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INVESTIGATION OF THE DEPENDENCE BETWEEN THE UNCERTAINTIES OF THE VOLUME OF HYDROCARBON RESERVES OF PRODUCTIVE SERIES IN THE SOUTH CASPIAN BASIN WITH GEOLOGICAL AND TECHNICAL CRITERIA

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A B S T R A C T

The article is devoted to the study of the relationship between the uncertainty of the volume of hydrocarbon reserves of Productive series in the South Caspian Basin and geological-technical criteria. As we know, the accuracy of the assessment of field reserves is directly affected by the degree of study of the calculation parameters. The study of these parameters depends to varying degrees on the geological and physical characteristics of this field. The main purpose of the study was to define the impact of these geological and technical factors on the uncertainty of the volume of hydrocarbon reserves. By classifying the fields according to their geological and physical characteristics, it is possible to analyze the relationship between geological and technical factors and the uncertainty of the volume of hydrocarbon reserves. As in all basins, the uncertainty of the volume of hydrocarbon reserves in the South Caspian Basin (SCB) depends on the degree of study of the calculated parameters of the fields (oil and gas field, effective thickness, porosity, oil and gas saturation, formation pressure, formation temperature, etc.). During the research, great importance was attached to the application of the cluster method. The Euclidean distance of the cluster analysis was used to identify homogeneous groups. Taking into account the general results of the research process, it should be noted that the uncertainty of the volume of Productive series (PS) hydrocarbon reserves in the SCB, in addition to the level of accuracy of calculation parameters, also depends on other geological and technical factors (depth of deposits, depth of sea, complexity of structure, number of tectonic blocks and development objects).

Keywords: field; formation; uncertainty; geological and technical factors; complexity of structure; reserve.

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Introductions

It is known that the uncertainty of the volume of hydrocarbon reserves of the South Caspian Basin (SCB) depends on the degree of study of the calculated parameters of the fields (oil and gas area, effective thickness, porosity, oil and gas saturation, formation pressure, formation temperature, etc.). The degree of study of these calculation parameters is also closely related to the degree of success of exploration work in the field and the quantity and quality of obtained geological data [1-4]. The main purpose of the study is to determine the relationship between exploration works in the basin, as well as geological researches carried out in the fields and uncertainty of the volume of hydrocarbon reserves (UVHCR) of Productive series (PS) by geological and technical criteria (depth of field, depth of sea, complexity of structure, number of tectonic blocks, number of objects) [5-10].

Materials and methods

In general, the ratio of P10 category reserves to P90 category reserves is calculated to assess the degree of uncertainty of hydrocarbon reserves in the fields of SCB and is shown in the histogram below (fig. 1).

The cluster method was used in the research [1]. Identification of homogeneous groups using the euclidean distance of the cluster analysis was considered.

The euclidean distance between objects is defined by the following formula:

$$d_{ij} = \sqrt{\frac{\sum_{k=1}^{n}(X_{ik} - X_{jk})^2}{n}} \quad (1)$$

Where, X_{ik} is the value of X in the object i; X_{jk} - the value of X indicators in the object j. The small value of d_{ij} indicates the similarity between objects, and the large value indicates the dissimilarity.

Using cluster analysis, the fields were divided into 4 groups. 6 fields were allocated in group I - Pirallahi, Chilov, Neft Dashlari, Gurgan-deniz, Palchiq Pilpilesi, Hazi Aslanov; 6 fields in group II - Cenub-1, Cenub-2, Gum-deniz, Kapaz, shallow-water Gunashli, ACG; 5 fields in group III – 8 Mart, Alat-deniz, Bahar, Karasu, Sangachal-Duvanni-Khara-Zira (SDXZ); 4 fields in group IV - Umid, Shah-deniz, Bulla-deniz, Absheron. For each group, influence of the above-mentioned geological and technical factors on the uncertainty of the volume of hydrocarbon reserves (ratio of reserves by P10/P90 categories) of the fields was studied. Notably, the reason behind great uncertainty of hydrocarbon reseveres of group I fields is depth of sturucture and tectonic complexity. (fig. 2 a and b).

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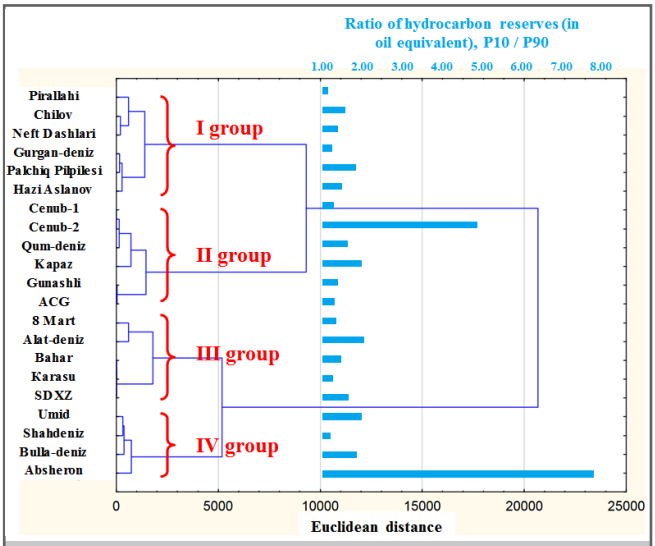

Fig. 1. Classification scheme according to geological and physical characteristics of fields and uncertainty histogram of hydrocarbon reserves

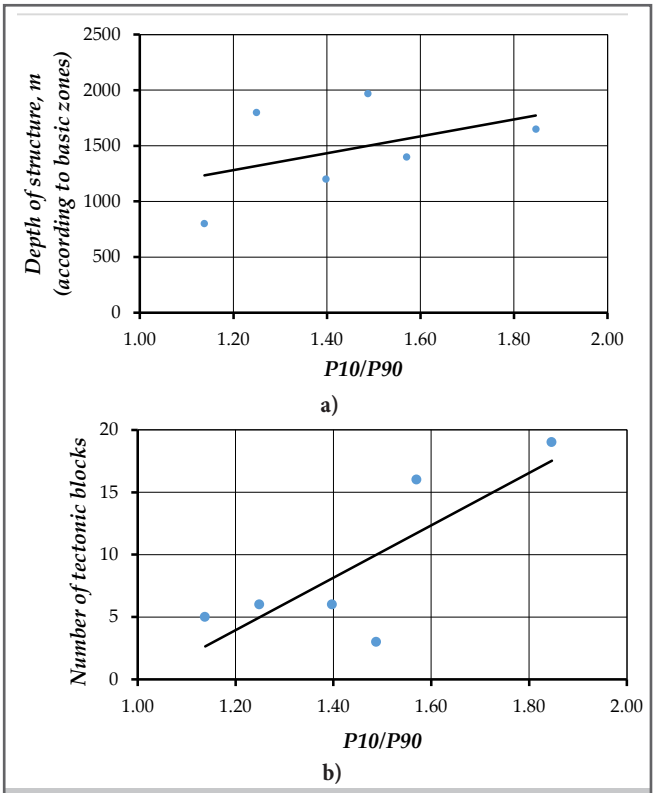

Fig. 2. Graphs of dependence of UVHCR on geological and technical factors (for group I)

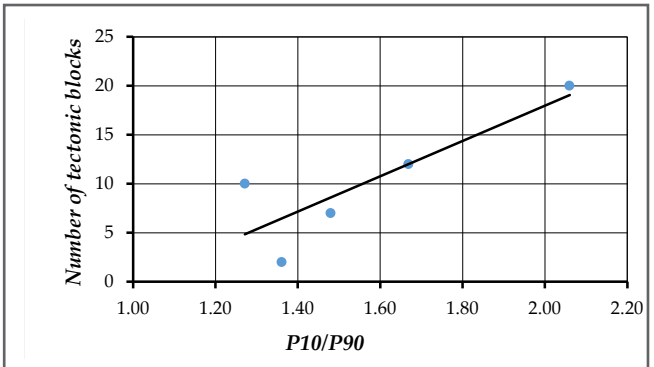

Fig. 3. Dependence graphs of UVHCR on geological and technical factors (for group III)

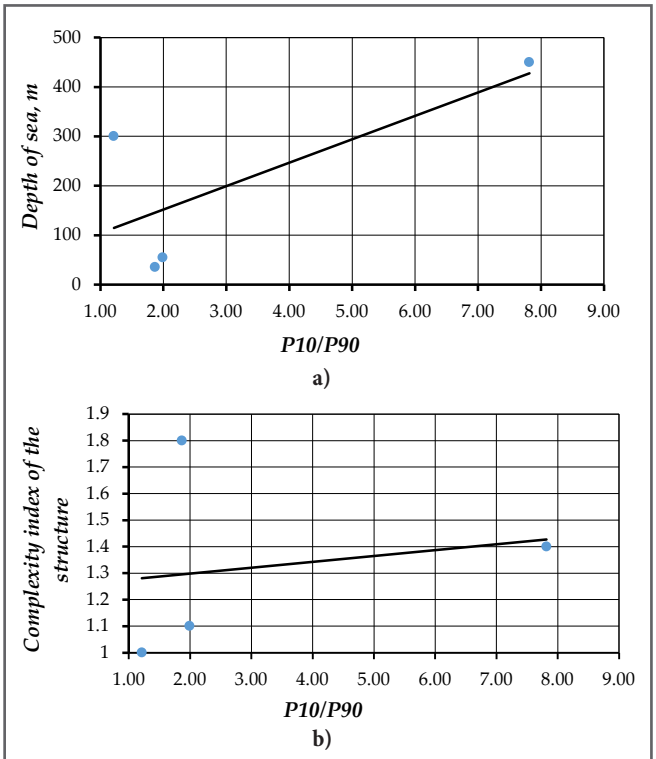

Fig. 4. Graphs of dependence of UVHCR on geological and technical factors (for group IV)

The UVHCR in this type of field has no direct proportionality to the number of exploitation layers, and this phenomenon can be explained by the fact that they have been in development for a long time. The depth of the sea in these fields is almost the same (5-10 m). Therefore, these factors don't directly affect to the study of hydrocarbon reserves.

At the fields of the group II (Cenub-1, Cenub-2, Qum-deniz, Kapaz, shallow-water Gunashli, ACG), UVHCR is mainly high at the Cenub-2 field, and large-scale exploration and geological studies were not carried out here due to the small volume reserves. In general, in these types of fields, tectonic complexity and lateral heterogeneity is the main root of UVHCR.

The results of the analysis in the group III fields show that UVHCR is directly correlated to the number of tectonic blocks and the complexity of the structure (fig. 3). In these fields (8 Mart, Alat-deniz, Bahar, Karasu, SDXZ) the depth of the sea, the number of objects and the depth of the base layers are almost identical.

Fields in group IV (Umid, Shahdeniz, Bulla-deniz, Absheron) are located in the deeper areas of the SCB. In these fields, the UVHCR varies with respect to depth of the sea and the complexity of the structure (fig. 4 a and b). UVHCR is higher in the Absheron field, which is due to the high sea depth (450 m). Therefore, a limited number of exploration wells were drilled and it was not possible to exactly estimate the reserves of all development objects in the field. However, exploration works continues in the field.

Considering the general results of the study, it should be noted that the uncertainty of the volume of hydrocarbon reserves of PS in the SCB depends on other geological and technical factors (field depth, sea depth, structure complexity, number of tectonic blocks, the number of development objects), in addition to level of accuracy of calculation parameters. Therefore, it is important to take into account the impact of these geological and technical factors when estimating the volume of hydrocarbon resources in prospective structures.

Conclusion

The geological and technical factors that directly affect the uncertainty of the hydrocarbon reserves of the oil and gas fields located in the SCB have been analyzed in the study and the following conclusions have been drawn.

UVHCR depends on the degree of study of the calculated parameters of reserves (oil and gas area, effective thickness, porosity, oil and gas saturation, formation pressure, formation temperature, etc.) also, other geological and technical factors in the fields. Although dependence of UVHCR on geological and technical factors is not identical in the fields analyzed in the study, it has been possible to study this relationship in different groups. It was determined that the reason of existence of UVHCR in the fields (Pirallahi, Chilov, Neft Dashlari, Gurgan-deniz, Palchig Pilpilesi, Hazi Aslanov) is mainly due to the lateral heterogeneity and tectonic complexity. UVHCR is also actual in the fields that are developed but located deeper (8 Mart, Alat-deniz, Bahar, Karasu, Sangachal-Duvanni-Khara-Zira). In the deep fields in the early stages of development (Umid, Shahdeniz, Bulla-deniz, Absheron) the main reasons for the UVHCR to exist is the high depth of the sea and the depth of the productive layers.

It would not be possible to analyze the impact of all these geological and technical factors on the UVHCR in the fields without classifying them according to the geological and physical conditions of the fields. Therefore, application of research methods and approaches in such basins is considered practical and expedient.

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Исследование зависимости неопределенностей объема запасов углеводородов Продуктивной толщи Южно-Каспийского бассейна с геолого-техническими критериями

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Реферат

Статья посвящена изучению зависимости неопределенностей объема запасов углеводородов Продуктивного толщи в Южно-Каспийский бассейне с геолого-техническими критериями. Как известно, на точность оценки запасов месторождения напрямую влияет степень изученности расчетных параметров. Изучение этих параметров в той или иной степени зависит от геологических и физических характеристик месторождений. Основной целью исследования было изучение влияния этих геолого-технических факторов на неопределенность объема запасов углеводородов. Классифицируя месторождения по геологическим и физическим характеристикам, удалось проанализировать зависимости геолого-технических факторов с неопределенностью объема запасов углеводородов. Как и во всех бассейнах, неопределенность объема запасов углеводородов Южно-Каспийского бассейна (ЮКБ) зависит от степени изученности подчетных параметров месторождений (площадь нефтегазоносности, эффективная толщена, пористость, нефтегазонасыщенность, пластовая давления, пластовая температура и др.). В ходе исследования большое значение придавалось применению кластерного метода. Евклидово расстояние кластерного анализа использовалось для выделения однородных групп. Принимая во внимание общие результаты исследовательского процесса, следует отметить, что неопределенность объема запасов углеводородов продуктивной серии (ПС) в ЮКБ, помимо уровня точности расчетных параметров, зависит также от других геологических и технические факторы (глубина залежей, глубина моря, сложность строения, количество тектонических блоков и объектов разработки).

Ключевые слова: месторождение; пласт; неопределенность; геолого-технические факторы; сложность структуры; запасы.

Cənubi Xəzər Çökəkliyində Məhsuldar qat çöküntülərinin karbohidrogen ehtiyatlarının həcminin qeyri-müəyyənliklərinin geoloji-texniki meyarlarla əlaqəsinin tədqiqi

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Xülasə

Məqalə, Cənubi Xəzər Çökəkliyində Məhsuldar qat çöküntülərinin karbohidrogen ehtiyatlarının həcminin qeyri-müəyyənliyinin geoloji-texniki meyarlarla əlaqəlisinin öyrənilməsinə həsr olunmuşdur. Bildiyimiz kimi, yataqların ehtiyatlarının qiymətləndirilmə dəqiqliyinə hesablama parametrlərinin öyrənilmə dərəcəsi birbaşa təsir edir. Həmin parametrlərin öyrənilməsi isə sahənin geoloji-fiziki xüsusiyyətləinin fərqli olması ilə əlaqədar müxtəlif dərəcədə öyrənilir. Tədqiqat işinin əsas məqsədi də bu geoloji-texniki amillərin karbohidrogen ehtiyatlarının həcminin qeyri-müəyyənliyinə təsirini öyrənməkdən ibarət olmuşdur. Yataqları geoloji-fiziki xüsusiyyətlərinə görə təsnif edərək, karbohidrogen ehtiyatlarının həcminin qeyri-müəyyənliyi ilə geoloji-texniki amillərin əlaqəsini təhlil etmək mümkün olmuşdur. Bütün hövzələr kimi, Cənubi Xəzər Çökəkliyinin (CXÇ) karbohidrogen ehtiyatlarının həcminin qeyri-müəyyənliyi yataqlar və işlənmə obyektləri üzrə hesablama parametrlərinin (neft-qazlılıq sahəsi, effektiv qalınlıq, məsaməlik, neftqazladoyma, lay təzyiqi, lay temperaturu və s.) sahə, kəsiliş üzrə öyrənilmə dərəcəsindən asılıdır. Tədqiqat zamanı klaster metodundan istifadəyə böyük əhəmiyyət verilmişdir. Eynicinsli qrupları ayırmaq üçün klaster analizinin Evklid məsafəsindən istifadə edilmişdir. Tədqiqatın ümumi nəticələrini nəzərə alaraq, qeyd etmək lazımdır ki, CXÇ-də Məhsuldar qatın (MQ) karbohidrogen ehtiyatlarının həcminin qeyri-müəyyənliyi hesablanmış parametrlərin dəqiqlik səviyyəsindən əlavə, həm də digər geoloji və texniki amillərdən (yatağın dərinliyi, dənizin dərinliyi, struktur mürəkkəbliyi, tektonik blokların və işlənmə obyektlərinin sayı) asılıdır.

Açar sözlər: : yataq; lay; qeyri-müəyyənlik; geoloji-texniki amillər; strukturun mürəkkəbliyi; ehtiyat.