ANAS Transactions Earth Sciences 1 / 2026

http://www.journalesgia.com

UPDATED HYDROCARBON RESOURCE ASSESSMENT OF THE MIDDLE KUR DEPRESSION, AZERBAIJAN

Tagiyev M.F.[1]*, Khuduzade A.I.[2], Akhundov Sh.Kh.[1], Akhundova Kh.R.[1]

[1]SOCAR, "OilGasScientificResearchProject" Institute, Azerbaijan

88a, H. Zardabi, Baku, AZ1122

[2]SOCAR, PU "AzNeft", Azerbaijan

73, Neftchiler, AZ1000, Baku

**Corresponding author: mushfiq.taghiyev@socar.az*

Keywords: *the Middle Kur Depression, oil and gas presence, prospective resources of hydrocarbons, C3 category of resources*

Summary. By the present time, the Middle Kur Depression territory has been subjected to dense and wide-ranging field geophysical, mainly seismic, investigations, resulting in a considerable clarification of the deep structure of the basin's sedimentary cover. Seismic sounding has made it possible to identify and delineate numerous structural highs, the areas of which vary from several to the first tens of square kilometers. While the existence of many previously recognised structures has been confirmed, a number of them were found to be considerably smaller in area compared with the results of earlier structural interpretations. In some cases, positive elements earlier interpreted as closed structures were found to be structural noses or were not confirmed. The areal characteristics of the identified structures together with the volumetric parameters such as thickness of the prospective reservoirs, their fluid storage capacity and predicted phase state of hydrocarbon accumulations allowed for calculation of prospective C3 resources. A forecast of the prospective oil and gas resources of the Paleogene and Cretaceous deposits in the Middle Kur Depression, which have proven industrial hydrocarbon potential, is presented. Estimates of C3 resources were presented for a number of prospective structures in the oil and gas bearing regions of Kur-Iori interfluve, Ganja and Muradkhanly, covering a total of 57 structures. The distribution of prospective resources across depth intervals reveals a clear distinction between the studied regions. The highest volumes of hydrocarbon resources are associated with depths of 3–4 km, while stratigraphically the largest resources are concentrated in the Eocene complex.

INTRODUCTION

The Kur intermountain depression occupies the easternmost and deepest part of the South Caucasus microplate. The depression is subdivided into the Middle Kur and Lower Kur segments within Azerbaijan (Huseynov, Shirinov, 1985).

The Middle Kur Depression is situated between the anticlinoria of the Greater and the Lesser Caucasus within the Kura intermountain depression, which represents a large synclinorium. It is bounded to the northwest by the Martkobi transverse structural saddle, to the southeast by the Araks deep fault, to the northeast by the Saatly–Mingachevir zone of buried uplifts, and to the southwest by the Fore-Lesser Caucasus deep fault (Khain, Alizadeh, 2005; Mamedov, 1977).

Deep seismic sounding data indicate that the surface of the pre-Alpine basement occurs at depths ranging from 2 to 16 km. Longitudinal and transverse deep faults define the configuration of major tectonic elements and influence the formation of both the basement surface, which is block-faulted and stepwise deepens toward the Caspian Sea, and the structure of the sedimentary cover (Nemčok et al., 2011).

Two major first-order tectonic troughs are distinguished within the Middle Kur Depression: the Iori–Ajinohur trough in the northwest and the Yevlakh–Aghjabedi trough in the southeast. These troughs are arranged in an en echelon pattern, articulate with one another, and represent separate petroliferous provinces. Within the territory of Azerbaijan, the Iori–Ajinohur trough includes the second-order Ajinohur, Alazani–Agrichay, and Jeyranchol troughs. The Yevlakh–Aghjabedi trough is represented by the Fore-Lesser Caucasus marginal monocline and the Goranboy–Muradkhanly second-order trough.

The pre-Jurassic basement undergoes stepwise subsidence from the margins toward the axial zone of

the depression, as well as along its strike from west to east, except within the Kurdamir–Saatly saddle.

Two structural complexes are distinguished within the Alpine sedimentary cover of the depression. The lower complex is represented by Mesozoic–Eocene carbonate–volcanogenic formations corresponding to the geosynclinal stage of development. These are overlain by an Oligocene–Anthropogene complex composed of orogenic molasse, which is subdivided into two subunits: the Lower Oligocene–Miocene (Maykop Fm.) subunit and the Upper Middle-Upper Miocene–Quaternary subunit.

The Mesozoic–Eocene complex is composed of a flysch formation and is characterised by gentle, stepwise bedding complicated by both small local uplifts and structural protrusions, as well as by longitudinal and transverse disjunctive faults.

The upper structural level formed as a result of oscillatory movements of varying intensity across different parts of the region is characterised by a gradual upward attenuation of folding within the stratigraphic section, where both horizontal and vertical structural zonation are observed.

GEOCHEMICAL REVIEW

According to Feyzullayev, Huseynov and Lerche (2016), most oils in the Middle Kur Basin originated from organic matter deposited in a saline lacustrine environment with a contribution of terrestrial material. Integration of biomarker evidence, Rock-Eval pyrolysis data, and paleo- and current thermal conditions indicates that the oils of the Middle Kur Basin were derived primarily from the middle-mature Tertiary source rocks with a possible contribution from the Cretaceous sediments.

Based on geochemical indicators, a source rock–oil correlation was established between the Upper Eocene–Maykop core samples and oils recovered from reservoirs ranging in age from Cretaceous to Lower Miocene (Klosterman et al., 1997). Although the investigated oils differ in density, bulk and hydrocarbon composition, and extent of biodegradation, the authors underscore their genetic unity within a single oil family. The petroleum fluids are interpreted to have been generated within Tertiary lithofacies complexes formed under essentially identical depositional environments.

In the Mesozoic-Cenozoic sediments of the Middle Kur Depression type II and III organic matter are dominant (Akhundov et al., 2021; Kocharli et al., 2019; Feyzullayev, 2025).

Seventeen core samples collected from wells drilled on structural highs were studied for organic maturity (13 of Eocene, 2 of Oligocene-Lower Miocene and 2 of Lower Cretaceous age). They spanned depth interval from 2000 to 4700 m. Based on %Ro measurements and pyrolysis parameters, the Middle and the Upper Eocene strata of the Yevlakh–Aghjabedi Depression remained thermally immature, as burial temperatures were insufficient to promote effective organic matter transformation (Akhundov et al., 2021). The depocentral parts of the depression are likely to have experienced a more advanced level of source rock catagenesis compared to the marginal areas.

OIL AND GAS PRESENCE

The study area is characterised by the widespread occurrence of oil, gas, and water shows of differing nature and intensity across a wide stratigraphic interval.

Reservoirs and seals of the Upper Cretaceous and the Eocene deposits of the Middle Kur Depression are characterised by diversity in composition and genesis, which causes sharp variations in well productivity in individual areas (Akhundov et al., 2022).

In the previously published work, we provided a brief description of the hydrocarbon accumulations identified in the Middle Kur Depression. In addition, highly prospective, prospective, and low-prospective zones were identified within the depression for further exploration and prospecting activities (Khuduzade et al., 2025).

Zones of extended longitudinal faults crossing possible hydrocarbon migration pathways indicate the presence of favorable structural-tectonic conditions for oil and gas accumulation in this area. The generalisation of factual data showed that the distribution of oil and gas accumulations is associated with faults that either divide structures into blocks and partially seal the discovered reservoirs, or act as lithological-fault or fault-stratigraphic seals.

The stratigraphic units of proven industrial hydrocarbon potential include the Upper Cretaceous volcanogenic and, to some extent, volcanogenic–carbonate deposits, the Eocene volcanogenic–sedimentary rocks, the Maykop sedimentary formations, as well as the Chokrak horizon (Alizadeh, 2008; Khuduzade et al., 2023).

Commercial oil deposits in the Upper Cretaceous volcanogenic formations have been discovered on the northeastern flank of the Yevlakh–Aghjabedi trough, in the Muradkhanly and Zardab areas (Guliyev, Guliyeva, 2012).

The Upper Cretaceous carbonate rocks are widely distributed but commercial oil accumulations have not been identified. In the Muradkhanly area, a local accumulation is noted within the carbonates, while in the Sovetler area, a flow of formation water with gas and oil has been encountered. On the Gazanbulag structural high, oil was encountered during testing of several wells. In the Terter area, strong oil–gas shows were observed culminating in a flow-

ing oil well. Minor oil inflows were noted only in the Dalimammadli, Naftalan, Gulluja, and Beylagan areas, and signs of hydrocarbon presence were identified in core samples from the Tarsdaller area.

The hydrocarbon potential of the Paleogene deposits has been established throughout the stratigraphic section in all oil and gas bearing regions of the Middle Kur Depression. Oil inflows and oil-gas shows have been recorded in individual wells, and signs of hydrocarbon presence from discrete intervals have been observed in the most of areas. Small oil accumulations have been identified as follows: in the Paleocene–Lower Eocene deposits, in the Gazanbulag, Naftalan, Dalimammadli, Duzdag–Godakboz, Ajidere, Sariyaldag, Aghjabedi, and Borsunlu–Kurekchay areas; in the Middle Eocene deposits, in the Dalimammadli, Gazanbulag, Naftalan, Borsunlu–Kurekchay, Terter, Duzdag–Godakboz, Muradkhanly, Zardab, Jafarli, Amirarkh, Tarsdaller, Gurzundag, and Damirtepe–Udabno areas; and in the Upper Eocene deposits, in the Dalimammadli, Gazanbulag, Godakboz and Zardab areas.

The Maykop deposits are the most extensively developed and studied. In the Ganja oil and gas bearing region, oil reserves were discovered in the Maykop deposits in the Naftalan, Gazanbulag, Ajidere, Terter, and Dalimammadli areas; oil inflows in individual wells were recorded in the Borsunlu, Aghjabedi, Beylagan, Shirvanly, and Gulluja areas; and signs of hydrocarbon presence were identified in the Sariyaldag, Aliushaghi and Bozyeri areas. The oil fields at Gazanbulag, Ajidere, Naftalan and Terter were in production until 1979.

In the Muradkhanly oil and gas bearing region, oil reserves have been established in the Muradkhanly and Zardab areas, while intense oil-gas shows in the Maykop formation were recorded in the Mil and Amirarkh areas.

The low level of data on the hydrocarbon presence of Maykop deposits in the oil and gas bearing region of the Kur-Iori interfluve is due to the fact that intervals where oil-gas shows were recorded during drilling were not tested.

Figure 1 presents a schematic map showing the distribution of oil fields and prospective structures within the Middle Kur Depression. Based on seismic data and the geological-geophysical characteristics of the structures, an assessment of prospective C3-category resources was carried out for these areas. A necessary condition was the presence of closed traps within structural highs. Figure 2 shows examples of structural maps for several areas of the Middle Kur Depression.

The concept of "oil and combustible gas resources" covers estimates of groups of identified and unidentified hydrocarbon accumulations that vary in their level of study and reliability. It covers a wide range of values from accumulated production, detailed explored (cat. A, B, C1) and preliminary estimated (cat. C2) reserves to prospective (cat. C3) and predicted resources (cat.D1 and D2) of liquid and gaseous hydrocarbons (Methodological guidelines…, 1983).

Forecast estimates of resources are necessary for planning the development of the oil industry in the long term, as well as for identification of priorities in exploration work.

The term “total resources” combines two groups that differ sharply from each other. The identified reserves of already discovered, explored and involved in development deposits are included in the first of them. Unidentified, not yet discovered resources, only assumed, predicted on the basis of geological and geophysical data and established ideas about the geological structure and oil and gas potential of the assessed regions are included in the second group. The establishment of commercial oil and gas potential (i.e. the discovery of a field) is the main boundary separating groups of identified and unidentified resources of a zone, region or area of oil and gas accumulation. In the traditional classification of reserves (accepted in the former USSR and still used today), such a boundary is drawn within categories C.

Preliminary estimated reserves of category C2 in already discovered fields, deposits and horizons exposed by drilling are separated from less reliable prospective resources of new horizons (category C3). The oil and gas potential of the latter has not yet been established by drilling in the fields of this oil and gas-bearing region.

Traps (objects) in these potentially oil-containing horizons should be prepared for exploratory drilling and outlined on the basis of study by geological and geophysical methods tested in this area. Based on this, estimates of prospective resources (cat. C3) should be classified as a group of undetected hydrocarbon volumes (Methodological guidelines, 1983).

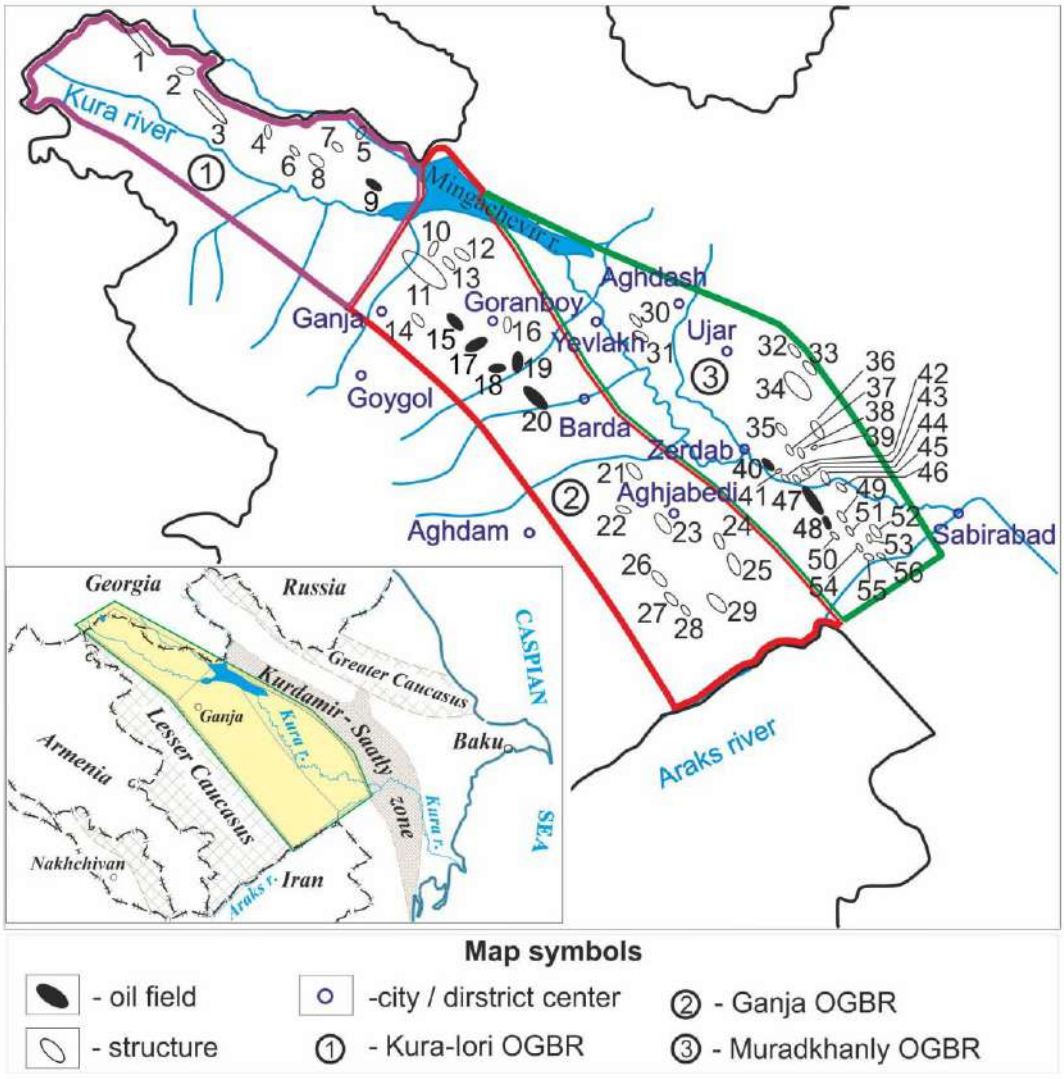
According to the degree of reliability hydrocarbon resources of sedimentary basins are divided into three categories: C3, D1 and D2.

The quantitative assessment of predicted resources (D1, D2) is based on the analysis of geological criteria for the oil and gas potential of known areas and territories, and the application of specified reference characteristics to unknown objects. These objects may be located within known areas or in adjacent regions that have similar geological characteristics for the formation and accumulation of oil and gas.

The division between the D1 and D1 categories is somewhat speculative. Category D1 may include lithostratigraphic objects which oil and gas potential in the given large territory has not yet been proven, but their hydrocarbon productivity has been established in

the adjacent territories with comparable geological characteristics. Category D2 is related to resources of promising but poorly studied territories and lithological-stratigraphic complexes. Therefore, it is not possible to speak about the reliability or good justification of the quantitative estimates of categories D1 and D2.

Different approaches and reference parameters may be used when quantitatively assessing the oil and gas potential of individual regions. As a result, the predicted resources can demonstrate significant fluctuations (Khuduzade et al., 2020).



Kura-lori OGBR

1 - Damirtepe-Udabno
2 - Sazhdag
3 - Molladag
4 - Aghtepe
5 - Eldaroyughu
6 - Garbi Gurzundag
7 - Kollug
8 - Gurzundag
9 - Tarsdaller

Ganja OGBR

10 - Soyugkhanly
11 - Dalimammadli
12 - Bozyeri
13 - Fakhrali
14 - Ziyadkhan
15 - Gazanbulag
16 - Godakboz
17 - Ajidere
18 - Sariyaldag
19 - Naftalan
20 - Terter
21 - Lemberan
22 - Hindarkh
23 - Aghjabedi
24 - Aghgol
25 - Janubi Aghjabedi
26 - Kebirli
27 - Gemerli
28 - Chebri
29 - Beylagan

Muradkhanly OGBR

30 - Mursel
31 - Garbi Amirarkh
32 - Mususlu
33 - Garabujag
34 - Garajaly
35 - Garghaly
36 - Garabat
37 - Beyimli
38 - Gishlag
39 - Shargi Gishlag
40 - Zardab
41 - Garavelli
42 - Shikhbaghi
43 - Soyudler
44 - Shargi Shikhbaghi
45 - Shahsunnu
46 - Mammadli
47 - Muradkhanly
48 - Jafarli
49 - Hasanli
50 - Aghamammadli
51 - Garaly
52 - Mil
53 - Hajigasimly
54 - Javadkhanly
55 - Shargi Garagashly
56 - Garagashly

Fig. 1. The Middle Kur depression. Location map of structures with estimated C3 category of prospective oil and gas resources

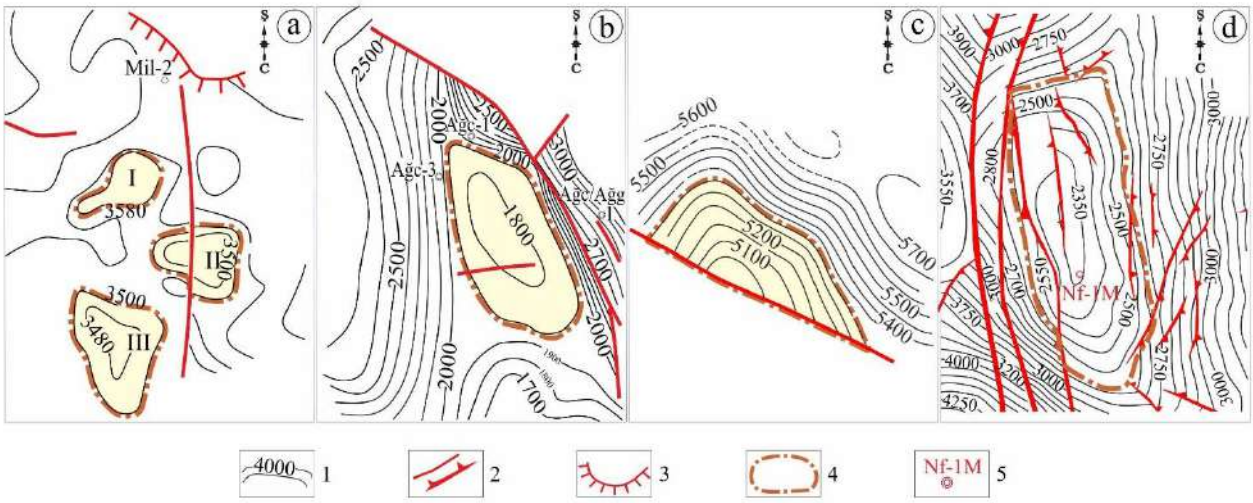


Fig. 2. Structural maps with reserve calculation contours indicating potential hydrocarbon saturation of reservoirs in individual areas of the Middle Kur Depression

Map Legend: 1 - isolines, and 2 - faults interpreted from seismic and well data; 3 - the Eocene pinch-out boundary; 4 - interpreted hydrocarbon saturation contours; 5 - proposed exploratory well location

fig. ⓐ - Structural uplifts (SH-III - on the eroded surface of Middle Eocene): - I-Hajigasimly; II-Shargi Garagashly; III-Garagashly; fig. ⓑ - Aghjabedi uplift (SH-III - on the eroded surface of the Middle Eocene); fig. ⓒ - Eldaroyughu uplift (on the Middle Eocene top); fig. ⓓ - Naftalan field (SH-V - seismic horizon in the uppermost Upper Cretaceous)

There are two deep depressions within Azerbaijan: the South Caspian and Yevlakh-Aghjabedi, which are separated by the Talysh-Vandam zone of positive gravity anomaly. This zone is associated with buried volcanogenic formations, mainly of the Mesozoic age. In the literature, it is also referred to as the "Kurdamir-Saatly Zone" (see Figure 1) and is associated with buried volcanogenic complexes, mainly of the Mesozoic age.

To appropriately assess the oil and gas potential of vast areas of the Middle Kur Depression, it is necessary to conduct more detailed geological, geochemical and geophysical studies both in terms of area and depth of the sedimentary basin. Despite the long history of geological exploration and drilling operations, our knowledge of the structure and cross-section of deep-lying horizons in many areas is insufficient to substantiate the prospects for their oil and gas potential.

Onshore of Azerbaijan given the relatively high level of exploration coverage of the upper level of oil and gas presence, reorientation of exploration work to deep-lying horizons, especially to the lower level of oil and gas presence (to Mesozoic deposits), to buried structures and non-anticline traps is an extremely urgent task (Kerimov et al., 2015).

EVALUATION OF FORECAST AND PROSPECTIVE RESOURCES

The quantitative estimates of predicted and prospective oil and gas resources in the Middle Kur Depression presented in previous studies mainly cover the stratigraphic interval from the Cretaceous to the Pliocene deposits. It is difficult to estimate the hydrocarbon potential of sedimentary facies of the Jurassic deposits due to the lack or limited data on the composition of solid and fluid components of these layers. It is known that in the Gusar-Devechi region and the southeastern subsidence zone of the Greater Caucasus (Khizi Synclinorium, Tengi-Beshbarmag Anticlinorium) these deposits are significantly thick and contain layers enriched in organic matter (OM). The Jurassic strata are considered prospective for the discovery of oil and gas deposits (Alizadeh, 2008).

A number of published works provide quantitative estimates of oil and gas regions of Azerbaijan differing both in geographical coverage and in stratigraphic detail. Naturally, these estimates are difficult to compare making the overall quantitative picture hard to interpret.

The results of quantitative assessment of hydrocarbon resources at a given geographical scale and stratigraphic limits are known from publications by various authors. Thus, according to Kerimov et al., (1999) the initial total hydrocarbon resources amount to 91 billion tons of geological and 34 billion tons of recoverable volumes (hereinafter in brackets, recoverable resources) in the sedimentary strata of the Kur-South Caspian Mega Depression. Under the term "The Kur-South Caspian Mega Depression" the authors unite the vast territory of the South Caspian, including the West Turkmen Depression in the east, the Azerbaijani marine area in the west, the Iranian sector in the south, as well as the Lower, Middle and Upper Kur basins, and even the

southern part of the Terek-Caspian Depression. The predicted resources of the Pliocene 18 (7.4), Paleogene-Miocene 7.0 (1.9) and Mesozoic 16.0 (6.2) complexes amount to a total of 41 (15.5) billion tons.

According to Guliyev I.S. et al. (2003), a schematic description of the predicted resources is presented in the form of color-coded zones within the Caspian basin and adjacent land. The main focus here lies in two schematic maps illustrating the distribution of potential hydrocarbon resources in the Oligocene-Miocene and Cretaceous-Eocene deposits. In the first map, within the Middle Kur Depression, the density of potential hydrocarbon resources is represented by a color scale of 20–50–75–100 thousand tons/km² of oil equivalent (toe) with the majority of the area coded as "20 thousand tons/km²". In the second scheme (the Cretaceous-Eocene), the coloring reflects the coding range of "5-100 thousand tons", where the overwhelming area is occupied by two color codes of 25 and 50 thousand tons/km^2.

Without detailing the data for individual regions of Azerbaijan, in total, potential hydrocarbon resources of the Oligocene-Miocene are represented by 3.54 billion toe (based on an area of 98.1 thousand km^2). Similar tabular data are also presented for the Cretaceous-Eocene. In total, potential hydrocarbon resources for this interval are represented by 2.15 billion toe (74.5 thousand km^2). The assessment of potential hydrocarbon resources for the Jurassic complex in Azerbaijan is characterised by a moderate value of 0.41 billion toe (38.1 thousand km^2). It should be noted that the authors' calculations for the Cretaceous-Eocene and Jurassic are limited to the upper part of the sedimentary cover, i.e., deposits lying no deeper than 7 km.

According to Aliyev H-M.A. and co-authors (2007) estimates are given the initial total geological hydrocarbon resources (in conventional units or in oil equivalent) for the Mesozoic, which in total amount to 1.25 billion toe. According to the geological fund materials we used to clarify this value, it represents estimates of reserves and resources in the onshore regions of Azerbaijan. In particular, the Muradkhanly, Ganja, Kur-Iori interfluve OGBRs and the Ajinohur prospective region located within the area of our study combined account for one third of the initial total resources (ITR) of the onshore Azerbaijan. As can be seen from Table 1, the ITR values are essentially formed from the predicted D1+D2 hydrocarbon categories.

So far, the Middle Kur Depression has undergone extensive and relatively high-density field geophysical surveys. The deep structure of the depression's sedimentary cover has been clarified to a significant extent due to seismic surveys carried out over the past decades. By means of seismic sounding using the common depth point method, numerous structural uplifts were identified and delineated with areas ranging from a few to several tens of square kilometers. Thus, the existence of many previously identified structures was confirmed, although some were found to be considerably smaller in area than earlier structural interpretations had suggested. In a number of cases, positive features formerly regarded as closed proved to be structural noses or lacked confirmation entirely.

The areal characteristics of the identified structures with such calculation parameters as thickness of the expected reservoirs, their fluid storage capacity properties made it possible to calculate the prospective resources of the C3 category taking into account the predicted phase state of hydrocarbon accumulations.

Table 2 summarises the main calculation parameters compiled from the analysis of reference areas, which are essentially known fields. The values of prospective hydrocarbon resources of category C3 are calculated on the basis of parameters, which include the area of the structure along the deepest closed contours, effective hydrocarbon-saturated thickness, open porosity, oil saturation, oil density and gas factor. The calculation formula also includes a correction for oil shrinkage. It is necessary to immediately make a reservation regarding open porosity. Along with pore space, it also reflects fracturing, a petrophysical parameter that has a significant impact on the filtration and capacity characteristics of rocks.

Table 1

Initial total hydrocarbon resources of the Mesozoic complex by OGBRs*
with indication of predicted resources D1+D2

On Mesozoic strata	Oil and gas bearing region			
	Muradkhanly	Ganja	The Kur-Iori interfluve	Ajinohur prospective region
ITR**	215	128	52	20
D1+D2	187	120	45	20

** OGBR – oil and gas bearing region*
*** ITR – initial total resources*

Table 2

Reference parameters used for the estimation of C3 category of oil and dissolved gas resources

OGBR	Reference area	Reference stratigraphic position	Net thickness (m)	Effective porosity (%)	Oil saturation (%)	Oil density (g/cm³)	Gas-oil ratio (GOR) (m^3/t)	Structural area (min–max); km^2
Kur-Iori	Tarsdaller	Middle Eocene	17.0	13.0	80.0	0.870	109.0	2.5-34.0
Kur-Iori	Muradkhanly	Upper Cretaceous	10.2	14.3	54.2	0.877	31.2	0.7-8.1
Ganja	Tarsdaller	Middle Eocene	17.0	13	80.0	0.870	109.0	2.2-12.5
Ganja	Muradkhanly	Middle Eocene	9.4	12	55.6	0.882	31.4	1.0-41.1
Ganja	Muradkhanly	Upper Cretaceous	10.2	14.3	54.2	0.877	31.2	5.5-15.0
Muradkhanly	Zardab-Shikhbaghi	Maykop formation	5.2	18	60	0.873	10	6.8
Muradkhanly	Jafarli	Middle Eocene	20.0	9.8	57.4	0.872	24	1.0-6.5
Muradkhanly	Muradkhanly	Middle Eocene	9.4	12	55.6	0.882	31.4	2.1-4.3
Muradkhanly	Muradkhanly	Upper Cretaceous	10.2	14.3	54.2	0.877	31.2	0.3-30.3

Resource estimates of category C3 were presented for a number of promising structures of the Middle Kur Depression. Thus, of this amount, the share of the Kur-Iori Interfluve OGR accounted for 8 structures. For the Ganja OGBR, 16 structures were covered by estimates, and 33 structures were quantitatively characterised for the Muradkhanly OGBR.

Table 3 shows the distribution of prospective resources by stratigraphic complexes. In this table, the data are divided between three oil and gas complexes: The Mesozoic, Eocene, and the Oligocene-Lower Miocene Maykop Fm. According to the presented estimates, the sedimentary section of the Muradkhanly oil and gas bearing region is characterised by the largest hydrocarbon resources of the C2 category (111/26 million tons). In individual consideration, the Eocene complex within the Ganja OGBR contains the largest volume of hydrocarbons (68/12 million tons) compared to all other elements of the table.

Table 3

Distribution of C3 category of prospective resources by stratigraphic complexes

HC resources C3 ► / **OGBR ▼**	**oil (thou.t)**	**dissolved gas (mln m³)**	**stratigraphic complex**					
	geological	geological	**Mesozoic**		**Eocene**		**Maykop**	
	recoverable	*recoverable*	oil	dissolved gas	oil	dissolved gas	oil	dissolved gas
Kur-Iori	59 937	5 465	13 727	428	46 210	5 037		
	16 883	*1 497*	*4 407*	*137*	*12 477*	*1 360*		
Ganja	84 639	5 383	16 201	505	68 438	4 877		
	17 023	*1 270*	*5 200*	*162*	*11 822*	*1 108*		
Muradkhanly	111 022	3 175	52 455	1 637	55 890	1 512	2 677	27
	26 399	*794*	*16 838*	*525*	*9 160*	*264*	*402*	*4*
Total	**255 598**	**14 023**	**82 383**	**2 570**	**170 538**	**11 426**	**2 677**	**27**
	60 305	***3 561***	***26 445***	***825***	***33 458***	***2 732***	***402***	***4***

Table 4 presents the distribution by depth intervals. Here, a distinct difference in the depth distribution of oil resources between the studied regions is observed. In the Ganja region, the peak of C3 oil resources corresponds to a depth interval of 1-2 km. In the Muradkhanly oil and gas bearing region, it is deeper – in the range of 2-3 km. In the region of Kur and Iori Interfluve, the peak occurs within deeply buried sedimentary layers, at depths exceeding 5 km. This can be explained by the fact that, in the Eldaroyughu area, which hosts the largest C3 resources, the seismogeological surface of the Middle Eocene occurs at depths exceeding 5 km.

Figure 3 presents the distribution of prospective resources by sedimentary cover depth for each OGBR individually as well as for their overall total. According to the obtained estimates, the largest volumes of hydrocarbon resources are concentrated at depths of 3–4 km (see Fig. 3b). Stratigraphically, the greatest volumes of resources are associated with the Eocene complex (see Fig. 3d).

The ratio between prospective (C3) and predicted (D1, D2) resources is of considerable interest (Figure 4). Predicted resource categories are considered the least reliable, due to the fact that they reflect the part of the hydrocarbon potential that is based on very approximate estimations. Nevertheless, the quantitative picture would be incomplete without them.

The hydrocarbon resource estimates presented in this study underscore the need to consider the deeper levels of oil and gas potential in the Middle Kur Depression, especially buried structures and non-anticlinal traps related to the Mesozoic formations. These areas require increased attention to enable the development of more scientifically robust assessments of oil and gas potential.

With advances in equipment and production technology, the development of unconventional hydrocarbon resources in the Middle Kur Depression has come to the forefront. The paleotectonic basis and the geological and geochemical conditions for the exploration of shale oil and shale gas in the Yevlakh–Agjabedi Depression are discussed in the publication by Huseynov et al., 2015.

The authors noted a number of factors that favor the search for shale hydrocarbons in the Maykop deposits of this depression. The subsidence of the Oligocene–Miocene strata in the depocentral area of the depression below 3.5 km promoted catagenetic transformation, a process necessary for hydrocarbon formation within shale formations. The quantity and type of organic matter suggest a capacity for the generation of gaseous hydrocarbons. The presence of alternating clayey layers and impermeable siltstone partings is regarded as advantageous from the standpoint of development potential. Preliminary encouraging results highlight the necessity to continue research aimed at identifying and delineating the most prospective areas for shale hydrocarbons.

Table 4

Distribution of C3 category of prospective resources by depth intervals of the sedimentary cover

HC resources C3 ► / **OGBR ▼**	**oil (thou.t) / k.t**	**dissolved gas (mln m³)**	**depth, km**											
	geological	geological	**0 - 1**		**1 - 2**		**2 - 3**		**3 - 4**		**4 - 5**		**5 +**	
	recoverable	*recoverable*	oil	dissol-ved gas	oil	dissol-ved gas	oil	dissol-ved gas	oil	dissol-ved gas	oil	dissol-ved gas	oil	dissol-ved gas
Kur-Iori	59 937	5 465					4 170	341	9 296	843	9 638	301	36 833	3 981
	16 883	*1 497*					*1 200*	*94*	*2 622*	*231*	*3 094*	*97*	*9 967*	*1 076*
Ganja	84 639	5 383	21 718	2 263	39 766	2 396	14 828	463	4 706	147	3 620	114		
	17 023	*1 270*	*5 595*	*603*	*5 741*	*490*	*4 279*	*134*	*1 155*	*36*	*253*	*8*		
Muradkhanly	111 022	3 175							80 213	2 374	21 246	571	9 563	230
	26 399	*794*							*21 941*	*669*	*3 579*	*103*	*880*	*21*
Total	**255 598**	**14 023**	**21 718**	**2 263**	**39 766**	**2 396**	**18 998**	**804**	**94 215**	**3 364**	**34 503**	**986**	**46 397**	**4 210**
	60 305	***3 561***	***5 595***	***603***	***5 741***	***490***	***5 479***	***228***	***25 717***	***936***	***6 926***	***208***	***10 847***	***1 097***

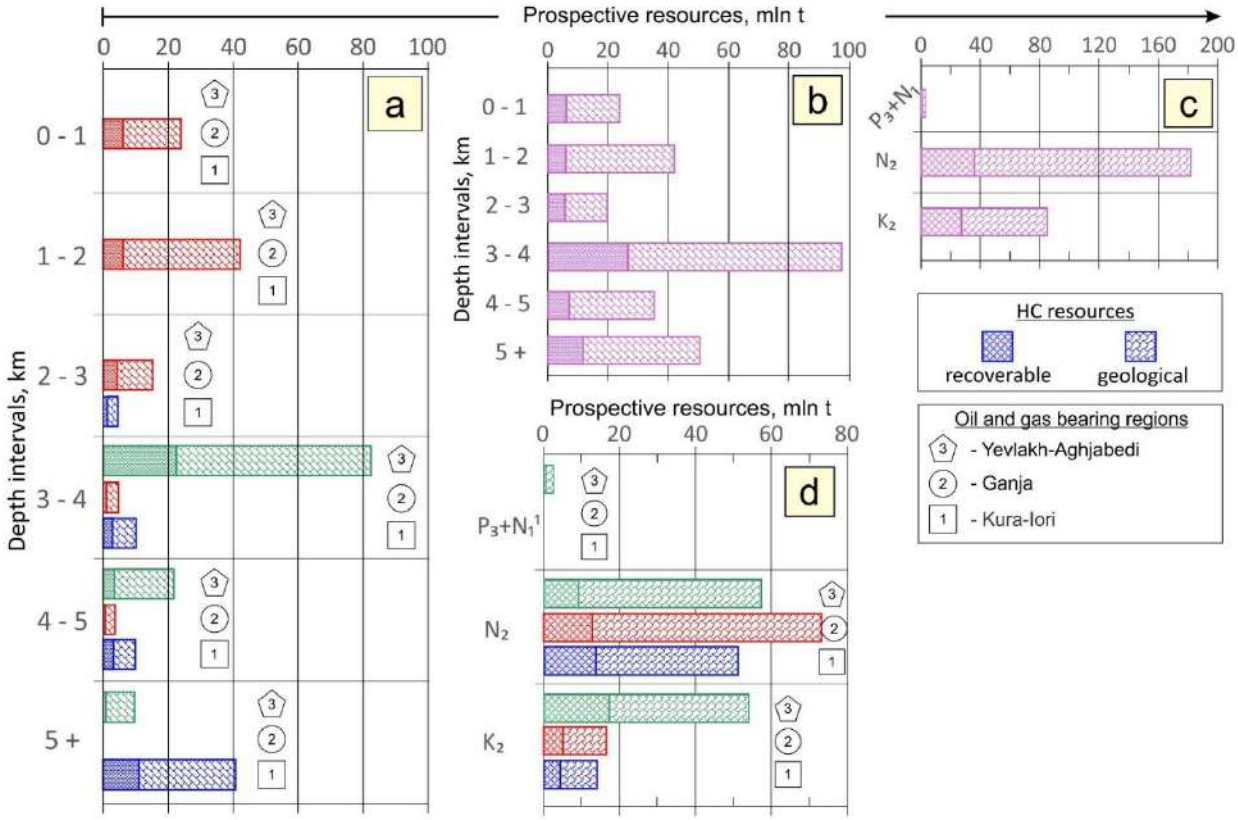


Fig. 3. Distribution of estimated C3 category of prospective resources in OGBRs: (a) by depth intervals; (b) total for the three OGBRs; (c) by stratigraphic units; (d) total for the three OGBRs

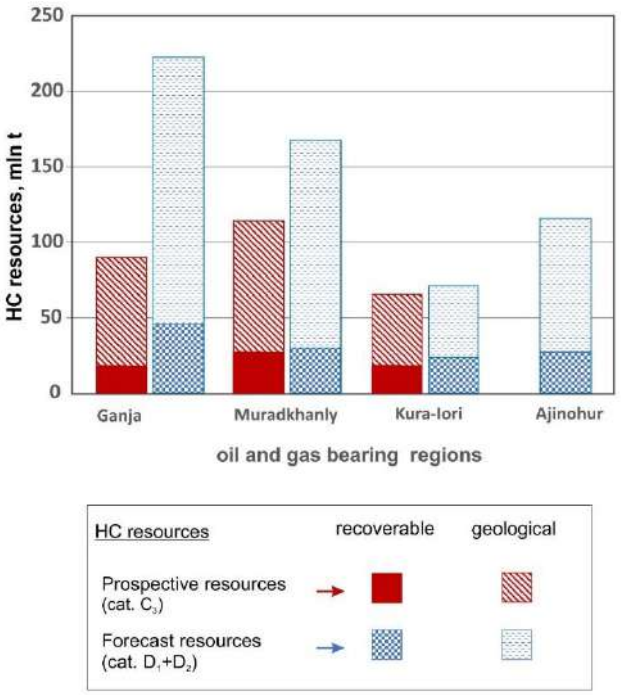


Fig. 4. Distribution of C3 and D1+D2 category of resources in the hydrocarbon-bearing regions of the Middle Kur Depression

The least studied deposits in the Middle Kur Depression are the Lower Cretaceous and Jurassic strata, which, fall outside the scope of this presentation due to the limited geological and geophysical explorations. Insufficient geochemical data to evaluate the hydrocarbon generation potential combined with the unknown extent and distribution of these deposits constitutes an additional constraint on resource assessment.

CONCLUSION

Prospective resource estimates (C3 category) were presented for a total of 57 prospective structures of the Middle Kur Depression.

Prospective resources are distributed between three major petroliferous stratigraphic complexes: the Mesozoic, Eocene and Maykop. The sedimentary strata in the Muradkhanly oil and gas bearing region is estimated to be the largest C3 category hydrocarbon resource container (with 111 / 26 million tons of geological / extractible HCs). When considered separately, the Eocene complex within the Ganja region contains the highest hydrocarbon volumes (68/12 million tons) compared to all other stratigraphic units of the studied regions.

In the distribution of oil resources by depth intervals, a clear difference is revealed between the hydrocarbon bearing regions under consideration. In the Ganja region, the C3 oil resource peak corresponds to a depth interval of 1-2 km. In the Muradkhanly region, it is deeper – in the range of 2-3 km.

In the Kur and Iori interfluve the peak even shifts to deeper sedimentary horizons (below 5 km).

In the distribution of prospective resources by depth of sedimentary pile, the highest volumes are confined to depths of 3-4 km. In the stratigraphic allocation the largest resources fall within the Eocene complex.

The mentioned estimates for hydrocarbon resources emphasise to some extent the need to pay attention to the lower stage of oil and gas presence in the Middle Kur Depression, particularly to the buried structures and non-anticlinal traps associated with the Mesozoic deposits.

REFERENCES

Akhundov ShKh, Khuduzade AI, Tagiyev MF, Mammadov EE (2022) Lithological and stratigraphic characterization of the Upper Cretaceous and Eocene sediments in the Middle Kura Depression, Azerbaijan. Mineral resources of Ukraine 1:17–23. https://doi.org/10.31996/mru.2022.1.17-23 (in Russian)

Akhundov ShKh, Tagiyev MF, Khuduzade AI, Aliyev AN (2021) Hydrocarbon generative properties and maturity of Cretaceous and Eocene sediments in the Middle Kura Depression, Azerbaijan. In: SPE Annual Caspian Technical Conference, Baku, Azerbaijan, Oct.5-7, 2021 (SPE-207041-MS)

Ali-zadeh AkA (ed) (2008) Geology of Azerbaijan. vol VII: Oil and gas. Nafta-Press, Baku, p 672 (in Russian)

Aliyev H-MA, Yusifov KhM, Suleymanov AM, Mustafayeva TM (2007) Geological justification of predicted hydrocarbon resources of Mesozoic deposits in onshore Azerbaijan. SOCAR, Institute of Scientific Research, Scientific Proceedings 08:3–10 (in Azerbaijani)

Feyzullayev AA (2025) Hydrocarbon systems of sedimentary basins: Theoretical foundations and scientific and practical aspects. Nafta-Press, Baku, p 448 (in Russian)

Feyzullayev AA, Huseynov DA, Lerche I (2016) Oil geochemistry of the Middle Kura Basin, Azerbaijan. Journal of Scientific and Engineering Research 3(6): 479–487

Guliyev IS, Levin LE, Fedorov DL (2003) Hydrocarbon potential of the Caspian region (systematic analysis). Nafta-Press, Baku, p 127 (in Russian)

Guliyev KG, Guliyeva BA (2012) Perspective of study on Oligocene-Miocene deposits of oil and gas fields. Azerbaijan oil industry 6:7–12 (in Russian)

Huseynov AN, Shirinov FA (1985) Petroleum geological zoning of the Azerbaijan SSR. Map scale 1:500,000 (Scientific editor: Mamedov AV) (in Russian)

Kerimov KM, Haciyev FM, Hasanov IS (1999) Hydrocarbon resources of the Kura-South Caspian megadepression. Azerbaijan oil industry 7:1–11 (in Russian)

Kerimov VYu, Guliyev IS, Huseynov DA et al (2015) Prediction of petroleum potential in regions with complex geological structure. Nedra, Moscow, p 404 (in Russian)

Khain VYe, Ali-zadeh AkA (eds) (2005) Geology of Azerbaijan, vol IV Tectonics. Nafta-Press. Baku, p 506 (in Russian)

Khuduzade A, Akhundov Sh et al (2025) Oil and gas prospects of the Middle Kura Basin. Azerbaijan geologist 28:75–87

Khuduzade AI, Akhundov ShKh, Tagiyev MF, Guliyev II (2023) Modeling of the tectonic setting and prediction of trap types in the petroleum-bearing area of the Kura-Iori Interfluve (Western Azerbaijan). In: Proceedings of the scientific-practical conference "Heydar Aliyev and the oil strategy of Azerbaijan: Achievements in petroleum geology and geotechnologies". May 23-26, Baku, p 92–97 (in Russian)

Khuduzade AI, Tagiyev MF, Askerov IN (2020) Estimation of undiscovered hydrocarbon resources: traditional methods and up-to-date development tendencies. Azerbaijan oil industry, 1:11–18 (in Azerbaijani)

Klosterman MJ, Abrams MA, Aleskerov EA et al (1997) Hydrocarbon system of the Evlakh-Agdzhabedi Depression. Azerbaijan geologist 1:90-120

Kocharli ShS, Ismayilova GG, Feyzullayev AA (2019) Prognosis evaluation of oil-gas bearing content in Ajinohur region of Azerbaijan based on geological-geochemical data. Azerbaijan oil industry 3:4–10 (in Russian)

Mamedov AV (1977) Geological evolution and paleogeography of the Middle Kura Depression and their relationship to hydrocarbon potential. Elm, Baku, p 212 (in Russian)

Methodological guidelines for the quantitative assessment of prospective oil, gas, and condensate resources (1983) All-Russian Scientific Research Geological Oil Institute (VNIGNI), Moscow, p 215 (in Russian)

Nemčok M, Feyzullayev AA, Kadirov FA et al (2011) Neotectonics of the Caucasus and Kura valley, Azerbaijan. Global Engineers and Technologists Review 1:1–14

ОЦЕНКА РЕСУРСОВ УГЛЕВОДОРОДОВ СРЕДНЕКУРИНСКОЙ ВПАДИНЫ НА ОСНОВЕ НОВЫХ ГЕОЛОГО-ГЕОХИМИЧЕСКИХ ДАННЫХ

Тагиев М.Ф.[1]*, Худузаде А.И.[2], Ахундов Ш.Х.[1], Ахундова Х.Р.[1]
[1]НИПИ «Нефтегаз» SOCAR, Азербайджан
AZ1122, Баку, просп. Г.Зардаби, 88а
[2] ПО «АзНефть» SOCAR, Азербайджан
AZ1000, Баку, просп. Нефтчиляр, 73
**Автор, отвечающий за переписку: mushfiq.taghiyev@socar.az*

Резюме. На сегодняшний день глубинное строение осадочной толщи Среднекуринской впадины в значительной степени детализировано сейсмическими исследованиями. Путем сейсмического зондирования выявлены и оконтурены многочисленные структурные поднятия, площади которых варьируют в пределах от нескольких до первых десятков квадратных километров. Хотя существование многих ранее выявленных структур подтверждено, при этом некоторые из них оказались значительно скромнее по площади, чем было представлено в результате предыдущих структурных интерпретаций. В ряде случаев считавшиеся ранее замкнутыми положительные элементы оказались структурными выступами или вовсе не нашли своего подтверждения. Площадные характеристики выявленных структур вкупе с такими подсчетными параметрами, как мощности предполагаемых резервуаров, их емкостные свойства и с учетом фазового состояния углеводородов в известных скоплениях легли в основу расчетов ресурсов. Таким образом, представилась возможность оценки перспективных ресурсов категории С3 в потенциально нефтесодержащих горизонтах структурных поднятий, не охваченных бурением. В данной работе представлен прогноз перспективных ресурсов нефти и газа палеогеновых и меловых отложений Среднекуринской впадины, имеющих доказанную промышленную нефтегазоносность. Оценки ресурсов категории С3 были представлены по ряду перспективных структур Гянджинского и Мурадханлинского нефтегазоносных районов и междуречья Куры и Иори. В общей сложности оценками были охвачены 57 структур. В распределении перспективных ресурсов по глубинным интервалам выявляется четкое различие между рассматриваемыми районами. Наиболее высокие объемы углеводородных ресурсов приурочены к глубинам 3-4 км, тогда как в стратиграфическом распределении наибольшие ресурсы приходятся на долю эоценового комплекса.

Ключевые слова: *Среднекуринская впадина, нефтегазоносность, перспективные ресурсы нефти и газа, категория С3*

YENI GEOLOJI-GEOKİMYƏVİ MƏLUMATLAR ƏSASINDA ORTA KÜR ÇÖKƏKLİYİNİN KARBOHİDROGEN RESURSLARININ QİYMƏTLƏNDİRİLMƏSİ

Tağıyev M.F.[1]*, Xuduzadə Ə.İ.[2], Axundov Ş.X.[1], Axundova X.R.[1]
[1] SOCAR, "Neftqazelmitədqiqatlayihə" İnstitutu, Azərbaycan
AZ1122, Bakı, H.Zərdabi küç., 88a
[2] SOCAR, "AzNeft" İB, Azərbaycan
AZ1000, Bakı, Neftçilər prosp., 73
**Yazışmalara məsul: mushfiq.taghiyev@socar.az*

Xülasə. Bu günə qədər Orta Kür çökəkliyinin çöküntü qatının dərinlik quruluşu seysmik tədqiqatlar vasitəsilə əhəmiyyətli dərəcədə dəqiqləşdirilmişdir. Seysmik zondlama vasitəsilə çoxsaylı struktur qalxımlar aşkar edilmiş və onların qapanma konturları müəyyən edilmişdir. Bu qalxımların sahəsi bir neçə kvadrat kilometrdən onlarla kvadrat kilometrə qədər dəyişir. Əvvəllər məlum olan strukturların çox hissəsinin mövcudluğu təsdiqlənsə də, onların bir qisminin əvvəlki struktur interpretasiyaların nəticələri ilə müqayisədə əhəmiyyətli dərəcədə kiçik sahəyə malik olduğu müəyyən edilmişdir. Bəzi hallarda əvvəllər qapalı sayılan müsbət struktur elementlər yeni interpretasiyada struktur çıxıntılar kimi şərh edilmiş və ya ümumiyyətlə öz təsdiqini tapmamışdır. Aşkar edilmiş strukturların sahəvi xüsusiyyətləri, ehtimal olunan rezervuarların qalınlığı, onların flüid tutum xassələri və proqnozlaşdırılan yığımların karbohidrogen faza halı nəzərə alınmaqla, C3 kateqoriyalı perspektiv resursların hesablanması həyata keçirilmişdir. Beləliklə, indiyədək qazma ilə əhatə edilməmiş struktur qalxımların perspektiv horizontları üçün C3 kateqoriyalı karbohidrogen resursların qiymətləndirilmə imkanı əldə edilmişdir. Məqalədə Orta Kür çökəkliyində neftqazlılığı təsbit edilmiş Paleogen və Təbaşir çöküntü intervalları üçün perspektiv neft və qaz resurslarının proqnozu təqdim olunur. Kür-Qabırrı çaylararası, Gəncə və Muradxanlı neftli-qazlı rayonlarının bir sıra perspektivli strukturları üçün C3 kateqoriyalı resursların qiymətləndirilməsi ümumilikdə 57 sahəni əhatə etmişdir. Baxılan rayonları müqayisə etdikdə perspektiv resursların müxtəlif dərinlik intervalları üzrə paylanma mənzərəsində aydın fərqlilik aşkar şəkildə görünməkdədir. Neft-qaz resurslarının ən böyük həcmləri 3-4 km dərinliklərə aid olduğu halda, stratiqrafik paylanma baxımından ən böyük resurs miqdarı Eosen kompleksinin payına düşür.

Açar sözlər: *Orta Kür çökəkliyi, neftqazlılıq, neft və qazın perspektiv resursları, C3 kateqoriyası*