role.

The tectonic structure of the Chardzhou stage shows that there are no major tectonic disturbances crossing the Cretaceous deposits, except for the Bukhara and Amudarya faults.

Only the Southwestern spurs of the Hissar are characterized by a tectonically active regime and a large dislocation. The largest fault (thrust) with an amplitude of about 1500 m is the Liangaro-Karail fault, separating the spurs of the Gissar ridge from the Bukhara-Khiva region. The Liangaro-Karail fault, which has a Northeastern extension, is bordered from the west and from the east by numerous parallel faults of the second order (upwellings, upwelling), also crossing Jurassic and Cretaceous (sometimes only Lower Cretaceous) deposits (Fig. 3). Due to the spread of the Liangaro-Karail fault in the areas located on the eastern side of the Beshkent trough, the Lower Cretaceous sand layers come into contact with the Jurassic productive limestones of the South Caucasus. Thus, conditions appeared for the flow of hydrocarbons from the Jurassic to the Cretaceous deposits, and in the presence of traps – to the accumulation of deposits.

The diverse nature of the tectonic disturbances presents here, according to the author, played a certain role in the placement of hydrocarbon deposits even within a single field. Surges and discharges crossing the Jurassic and Cretaceous sediments

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could well serve as routes for vertical fluid migration during the formation of hydrocarbon deposits not only in the Jurassic, but also in the Cretaceous sediments

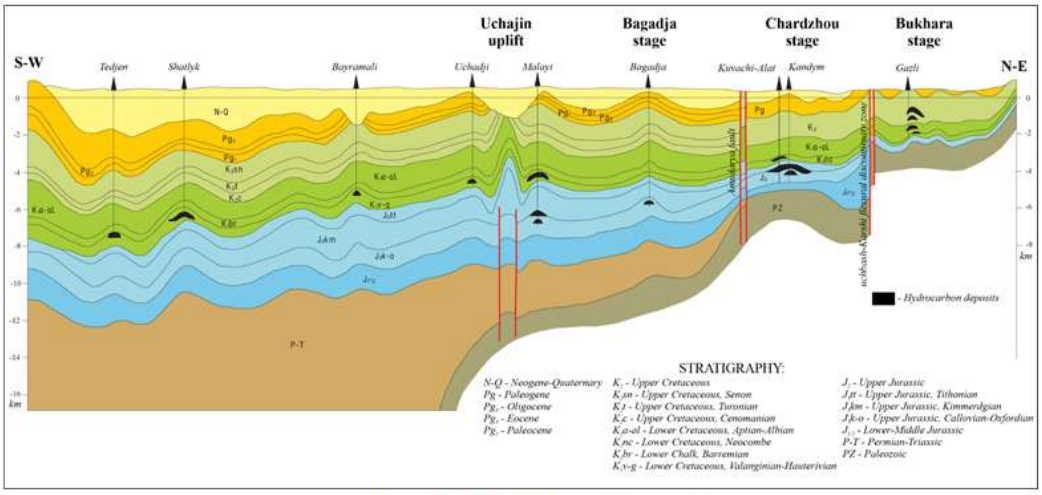

Figure 2. Geological profile extending from southwest to northeast

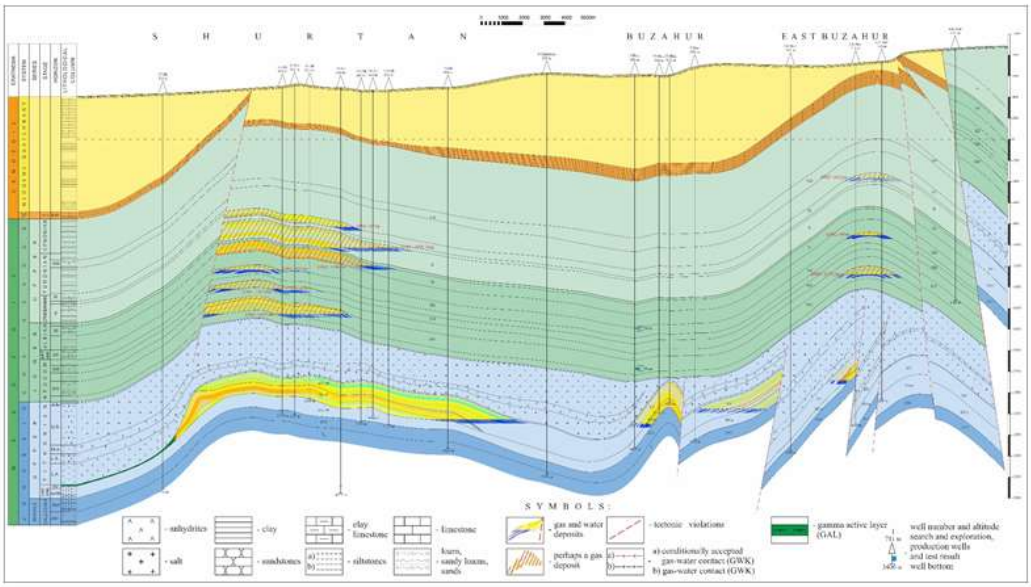

Figure 3. Regional geological profile along the I-I line

If, at the same time, the vertical migration of hydrocarbons occurred due to tectonic disturbances, then the horizontal migration should take place along permeable sand layers of Cretaceous age. Meso-Cenozoic deposits take part in the structure of the geological section of the studied territory, in the complex of Cretaceous deposits there are six oil and gas floors – Neocomian, Albian, Aptian, Cenomanian, Turonian and Senonian, which include VIII, IX, X, XI, XII, XIII and XIV horizons with favorable conditions (reservoirs) for accumulation hydrocarbons. Their concentration (accumulation) should occur in positive structures with reliable tires in their section. The fluid barrier for the upper part of

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the Lower Cretaceous is a thick thickness of Albian clays (93-180 m) and for the middle part of the Upper Cretaceous is a thickness of Turonian clays (108-276 m), which are good tires at many BHNGO deposits (Sunnatov M.S., 2023).

CONCLUSION

The presence of regional faults played a certain role in the placement of hydrocarbon deposits in Cretaceous sediments and favored the entry of hydrocarbons from the Jurassic into the Cretaceous sediments, as well as being supply channels during the formation of deposits. During the lateral migration of hydrocarbons from carbonate deposits to Cretaceous, the gas becomes sulfur-free. The existing characteristic patterns in the placement and formation of oil and gas deposits in Cretaceous deposits in the future will be able to change the ratio of reserves when the same level of study is achieved in favor of Cretaceous deposits in the territory of the Chardzhou stage of the Bukhara-Khiva oil and gas region, in particular the eastern side of the Beshkent trough. Formed hydrocarbon deposits near tectonic disturbances will allow to obtain industrial inflows of sulfur-free gas.

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