Short Communication

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Forecasting the Prospects for Oil and Gas Deposits at Great Depths in the Oil and Gas Regions of Azerbaijan (on the example of the Neft Dashlary field and others...)

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Abstract

Due to the oil and gas prospects of the deep layers in Azerbaijan, a large amount of geological prospecting and geophysical work has been carried out recently, and scientific criteria have been developed that could be the basis for future exploration. It was noted that the main oil and gas fields are associated with the South Caspian and Kura basins, which were intensively buried during the Mesoceneozoic. Although researchers have no doubt that these sediments are highly promising in the central part of the basin and in the deeper layers in general, a quantitative or quantitative expression of the problem has not yet been found. It is known that exploration, production and assessment of potential in oil and gas fields is highly dependent on the collected information about the petrophysical characteristics of the layers, found in the geological profile.

The article presents a comparative analysis of deep reservoir rocks based on petrophysical studies conducted in the South Caspian Depression, the Kuran Depression and the Caspian-Guba oil and gas region. Analysis and interpretation of geological and geophysical and petrophysical data revealed that oil and gas reservoirs are mainly in volcanic-sedimentary and carbonate rocks. Briefly, the petrophysiological mapping of rocks drilled from exploratory wells in the area has been clarified. Summarizing the data obtained, it can be concluded that a large-scale change in the reservoir properties of field conversations is due to their lithological diversity and thermobaric conditions at depths.

Given the oil and gas prospect of this region, the presence of unexplored local deposits and the possibility of the appearance of new oil and gas fields in them, the study of the geological structure and collective features of the field when determining promising structures and objects of the oil and gas complex is an important problem.

Keywords: Petrophysics, Density, Wave Propagation Velocity, Porosity, Well, Rocks

Introduction

Recently, a large amount of geological prospecting and geophysical work has been carried out in Azerbaijan in connection with the prospects of oil and gas in the deep layers, which has led to the creation of a number of scientific criteria that could be the basis for future exploration. Thus, the development of maps based on geological-geophysical and petrophysical data, reflecting the tectonic, oil-geological mapping and reservoir characteristics of the region, can be an example. It was noted that the main oil and gas fields are associated with the South Caspian and Kura basins, which were subjected to intensive mining during the Mesocainazoy period. Although researchers have no doubt that these sediments are highly perspective in the central part of the basin and in the deeper layers in general, there is no quantitative expression of the problem. However, in many countries around the world, oil and gas flows have been extracted from great depths.

The study of petrophysical properties of reservoirs is of particular importance in terms of the presence of oil and gas fields at great depths. In particular, the study of critical values of porosity and permeability parameters depending on the depth is considered an important exploration criterion. These studies were conducted in the Azerbaijani section of the South Caspian Basin, in various areas of the Kura Basin and the Caspian-Guba oil and gas regions, and positive results were obtained [1,2].

Problem Statement

From this point of view, the reservoir features of the deep-lying oil and gas rocks of the Azerbaijan section of the South Caspian Basin, the Kura Basin and the Caspian-Guba fields have been studied by petrophysical studies. In this regard, the density (σ, g/cm3), porosity (m, %), ultrasonic wave propagation velocity (V, m/sec), carbonate content (%), permeability (10-15m2) and granulometric

composition of rock samples taken from deep exploration wells were studied by modern methods. more than 1000 samples studied

The South Caspian Basin is one of the deepest oil and gas depressions in the world. Structures with similar geological structures located in different anticline zones are spread in the South Caspian basin. Thus, these structures are the Gurgan-Deniz located in the Darwin Bank - Janub anticline and the Chilov Island located in the boundary of Khali - Neft-Dashlary anticline zone. The structures located in these anticline zones have been studied relatively well. Petrophysical surveys were conducted in the area in order to have detailed information on the lithological-petrographic and reservoir rocks of the area, to clarify the hydrocarbon reserves of the reservoirs, as well as to help direct exploration work. Let's focus on the Neft-Dashlary, Gurgan-Deniz and Chilov Island structures typical for this region.

Various geological-geochemical and physical factors affecting the gas content of oil and gas-condensate deposits of the Mesocainozoic sediments of the South Caspian Basin, as well as the reservoir characteristics of sedimentary rocks distributed in the area have been studied. Studies show that in the schematic paleoprofiles along the Kurdakhani-Shah Deniz anticline Pliocene-Anthropogenic sediments were collected in small thicknesses from 100 to 200 m in the north-western part of the zone. The thickness of these sediments increases up to 3600 m in the structure of Gum Island and 6000 m in Shah Deniz. The thickness of the above-mentioned sediments within the synclines is higher - 3,000 m in the northwest and 10,000 m in the Shah Deniz region.

Considering the oil and gas prospects of the Kura Basin, the presence of unexplored local uplifts and the possibility of discovering new oil and gas fields, the study of geological structure and reservoir characteristics is one of the important issues in identifying promising structures and oil and gas facilities.

Undoubtedly, these rocks are occurred by the created forces of various physical and chemical processes in the deep layers of the earth under natural conditions. During their epigenesis, under the influence of pressure and temperature, minerals dissolve and the pores of rocks change. During the drilling a well surfaced rock samples incur certain elastic deformation. The study of these allows to obtain accurate information about the physical and reservoir properties of rocks, in accordance with their depth of deposition. Thus, as a result of these studies, it is important to determine the elastic and thermobaric changes in the reservoir properties of the layers during the development of deposits. Studies have shown that the physical properties of rocks of the same name and age change as a result of geological and physical processes and take on different values. These results have been confirmed by petrophysical studies conducted under pressure and temperature

Solution Methods:

The Neft-Dashlary field, which has a complex geological structure, has a large sedimentary composite from the Lower Paleocene (Govundag layer group - Eocene) to Gyrmaki sediments with a total maximum thickness of 3350 m. The arching part of the fold is washed away, and in its core the Gyrmaki layer group from the bottom of the sea rises to the surface.

The Maykop Formation (Oligocene, Lower Miocene) is composed of sandy and volcanic ash, multicrushed, unstructured, typical microfauna clays which were subsurfaced through a drilled well in the arching part of the fold.

Govundag and Maykop strata, middle and upper Miocene and Pliocene sediments were discovered and studied through deep exploration wells. Rich multi-storey oil fields have been discovered in the reservoirs of the MQ. QaLD mainly consists of clay sediments and sandstone layers alternating with siltstone and fine-grained sand layers. The sands are quartz, medium and fine-grained, while the clays are weakly sandy and weakly carbonate. The lithofacity and thickness of sandy horizons and the clay layers that separate them are not constant across the site. The net to gross (sand content) of the section increases toüard the arch. The net to gross of the stratum increases from the arch to the limb and reaches 70%.

There are 4 oil and gas horizons in this formation. In addition, 4 more horizons are marked at the bottom of the stratum in some blocks.

Lithological-petrographic and reservoir characteristics of bottom layers were determined by core samples taken from exploration wells drilled in the above-mentioned area. In addition to the geological and geophysical researches carried out in the field to determine the patterns of change in the field, the carbonate content, porosity, permeability, density, granulometric composition and ultrasonic waves propagation velocity of core samples taken from drilled wells were studied and the lower, upper and middle limits of physical properties of rocks were determined. At the same time, the study of the dependence of reservoir properties with each other, depths and various physical factors was considered, and the reservoir properties of rocks were thoroughly investigated.

In the oil facilities of the field, the gas is dissolved in oil. However, the presence of free gas at some facilities was noted. The oil content of QaLD was determined in all blocks of the field.

The maximum thickness of PT(Productive Tosha) sediments drilled by wells in the area is 2400 m. However, in some areas, some PT horizons have been discovered at deeper depths, i.e. in the lower strata, through deep exploration wells. Here, the density of clay rocks is 2.20-2.48 g/cm^3, porosity is 8.3-17% (in some cases up to 25%), and ultrasonic waves propagation velocity is 2150-2200 m/sec. The density of siltstones varies from 2.13 to 2.60 g/cm^3, the porosity - from 15 to 28%, and ultrasonic waves propagation velocity varies from 1300 to 2200 m/sec. The density of sandstones varies between 2.00-2.50 g/cm^3, and the porosity varies be-

tween 7.2-22.0%. As in other rocks, ultrasonic waves propagation velocity in sandstones varies from 850 to 2800 m / s, depending on their lithological composition. Due to the changes in PT aged carbonate clays involved in the geological structure of the field, their physical properties: density 2.02-2.59 g/m3, porosity 8.5-30% and ultrasonic waves propagation velocity varies between 2100-3500 m/sec. It should be noted that the carbonate content and permeability of PT sediments have also changed to some extent [3,4].

Table 1: Limits of change, average values of physical properties and the degree of permeability of sedimentary rocks of the PS field of Neft Dashlari

Depth intervals, m Depth intervals, m	Lithology	Carbonate, % min - max average	Density, σ, g/cm^3 min - max average	Speed of propagation of elastic waves, V, m/sec. min - max average	Porosity, % min - max average	Permeability, 10-15 mkm2 min - max average	Degree of permeability
430–480	sandy argillaceous aleurolites	8,3 - 12,8 9,7	2,42 - 2,50 2,45	2200 - 2600 2400	11,6 - 20,1 16,3	28,5 - 79,4 59,7	good
480–600	aleurite clay	4,9 - 26,8 19,14	2,36 - 2.56 2,50	2000 - 3100 2650	12,4 - 17,0 11,0	2,6 - 8,1 5,35	very weak
640–690	clayey sandy aleurolites	5,8 - 12,4 7,53	1,6 - 2,34 2,20	1700 - 2400 1980	11,0 - 33,6 16,92	0,1 - 95,7 40,68	good
690–930	clayey sandy aleurolites	8,9 - 9,9 9,37	2,01 - 2,10 2,05	2400 - 2600 2500	19,5 - 22,9 21,4	0,1 - 95,7 2,20	very weak
930–940	sandyargillaceous aleurolites	8,2 - 9,4 8,8	2,01 - 2,47 2,37	2300 - 3200 3000	9,9 - 25,7 15,5	1 - 3,5 2,3	very weak
940–1130	clayey aleurolites	4,5 - 6,0 5,27	2,37 - 2,67 2,56	2500 - 3000 2800	6,0 - 16,0 9,57	214,9	high
1130–1400	clayey sandy aleurolites	23,4 - 25,8 24,60	2,38 - 2,53 2,44	2100 - 3200 2580	9,7 - 11,1 10,40	2,25 - 6,23 4,24	very weak
1500–1550	clayey aleurolites	3,0 - 11,0 7,0	2,40 - 2,47 2,44	2300 - 2400 2350	12,6 - 14,9 13,75	0,6 - 2,0 1,3	missing
1600–2050	clayey aleurolites	3,8 - 15,7 11,8	2,47 - 2,56 2,51	3500 - 3600 3550	7,6 - 10,8 9,02	56,9	good
2050–2200	sandyargillaceous aleurolites	4,1 - 14,6 9,79	2,36 - 2,43 2,40	3150	13,6 - 17,9 14,8	12,5	medium
2200–2500	clayey aleurolites	3,8 - 15,7 11,8	2,47 - 2,56 2,51	3500 - 3600 3550	7,6 - 10,8 9,02	56,9	good
2550–3550	clayey aleurolites	7,8 - 8,7 8,1	2,43 - 2,60 2,56	3600	8,5 - 10,0 9,9	66,9	good
3550–4600	clayey sandy aleurolites	2,8 - 10,8 6,8	2,58 - 2,64 2,61	4000	5,3 - 14,2 9,57	60,5	good
Notes: In the numerator – the minimum and maximum values, in the denominator – the average values.							

The obtained regularities in the variations in the petrophysical characteristics of the reservoirs in depth (Figure. 1) can also be tested in neighboring areas, in case its paleogeographic commonality and structural-tectonic formation conditions.

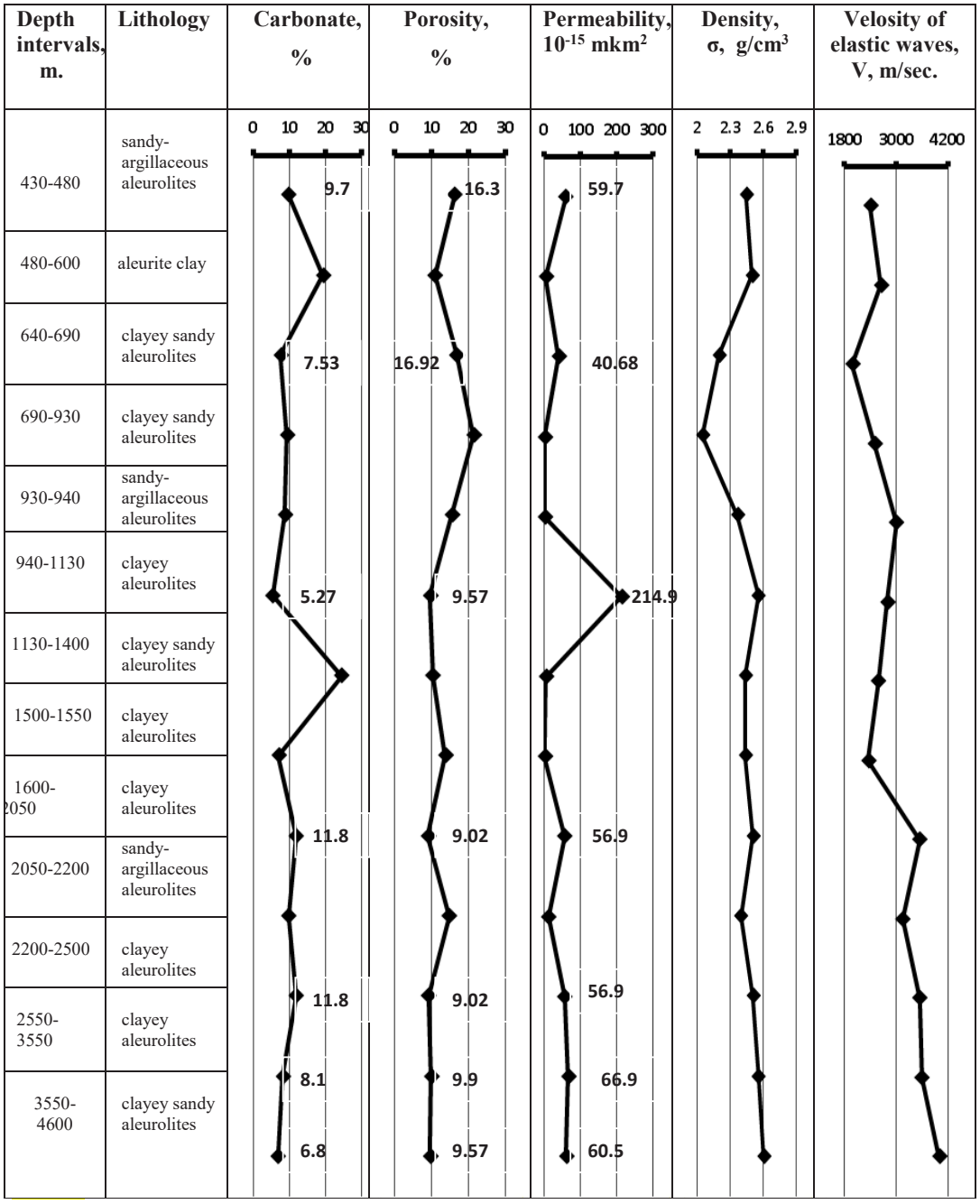

Figure 1: Changes of the mean values of the physical parameters of the sedimentary rocks for the PS field of Neft Dashlari

In consideration of the multi-layered nature of the field, in order to clarify the character of the variation of the reservoir properties of rocks depending on the layers and depth, the rate of change of physical parameters in the field was analyzed comparatively. As a result, it was found that although the lower and upper layers differ slightly in composition, the difference in physical parameters is noticeable. That is, there is a decrease in porosity at depth and a relative increase in the density and speed of propagation of ultrasound waves.

The analysis allows us to determine the wide range of characteristics of the objects of study due to the lithological heterogeneity of the main complexes, the diversity of rocks and tectonic conditions. The regularity between the porosity and permeability coefficients was determined.

As a result of processing and interpretation of petrophysical and petroleum geophysical data, it was determined that some horizons of the MQ are more perspective in terms of oil and gas.

Thus, the analysis of lithological and petrographic features of the field and the reservoir properties of core samples taken from the field and the study of geological and geophysical materials allow predicting the oil and gas content of the deeper layers along with the upper layers.

Lithological-petrographic features and petophysical properties of the Mesocainozoic sedimentary rocks of the South Caspian Basin have been studied in detail, and their main parameters have been determined. Thus, it has been analyzed that the reservoir properties have different value with the depth of immersion of rocks. In other words, the prospects of the South Caspian basin are mainly related to the lower part of the PT.

The lithological-petrographic and petrophysical data obtained as a result of the research can be used in the processing and interpretation of logging data, which in turn increases the effectiveness of the research.

It should be noted that the research covered the study of porosity, permeability, carbonate content and granulometric composition of reservoir rocks in neighboring areas.

Thus, the analysis of lithological-petrographic features of the depression and the reservoir properties of core samples taken from the field allows to predict the oil and gas content of the layers.
As the Kura Basin is one of the most perspective areas of Azerbaijan in terms of oil and gas, the issues related to the study of the petrophysical parameters of the rocks of geological section have always been in the focus of experts. Despite a comprehensive and extensive analysis of rock samples taken from numerous exploration wells drilled in various areas of the basin, there is still a need to solve issues in this area. One of them is the study of the impact of geological and physical factors on the individual physical properties of rocks in perspective areas of the Kura basin.

For this purpose, the petrophysical properties of rock samples taken from wells drilled in the Muradkhanly, Zardab, Tersdallar, Kursangi, Jafarli and others fields of the Kura basin were analyzed and compared with the results of geological surveys conducted in this area. At this time, all sediments opened by drilled wells were involved in the researches. It covers the part of the section from modern sediments to Upper Cretaceous sediments.

Studies have shown that the physical properties of rocks with the same name and age change as a result of geological and physical processes and receive different values. These results were confirmed once again by petrophysical studies carried out under pressure and temperature.

In consideration of the important role of parameters in the processing of geophysical data, detection of tectonic fault and fracture zones, determination of abnormal formation pressure zones, rock density and wave propagation velocity these petrophysical results have been comparatively analyzed. Studies have confirmed that there is no single pattern for the overall area. Here, the density of rocks and the wave propagation velocity depends mainly on the depth and tectonic changes, so the values of density and velocity increase with depth and vary over a wide range. In sand, clay, siltstone and carbonate rocks, the average density and wave propagation velocity increase.

Analysis of the physical properties of the rocks involved in the geological structure of the Muradkhanly field shows that the oil layers in the deep intervals of the field are associated with Upper Cretaceous rocks (porosity 11%), Eocene carbonate sediments (marl and limestone - porosity 9.6-10.9%) and Eocene-Maykop porous terrigenous rocks (siltstone, sandstone - 15-19%).

Rocks from the deep exploration wells drilled in the Zardab field belong to the Mesocainazo. The physical properties of Upper Cretaceous volcanic and sedimentary facies (limestone, carbonate clay, argillite and siltstone) rocks have been studied in detail.

Siyazan monocline, which has a compositive geological structure, is divided into several groups according to its oil and other geological characteristics. The geological structure of the monocline includes Upper Cretaceous, Paleogene-Miocene sediments in the mountainous area, and Pliocene sediments in the plain area. The petrophysical properties of all these sediments were studied in detail, and on the basis of the obtained data, a petrophysical model of the field was developed on the basis of regular distribution of physical properties of different types of rocks involved in geological structure in different oil and gas fields. At the same time, the limit of change of reservoir properties of layers and average values are calculated.

In this regard, in the Caspian-Guba oil and gas region reservoir characteristics of deep-formed layers and rock samples of existing fields or structures have been identified, the density of clay sandstones located relatively on the surface PT was studied in wet and dry state and proved to change over a large range (1.94-2.36 q/cm3). The porosity of these rocks is 7-30%, and the ultrasonic waves propagation velocity varies between 2500-3000 m/sec. Sartmat age: density of sandstone-argillite rocks - 1.78-2.29 g/cm3 (dry), 2.68-2.98 g/cm3 (wet), porosity is 6.15-30% and velocisty changes in 1800-2200 m/sec. Thus, at depths, we are witnessing differences in the reservoir properties of rocks and these values are sharply changes with each other [5-7].

Conclusion

On the basis of petrophysical studies carried out in the direction of the South Caspian, Kura basin and Caspian-Guba oil and gas region, a comparative analysis of deep reservoir rocks was given. The research was generally obtained in different oil and gas regions. For this purpose, the samples were separated according to their granulometric composition, and porosity and permeability variation depending on the depth was clarified for the sedimentary

complex dominated by different sized fractions (clay, siltstone and sand). Analysis of the parameters of density, porosity, permeability, carbonate content, ultrasonic waves propagation velocity and granulometric composition of deep Mesocainazoic sedimentary rocks allows to predict the presence of oil and gas reservoirs at great depths.

In order to determine the oil and gas content in the deep layers of the field, it is especially important to study the petrophysical properties of the reservoirs in terms of the availability of deposits, along with the optimal methods of exploration geophysics.

References

1. Kerimov KM, Rahmanov R R, Xeyrov M B (2001) - Oil and gas contest of South Caspian mega basin Baku 2001: 317.
2. Kocharli ShS (2015) Problems of oil and gas geology of Azerbaijan. Baku-2015:278.
3. NB Dortman-MNedra (1976) Physical structure of layers and effective deposits by supervision of 1976: 527.
4. Creating the catalog of the collector characteristics of Mezo-Cenozoic deposits of oil and perspective oil-gas structures of Azerbaijan - Report of scientific-prospective institute of Geophysics 105-2009. Fond of administration of Geophysics and Geology. Baku 2010.
5. Gurbanov VSh (2015) Sultanov LAO nefteqazonosnosti mezozoiskikh otlozhenii Azerbaidzhana [On oil-and-gas content of Mesozoic deposits in Azerbaijan]. Vestnik Permskoqo nacionalnoqo issledovatelskoqo politekhnicheskoqo universiteta. Geologiya. Nefteqazovoe i qornoe delo 16 :7-13.
6. Qurbanov VS, Sultanov LA, Abbasova QQ (2014) “Lithological -petrophisical and collector contents of Mesozoic deposits of Precaspian-Quba oily and gas zone. Geophysics news of Azerbaijan. N3 10-13.
7. Gadirov VG (2001) Magmatic volcanism of the middle Kura depression of Azerbaijan and its role in the accumulation of hydrocarbons. International Scientific Institute "Education" III 10: 64-69.