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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

LITHOLOGY AND OIL-GAS PROSPECTS THE MESOZOIC DEPOSITS OF THE SOUTHEAST IMMERSION OF THE GREATER CAUCASUS

Specialty: 2517.01 - "Lithology"

Field of sciences: Earth sciences

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The work was performed at the "Oil and gas geology" department and at the "Physical properties of rocks fossil fuels" scientific research laboratory of the Geological Exploration Faculty at Azerbaijan State Oil and Industry University.

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GENERAL CHARACTER OF THE WORK

The relevance of the topic and the degree of scientific development of the problem. The lithology and reservoir characteristics of the Mesozoic sediments of the south-eastern plung of the Great Caucasus, paleogeographic and paleotectonic research have a very important effect on the monitoring of hydrocarbon resources of the studied area. The study of the lithofacies characteristics of the sedimentary complex, which is one of the main criteria of oil and gas production, is the basis of the dissertation topics. Therefore, the determination of the lithological composition, petrophysical characteristics and oil and gas potential of the Mesozoic deposits, which are widespread in the study area, can be considered an urgent task.

The object and subject of the research. The study of the geological structure and oil and gas content of the area was carried out by Q.B. Abikh, K.I. Bogdanovich, V.Y. Khain, M.F. Mirchink, I.M. Gubkin, A.A. Alizadeh, Sh.F. Mehdiyev, A.S. Shikhalibeyli, N.B. Vassoevich, etc.

Recently, this area has been researched by X.B. Yusifzade, Ch.M. Khalifazade, I.S. Guliyev, A.A. Narimanov, A.A. Feyzullaev, E.Kh-M. Alieva, A.V. Suleimanov, Sh.S. Kocherli, H.M. Yusifov, A.M. Salmanov, B.S. Aslanov, B.I. Magerramov and A.I. Khuduzade.

In the dissertation work, studying the lithological complex, data from mining geophysical methods were also used. Geophysical materials of numerous wells in the area were examined, as well as core samples were studied by microscopic and macroscopic methods, and log diagrams of exploration and parametric wells were interpreted. Geological literature and geological fund materials of AzNeft were widely used in the research. The petrophysical properties and collector properties of the rocks were studied on the obtained core samples. As a result of research and studies, a large number of geological profiles, structural maps and cross-sections have been compiled. The dissertation work was carried out at the

“Oil and gas geology” department and at the "Physical properties of rocks fossil fuels" scientific research laboratory of the Geological Exploration Faculty. During the research, several geological models were built on the basis of petrophysical parameters, and the explanation and application of the essence of those models was reflected in scientific reports and a number of scientific articles.

Research goals and objectives. Modern lithological exploration of the Mesozoic deposits of structures of the southeastern part of the Greater Caucasus and the forecast of oil and gas potential, as well as the identification of factors affecting the distribution of hydrocarbon resources.The main research questions performed to achieve this goal showed below:

1. Study of lithostratigraphic, paleogeographic-paleotectonic features and petrophysical parameters of Mesozoic sediments of the south-eastern part of the Great Caucasus:
2. Geological assessment and analysis of data from borehole geophysical surveys (DGS) carried out in the Mesozoic deposits of the area;
3. Prediction of productivity and fluid storage dynamics of oil-gas reservoirs in the Mesozoic sedimentary zone structures of the south-eastern part of the Great Caucasus.

Research methods. Complex lithological research methods were used during the dissertation work. A large number of well materials, samples of cores were microscopically and macroscopically studied, and the log materials of exploratory and parametric wells (DGS) were qualitatively interpreted. The petrographic composition of the core samples taken from the exploratory wells dug in the Mesozoic sedimentary of the south-eastern part of the Great Caucasus, as well as the laboratory research, were determined as a result of the reservoir properties of the rocks. In general, more than 500 types of samples, their composition and petrophysical properties have been studied in laboratory conditions. Sizes of minerals, granulometric composition, selection rates, authigenic and terrigenous content, as well as cement content of rocks were determined in up to 60 sections made of sandstone -

siltstone, carbonate and clay rocks in the research area. Also, petrophysical parameters of reservoir and cover rocks were determined.

Key provisions to be defended:

1. The presence of favorable lithofacies and paleogeographic-paleotectonic conditions for the generation and formation of hydrocarbon deposits in the Mesozoic deposits in the southeastern part of the Greater Caucasus;

2. Construction of mathematical 2D-3D models for the evaluation and quantitative specification of the filtration capacity characteristics of the collectors in the prediction of oil and gas production in the research area;

3. Determining the effect of carbonate on the porosity in the reservoirs by areas and compiling stable correlation dependences.

Scientific novelty of the research:

1. Apt-Barrem sediments, which mainly consist of clays in the tectonic zone, cover terrigenous-carbonate Neokom sediments; the increase in bituminity of the rocks, oil and gas manifestations and flows in the wells have been determined to be industrially important oil and gas Mesozoic sediments in the zone;

2. Favorable conditions for the accumulation of oil and gas in the new sandstone and terrigenous-carbonate rocks in the Neocom section and in the exposed middle Jurassic sediments have been determined.

3. The dependence of the filtration-capacity properties of the collectors on depth and other factors, as well as the laws of change on the depth, were studied;

4. Based on the correlation of petro-physical parameters on structures located on land and sea, it was determined that the productive horizons are related to lithological heterogeneity, variety of lying depth and tectonic conditions;

5. In addition to the traditional methods for predicting the oil-gasiness of the research objects, graphical dependences were drawn up for the assessment and prediction of the filtration capacity characteristics of the collectors with a different approach;

6. The effect of carbonation on porosity in reservoir rocks was determined in the field. The regularity between the coefficients reflecting the collection quality is determined and stable correlations are described.

Theoretical and practical significance of the work. In the structures of the Mesozoic sediments of the south-eastern part of the Greater Caucasus, the reservoire characteristics of the rocks were summarized and analyzed;

Approximation dependences between the petrophysical quantities of the productive reservoirs in the section of the fields in the area were established and a new approach for predicting the productivity dynamics of oil-gas reservoirs was proposed.

The obtained results are of scientific and practical importance in the prediction of oil and gas promising objects and in increasing the efficiency of hydrocarbon production. At the same time, taking into account the precise location of new exploitation intervals in the structures of Mesozoic sediments of the south-eastern part of the Greater Caucasus will allow obtaining great economic indicators.

The results of the research are intended to be used in the planning of prospecting works of oil and gas fields in the relevant institutions of SOCAR and in the implementation of scientific and research work conducted in the "Oil and gas geology" department of the ASOIU.

Approbation and application of the work. The main results of the dissertation were presented and discussed at the following international and national conferences:

The results obtained during the study were presented at a number of international scientific conferences; 33 scientific papers were published, including 14 articles (6 abroad (3 - Scopus), 18 abstracts and conference proceedings (6 abroad) and 1 monograph (abroad).

1. Abbasova, Q.Q., Sultanov, L.A. Böyük Qafqazın Azərbaycan hissəsinin cənub-şərq davamının neftli-qazlı komplekslərinin kollektor xüsusiyyətləri haqqında // Azərbaycan xalqının Ümummilli Lideri Heydər Əliyevin anadan olmasının 90 illiyinə həsr olunmuş

“Azərbaycan 2020: neft-qaz sənayesinin inkişaf perspektivlikləri” adlı elmi praktiki konfransı, – Bakı: ADNA, – 2-3 may, – 2013, – s. 22-24;

2. Султанов, Л.А., Наджаф-Кулиева, В.М., Аббасова, Г.Г. О закономерности распределения скорости продольных волн и Плотности осадочных пород Прикаспийско-Кубинской и Междуречья Куры и Габырры // XX Губкинские чтения, – Москва: – 28-29 ноября, – 2013, – s. 195;

3. Abbasova, Q.Q. Yalama-Xudat antiklinalının Mezokaynazoy çöküntülərinin litoloji-petroqrafik və kollektor xüsusiyyətləri haqqında // International Student Conference “Perfect Education-The Key To Success In Oil Production”, – Baku: – 20-23 aprel, – 2016, – s. 32;

4. Sultanov, L.A., Abbasova, Q.Q., Qənbərova, Ş.Ə. Bəyimdağ-Təkçay, Yaşma və Yalama-Xudat qalxımlarının Mezokaynozoy çöküntülərinin neftli-qazlılıq perspektivliyinin petrofiziki tədqiqatlarla proqnozlaşdırılması // Azərbaycan xalqının Ümummilli Lideri Heydər Əliyevin anadan olmasının 93-cü ildönümünə həsr olunmuş “Geologiyanın aktual problemləri” mövzusunda Respublika Elmi Konfransının Materialları, – Bakı: BDU, – 2016, – s. 205-207;

5. Аббасова, Г.Г. Литолого-стратиграфическая характеристика и о перспективе нефтегазоносности мезозойских отложений Прикаспийско-Губинской области // XXI Губкинские чтения, Тезисы Докладов, – Москва: – 24-25 марта, – 2016, – с. 3-5;

6. Aslanzade, F.B., Abbasova, G.G. About structural tectonic properties of mesozoic sediments of Shahdag-Khizi sinklinorium // VII International conference of young scientists & students, – Baku: AMEA, – 15-18 October, – 2018, – s. 155-156;

7. Гурбанов, В.Ш., Султанов, Л.А., Аббасова, Г.Г. Геолого-петрофизические характеристики мезокайнозской отложений площадей Прикаспийско-Губинском нефтегазоносном районе // Бакировские чтения, РГУ нефти и газа (НИУ) имени И.М. Губкина г. Сборник научных трудов «Бакировские чтения»-М,"Нефть и газ", – Москва: – 01-02 март, – 2018, – с. 47-48;

8. Гурбанов, В.Ш., Аббасова, Г.Г. Перспективность литолого-стратиграфических комплексов и прогнозирование глубокозалегающих нефтегазовых коллекторов площадей Прикаспийско-Губинском районе // XIV Международной конференции «Новые идеи в науках о Земле», – Москва: – 2-5 апреля, – 2019, – с. 39-42;

9. Gurbanov, V.Sh., Gasanov, A.B., Abbasova, G.G. Depth distribution of petrophysical properties of mesozoic sediments of Khizi tectonic zone // – Gelendzhik: Geomodel 2021 - 23th Conference on oil and gas, Geological Exploration and Development, – 2021. №1, – p. 1-6 Scopus.

Personal contribution of the author.

The basis of the dissertation work is the research conducted by the author. He compiled lithofacies and paleogeographic maps of the Jurassic and Cretaceous stratigraphic units of the sedimentary complex of the southeastern part of the Greater Caucasus.

The author has compiled maps of the distribution of reservoir properties of Jurassic and Cretaceous rocks in the study area. The influence of the mineralogical and granulometric composition of rocks on their properties has been studied.

The author was directly involved in the selection of core samples and interpretation of data from the study area. The researcher presented 2D-3D models showing the average depth of porosity of reservoir rocks of productive horizons, and also plotted the effect of fraction sizes on porosity in different types of rocks.

The organization where the dissertation has been carried out. The dissertation work was carried out at the “Oil and gas geology” department and at the "Physical properties of rocks fossil fuels" scientific research laboratory of the Geological Exploration Faculty at Azerbaijan State Oil and Industry University

The volume and structure of the dissertation. Dissertation work consists of introduction, 5 chapters, conclusion and 106 list of bibliography. The volume of the work consisted of 194 pages, 11 tables and 83 pictures were included in its text. Introduction - 7 pages, I chapter - 20 pages, II chapter - 34 pages, III chapter 50 -

pages, IV chapter - 18 pages, V chapter - 37 pages, conclusion - 2 pages, bibliography - 13 pages.

It consists of 203431 symbols without tables, graphs, pictures and bibliography.

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In order to create the necessary conditions for the implementation of the thesis, the rector of ASOIU, prof. M.B. Babanly and prof. R.Yu. Aliyarov, as well as the head of the department of the University "Oil and gas geology" Kh.Z. Mukhtarova and the staff of the department.

MAIN CONTENT OF THE DISSERTATION

In the introduction, the relevance of the dissertation justified and brief information is given about the solutions to the issues.

In the first chapter, the study history and structural-tectonic characteristics of the Mesozoic sediments of the south-eastern part of the Great Caucasus are given. It has been shown that the area of the Pre-Caspian-Guba oil and gas bearing region has been studied by exploratory geophysical methods since the 30s of the last century. Land operations was carried out in geophysical production, and research work was mainly carried out by research institutes. In this area, geological and geophysical exploration works have been carried out for many years and about 50 local structures have been discovered. Most of the studied structures belong to the Mesozoic era.

In order to study the gravity field and tectonic structure, regional investigations were carried out on planning gravimetric studies in the Pre-Caspian-Guba oil and gas bearing region. A regional gravity minimum corresponding to the Guba-Davachi syncline, extending in the northwest direction was determined. In

these areas, high-quality gravity reconnaissance surveys were carried out, mainly with a static gravimeter.

The oil and gas prospects of the area were mainly associated with Mesozoic and Paleogene-Miocene sediments. Although large oil and gas deposits are not found in these thick and potential with hydrocarbons layers, the industrially important oil seepages obtained from wells drilled in a number of oil and gas fields of the country indicate that these deposits are promising. The chapter also examines the available information about some deposits within region in detail.

The Absheron bank oil field, that is located in aquatorial part of Caspian Sea, in the shallow water zone of the northern part of the Absheron archipelago,is related to the so-naimed underwater uplift. Deep drilling in the structure of the Absheron bank was started in 1951 with the drilling of well №1. Oil and gas seeps were not received from the wells drilled and opened the PS in the following years. Finally, during the testing of well № 4, 150-240 thousand m^3 of free gas and 15-20 tons of gas condensate were obtained per day from the depth interval of 1667-1661 m of QalD.

The second chapter provides information on the lithofacies and lithostratigraphic features of the Mesozoic sediments of the south-eastern plunge of the Great Caucasus. It is shown that the upper Leyas-Toar sediments are distributed in the Upper Caucasus Range. In addition, Toar sediments were found in the upper stream of Gudyalchay, Karachay and Valvelachay rivers. The sediments mainly consisted of the alternation of sands and clays. Clay is predominant here. These deposits were discovered in the Gusar-Devachi sub-basin and the Khizy tectonic zone. Valangin aged sediments consist of carbonate-terrigenous flow facies in the Greater Caucasus and are mainly distributed in the Shahdag-Sudur, Tengi-Beshbarmag, Khizy tectonic zones, in the area from Gilgilchay to Atacha, and in the Dubrar basin.[1]

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[1]Халифа-заде,Ч.М., Магомедов, А.М., Среднеюрские отложения восточной части Большого Кавказа изд-во «Наука» Москва. 1982, 263 с.

Aalenian sediments of the Middle Jurassic are widespread in the central part of the Greater Caucasus. In the upper stream of the Samur River, the thickness of the Lower Aalen sediments is more than 5000 m. (Ch.M. Khalifazade)

Bayos aged sediments are widespread in the Tangi-Beshbarmag and Tufan uplift zones. In the anticlinal uplifts of the Khizy tectonic zone, the Bayos aged sediments came to the surface.

Upper Cretaceous sediments are distributed in the south-eastern part of the Greater Caucasus. These deposits were discovered in the Gusar-Devachi retinue basin and the Khizy tectonic zone.

In the south-eastern part of the Khizy tectonic zone, in the eastern flanks of the Sitalchay and Shurabad uplifts, the sediments of the Cenomanian age are mostly exposed. In the south-eastern part of the Khizy tectonic zone, the thickness of the suite reaches up to 200 m.

Maastrichtian sediments are spread over large areas in the Greater Caucasus. In the Pre-Caspian-Guba region, sediments are widespread mainly in the Shahdag and Sudur zones, around the Kyzylgaya mountain and in the Khizy tectonic zone. The thickness of sediments reaches 125 m.

Thus, in the Pre-Caspian-Guba region, carbonate sediments are replaced by sediments that change from north to south and to the southeast, and then contain conglomerate layers. The thickness of sediments is varies from 40-50 m to 90-100 m.

The petrographic composition of core samples taken from exploratory wells in the region was determined with a microscope, as well as the reservoir properties of rocks were determined as a result of laboratory studies. In general, the composition and petrophysical properties of more than 500 types of rock samples have been studied in laboratory conditions. From the samples, up to 60 slices made of sandstone-siltstone, carbonate and clay rocks were studied. Optical properties were studied, the sizes, granulometric composition, selection rates, authigenic and terrigenous content of the samples, as well as the cement substance were determined [1-6, 8-12, 16-20].

The third chapter provides information on the reservoirs characteristics of the Mesozoic sediments of the south-eastern part of the Great Caucasus. As a result of the research, the study of the reservoir properties of the rocks involved in the geological section of the PreCaspian-Guba oil and gas bearing area and the characteristics of sedimentary layers showed that the sandy-siltstone reservoirs are weakly carbonated (the average value does not exceed 15%). Cement is mostly consist of clay. Lime and siliceous cements are also found. Total porosity is 3-22%, effective porosity is 1-3%, and permeability (1-35) varies between 10-15 m^2. Poor permeability is due to the remineralization process.

In the Lower Cretaceous Berrias-Valanjin, Hoteriv and Barrem suites, sandstones and siltstones occur in the form of thin (5-10 cm) layers.

Sandstones are hard, small and medium-grained, calcareous. They are poorly sorted; they differ in the presence of a mixture with a fraction of 0.01 mm. They are characterized by low porosity (up to 10%) and permeability (10·10-15 m^2).

The samples were grouped according to their origin in Atacay-Gilgilchay, Beyimdag, Tekchay, Shurabad and Yashma areas and researches were carried out separately for those areas.

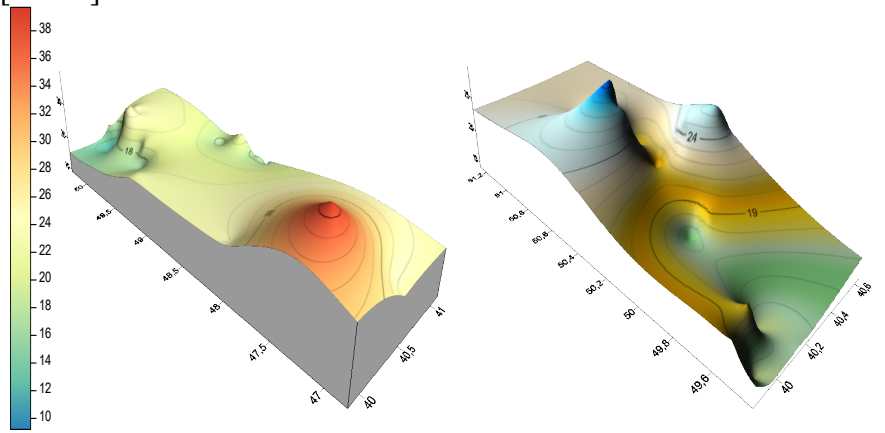
Thus, in the Pre-Caspian-Guba oil-gas bearing region, it was found that terrigenous reservoirs are related to the Berrias-Valangin, Hoteriv, Barrem, Alp, Cenomanian, Turonian, Santonian, Campanian, and Maastrichtian ages in the upper Cretaceous complex. The best reservoir properties are recorded in rocks of Cenomanian age. More fractured carbonate rocks are identified in the Berrias-Valangin-Hoteriv, Cenomanian, Turonian-Coniacian, and upper Campanian-Maastrichtian ages.

Clay layers of the Hoteriv-Barrem-Apt and Santon-alt Campanian ages can play the role of regional rock cover in the chalk section. At the studied depths (500-2000 m), the dependence of porosity on carbonate content in different types of rocks has numerically expressed [7, 13-15, 21-23].

Carbonate content and porosity, in addition to depending on depth, also differ in some areas.

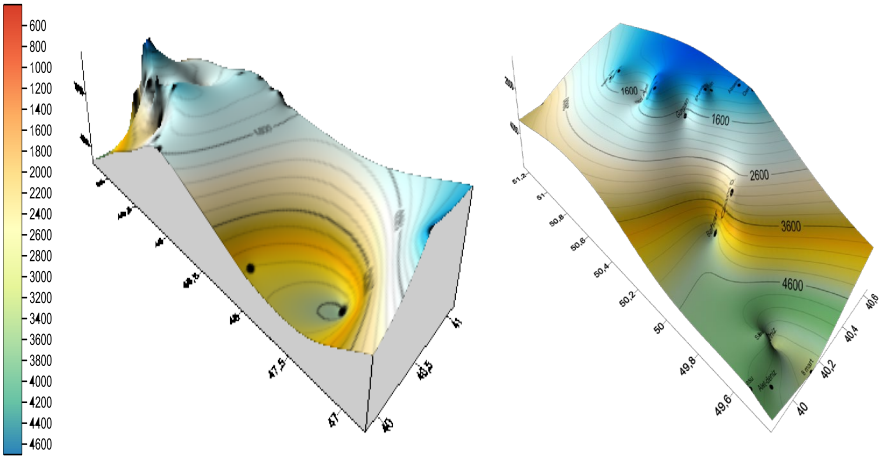
It was determined for the areas that when the carbonate content increases or decreases, the porosity decreases or increases, respectively. In particular, it is about 6.7% per 100 m in Atacay-Gilgilchay area, 2.7% in Beyimdag area, 0.7% in Shurabad area, 1.5% in Takchay area and 3.5% in Yashma area. Afurja and Keshchay uplifts, where industrially important oil, gas and condensate portions were obtained from these sediments, are considered the most promising. From this point of view, the Khizy zone, where Lower Cretaceous and Middle Jurassic sediments are widespread, is of particular importance. In the southeast of the Khizy zone, a sharp change in the thickness of the Lower Cretaceous sediments and the lithological composition of the rocks (in vertical and lateral directions) is observed. This variability can be explained by interruptions in the process of sediment accumulation and tectonic movements leading to folding.

Average depths of productive horizons of oil and gas deposits located onshore and offshore as well as the distribution of porosity of hydrocarbon reservoirs on the territory were studied (figure 1, 2) [22-23].



a) **b)**

Figure 1. Average porosity of productive horizons onshore a) and offshore b) oil and gas fields



a) **b)**

Figure 2. Average depths of productive horizons of oil and gas fields on land a) and offshore b)

Based on the variation of petrophysical quantities in Azerbaijan's onshore and offshore deposits in a wide range, it has been determined that productive horizons are related to lithological heterogeneity, variety of bedding depths, and tectonic conditions [19, 27].

The petrophysical characteristics of the Meso-cenezoic sediments of the Absheron bank and the Western Absheron deposits, which are located within the Absheron uplift system, have been studied and the patterns of their depth changes have been determined.

The selection of the investigated areas within the framework of our research was aimed, on the one hand, at examining the results of deep exploratory excavations carried out in recent years, and on the other hand at comparing those new data with traditional knowledge and seismic sections. In particular, the horizons exposed in the Beyimdagh-Takchay, Shuraabad, area of the Pre-Caspian-Guba-Khizy tectonic zone correspond to the Bayos-Bat age and are determined that they consist of shaly clays, sandstones and siltstones.

There is no doubt that the identification of oil-gas-rich intervals in the mentioned areas will create the basis for proper planning of future prospecting works.

Analytical summarization of the data of Beymdag-Tekchay oil field was carried out. The distribution of rock-forming fractions (grains) according to the groups of rocks involved in the study of four groups of rock types is depicted as pie charts. It can be seen from these studies that in the first group of rocks (clay silty sands), the fraction with the size of grains 0.175 mm is predominant. The other two fractions are approximately equal in volume with grain sizes of 0.055 mm and 0.01 mm, and the last coarse-grained fraction (0.25 mm) is a small fraction of the volume and can be ignored (figure 3) [20].

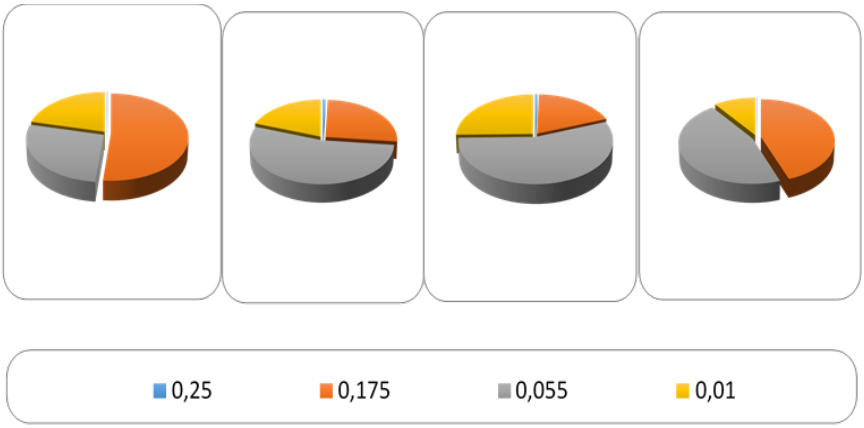
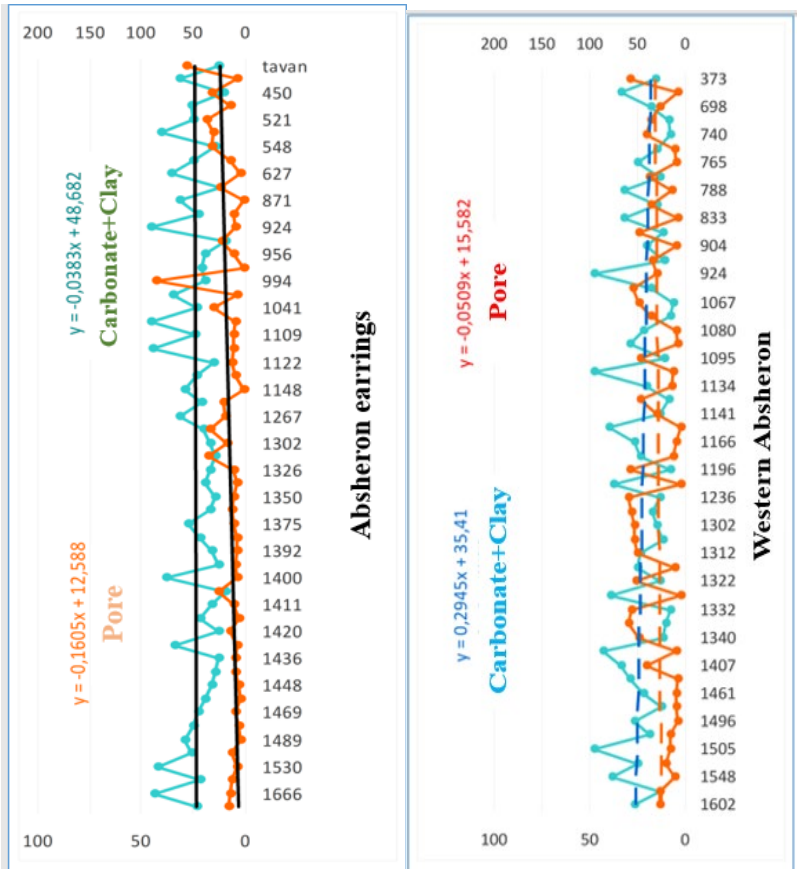


Figure 3. Circular diagrams of the distribution of rock-forming fractions (grains) according to rock groups. (Beyimdag-Tekchay area)

So, according to our research, the cross-sectional change of porosity, which is the main filtration capacity indicator of productive reservoirs on selected fields (land and sea), was summarized. As can be seen from the pictures, the porosity of the rocks is characterized by unstable quantities along the cross-section, but in general there is a tendency of decreasing porosity with depth.

Thus, the average value in the Absheron bank is 8%, and the decreasing pattern of porosity can be estimated by the linear depend-

ence of Y= - 0.16X+12.59, which is approximately 0.6% per 100 m step. Although the values of porosity change more sharply in Western Absheron, the average value is 14.2% and the decreasing trend is weaker as the depth increases (every 100 m is 0.25%) (figure 4).



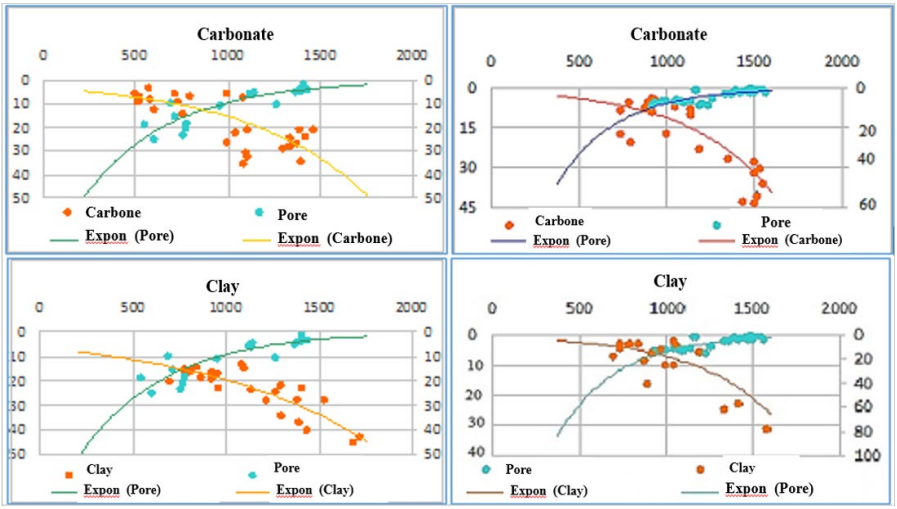
a) b)

Figure 4. Changes in granulometric composition and porosity at the intersection of offshore deposits in (a-Absheron earrings, b-Western Absheron)

At the same time, both carbonate and clay have an opposite effect on the porosity of rocks, but the joint effect of the two parame-

ters manifests itself in different ways in the sections of the studied deposits [18, 19, 31-33].

As a result, the inverse correlation of rock porosity with carbonate and clay content was confirmed in both fields (Absheron bank and Western Absheron) (figure 5) [19].



a) b)

Figure 5. Dependences of porosity, carbonate and shale contents in the PS section of North Absheron archipelago: a) Abşeron bank; b) Western Absheron

The last result shows that, in some cases, the porosity of reservoir rocks depends on other influencing factors besides carbonate and clay consistency. In order to investigate this, we reviewed the quantities compared in the cross-section of the studied fields. In particular, the effective diameter of grains (D_{ef}) and coefficient of inhomogeneity (Kg) were also determined in those cross-sections along with granulometric constituent indicators that provide porosity in productive reservoirs.

Thus, the variation of the effective diameter (D_{ef}) of the rock-forming grains of the reservoirs in the section of the Beyimdag-

Takchay field obeys the exponential law inversely proportional to the dominant fraction. In the Western Absheron field, the change of the heterogeneity coefficient of the reservoirs depending on the depth directly depends on the change of the predominant (dominant) fractions.

As a result, it was determined that a weak pattern is evident in the decrease of porosity along the stratigraphic depth. No pattern is observed between carbonate consistency and permeability. The porosity coefficient of the reservoirs is characterized by unstable values along the section, but in general, there is a tendency of decreasing porosity with increasing depth. The established pattern between porosity and rock-forming fractions, as well as other coefficients reflecting reservoir quality, is described by stable correlation dependencies [24, 26].

Mathematical and 2D graphical dependences were determined for the evaluation and numerical prediction of reservoirs' filtration capacity characteristics with a different approach, in addition to traditional methods of well-mining data to predict deep oil-gas potential layers of various deposits.

For different rock groups (clay-sandy sediments, sandy-clay pebbles and clayey sands), fractions with grain sizes of 0.055 mm and relative differences of 0.175 and 0.01 mm prevailed.

In general, while noting the oil-gas potential of the Lower Cretaceous sediments in the Pre-Caspian-Guba oil and gas bearing area, consider the increase in the thickness and composition of carbonate and terrigenous rock-containing layers in the intersections of these junctions in the direction of large-amplitude anticlinal folds (Shuraabad, Sitalchay, Beyimdag-Takchay, etc.) located in the Khizy zone. can't be missed. As it known, oil and gas prospects of the Khizy tectonic zone are related to Middle Jurassic and Lower Cretaceous sediments. According to the Middle Jurassic well data, the maximum thickness is 1850 m in Keschay area.

In the fourth chapter, the paleogeographical and paleotectonic conditions of the Mesozoic sediments of the south-eastern part of the Greater Caucasus are explained. Thus, the accumulation of Low-

er Jurassic sediments consisting of conglomerates, arkose sandstones and clayey shales with a thickness of 2000-2500 m during the transgression on the southern slopes of the Greater Caucasus indicates significant shrinkage. From this period, the concept loses its meaning, and it is more appropriate to call the considered area the Kura geoanticline.

At the end of the Toar period, tectonic movements intensified in the miogeosyncline of the Great Caucasus, and seafloor uplift was observed in the area corresponding to the current Great Caucasus Range.

During the Aalen Age, the process of sea floor subsidence continues. In the central uplift zone, the uplifting process is marked by the formation of folds. At the same time, as a result of the intensification of tectonic movements, magmatic processes continue mainly in underwater conditions in the Great Caucasus fault.

In the area of the Gusar-Shabran retinue depression, the Upper Aalenian sediments around the Beyimdag-Takchay zone belong to the distal facies.

The investigations show that the paleotectonic and paleogeological conditions in the basins where the Upper Jurassic sediments accumulated were very harsh. A large-scale regression process was replaced by gradual transgressions under difficult paleotectonic conditions during the late Middle Jurassic and early Upper Jurassic periods. In the Kimmerian and Tithonian ages, organic detrital oolite and pseudo-oolitic limestones were accumulated in the sedimentary basin as a result of the intensity attenuation of sedimentation processes. This type of sediments are more widespread in the Shahdag zone of Azerbaijan and have greater thicknesses reaching 800 m. According to V.V. Bogachev, these sediments belongs to Kimeric-Oxfordian age, according to A.V.Wichert and others, Kelloway-Titonian age.

The different ages of the reef massifs depend on the time, when the tectonic blocks, where they are located, had favorable conditions for living organisms, that formed the reef massifs (Ch. M. Khalifazade). In the Shalbuzdag-Shahdag-Kyzylgaya massif, which is surrounded by the Gazma-Gryz fault from the north, and the South

Shahdag and Budug faults from the south, the favorable conditions, created during the Oxford-Kimeric period, continued to the Tithon, Berrias, Hoteriv and even in some areas, the Barrem. In contrast, favorable conditions for the formation of reefs existed mainly in the upper Oxford-Kimeric ages in separate areas located within the Tangi-Beshbarmag anticlinorium, which is bounded by the Siyazan fault from the north and the Klit-Garabulagh fault from the south.

The existence of organic limestones at the border of the Khizy tectonic zone and the Dubrar depression indicates that there are favorable conditions for the formation of reef-derived massifs in the Malkamud-Germian deep fault zone, which is the essential fault of the Greater Caucasus, which separates these tectonic units. The uplift processes intensified at the end of the Tithonian age resulted in the formation of folds and the regression of the sea in the Berrias age in the Southeast Caucasus. This created the Achichay-Alat, Gaynar-Zangi, Siyazan deep faults in the pan-Caucasus direction, and then the faults, separating the paleotectonic units at the end of the Jurassic period and the beginning of the Cretaceous period.

Geological and geophysical studies show that the Achichay-Alat, Gaynar-Zangi, Siyazan deep faults in the pan-Caucasus direction were the faults that separated the paleotectonic units at the end of the Jurassic period and the beginning of the Cretaceous period. The Western Caspian deep fault, manifested in the form of a gravity step on the eastern slope of the Talysh-Vendam gravity maximum, separates the Lower Kura depression from the system of Middle Kura depressions, which differ sharply from it in terms of geological structure. This fault, which continues in the meridional direction in the north, separates the Shamakhi-Gobustan depression in the Alazan-Eyrichay depression in the Girdiman river basin, and the Khizy tectonic zone in the Valvala river basin from the Shahdag zone.

At the beginning of the Cretaceous period, the transgression occupies a wider area. This transgression reached a high level in the first half of the Aptian century. In the Berrias-Hoteriv interval of the Lower Cretaceous, the uplift of the Southeast Caucasus, the Tufan

anticlinorium extends into the Valvalachay basin in the form of a peninsula of Middle Jurassic sandy clays. To the south of the Tengi-Beshbarmag cordillera, the sediments of the Babadag Formation with different facies characteristics were accumulated under tectonic activity and relatively shallow marine conditions. In the Khoja tectonic zone, which forms the southeastern part of the Tufan anticlinorium, as well as in the vicinity of such anticlines as Kizilgazma, Beyimdag-Tekchay, Sitalchay, Keshchay, flysch sediments are observed in underwater ravinement zones.[2]

The expanding marine transgression during the Neocomian period covered the northeastern part of Azerbaijan in the second half of the Barremian period. There were no serious changes in the paleotectonic structure during the Aptian and Albian periods of the Cretaceous age. As in the Neocomian period, the process of sediment accumulation continues in the northeastern part of the Pre-Caspian-Guba region and the area covering the southeastern part of the South Dagestan basin. The lower Turonian sediments form a transition between the facies terrigenous Hoteriv-Cenomanian sediments and the overlying upper Turonian-Maastrichtian sediments, which are mostly carbonate, in the Southeast Caucasus. In the second half of the Turanian period, the marine transgression expanded. The configuration of the basin in the Southeast Caucasus did not change much during the Santonian period. The Shahdag zone continues to remain a dry area. The sea advances to Shahdag zone for the first time after the Albian century. At the beginning of the Maastrichtian age, the cordilleras in the South-Eastern Caucasus began to rise again.

Since the paleogeographical and paleotectonic conditions existing in the second half of the Campanian age in the Khizy tectonic zone and in the Dubrar depression did not change, the Agburun stratum of upper Campanian-Maastrichtian age, composed mainly of

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[2]Халифа-заде, Ч.М., Палеогеографичесские условия образования среднеюрских отложений северного Азербайджана и Дагестана. Состояние и задачи Советской литологии. Изд. “Наука”, Москва, 1970, с. 120-128.

limestone and marls, was formed here. The absence of terrigenous sediments in the section of the Agburun formation shows that Beshbarmag and Beyimdag-Tekchay-Sitalchay ravinement areas are not above sea level. The thickness of this group varies from 200 to 300 m in the central part of the Khizy zone, while the thickness reaches 400 m in the Budug syncline. The stages of paleotectonic evolution covering the Mesozoic period in the Pre-Caspian-Guba region are described in separate paleoprofiles.

Geological information about the paleotectonic and paleogeographical conditions of the Lower Cretaceous period in the northeastern part of the Pre-Caspian-Guba region is relatively low comparing to the southeastern part of the Caucasus, and it is known that the Upper Cretaceous sediments are not involved in the Gusar-Khachmaz buried uplift zone and the section of the Tolibi anticline, which is located south of it.

Paleotectonic cross-sections derived from the geological task and the unique complex geological-tectonic structure of the research region are being drawn up in other directions as well. These sections will greatly help in the relative clarification of the formation conditions of reservoirs and traps in Mesozoic sediments and their oil and gas content [28-30].

In the fifth chapter, the prospect of oil and gas production of the Mesozoic sediments of the south-eastern part of the Great Caucasus and the directions of future exploration work are explained. As it is known, Mesozoic sediments are widespread in the Pre-Caspian-Guba oil and gas bearing region, and there are a number of local non-anticlinal structural traps in its section. Exploratory excavation works were carried out in Shurabad, Keschay, Sitalchay, Beyimdag-Tekchay and Gedisu areas in order to study the Mesozoic sediments section and oil-gas content in the Khizy zone. During drilling in the Shurabad area, gas occurrences were recorded from Upper and Lower Cretaceous and Middle Jurassic sediments of varying intensity, and oil occurrences from the Albian-Barrem, Campanian-Santonian intervals of the section. Oil and gas seepage were found during testing from the Albian sediments.

To explain the observed difference, the method of stratigraphic correlation applied in all stages of development of geological science was used.

In this way, the complex analysis of existing geological-geophysical and well data gives reason to assume that in Azerbaijan, especially in the Pre-Caspian-Guba oil and gas bearing region, the Mesozoic sediments have favorable structural-tectonic, lithofacies, paleotectonic, geochemical and thermodynamic conditions existed. These possibilities were later confirmed by excavation. It was determined that the stratigraphic range of oil and gas in the Mesozoic sediments section covers a wide interval from the Middle Jurassic to the Upper Cretaceous. Research has also shown that the Pre-Caspian-Guba oil and gas bearing region is quite promising from the point of view of searching for oil and gas deposits in lithological-stratigraphic and screen-type traps in the Mesozoic section (Ch. M. Khalifazade).

Middle Jurassic sediments are the oldest and oil-and-gas rich Mesozoic sediments studied by drilling in the territory of Pre-Caspian-Guba oil and gas bearing region. Oil and gas seepage were obtained from these sediments in Keshchay and Afurca fields located in the Khizi zone. Thick-layered clay and clay-carbonate layers with high organic content have been identified in the open section of the Middle Jurassic. In addition, sandy-siltstone lithological horizons with an average thickness of 50 m, which can be the object of oil and gas exploration, are noted in the Middle Jurassic section. From these reservoirs, it can be assumed that the slopes of ancient local uplifts directed to oil-gas formation zones are more promising.

The Afurca and Keshchay uplifts, where industrial seepages of oil, gas and condensate were obtained from these sediments, are considered the most promising. In this sense, the Khizy zone, where Lower Cretaceous and Middle Jurassic sediments are widespread, is of particular importance. A sharp lithological change (in the vertical and lateral directions) of the thickness of the lower Cretaceous sediments and rocks is observed in the southeastern direction of the Khizy zone. This variability can be explained by the occurrence of

breaks in the process of sediment accumulation and tectonic movements (vertical and horizontal) that form folds.

The reservoirs of the Middle Jurassic sediments consist of sandy-siltstone-argillite horizons separated by rather thick argillized clay layers. As the Barrem floor consists of a large (1000 m) clay layer together with the lower Apt half-aged sediments, it plays the role of a regional cover. Only the marl-clay formation lying in the lower part of the Barrem age has reservoir properties due to certain porosity and fissures.

In conclusion, it can be noted that based on the results of the generalization and qualitative interpretation of the logging diagrams carried out on the research area, as well as the performance of special studies for the evaluation of the capacity characteristics of the rocks involved in the well sections drilled in the area, it is based on a good assessment of the existing reservoir here [27, 31].

Oil and gas occurrence was recorded in the whole cross-section of Mesozoic sediments opened by drilling in the Khizy tectonic zone. The oil and gas releases observed by fountain occurred when the Albian (Shurabad), Valanjin (Beyimdagh-Takchay) and Middle Jurassic (Keshchayda) sediments were exposed.[3]

Lower Cretaceous and Jurassic sediments, which are widespread and very thick in the territory of the Khizy oil-and-gas region, are considered to be syngenetic oil-and-gas deposits.

According to the above mentioned, the lower part of the Middle Jurassic, Lower Cretaceous Valangin, Hoteriv stages and the Barremian stage can be considered promising. Keshchay, Beyimdag-Tekchay, Sitalchay, Shurabad and Yashma are considered as promising areas, with the recommendation to carry out prospecting and exploration works.

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[3]Yusifov, X.M., Süleymanov, Ə.M. Azərbaycanda Mezozoy çöküntülərində neft-qaz axtarışının geoloji əsasları. Bakı-2015 “Mars Print,” 308 s.

CONCLUSION

Based on the research conducted in the dissertation on the lithology of Mesozoic deposits and the oil and gas potential of the southeastern part of the Greater Caucasus, the following generalized results were obtained:

1. The Maastrichtian deposits are represented by two facies in the southeast of the Greater Caucasus: clays predominate in the northern regions, and limestones in the southern regions. The oil and gas potential of the Maastrichtian deposits has been established mainly in a section composed of thick fragments and sandstone layers composed of fractured carbonate deposits;

2. Maastrichtian sediments are represented in two facies in the southeast of the Greater Caucasus, clays dominate in the northern regions and limestones dominate in the southern regions. The oil-gas content of the Maastrichtian strata sediments has been determined, mainly in the cross-section, consisting of thick clasts and sandstone layers consisting of fractured-carbonate sediments;

3. Determining the petrographic composition of core samples taken from exploratory wells with a microscope, as well as determining the reservoir properties of rocks as a result of laboratory research, gives the basis for a number of new considerations;

4. In order to establish the cause of porosity variability at different depths, the influence of the degree of carbonate content and clay content of individual rock samples on their porosity was studied; on the structures of Absheron kyupesi and Gyarbi Absheron, an inverse relationship was established between carbonate content and clay content of reservoirs with porosity;

5. Qualitative interpretation of generalization and cartographic diagrams carried out in the study area, as well as special studies to assess the saturation characteristics of rocks extracted from gas well sections in the study area, it is reasonable to assess the conductive layers found here as good reservoirs;

6. The lithological heterogeneity of the productive horizons, the diversity of their depths, and the fact that they are related to

tectonic conditions, based on the wide range of changes in petrophysical quantities on the land and sea deposits of the territory;

7. To predict the oil and gas content of the deep layers of the explored fields, along with traditional methods for assessing the porosity and reservoir characteristics of reservoirs, mathematical 2D and 3D models were built for quantitative numerical prediction;

8. The influence of the degree of carbonatization of reservoirs on porosity was determined by area: approximately 6.7% per 100 m in the Atachai-Gilgilchay area, 2.7% in the Beyimdag area, 0.7% in the Shurabad area, 1.5% in the Takchay area and 3, 5% in the Yashminsky district;

9. The regularity determined between the porosity and rock-forming fractions, as well as other coefficients reflecting the quality of the reservoires, is described by stable correlation dependencies;

10. A comprehensive analysis of geological, geophysical and well data shows that in the region of the Caspian-Guba OGR, the Mesozoic strata are favorable for the formation of anticlinal and non-anticlinal hydrocarbon deposits. The presence of tectonic, lithofacies and paleotectonic types of deposits has been confirmed;

11. Oil and gas shows were noted in the entire section of Mesozoic deposits discovered by drilling in the Khyzy tectonic zone. It has been proven that the oil and gas manifestations received by the fountain are associated with Albian (Shurabad), Valanginian (Beyimdag-Tekchay) and Middle Jurassic (Keshchay) deposits;

12. The Middle Jurassic, Lower Cretaceous (Valangin, Hauterives, as well as the lower part of Barremian) can be considered promising. Keshchay, Beyimdag-Tekchay, Sitalchay, Shurabad and Yashma are considered as promising areas with a recommendation for prospecting and exploration.

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