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Clarification and comparison of lithofacies properties of complex-structural deposits (on the example of the deposits of Darwin Bank and Pirallahi Island)

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Уточнение и сравнение литофациальных свойств сложноструктурных месторождений (на примере месторождений Банка Дарвина и острова Пираллахи)

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deposit, sandstone, clay, silt, rock, facies, correlation, facies model.

Both fields considered in the study belong to the class of long-term fields that are in the final stage of development. Both fields have a tectonically complex structure. Although they have been in development since the last century, they have significant oil reserves. Therefore, the structural-tectonic structure of fields, lithofacies composition, balance and recoverable reserves, and development parameters are of great importance. Although the fields are separated from each other by conditional faults, they are very diverse from the structural and tectonic point of view. The fields of the Darwin Bank and Pirallahi Island were poorly studied from the lithofacies point of view. That is why the study of lithofacies characteristics is of particular interest. Therefore, the goal was set to determine the lithofacies of these deposits and to compare them for the first time. The facies types of deposits of the Kirmakinskaya suite (KS), Podkirmakinskaya suite (PS), Kalinskaya suite (KaS) were studied, lithofacies characteristics in the areal and vertical directions were determined, three-dimensional models were compiled and compared. As a result, the lithofacies characteristics of both fields were mutually tracked in all directions and changes were detected. It was established that the main cause of lithofacies diversity was different paleogeographic conditions, despite the proximity of fields. Thus, in the Darwin Bank field, the KS, PS, and KaS horizons, respectively, wedged from the arch to the wings. At the Pirallahi field, KaS wedged into the southern part. This wedging out sequence increased the likelihood of non-anticlinal traps forming at these locations and created a trap for hydrocarbon accumulation. The PS formation in the Darwin Bank field was mostly composed of sands, but in the Pirallahi field the lower part of this formation was composed of shale and the upper part was composed of sands. In these two deposits, the physical and geographical conditions during the KS period were different, and different lithofacies were formed. The collected materials, the research work carried out on them and the results obtained were of great importance in the effective exploitation of these fields, in the drilling of new wells and, most importantly, in the search and exploration of new oil-bearing zones.

Ключевые слова:
месторождение, песчаник, глина, алеврит, порода, фация, корреляция, фациальная модель.

Оба рассматриваемых в исследовании месторождения относятся к классу долгосрочных месторождений, находящихся в завершающей стадии разработки. Оба месторождения имеют тектонически сложное строение. Несмотря на то, что они находятся в разработке с прошлого века, они обладают значительными запасами нефти. Поэтому большое значение имеют структурно-тектоническое строение месторождений, литолого-фациальный состав, балансовые и извлекаемые запасы, параметры разработки. Хотя месторождения отделены друг от друга условными разрывами, они очень разнообразны со структурно-тектонической точки зрения. Отложения Дарвинской Банки и острова Пираллахи слабо изучены и исследованы с литофациальной точки зрения. Именно поэтому изучение литофациальных характеристик представляет особый интерес. В связи с этим была поставлена цель – определить литофации этих месторождений и впервые провести их сравнение. Исследованы фациальные типы отложений Кирмакинской свиты (КС), Подкирмакинской свиты (ПК), Калинской свтиы (КаС), определены литофациальные характеристики в площадном и вертикальном направлениях, составлены и сопоставлены трехмерные модели. В результате литофациальные характеристики обоих месторождений взаимно отслеживались по всем направлениям и выявлялись изменения. Установлено, что основной причиной литофациального разнообразия являются разные палеогеографические условия, несмотря на соседство месторождений. Таким образом, в месторождении Дарвиновского банка горизонты КС, ПК и КаС соответственно вклиниваются от сводовой части к крыльям. На месторождении Пираллахи КаС вклинивается в южную часть. Такая последовательность выклинивание увеличивает вероятность образования в этих местах ловушек неантиклинального типа и создает ловушку для скопления углеводородов. Свита ПК на месторождении Дарвин-Бэнк в основном сложена песчаными породами, но на месторождении острова Пираллахи нижняя часть этой формации сложена глинистыми породами, а верхняя часть сложена песчаными пластами. В этих двух месторождениях физико-географические условия в период КС были разными, и формировались разные литофации. Собранные материалы, проведенные по ним исследовательские работы и полученные результаты имеют большое значение в эффективной эксплуатации этих месторождений, в бурении новых скважин и, главное, в поиске и разведке новых нефтеносных зон.

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Introduction

At present, the increased interest in the discovery of previously lost productive horizons in oil and gas fields with a long period of development and in the recovery of residual oil leads to a deeper and more comprehensive study, assessment of the mineralogical composition of rocks and lithofacies properties based on geological, geophysical, hydrogeological, and other data [1, 2].

The deposits of the Darwin Bank and Pirallahi Island are located east of the Absheron Peninsula, in the northwestern part of the Absheron archipelago, in the anticlinal zone of the Absheron Bank, Darwin Bank, Pirallahi Island, Gyurgyan Sea.

The southeastern pericline of the Darwin Bank field borders the northern part of the Pirallahi Island field, and the two fields are separated from each other by fault No2 (Fig. 1). In terms of their structure, these deposits are complex-structured [3]. The reason for this is the presence of longitudinal and transverse tectonic faults (faults) in the structure, as well as faults of the thrust type, erosion of zones in the roof part of several formations, the presence of a basin of the coastal type and an island in the process of sedimentation, etc. [4].

The study of conditions for these structures formation showed that some uplifts developed as independent from the beginning of sedimentation, while in others, on the contrary, after a certain period of time, the process of development was stopped.

Correlation of Darwin Bank deposits and Pirallahi Island

Studies of thicknesses and lithofacial properties of productive strata (PS) formations in the northwestern part of the Apsheron Archipelago indicate that these sediments were accumulated in the Paleovolga River delta [4].

The spreading of terrigenous sediments brought by the Paleovolga River along with the delta tributary streams in the northeastern part of the Apsheron Archipelago had a significant impact on the uplifts which were still in consediment development.

Coarse-grained sandy sediments are concentrated in the high-flow tributaries of the delta, while clayey sediments are predominantly accumulated in the intertributary zones. During this period, the thickness decreases towards the roof of the uplifts undergoing sedimentary development. Disjunctive dislocations occur on uplifts which subjected to more intense tectonic movements, and sediments collected in these zones break up and slide from the vault to the wings, concentrate in synclinal troughs, and are transported by deep-sea currents to deeper parts of the sea [5].

Naturally, lithofacies is characterized by a decrease in the size of rock particles in the direction of the deep sea and an increase in the degree of interlayering of strata. The presence of clayey strata is predominant in zones formed in deep sea conditions far from the delta. The size of rock particles depends on the distance from the delta and the depth of the sea.

As a result of various paleogeographic conditions of the field, being located close to each other, some areas are similar during sedimentation, and various types of facies have formed in some areas. To prove this, a facies interpretation of the log data was performed. All wells of these fields were studied and facies was correlated by sections (Fig. 2) [5–23].

The correlation diagram of the Darwin Bank field shows an increase in sandiness from top to bottom throughout the section in the Kirmakinsky Formation (KF). At this,

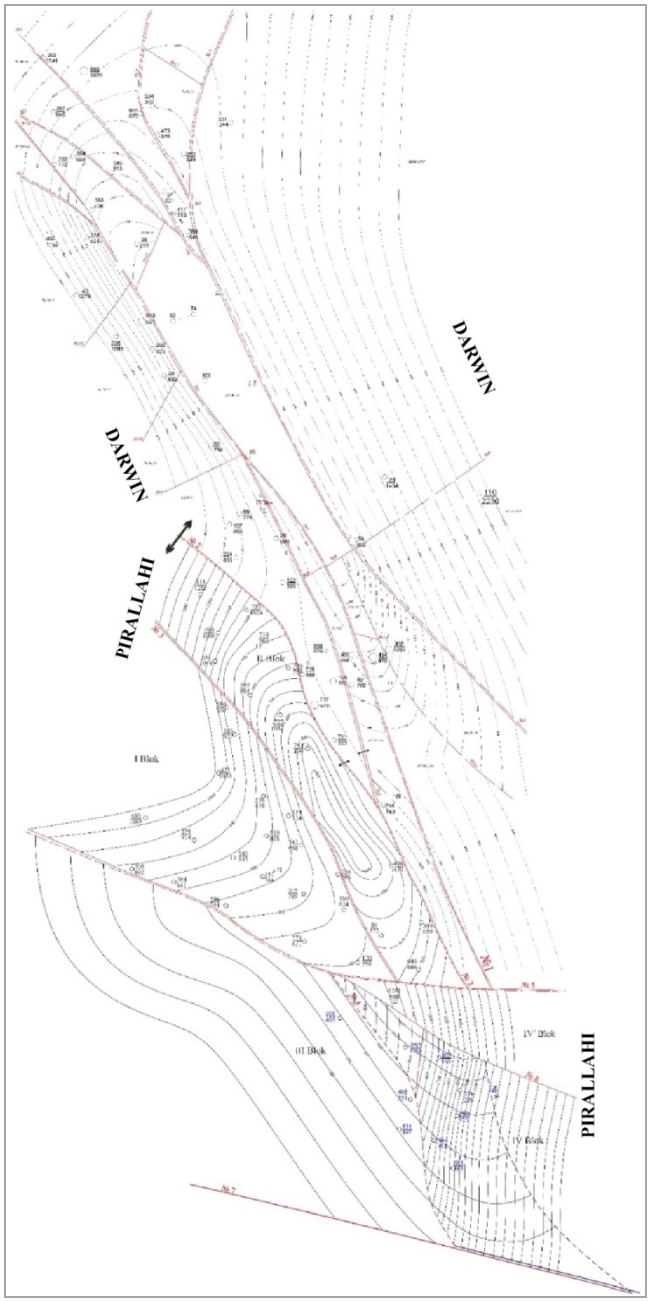


Fig. 1. Structural map of the deposits of Darwin Bank and Pirallahi Island

it should be noted that in the upper part of the KF-Upper horizon the clay content is high, and in the direction of the lower part the clay content percentage decreases and sandy interlayers appear.

In the KF-Lower horizon, the sandiness increases and the percentage of clay content is low. In the well section of the Pirallahi field, the KF, as in the Banki Darwin field, consists mainly of alternating sandy and clayey rocks. The upper horizon is represented by clayey rocks. The KF Lower horizon also shows an increase in sandiness from top to bottom. In both deposits the sedimentation process of KF corresponds to the same paleogeographic conditions. But at the Darwin field in the vaulted part of the structure the process of sedimentation was interrupted, thus proving that at that period the sea level was shallow. Closer to the vault part, an increase in rock particle size and sandiness is observed. In the wings and periclines, similarities with the Pirallahi deposit are observed [5, 7–11].

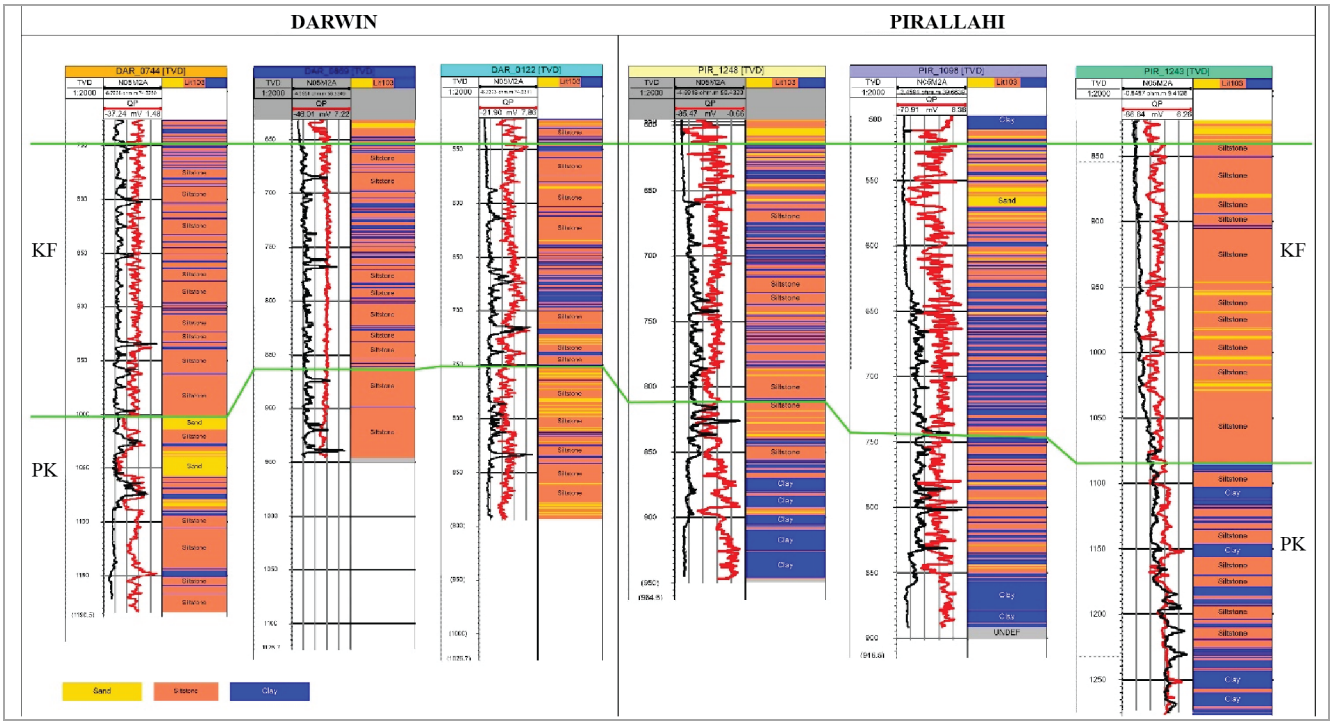
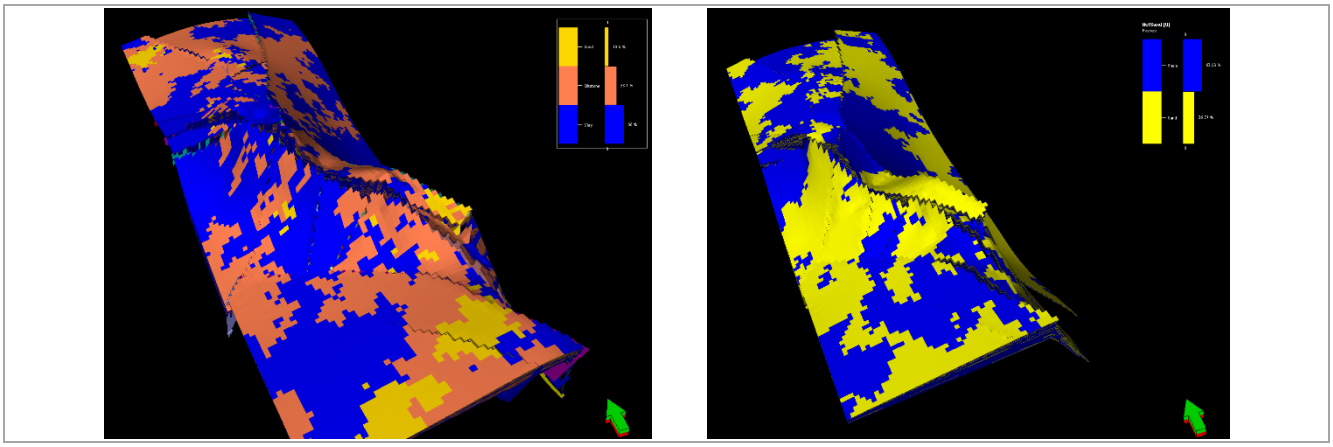


Fig. 2. Lithofacies correlation of the Darwin and Pirallakhi deposits



a *b*

Fig. 3. Deposits of Darwin Bank and Pirallahi Island: *a* - 3D-facial modeling; *b* - model of "collector and non-collector" property distribution

When comparing the Podkirmakinskaya Formation (PC), significant differences can be seen. This is because the PC is subject to internal variability not only between fields, but also within the field itself. In the Darwin Bank field, the same layers of the PC series can vary dramatically throughout the formation. While fine-grained alternation of sand and clay is observed in some areas of the deposit, thick interbeds of sand appear in some areas. This confirms that sedimentation conditions are similar in all areas of the field. Oil fields are mainly located in areas with sandy interbeds. In the Pirallahi field, the PC horizon can be divided into three parts (PC1, PC2, PC3). From top to bottom, the sand content decreases significantly and is replaced by clayey rocks. This indicates the presence of different paleogeographic conditions in the sediments during the PC period. Thus, the Darwin Bank does not involve PC sediments in the vault and adjacent areas. The coarseness of rock grains and the predominance of sandy rocks are caused by the presence of coastal and bar facies in the area. At the edges of the structure, sand content decreases, grain size decreases and clay content increases. Thus, in the Pirallahi field, the increase in the upper part of sand in the PC sediments and decrease in clay content are related to the water depth at this time. Thus, the sea was relatively deeper at the beginning of the PC Formation period, and by the end of the period, the depth of the sea began to decrease. This directly influenced the formation of facies [6, 16, 18–21].

3D Model Construction

Facies studies should not be limited to logging data alone. These parameters, which are important for reserve allocation, identification of new prospects and risk calculations, should be determined on the basis of the area and volume of the field. To this end, a 3D facies model of the Darwin and Pirallahi Bank deposit was developed (Fig. 3, *a*). This model is very important for good distribution tracking, it allows tracking the change of individual formation layers [38–44].

At the Darwin Bank field, the Kalinskaya Formation (KaF) was identified on the basis of lithological characteristics of exploration wells by the rock samples

taken from the wells [6]. KaF consists of poorly sorted rocks, a small amount of sandstones and siltstones, alternating with thin sandy, argillaceous siltstones. The study of the lithological and petrographic features of this mass has shown that both poorly and well-sorted rocks are found in the area of the deposit. At the Pirallahi deposit, KaF consists of fine-grained sands and gray brown sandy clays. The sands are sometimes limestone. The southern Pirallahi sand facies is a coastal facies [24–28].

The Podkirmakinskaya Formation (PK) of the Darwin Bank field covers a large area. This formation is one of the main oil and gas formations of the Lower Pliocene and is well defined according to the logging data over the entire area. The PK formation is characterized by high sandiness (69–92 %) and consists of sand and sandstone, medium- and coarse-particle quartz sands, a small amount of silt and clays. The rocks of this formation are generally characterized by high sadness. Only in the Pirallahi area the rocks are scattered and consist of gray clays and alternating fine-grained layers of sand and medium- and coarse-grained quartz sand. Sometimes there are black sands, pebbles with a diameter of up to 4 mm There is an increase in sandiness from bottom to top [45–51].

The Kirmakinskaya Formation (KF) of the Darwin Bank field is one of the most widespread oil formations. The difference between this formation and other formations is the repeated alternation of different rock types. The horizons of the Kirmakinskaya Formation lithologically consist of alternating sand and clay. The KF deposits undergo extensive facies changes in the direction of the basement throughout the section; clay thickness decreases, the grain size of sandy interbeds increases, and the lithologic and reservoir properties of sandy siltstones improve. At the Pirallakhi field the Kirmakinskaya Formation is represented by alternation of mainly fine-grained gray and brown sands and clays. There are often interbeds of hard or loose sandstones. The thickness of this formation is 10-70 m and increases in the direction of the buried parts of the fold. In the roof part of this formation the thickness of clay interbeds increases up to 65 m and sandiness increases towards the footwall.

One of the main purposes of studying the field data listed above is to separate reservoir and nonreservoir rock groups. In the oil industry, it is important to determine the reservoir and nonreservoir portions of the fields [29–34]. 3D models of reservoir distribution were constructed (Fig. 3, *b*). For detailed analysis, the vertical distribution was analyzed in 100 cells. The models built for these fields are reliable resources for determining oil and gas accumulations and estimating reserves. Changes in facies in deposits are one of the reasons for changes in a number of other parameters. For example, the distributions of carbonate, porosity, and permeability were considered. There are no significant changes in the average values of parameters for the KF series, but these changes are determined for the PK series. At the Darwin Bank deposit, the reservoir rocks of the PK formation are represented by poorly sorted rocks. Here, the petrophysical properties of sands, sandstones, silts and siltstones differ significantly. Based on the analysis of rock samples, the carbonate content was 14.6 %, the average porosity was 18.1 %, and the permeability was 116.6 • 10-15 m^2 [8]. Based on the results of core studies taken on Pirallahi Island, and based on the results of data from more than 600 different analyses, the PK formation was examined in detail. In the studied rocks, the carbonate content is within 22.0%, the porosity is 22.0 % and permeability – 425•10-15m^2 [35–37].

Conclusion

1. Based on geological and geophysical materials, sedimentary rocks in the fields are divided into collector and non-collector groups and 3D models are created.

2. 3D facies models were created to track lithofacial changes in the fields.

3. In the Darwin Bank field, the KF, PK and KaF horizons are adjacent from the vaulted part towards the wings. In the Pirallahi field, the KaS horizon is adjacent in the southern part. This is the reason for the formation of lithofacial variability.

4. At the Darwin Bank field, the PK Formation consisted mainly of sandy rocks, while at the Pirallahi field, this Formation consisted of clayey interbeds in the lower part and sandy interbeds in the upper part. These fields had different physiographic conditions and formation of different lithofacies during the PK period of the series.

5. The deposits during the KF period of the Formation consisted of sandstone in the lower part and clayey facies in the upper part. Hence, for both deposits, the physiographic conditions during this period were similar. The only difference is the predominance of facies of sands of coastal origin in the abutment zone at the Darwin Bank deposit.

6. Adjacent sedimentary rocks of the productive stratum in the vaulted and near-vaulted part indicate the existence of conditions for the formation of non-anticlinal traps and thus the accumulation of hydrocarbons.

7. The changes in the field parameters were compared and the results obtained will be used for more accurate study and development of the fields in future work.

References

1. Gurbanov V.Sh., Sultanov L.A. Petrofizicheskie osobennosti glubokozalegaiushchikh kollektorov Apsheronskogo i Bakinskogo arkhipelagov [Petrophysıcal propertıes of deep reservoırs of Absheron and Baku archıpelagos]. *Vestnik Permskogo natsional'nogo issledovatel'skogo politekhnichekogo universiteta. Geologiia. Neftegazovoe delo,* 2019, vol. 19, no. 3. pp. 204-215. DOI: 10.15593/2224-9923/2019.3.1

2. Gurbanov V.Sh., Sultanov L.A., Gulueva N.I. Analiz petrofizicheskikh issledovanii glubokozalegaiushchikh neftegazovykh kollektorov sukhoputnykh i morskikh mestorozhdenii Azerbaidzhana [Analysis of petrophysical studies of deep-lying oil and gas reservoirs of onshore and offshore fields in Azerbaijan]. *Nedropol'zovanie,* 2020, vol. 20, no. 3, pp. 204-213. DOI: 10.15593/2712-8008/2020.3.1

3. Kheiderli S.O. Utochnenie strukturno-tektonicheskogo stroeniia i geologicheskie riski v otsenivanii zapasov mestorozhdeniia Darvin kiupesi [Refinement of the structural and tectonic structure and geological risks in the estimation of the reserves of the Darwin Kyupesi field]. *Azerbaidzhanskoe neftianoe khoziaistvo,* 2022, no. 03, pp. 4-9.

4. Galkin V.I., Rezvukhina D.V. Razrabotka statisticheskikh modelei dlia prognoza pogloshchenii po kharakteristikam razryvnykh narushenii [Development of Statistical Models for Predicting Circulation Losses Based on Characteristics of Faults]. *Nedropol'zovanie*, 2021, no. 21(3), pp. 102-108. DOI: 10.15593/2712-8008/2021.3.1

5. Gurbanov V.Sh., Mustafaev Iu.R. Analiz litologo-fatsial'nykh kharakteristik nizhnepliotsenovykh otlozhenii mestorozhdeniia Pirallakhi [Analysis of lithofacies characteristics of the Lower Pliocene deposits of the Pirallahi field]. *Geolog Azerbajdzhana*, 2020, no. 24, pp. 91-95.

6. Dzhafarov R.R., Gadzhiev S.S. K vyiavleniiu novykh tektonicheskikh blokov i stratigraficheskikh razrezov na mestorozhdeniiakh, nakhodiashchikhsia na zavershaiushchei stadii razrabotki (na primere banka Darvin i mestorozhdenii Pirallakhi) [To the identification of new tectonic blocks and stratigraphic sections in fields that are at the final stage of development (on the example of the Darwin Bank and the Pirallahi field)]. *Azerbaidzhanskoe neftianoe khoziaistvo,* 2012, no. 9, pp. 5-10.

7. Khalifazade S.M., Mamedov I.M. Fatsial'no-formatsionnoe izuchenie osadochnykh porod i basseinov [Facies-formational study of sedimentary rocks and basins]. Baku: Mutertsim, 2003, pp. 39-81.

8. Akhundov Ia.G. O tselesoobraznosti prodolzheniia zavodeniia po zalezham mestorozhdeniia o. Artema [On the feasibility of continuing watering on the deposits of the Artem Island field]. *Azerbaidzhanskoe neftianoe khoziaistvo*, 1984, no. 9, pp. 15-18.

9. Suleimanov Sh.A., Mirzeev I.A., Mekhtiev I.P. Kollektorskie svoistva otlozhenii produktivnogo sloia severnoi chasti Bakinskogo arkhipelaga [Reservoir properties of deposits of the productive layer of the northern part of the Baku archipelago]. *Azerbaidzhanskoe neftianoe khoziaistvo*, 2005, no. 1, pp. 12-16.

10. Ali-zade A.A., Akhmedov G.A., Akhmedov A.M. Geologiia neftianykh i gazovykh mestorozhdenii Azerbaidzhana [Geology of oil and gas fields in Azerbaijan]. Moscow: Nedra, 1966, pp. 25-47.

11. Nerimanov N.R., Khalilov N.Iu., Khidirova R.A. Geotemperaturnye usloviia i neftegazogeneratsionnyi potentsial Pirallakhi-Kel'korskogo progiba [Geotemperature conditions and oil and gas generation potential of the Pirallahi-Kelkor trough]. *Azerbaidzhanskoe neftianoe khoziaistvo*, 2002, no. 9, pp. 7-11.
12. Khuduzade E.B. O mestonakhozhdenii zalezhei nefti i gaza v otlozheniiakh nizhnego produktivnogo sloia ostrova Pirallakhi, Gurganskoi morskoi zony [On the location of oil and gas deposits in the lower productive layer of Pirallahi Island, Gurgan sea zone]. *ADPU. Seriia estestvennykh nauk*, 2006, no. 1, pp. 183-188.
13. Mekhtiev U.Sh., Kheiirov M.B. Litologicheskaia kharakteristika nizhnepliotsenovykh otlozhenii Azerbaidzhana i zakonomernosti izmeneniia kollektorskikh svoistv vo vremeni i prostranstve [Lithological characteristics of the Lower Pliocene deposits of Azerbaijan and patterns of changes in reservoir properties in time and space]. *Azerbaidzhanskie geofizicheskie innovatsii*, 2005, no. 1, pp. 24-32.
14. Kheirov M.B., Khalilova L.N. Kollektorskie svoistva peschano-alevritovykh porod verkhnego otdela PT Severnyi Absheronskoi zony podniatii [Reservoir properties of sandy-silty rocks of the upper section of the Northern PT of the Absheron uplift zone]. *Azerbaidzhanskoe neftianoe khoziaistvo*, 2006, no. 8, pp. 4-11.
15. Ragimov F.V., Eminov A.Sh., Guseinov R.M. Otsenka riska i neopredelennosti pri podschete zapasov [Risk and Uncertainty Assessment While Estimation of Reserves]. *SPE Annual Caspian Technical Conference and Exhibition*, 2017, pp. 1-5. DOI: 10.2118/189019-MS
16. Rakkhmanov R.R. Patterns of formation and placement of oil and gas accumulation zones in the Mesozoic deposits of Azerbaijan. Baku: Elm, 1985, 108 p.
17. Mekkhtiev U.Sh., Kkheirov M.B. Lithological and petrographic features and reservoir properties of rocks of the Kalinsky and Podkirmakinsky suites of the Absheron oil and gas region of Azerbaijan. Baku, 2007, part 1, 238 p.
18. Gurbanov V.Sh., Sultanov L.A., Valiev S.A., Babaeva M.T. Litologo-petrograficheskie i kollektorskie xarakteristiki mezokainozoiskikh otlozhenii severo-zapadnoi chasti Iuzhno-Kaspiiskoi vpadiny [The lihtophysical and collector characteristics of Mesozoic-Cenozoic deposits of North-Western part of the Caspian depression]. *Vestnik Permskogo natsional'nogo issledovatel'skogo politekhnicheskogo universiteta. Geologiia. Neftegazovoe i gornoe delo*, 2015, no. 17, pp. 5-15. DOI: 10.15593/2224-9923/2015.17.1
19. Gasanov A.B., Melikov Kh.F. Trekhmernaia model' produktivnykh plastov po dannym geofiziki i petrofiziki. Vliianie sovremennoi geodinamiki na fiziko-mekhanicheskoe sostoianie geologicheskoi sredy osadochnogo chekhla [Three-dimensional model of productive layers according to geophysics and petrophysics. Influence of modern geodynamics on the physical and mechanical state of the geological environment of the sedimentary cover]. *Materialy mezhdunarodnogo seminara*, Baku, 2010, pp. 101-108.
20. Aliiarov R.Iu., Gasanov A.B., Aslanzade F.B., Samedzade A.A. Raspoznavanie zon techeniia fliuidov v neftianykh plastakh karotazhnymi metodami [Recognition of fluid flow zones in oil reservoirs by logging methods]. *Azerbaidzhanskii geolog*, 2018, no. 22, pp. 121-128.
21. Salmanov A.M., Suleimanov A.M, Magerramov B.I. Paleogeologiia neftegazonosnykh raionov Azerbaidzhana [Paleogeology of oil and gas bearing regions of Azerbaijan]. Baku, 2015, 470 p.
22. Kozhevnikov D.A. Petrofizicheskaia invariantnost' granuliarnykh kollektorov [Petrophysical invariance of granular reservoirs]. *Geofizika*, 2001, no. 4, pp. 31-37.
23. Sultanov L.A. Geologicheskoe stroenie i rezul'taty petrofizicheskikh issledovanii neftegazonosnykh ploshchadei mestorozhdeniia severo-zapadnoi chasti Iuzhno-Kaspiiskoi vpadiny [Geological structure and results petrophysical laughters of the oil-and-gas areas of the field of the Northwest part of the Southern Caspian hollow]. *Bulatovskie chteniia: III Mezhdunarodnoi nauchno-prakticheskoi konferentsii*. Krasnodar: Kubanskii gosudarstvennyi tekhnologicheskii universitet, 2019. pp. 143-145
24. Gasanov A.B., Kiazimov R.R., Mamedova D.N., Mutallimova O.M. Variatsii plastovogo davleniia i fil'tratsionno-emkostnye svoistva kollektorov glubokozalegaiushchikkh mestorozhdenii Iuzhnogo-Kaspiia [Reservoir pressure variations and reservoir properties of reservoirs in deep fields of the South Caspian]. *Geologiia, geodinamika i geoekologiia Kavkaza: proshloe, nastoiashchee i budushchee: materialy nauchno-prakticheskoi konferentsii*. Makhachkala, 2016, pp. 242-247.
25. Gasanov A.B., Balakishibeili Sh.A. Vliianie sovremennoi geodinamiki na fiziko-mekhanicheskoe sostoianie geologicheskoi sredy osadochnogo chekhla [Influence of modern geodynamics on the physical and mechanical state of the geological environment of the sedimentary cover]. *Otsenka sinteticheskikh uprugikh parametrov kollektorov, nasyshchennosti fliuidnoi fazy i temperatur na nedrakh: materialy mezhdunarodnogo seminara*. Baku, 2010, pp. 90-98.
26. Gurbanov V.Sh., Sultanov L.A. O neftegazonosnosti mezozoiskikh otlozhenii Azerbaidzhana [On oil-and-gas content of Mesozoic deposits in Azerbaijan]. *Vestnik Permskogo natsional'nogo issledovatel'skogo politekhnicheskogo universiteta. Geologiia. Neftegazovoe i gornoe delo*, 2015, no. 16, pp. 7-13. DOI: 10.15593/2224-9923/2015.16.1
27. Ali-Zade A.A., Akkhmedov G.A., Akkhmedov A.M., Aliev A.K., Zeinalov M.M. Geologiia neftianykkh i gazovykkh mestorozhdenii Azerbaidzhana [Geology in the oil and gas fields of Azerbaijan]. Moscow: Nedra, 1966, 390 p.
28. Vassoevich N.B. Spravochnik po litologii [Handbook of Lithology]. Moscow, 1988, 509 p.
29. Alizade Ak.A. Geologiia Azerbaidzhana. Litologiia [Geology of Azerbaijan. Lithology]. Baku: Elm, 2005, 257 p.
30. Alizade Ak.A., Babazade A.D., Novye kardiidy akchagyl'skogo iarusa Shemakhinskogo raiona. Problemy stratigrafii i fauny mezokainozoiskikh otlozhenii Azerbaidzhana [New cardiids of the Akchagyl stage of the Shamakhi region. Problems of stratigraphy and fauna of the Meso-Cenozoic deposits of Azerbaijan]. Moscow: Nedra, 1967, 74 p.
31. Bairamova Sh.Sh., Tagieva Iu.N. Palinostratigrafiia i paleogeografiia maikopskikh otlozhenii Absheronskogo regiona (razrez Pirakushkul') [Palinostratigraphy and paleogeography of the Maikop deposits of the Absheron region (Pirakushkul section)]. *Stratigrafiia i sedimentologiia neftegazovykh basseinov*, 2009, no. 1, pp. 24-32.
32. Bukri D. Stratigrafiia fitoplanktona, tsentral'naia chast' Tikhogo okeana, etap 171 proekta glubokovodnogo bureniia [Phytoplankton Stratigraphy, Central Pacific Ocean, Deep Sea Drilling Project Leg 171]. Geologicheskaia sluzhba SShA. La-Khoiia, Kaliforniia, 1973, 871 p.
33. Korliss B.Kh., Obri M.-P., Berggren V.A., Fenner Dzh.M., Keigvin L.D., Keller G. Pogranichnoe sobranie ochen'/oligochena v glubokom more. (Pogranichnoe sobytie eotsena/oligotsena v morskikh glubinakh) [The border assembly is very/oligocene in the deep sea. (Eocene/Oligocene boundary event in the deep sea)]. *Nauka*, 1984, no. 226, pp. 806-810.
34. Koksall Kh.K., Uilson P.A., Palike Kh., Lir Ch.Kh., Bekman Dzh. Bystroe stupenchatoe nastuplenie antarkticheskogo oledeneniia i bolee glubokaia kal'tsitovaia kompensatsiia v Tikhom okeane [Rapid stepwise onset of Antarctic glaciation and deeper calcite compensation in the Pacific Ocean]. *Priroda*, 2005, no. 433, pp. 53-57.
35. Khak B.U., Khardenbol Dzh., Veil P.R. Khronologiia kolebanii urovnia moria s triasa (250 millionov let nazad po nastoiashchee vremia) [Timeline of sea level fluctuations from the Triassic (250 million years ago to present)]. *Nauka*,1987, no. 235, pp. 1156-1167.
36. Ivani L.S., Patterson V.P., Lomann K.S. Bolee prokhladnye zimy kak vozmozhnaia prichina massovykh vymiranii na granitse eotsena i oligotsena [Cooler winters as a possible cause of mass extinctions at the Eocene-Oligocene boundary]. *Priroda*, 2000, no. 407 (6806, pp. 887-890.
37. Keigvin L.D. Paleookeanograficheskie izmeneniia v Tikhom okeane na rubezhe eotsena i oligotsena [Paleo-oceanographic changes in the Pacific Ocean at the turn of the Eocene and Oligocene]. *Priroda*, 1980, no. 287, pp. 722-725.
38. Kennett Dzh.P., Sheklton N'iu-Dzhersi. Izotopy kisloroda svidetel'stvuiut o razvitii psikhrosfery 38 mln let nazad [Oxygen isotopes testify to the development of the psychosphere 38 million years ago]. *Priroda*, 1976, no. 260, pp. 513-515.
39. Kerimova, N.T. Izuchenie diatomei maikopskikh otlozhenii na zapadnom sklone Iuzhno-Kaspiiskoi vpadiny (po razrezu Shikhzagirly Shamakhinsko-Gobustanskoi ploshchadi) i nekotorye paleoekologicheskie vyvody [Study of Maikop diatoms on the western slope of the South Caspian Basin (along the Shikhzagirly section of the Shamakhi-Gobustan area) and some paleoecological conclusions]. *Stratigrafiia i sedimentologiia neftegazonosnykh basseinov*, 2017, no. 1, pp. 11-24.
40. Miller K.G. Stabil'nye izotopy, klimat i glubokovodnaia istoriia ot srednego eotsena do oligotsena: sobytie v terminal'nom eotsene: eotsen-oligotsenovaia klimaticheskaia i bioticheskaia evoliutsiia [Stable Isotopes, Climate, and Deep Sea History from the Middle Eocene to the Oligocene: An Event in the Terminal Eocene: Eocene-Oligocene Climatic and Biotic Evolution]. *Prinstonskaia seriia po geologii i paleontologii.* N'iu-Dzhersi: Princeton University Press, 1992, pp. 160-177.
41. Miller K.G., Rait Dzh.D., Ferbenks R.G. Otkrytie ledianogo doma: oligokhen-miotsenovye izotopy kisloroda, evstaziia i eroziia kraev [Discovery of an ice house: Oligochene-Miocene oxygen isotopes, eustasia, and edge erosion]. *Zhurnal geofizicheskikh issledovanii*, 1991, no. 96, pp. 6829-6848.
42. Miller K.G., Ferbenks R.G., Mauntin G.S. Sintez tretichnykh izotopov kisloroda, istoriia urovnia mureny i erozii kontinental'noi okrainy [Synthesis of tertiary oxygen isotopes, history of moray level and continental margin erosion]. *Paleookeanografiia*, no. 2, C. 1–19.
43. Miller K.G., Brauning Dzh.V., Obri M.-P., Ueid B.S., Kats M.E., Kul'pets A.A., Rait Dzh.D. Eocene–Oligocene global climate and sea-level changes: St. Stephens Quarry, Alabama. *GSA Bulletin*, 2008, vol. 120 (1-2), pp. 34-53. DOI: 10.1130/B26105.1
44. Molina E., Gonzalvo C., Ortiz S., Cruz L., Molina E., Gonzalvo K., Ortis S., Kruz L. Krugovorot foraminifer pri perekhode ot eosena k oligochenu v kal'dere Fuente, Iuzhnaia Ispaniia: otsutstvie prichinno-sledstvennoi sviazi mezhdu udarami meteoritov i vimiraniem: morskaia mikropaleontologiia [Foraminiferal cycling during the Eosene to Oligocene transition in the Fuente caldera, Southern Spain: no causal relationship between meteorite impacts and extinction: marine micropaleontology]. *Morskaia mikropaleontologiia*, 2006, no. 58 (4), pp. 270-286.
45. Savin S.M., Duglas R.G., Steli F.G. Tertiary marine paleotemperatures, *GSA Bulletin*, 1975, no. 86, pp. 1499-1510. DOI: 10.1130/0016-7606(1975)86<1499:TMP>2.0.CO;2
46. Pekar S.F., Kristi-Blik N., Miller K.G., Komints M.A. Kalibrovka evstazii oligokhena po izotopno-kislorodnym dannym: evstaticheskie tochki po dvumernoi fleksurnoi obratnoi zachistke kontinental'noi okrainy N'iu-Dzhersi [Oligochene Eustasia Calibration from Oxygen Isotope Data: Eustatic Points from 2D Flexural Backsweep of the New Jersey Continental Margin]. EGS-AGU-EUG, 2003.
47. Zakhos Dzh., Pagani M., Sloan L., Tomas E., Billaps K. Tendenchii, ritmy i aberratsii global'nogo klimata c 65 mln let do nastoiashchego vremeni [Trends, rhythms and aberrations of the global climate from 65 million years to the present]. *Nauka*, 2001, no. 292, pp. 686-693.
48. Zaklinskaia Iu.D. Opisanie nekotorykh vidov pyl'tsy i spor, izvlechennykh iz tretichnykh otlozhenii Pasekovskogo kar'era Voronezhskoi oblasti [Description of some types of pollen and spores extracted from the Tertiary deposits of the Pasekovsky quarry in the Voronezh region]. *Trudy Instituta geologii AN SSSR, vypusk 142: Geologicheskaia seriia*, 1953, no. 59.
49. Zaklinskaia Iu.D. Materialy k istorii paleogenovoi i neogenovoi flory Severnogo Kavkaza [Materials on the history of the Paleogene and Neogene flora of the North Caucasus]. *Voprosy petrografii i mineralogii*, 1953, no. 1.
50. Zanazzia A., Judd E., Fletcher A., Bryant H., Kohn M.J. Eocene-Oligocene Latitudinal Climate Gradients in North America inferred from Stable Isotope Ratios in Perissodactyl Tooth Enamel. *Palaeogeography, Palaeoclimatology, Palaeoecology,* 2015, no. 417, pp. 561-568. DOI: 10.1016/j.palaeo.2014.10.024
51. Alieva E.G., Karimova N.T., Allakhverdieva Kh.A. Oligochenovoe znachenie o klimate i izmenenii urovnia mureny v Iuzhno-Kaspiiskom basseine i integratsii litofazii i analiza diatomovykh vodoroslei [Oligocene Significance on Climate and Moray Level Change in the South Caspian Basin and Integration of Lithophasia and Diatom Analysis]. *Stratigrafiia i sedimentologiia neftegazonosnykh basseinov*, 2018, no. 2, pp. 26-42.

Билиографический список

1. Гурбанов В.Ш., Султанов Л.А. Петрофизические особенности глубокозалегающих коллекторов Апшеронского и Бакинского архипелагов // Пермский журнал нефтегазового и горного машиностроения. – 2019. – Т. 19, № 3. DOI: 10.15593/2224-9923/2019.3.1
2. Гурбанов В.Ш., Султанов Л.А., Гулуева Н.И. Анализ петрофизических исследований глубокозалегающих нефтегазовых коллекторов сухопутных и морских месторождений Азербайджан // Пермский журнал нефтегазового и горного машиностроения. – 2020. – Т. 20, № 3. – С. 204–213. Doi: 10.15593/2712-8008/2020.3.1

3. Хейдерли С.О. Уточнение структурно-тектонического строения и геологические риски в оценивании запасов месторождения Дарвин кюпеси // Азербайджанское нефтяное хозяйство. – 2022. – № 03. – С. 4–9.
4. Галкин В.И., Резвухина Д.В. Разработка статистических моделей для прогноза поглощений по характеристикам разрывных нарушений // Недропользование. – 2021. – № 21(3). – С. 102–108.
5. Гурбанов В.Ш., Мустафаев Ю.Р. Анализ литолого-фациальных характеристик нижнеплиоценовых отложений месторождения Пираллахи // Геолог Азербайджана. – 2020 – № 24. – С. 91–95.
6. Джафаров Р.Р., Гаджиев С.С. К выявлению новых тектонических блоков и стратиграфических разрезов на месторождениях, находящихся на завершающей стадии разработки (на примере банка Дарвин и месторождений Пираллахи) // Азербайджанское нефтяное хозяйство. – 2012. – № 9. – С. 5–10.
7. Халифазаде С.М., Мамедов И.М. Фациально-формационное изучение осадочных пород и бассейнов. – Баку: Мутерцим, 2003. – С. 39–81.
8. Ахундов Я.Г. О целесообразности продолжения заводения по залежам месторождения о. Артема // Азербайджанское нефтяное хояйство. –1984. – № 9. – С. 15–18.
9. Сулейманов Ш.А., Мирзеев И.А., Мехтиев И.П. Коллекторские свойства отложений продуктивного слоя северной части Бакинского архипелага // Азербайджанское нефтяное хозяйство. – 2005. – № 1. – С. 12–16.
10. Али-заде А.А., Ахмедов Г.А., Ахмедов А.М. Геология нефтяных и газовых месторождений Азербайджана. – М.: Недра, 1966. – С. 25–47.
11. Нериманов Н.Р., Халилов Н.Ю., Хидирова Р.А. Геотемпературные условия и нефтегазогенерационный потенциал Пираллахи-Келькорского прогиба // Азербайджанское нефтяное хозяйство. – 2002. – № 9. – С. 7–11.
12. Худузаде Э.Б. О местонахождении залежей нефти и газа в отложениях нижнего продуктивного слоя острова Пираллахи, Гурганской морской зоны // АДПУ. Серия естественных наук. – 2006. – № 1. – С. 183–188.
13. Мехтиев У.Ш., Хейиров М.Б. Литологическая характеристика нижнеплиоценовых отложений Азербайджана и закономерности изменения коллекторских свойств во времени и пространстве // Азербайджанские геофизические инновации. – 2005. – № 1. – С. 24–32.
14. Хеиров М.Б., Халилова Л.Н. Коллекторские свойства песчано-алевритовых пород верхнего отдела ПТ Северный Абшеронской зоны поднятий // Азербайджанское нефтяное хозяйство. – 2006. – № 8. – С. 4–11.
15. Ragimov F.V., Eminov A.Sh., Guseinov R.M. Risk and Uncertainty Assessment While Estimation of Reserves. SPE Baku SPE Annual Caspian Technical Conference and Exhibition, 2017, pp. 1-5. DOI: 10.2118/189019-MS
16. Rakkhmanov R.R. Patterns of formation and placement of oil and gas accumulation zones in the Mesozoic deposits of Azerbaijan. Baku: Elm, 1985, 108 p.
17. Мекхтиев У.Ш., Кхеиров М.Б. Литологопетрографические особенности и коллекторские своиства пород калинскои и подкирмакинскои свит Апшероноскои нефтегазоноснои области Азербаиджана // Lithological and petrographic features and reservoir properties of rocks of the Kalinsky and Podkirmakinsky suites of the Absheron oil and gas region of Azerbaijan. – Baku, 2007. – Part 1. – P. 238.
18. Литолого-петрографические и коллекторские характеристики мезокайнозойских отложений северо-западной части Южно-Каспийской впадины / В.Ш. Гурбанов, Л.А. Султанов, С.А. Валиев, М.Т. Бабаева // Вестник Пермского национального исследовательского политехнического университета. Геология. Нефтегазовое и горное дело. – 2015. – № 17. – С. 5–15. DOI: 10.15593/2224-9923/2015.17.1
19. Гасанов А.Б., Меликов Х.Ф. Трехмерная модель продуктивных пластов по данным геофизики и петрофизики. Влияние современной геодинамики на физико-механическое состояние геологической среды осадочного чехла // Материалы международного семинара. – Баку, 2010. – С. 101–108 с.
20. Распознавание зон течения флюидов в нефтяных пластах каротажными методами / Р.Ю. Алияров, А.Б. Гасанов, Ф.Б. Асланзаде, А.А. Самедзаде // Азербайджанский геолог. – 2018. – № 22. – С. 121–128.
21. Салманов А.М., Сулейманов А.М, Магеррамов Б.И. Палеогеология нефтегазоносных районов Азербайджана. – Баку, 2015. – 470 с.
22. Кожевников Д.А. Петрофизическая инвариантность гранулярных коллекторов // Геофизика 2001. – № 4. – С. 31–37.
23. Султанов Л.А. Геологическое строение и результаты петрофизических исследований нефтегазоносных площадей месторождения северо-западной части Южно-Каспийской впадины // Булатовские чтения: III Междунар. науч.-практ. конф. – Краснодар: Кубанский государственный технологический университет, 2019.
24. Гасанов А.Б., Киазимов Р.Р., Мамедова Д.Н., Муталлимова О.М. Вариации пластового давления и фильтрационно-емкостные свойства коллекторов глубокозалегающих месторождений Южного Каспия // Геология, геодинамика и геоэкология Кавказа: прошлое, настоящее и будущее: материалы научно-практическои конферентсии. – Махачкала, 2016. – С. 242–247.
25. Гасанов А.Б., Балакишибейли Ш.А. Влияние современной геодинамики на физико-механическое состояние геологической среды осадочного чехла // Оценка синтетических упругих параметров коллекторов, насыщенности флюидной фазы и температур на недрах: материалы международного семинара. – Баку, 2010. – С. 90–98.
26. Гурбанов В.Ш., Султанов Л.А. О нефтегазоносности мезозойских отложений Азербайджана. Вестник Пермского национального исследовательского политехнического университета. Геология // Нефтегазовое и горное дело. – 2015. – № 16. – С. 7–13. DOI: 10.15593/2224-9923/2015.16.1
27. Геология нефтяных и газовых месторождений Азербаиджана / А.А. Али-Заде, Г.А. Акхмедов, А.М. Акхмедов, А.К. Алиев, М.М. Зеиналов. – М.: Недра, 1966. – 390 р.
28. Вассоевич Н.Б. Справочник по литологии. – М.,1988. – 509 с.
29. Ализаде Ак.А. Геология Азербайджана. Литология. – Баку: Элм, 2005. – 257 с.
30. Ализаде Ак.А., Бабазаде А.Д., Новые кардинды акчагыльского яруса Шемахинского района. Проблемы стратиграфии и фауны мезокайнозойских отложений Азербайджана. – М.: Недра, 1967. – С. 74.
31. Байрамова Ш.Ш., Тагиева Ю.Н. Палиностратиграфия и палеогеография майкопских отложений Абшеронского региона (разрез Пиракушкуль) // Стратиграфия и седиментология нефтегазовых бассейнов. – 2009. – № 1. – С. 24–32.
32. Букри Д. Стратиграфия фитопланктона, центральная часть Тихого океана, этап 171 проекта глубоководного бурения / Геологическая служба США. – Ла-Хойя, Калифорния, 1973. – 871 с.
33. Пограничное собрание очень/олигочена в глубоком море. (Пограничное событие эоцена/олигоцена в морских глубинах) / Б.Х. Корлисс, М.-П. Обри, В.А. Берггрен, Дж.М. Феннер, Л.Д. Кейгвин, Г. Келлер // Наука. – 1984. – № 226. – С. 806–810.
34. Быстрое ступенчатое наступление антарктического оледенения и более глубокая кальцитовая компенсация в Тихом океане / Х.К. Коксалл, П.А. Уилсон, Х. Палике, Ч.Х. Лир, Дж. Бэкман // Природа. – 2005. – № 433. – С. 53–57.
35. Хак Б.У., Харденбол Дж., Вейл П.Р. Хронология колебаний уровня моря с триаса (250 миллионов лет назад по настоящее время) // Наука. – 1987. – № 235. – С. 1156–1167.
36. Ивани Л.С., Паттерсон В.П., Ломанн К.С. Более прохладные зимы как возможная причина массовых вымираний на границе эоцена и олигоцена // Природа. – 2000. – № 407 (6806). – С. 887–890.
37. Кейгвин Л.Д. Палеоокеанографические изменения в Тихом океане на рубеже эоцена и олигоцена // Природа. – 1980. – № 287. – С. 722–725.
38. Кеннетт Дж.П., Шеклтон Нью-Джерси. Изотопы кислорода свидетельствуют о развитии психросферы 38 млн лет назад // Природа. – 1976. – № 260. – С. 513–515.
39. Керимова, Н.Т. Изучение диатомей майкопских отложений на западном склоне Южно-Каспийской впадины (по разрезу Шихзагирлы Шамахинско-Гобустанской площади) и некоторые палеоэкологические выводы // Стратиграфия и седиментология нефтегазоносных бассейнов. – 2017. – № 1. – С. 11–24.
40. Миллер К.Г. Стабильные изотопы, климат и глубоководная история от среднего эоцена до олигоцена: событие в терминальном эоцене: эоцен-олигоценовая климатическая и биотическая эволюция // Принстонская серия по геологии и палеонтологии. – Нью-Джерси: Princeton University Press, 1992. – Р. 160–177.
41. Миллер К.Г., Райт Дж.Д., Фэрбенкс Р.Г. Открытие ледяного дома: олигохен-миоценовые изотопы кислорода, евстазия и эрозия краев // Журнал геофизических исследований. – 1991. – № 96. – С. 6829–6848.
42. Миллер К.Г., Фэрбенкс Р.Г., Маунтин Г.С. Синтез третичных изотопов кислорода, история уровня мурены и эрозии континентальной окраины // Палеоокеанография. – № 2. – С. 1–19.
43. Eocene–Oligocene global climate and sea-level changes: St. Stephens Quarry / K.G. Miller, Dzh.V. Brauning, M.-P. Obri, B.S. Ueid, M.E. Kats, A.A. Kul'pets, Dzh.D. Rait // GSA Bulletin. – Alabama, 2008. – Vol. 120 (1–2). – P. 34–53. DOI: 10.1130/B26105.1
44. Круговорот фораминифер при переходе от эосена к олигочену в кальдере Фуэнте, Южная Испания: отсутствие причинно-следственной связи между ударами метеоритов и вимиранием: морская микропалеонтология / E. Molina, C. Gonzalvo, S. Ortiz, L. Cruz, Э. Молина, К. Гонзалво, С. Ортис, Л. Круз // Морская микропалеонтология. – 2006. – № 58 (4). – С. 270–286.
45. Savin S.M., Duglas R.G., Steli F.G. Tertiary marine paleotemperatures // GSA Bulletin. – 1975. – No. 86. – P. 1499–1510. DOI: 10.1130/0016-7606(1975)86<1499:TMP>2.0.CO;2
46. Калибровка евстазии олигохена по изотопно-кислородным данным: эвстатические точки по двумерной флексурной обратной зачистке континентальной окраины Нью-Джерси / С.Ф. Пекар, Н. Кристи-Блик, К.Г. Миллер, М.А. Коминц // ЭГС-АГУ-ЕУГ. – 2003.
47. Тенденчии, ритмы и аберрации глобального климата с 65 млн лет до настоящего времени / Дж. Захос, М. Пагани, Л. Слоан, Э. Томас, К. Биллапс // Наука. – 2001. – № 292. – С. 686–693.
48. Заклинская Ю.Д. Описание некоторых видов пыльцы и спор, извлеченных из третичных отложений Пасековского карьера Воронежской области // Труды Институт геологии АН СССР. – Вып. 142: Геологическая серия. – 1953. – № 59.
49. Заклинская Ю.Д. Материалы к истории палеогеновой и неогеновой флоры Северного Кавказа // Вопросы петрографии и минералогии. – 1953. – № 1.
50. Zanazzia A., Judd E., Fletcher A., Bryant H., Kohn M.J. Eocene-Oligocene Latitudinal Climate Gradients in North America inferred from Stable Isotope Ratios in Perissodactyl Tooth Enamel // Palaeogeography, Palaeoclimatology, Palaeoecology. – 2015. – No. 417. – P. 561–568. DOI: 10.1016/j.palaeo.2014.10.024
51. Алиева Э.Г., Каримова Н.Т., Аллахвердиева Х.А. Олигоценовое значение о климате и изменении уровня мурены в Южно-Каспийском бассейне и интеграции литофазии и анализа диатомовых водорослей // Стратиграфия и седиментология нефтегазоносных бассейнов. – 2018. – № 2. – С. 26–42.

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