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«ҚАЗАҚСТАН РЕСПУБЛИКАСЫ  
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«ХАЛЫҚ» ЖҚ

# Х А Б А Р Л А Р Ы

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## ИЗВЕСТИЯ

РОО «НАЦИОНАЛЬНОЙ  
АКАДЕМИИ НАУК РЕСПУБЛИКИ  
КАЗАХСТАН»  
ЧФ «Халық»

## N E W S

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*NAS RK is pleased to announce that News of NAS RK. Series of geology and technical sciences scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of geology and technical sciences in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of geology and engineering sciences to our community.*

*Қазақстан Республикасы Ұлттық ғылым академиясы «ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы» ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Web of Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.*

*НАНПК сообщает, что научный журнал «Известия НАНПК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАНПК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.*



## ЧФ «ХАЛЫҚ»

В 2016 году для развития и улучшения качества жизни казахстанцев был создан частный Благотворительный фонд «Халык». За годы своей деятельности на реализацию благотворительных проектов в областях образования и науки, социальной защиты, культуры, здравоохранения и спорта, Фонд выделил более 45 миллиардов тенге.

Особое внимание Благотворительный фонд «Халык» уделяет образовательным программам, считая это направление одним из ключевых в своей деятельности. Оказывая поддержку отечественному образованию, Фонд вносит свой посильный вклад в развитие качественного образования в Казахстане. Тем самым способствуя росту числа людей, способных менять жизнь в стране к лучшему – профессионалов в различных сферах, потенциальных лидеров и «великих умов». Одной из значимых инициатив фонда «Халык» в образовательной сфере стал проект *Ozgeris powered by Halyk Fund* – первый в стране бизнес-инкубатор для учащихся 9-11 классов, который помогает развивать необходимые в современном мире предпринимательские навыки. Так, на содействие малому бизнесу школьников было выделено более 200 грантов. Для поддержки талантливых и мотивированных детей Фонд неоднократно выделял гранты на обучение в Международной школе «Мирас» и в Astana IT University, а также помог казахстанским школьникам принять участие в престижном конкурсе «USTEM Robotics» в США. Авторские работы в рамках проекта «Тәлімгер», которому Фонд оказал поддержку, легли в основу учебной программы, учебников и учебно-методических книг по предмету «Основы предпринимательства и бизнеса», преподаваемого в 10-11 классах казахстанских школ и колледжей.

Помимо помощи школьникам, учащимся колледжей и студентам Фонд считает важным внести свой вклад в повышение квалификации педагогов, совершенствование их знаний и навыков, поскольку именно они являются проводниками знаний будущих поколений казахстанцев. При поддержке Фонда «Халык» в южной столице был организован ежегодный городской конкурс педагогов «Almaty Digital Ustaz».

Важной инициативой стал реализуемый проект по обучению основам финансовой грамотности преподавателей из восьми областей Казахстана, что должно оказать существенное влияние на воспитание финансовой грамотности и предпринимательского мышления у нового поколения граждан страны.

Необходимую помощь Фонд «Халык» оказывает и тем, кто особенно остро в ней нуждается. В рамках социальной защиты населения активно проводится

работа по поддержке детей, оставшихся без родителей, детей и взрослых из социально уязвимых слоев населения, людей с ограниченными возможностями, а также обеспечению нуждающихся социальным жильем, строительству социально важных объектов, таких как детские сады, детские площадки и физкультурно-оздоровительные комплексы.

В копилку добрых дел Фонда «Халык» можно добавить оказание помощи детскому спорту, куда относится поддержка в развитии детского футбола и карате в нашей стране. Жизненно важную помощь Благотворительный фонд «Халык» оказал нашим соотечественникам во время недавней пандемии COVID-19. Тогда, в разгар тяжелой борьбы с коронавирусной инфекцией Фонд выделил свыше 11 миллиардов тенге на приобретение необходимого медицинского оборудования и дорогостоящих медицинских препаратов, автомобилей скорой медицинской помощи и средств защиты, адресную материальную помощь социально уязвимым слоям населения и денежные выплаты медицинским работникам.

В 2023 году наряду с другими проектами, нацеленными на повышение благосостояния казахстанских граждан Фонд решил уделить особое внимание науке, поскольку она является частью общественной культуры, а уровень ее развития определяет уровень развития государства.

Поддержка Фондом выпуска журналов Национальной Академии наук Республики Казахстан, которые входят в международные фонды Scopus и Wos и в которых публикуются статьи отечественных ученых, докторантов и магистрантов, а также научных сотрудников высших учебных заведений и научно-исследовательских институтов нашей страны является не менее значимым вкладом Фонда в развитие казахстанского общества.

**С уважением,  
Благотворительный Фонд «Халык»!**

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## **PRE-JURASSIC STAGE OF DEVELOPMENT AND PROSPECTS OF OIL AND GAS POTENTIAL NORTHERN USTYURT**

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**Abstract.** The article presents the regional structural-tectonic and geological-geophysical features of the structure of the Northern Ustyurt region in the western part of the Turan plate. Given the state of the study and the main stages of the development of the region, as well as new data and results obtained on individual local areas in recent years. The aim of the work is to clarify the geological and tectonic features of the structure and composition of sediments at the pre-Jurassic stage of the region's development in connection with the assessment of oil and gas potential. Taking into account the results of the analysis and generalization of the available materials, an assessment of the methodological "approaches" that were at the heart of all previous stages of the study is given. The views on the regional tectonics of the region, which were insufficiently perfect due to the use of the geographical principle of zoning and the allocation of the Western-Aral and Eastern-Aral parts in the territory under consideration, are taken into account. An assessment of the geostructural position of the Aral-Kyzylkum dislocation system is given. On the example of the structural elements of the Shalkar trough, the views on the model of the structure of the Koshkaratinsky and Tobebulak mulda are clarified. In accordance with this, an assumption is made about the development of elementary zones of oil and gas accumulation, which are widespread within the North-Ustyurt system of deflections and uplifts. At the same time, the results of combining data from exploratory drilling, seismic exploration, anomalies of potential physical fields, trends and strike elements of fault tectonics are taken into account. The features of the structural plan and the nature of the manifestation of oil and gas potential in the context of large deflections and uplifts (Bozashinskiy and Aktumysyk uplift, Koltyk-



Kulazhatskiy, Barsakelmesskiy, Sudochiy and Shalkar deflections, Arystanovskaya and Mynsualmassky stage) are clarified. The regularities in the areal distribution of oil and gas accumulations of a certain phase composition of hydrocarbons are highlighted. The areal distribution of prospective local objects is determined by the influence of regional features of the region, including the proximity of local structures to the routes of regional faults, the presence of large inherited uplifts in the context of the Pre-Jurassic complex. The main results of the study are the substantiation of the high prospects of Paleozoic deposits, the development of which influenced the formation of transitional anticlinal zones (shaft-like uplifts), large uplifts (shafts) within regional deflections and projections (foundation, Paleozoic) between adjacent deflections. Substantiated recommendations for expanding the range of prospective local oil and gas traps in the context of the Pre–Jurassic complex associated with large Paleozoic uplifts of massive consedimentary type. Clarified the directions of search operations in the context of the deposits of the Pre-Jurassic complex (Paleozoic), structural complications representing "delays" on the monoclines of the sides, slopes of deflections and protrusions of bedrock are of search interest.

**Keywords:** complex, Paleozoic, structure, oil and gas trap, oil and gas content, hydrocarbons

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## СОЛТҮСТІК ҮСТІРТТІН ЮРАҒА ДЕЙІНГІ ДАМУ КЕЗЕҢІ ЖӘНЕ МҰНАЙ МЕН ГАЗДЫҢ ПЕРСПЕКТИВАЛАРЫ

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**Аннотация.** Мақалада Тұран плитасының батыс бөлігіндегі Солтүстік Үстірт өңірі құрылымының аймақтық құрылымдық-тектоникалық және геологиялық-геофизикалық ерекшеліктері келтірілген. Зерделенудің жай-күйі және өңірді игерудің негізгі кезеңдері, сондай-ақ соңғы жылдары жекелеген жергілікті

алаңдарда алынған жаңа деректер мен нәтижелер келтірілген. Жұмыстың мақсаты мұнай-газ әлеуетін бағалауға байланысты аймақтың дамуының Юра кезеңіне дейінгі геологиялық-тектоникалық құрылымдық ерекшеліктерін, шөгінділердің құрамын нақтылау болып табылады. Қолда бар материалдарды талдау және жалпылау нәтижелерін ескере отырып, зерттеудің барлық алдыңғы кезеңдерінде негізделген әдістемелік "тәсілдерге" баға берілді. Қаралып отырған аумақта Батыс-Арал және Шығыс-Арал бөліктерін аудандастырудың және бөлудің географиялық қағидатын пайдалануға байланысты жеткіліксіз болып табылған өңірдің өңірлік тектоникасына ұсынымдар ескерілді. Арал-Қызылқұм дислокация жүйесінің геоструктуралық жағдайына баға берілді. Шалқар ойысының құрылымдық элементтерінің мысалында Қошқарата және Тобебұлақ ойығы құрылысының моделіне ұсыныстар нақтыланды. Осыған сәйкес Солтүстік-Үстірт бүгілу және көтерілу жүйесі шегінде таралуы бар мұнай-газ жинақтаудың қарапайым аймақтарын дамыту туралы болжам жасалды. Бұл ретте іздестіру бұрғылау, сейсмикалық барлау, әлеуетті физикалық өрістердің аномалиялары, сыну тектоникасы элементтерінің үрдістері мен жайылуы деректерін кешендеу нәтижелері ескерілген. Құрылымдық жоспардың ерекшеліктері және ірі майысулар мен көтерулер (Бозашы және Ақтұмсық көтерілісі, қолтық-Құлажат, Барсакелмес, кеме жолы және Шалқар ойысы, Арыстанов және Мыңсуалмас сатылары) бөлінісінде мұнай-газдылықтың көріну сипаты нақтыланды. Көмірсутектердің белгілі бір фазалық құрамындағы мұнай мен газ жинақталуының аудандық таралуындағы заңдылықтар анықталды. Перспективалы жергілікті объектілердің алаңдық таралуы өңірдің өңірлік ерекшеліктерінің әсерімен айқындалады, оның ішінде: жергілікті құрылымдардың аймақтық жарылыстар трассаларына орайласуы, юра кешеніне дейінгі қимада мұраланған ірі көтерілістердің болуы. Жүргізілген зерттеудің негізгі нәтижелері палеозой шөгінділерінің жоғары перспективалылығын негіздеу болып табылады, олардың дамуы антиклинальды аймақтардың (білік тәрізді көтерілістер), ірі көтерілістердің (біліктер) іргелес иілімдері арасында аймақтық иілімдер мен шығыңқы жерлер (іргетас, палеозой) шегінде ауысудың қалыптасуына әсер етті. Жаппай конседиментациялық типтегі ірі палеозой көтерілістерімен байланысты юра кешені аясында мұнай мен газдың перспективалы жергілікті тұзақтарының спектрін кеңейту бойынша ұсыныстар негізделген. юра кешеніне дейінгі (палеозой) шөгінділер қимасындағы іздеу жұмыстарының бағыттары нақтыланды, борттардың моноклиналаларында, беткейлердің беткейлерінде және түпкі жыныстардың шығыңқы жерлерінде "кідірістер" болып табылатын құрылымдық асқынулар іздеу қызығушылығын тудырады.

**Түйін сөздер:** кешен, палеозой, құрылымы, мұнай мен газдың тұзағы, мұнай-газдылық, көмірсутектер

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## ДОЮРСКИЙ ЭТАП РАЗВИТИЯ И ПЕРСПЕКТИВЫ НЕФТЕГАЗОНОСНОСТИ СЕВЕРНОГО УСТЮРТА

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**Аннотация.** В статье описаны региональные структурно-тектонические и геолого-геофизические особенности строения региона Северный Устюрт в западной части Туранской плиты, приведено состояние изученности и основные этапы освоения региона, а также новые данные и результаты, полученные на отдельных локальных площадях в последние годы. Целью работы является уточнение геолого-тектонических особенностей строения, состава отложений на доюрском этапе развития региона в связи с оценкой перспектив нефтегазоносности. С учетом результатов анализа и обобщения имеющихся материалов дана оценка методическим «подходам», которые были в основе на всех предыдущих этапах изучения. Учтены представления о региональной тектонике региона, которые являлись недостаточно совершенными в силу использования географического принципа районирования и выделения Западно-Аральской и Восточно-Аральской части на рассматриваемой территории. Дана оценка геоструктурного положения Арало-Кызылкумской системы дислокаций. На примере структурных элементов Шалкарского прогиба уточнены представления на модель строения Кошкаратинской и Тобебулакской мульды. В соответствии с этим сделано предположение о развитии элементарных зон нефтегазоаккумуляции, которые имеют распространение в пределах Северо-Устюртской системы прогибов и поднятий. При этом учтены результаты комплексирования данных поискового бурения, сейсморазведки, аномалий потенциальных физических полей, трендов и простирания элементов разломной тектоники. Уточнены особенности структурного плана и характер проявления нефтегазоносности в разрезе крупных прогибов и поднятий (Бозашинское и Актумсыкское поднятие, Колтык-Кулажатский, Барсакельмесский, Судочий и Шалкарский прогибы, Арыстановская и Мынсуалмасская ступень). Выделены закономерности в площадном распространении скоплений нефти и газа определенного фазового состава углеводородов. Площадное распространение перспективных локальных объектов определяется влиянием региональных особенностей региона, в

т.ч. приуроченность локальных структур к трассам региональных разломов, наличие крупных унаследованных поднятий в разрезе доюрского комплекса. Основными результатами проведенного исследования является обоснование высокой перспективности палеозойских отложений, развитие которых влияло на формирование переходных между смежными прогибами антиклинальных зон (валообразных поднятий), крупных поднятий (валы) в пределах региональных прогибов и выступов (фундамент, палеозой). Обоснованы рекомендации по расширению спектра перспективных локальных объектов — ловушек нефти и газа в разрезе доюрского комплекса, связанных с крупными палеозойскими поднятиями массивного конседиментационного типа. Уточнены направления поисковых работ в разрезе отложений доюрского комплекса (палеозой), поисковый интерес представляют структурные осложнения, представляющие собой «задержки» на моноклиналях бортов, склонов прогибов и выступов коренных пород.

**Ключевые слова:** доюрский комплекс, палеозой, Северный Устюрт, структура, горизонт, ловушка нефти и газа, особенности строения, прогиб, нефтегазоносность, углеводороды

### **Introduction**

In regional tectonic terms, the northern Ustyurt defines a large tectonic block bordering the Caspian Basin as part of the western part of the Turan Plate and, together with the zone of the large Bozashinsky uplift, is part of the Ustyurt-Bozashinsky sedimentary basin (Akchulakov et al., 2009–2013; Akchulakov, 2015: 21–29). The region under consideration in tectonoformational terms represents a system of dislocations of the Upper Paleozoic and Upper Permian-Triassic age.

The region of Northern Ustyurt has long been considered an unpromising territory. In the 60s of the last century, industrial gas content of Paleogene deposits was revealed on a number of structures (Bazay, Shagyrlы-Shomyshty, Kyzыloy, Akkulkovskaya). For the first time industrial oil inflows were obtained in the area of Arystanovskaya in 1968 from Jurassic deposits. After that, there was a significant activity in the study of structures North Ustyurt at the local level and prepared them for exploratory drilling in the Upper Jurassic-Cretaceous part of the section. As a result, the areas of Amanzhol, Amanzhol Zapadny, Sharshikuduk, Beineu, Begesh, Sheluran, Kyryn, Karakuduk, Yeligazhi, Adamli, Ashchitaypak, Zhayylgan, Khorlyk, Astauoy, Kushata, Murynsor, Tasurpa, Manashi, Tereshkovskaya, Khakimovskaya, etc. were put into exploratory drilling (Volozh et al., 2016: 1–46).

According to the results of the exploratory work carried out in the Jurassic sediments, the Karakuduk, Kolytk, and Komsomolskoye oil fields were successively discovered. However, during the subsequent long period and in general, the statistics in obtaining positive results in the region remained low, which was a consequence of relatively uneven, and in some places very weak knowledge. The low degree of conditioning and data linking between individual large tectonic zones within the Northern Ustyurt, which, in turn, is characterized by a significant area, was also one of the factors that influenced the efficiency and effectiveness of prospecting during that period.

Historically, the northwestern part of the Northern Ustyurt (the Shalkar trough and the adjacent territory) belonged to the Northwestern and Northern Aral Sea, i.e. to the zones that were allocated earlier, taking into account their geographical location in relation to the Aral Sea. The Northeastern Aral Sea Region stood out even further to the east, and the Southern Aral Sea Region stood out on the southern coast of the Aral Sea (Gafarov et al., 2010: 261). The allocation of these geographical areas due to the lack of sufficient objective data on the regional structure was convenient and preferable, and subsequently predetermined the zoning of the entire Aral Sea region when justifying the prospects of oil and gas potential and assessing the hydrocarbon potential of this territory.

In the future, taking into account the gradual increase in the degree of study, to the west and east of the strip of the Aral-Kyzylkum dislocation system (hereinafter – AKSD), researchers identified the Western Aral and Eastern Aral parts of the Aral Sea region (Zholtayev, 2000: 13–23). This was based on differences in the features of the regional tectonic structure and the composition of the formation and lithological-stratigraphic complexes composing the section on both sides of the fault. At the same time, the position of the eastern limit of the Northern Ustyurt at the level of the Aral Sea remained ambiguous and completely uncertain. Nevertheless, as a result of geological exploration in the Mesozoic sediments of the Western Aral part of the Aral Sea region, the Akkulkovskaya, Kyzyluy and Bazoy gas deposits were discovered. An important result was the success of Uzbek geologists in discovering a number of new deposits in the Southern Aral Sea region. Thus, at the early stages of the study, part of the Northern Ustyurt in the eastern part belonged to the Aral Sea region.

Another fundamental feature of this part of the territory was the presence in the section of a powerful coarse-grained strata of the Upper Permian-Triassic age, which resulted from the interaction and collision of the passive margin of the ancient East European platform and the young Kazakh plate at the Paleozoic stage of development. According to seismic data, the filling thickness is about 5.0–6.0 km. The collision area of tectonic plates determines the geostructural position of the AKSD band. Later, based on the results of the compiled "Forecast Map of Kazakhstan's oil and gas potential" (2002) and the Project "Comprehensive study of sedimentary basins of the Republic of Kazakhstan" for the period 2009–2013 (hereinafter referred to as the KIOB RK Project), a clear justification was given for the border between the Northern Ustyurt (Ustyurt-Bozashinsky basin) and the Aral Basin, which is defined and runs along the AKSD strip.

From the point of view of contemporary ideas about regional tectonic features and the model of the internal structure of the section, according to the authors, there are quite objective reasons explaining the low efficiency of prospecting, the result of which is an ambiguous assessment of the prospects of oil and gas potential of the section the territory of Northern Ustyurt.

Among them, and at the core, it can be stated that the degree of study of the section is uneven in area and insufficient in depth of study (Babasheva et al., 2022: 55–73). Secondly, these are well-established ideas about the nature and formation composition of the lower Pre-Jurassic part of the section (Paleozoic, Triassic). It should be noted that

the Pre-Jurassic interval of the section was previously determined and presented as a single thickness due to the limitations of actual materials. A fairly clear identification of this stratum was largely limited by the objectively low level of technical support and the capabilities of geological and seismic methods. The allocation of Paleozoic formations in the Pre-Jurassic part of the section, as well as the boundaries between the Paleozoic and Triassic, was of a debatable nature, and in the context of individual regions, the Paleozoic complex was dated by the foundation. In general, in the context of the west of the Turan plate (Ustyurt-Bozashi, Mangyshlak), the researchers justified the seismic horizons "F" and "V". In turn, the "V" boundary in areas with a high degree of cut resolution and the presence of relatively more confident reflections inside the Pre-Jurassic strata corresponded to the lower part of the Triassic.

Thirdly, it was not possible to judge any differentiation in terms of the main geological and commercial characteristics and filtration and reservoir properties within the Pre-Jurassic strata between Paleozoic and Triassic sediments in terms of their conditions. And the Triassic range of the section was characterized mainly by the continental genesis of sediments. In this regard, the lower Pre-Jurassic part of the section has not been considered for a long time as a sufficiently promising direction of prospecting.

In comparison with the Northern Ustyurt region, in this respect, the main parameters of the lithological-stratigraphic section and paleogeographic features of the development of the adjacent territory of the Caspian Depression and Mangyshlak, respectively, from the north and south, are quite sharply contrasted (Volozh et al., 2013: 29–43). We assume that the prevailing ideas and such imperfection of the model of the structure of the Pre-Jurassic strata (along with the Jurassic-Cretaceous strata) in the context of the Northern Ustyurt have been a deterrent for researchers for a long time when planning prospecting and assessing the prospects of this territory. As a result, the currently available views on the model of the structure of the territory in question, in turn, do not receive the proper impetus for further improvement and new discoveries.

At the same time, despite the high percentage of negative results, search operations in Northern Ustyurt continued on separate structures as the standard data accumulated. In recent years, positive results have been obtained in the Tepke area, and the productivity area of the Akkulkovsko-Bazaiskaya gas accumulation zone has been expanded, in the cut of which oil inflows have been obtained for the first time (Akkulkovskoye and Kulbas areas). The detection data, taking into account the totality of accumulated geological and geophysical materials and the experience of prospecting, as well as the high degree of complexity of the internal structure, give reason to consider the region of Northern Ustyurt a promising territory. In this regard, in recent years, when assessing and preparing local objects, geological prospectors have set the main geological tasks, which include a detailed analysis and search for relationships in structural plans for the roof of the foundation, Paleozoic and Mesozoic strata, explaining the actual zonal nature of the manifestation of oil and gas (Azhaliev, 2016: 51–63). The new tasks also include a comprehensive study of the tectonic basis in order to clarify the conditions and geochemical features of sedimentation, formation and inheritance of lithological-facies sedimentation environments of the Northern Ustyurt block.

### **Research Material and methods**

When clarifying the features of the internal structure and assessing the prospects of oil and gas potential of the territory under consideration, the authors of the article involved the materials and results of the previously completed regional industry Project KIOB RK Project (Akchulakov, 2015: 21–29).

Taking into account the territory of the neighboring states of Kazakhstan and Uzbekistan, Kosbulakskiy, Shalkarskiy, Koltyk-Kulazhatskiy, Barsakelmesskiy, Sudochiy deflection, Aktumsykskiy uplift, etc. a single system of deflections is defined, which belongs to the Northern Ustyurt and, at the same time, is the western part of the vast Ustyurt plateau (Gafarov et al., 2010: 11–12). At the same time, the eastern part of the Ustyurt plateau is completely located within Uzbekistan and is represented as Eastern Ustyurt. In this regard, the considered region of Northern Ustyurt is the western part of the Ustyurt plateau, expanded in the north direction, which in the east, at the same time, "neighbors" through the AKSD strip with the Aral sedimentary basin. Taking into account these regional tectonic features, the Northern Ustyurt section on the foundation surface is considered as a single North Ustyurt system of deflections and uplifts. Major elements of the western part of the Ustyurt plateau are also the Samskiy and Koltyk-Kulazhatskiy bends, the Mynsualmasskaya step, the Amanzhol saddle (Fig. 1).

The block structure of the territory along the foundation is characterized mainly by the north-western (sublatitudinal) orientation of tectonic elements of the second order, there is a regular arrangement of deflections and transitional linear zones between them with higher hypsometric marks of occurrence of the same-age strata of the Paleozoic and Mesozoic in the mulds and areas of regional uplift. These "transitional" linear zones are represented by tectonic shafts, which, in turn, are markers and clearly record the contours of large deflections and their peripheral zones (see Fig. 1). The mark of the foundation roof in large deflections (Kosbulakskiy, Shalkarskiy, Koltyk-Kulazhatskiy) is minus 7–11 km. In the south direction (Barsakelmesskiy, Sudochiy deflection), the mark of the foundation is experiencing a rise in the isohips range from 5–7 to 3–5 km (Marabayev et al., 2005: 194).

In the process of handling the materials, the authors carried out work to clarify the nature of the occurrence of elements of the II-th order — large blocks representing deflections and protrusions along the foundation and Paleozoic complex. Also, the systematization of large blocks was carried out for the purpose of identifying structures of a relatively lower order within their limits: mulds, projections along the Paleozoic complex, shaft-like uplifts (see Fig. 1), which may be of interest in terms of substantiating promising local objects.

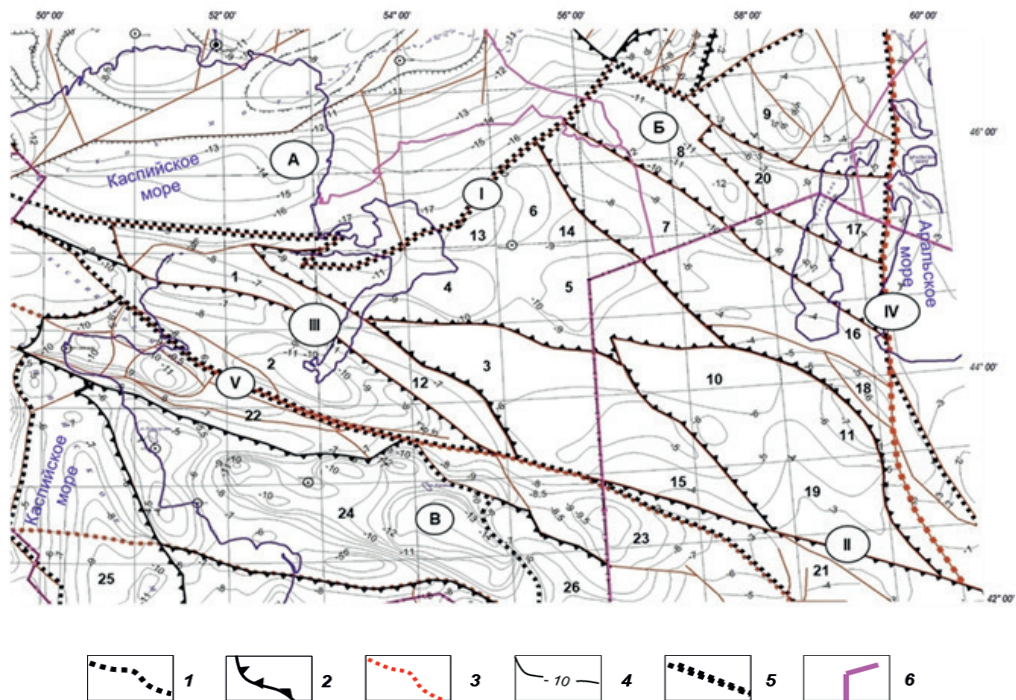


Figure 1. Diagram of the basement surface of the western part of the Turan Plate (according to Akchulakov et al.; 2009–2013)

1 – first-order structures / basins (A-Caspian region, B-Ustyurt-Bozashi, C-Mangyshlak); 2-contours of large basement blocks. Regional structures of the second order (1-North Bozashinsky salient, 2 – South Bozashinsky trough, 3-Arystanovsky stage; troughs: 4 –Kolytykskiy, 5 – Kulazhatskiy, 6 – Mynsualmass, 7 – Samskiy, 8 – Kosbulakskiy, 9 – Koshkaratinsky, 10 – Barsakelmesskiy; 11 – Sudochii; projections: 12 – Tokubai, 13 – Zhayylgan, 14 – Shagyrlı, 15 – Baichagy, 16 – Kassarminsky, 17 – Kulandinsky, 18 – Takhtakairsky, 19 – Kuanysh-Koskalinsky, 20 – Akkulkovskaya step, 21 – Karakum block, 22 – Central Mangyshlak zone, 23-Assake-Audansky trough, 24-Segendyk-Zhazgurli zone of protrusions and troughs, 25-Samur-Peschanomyssky block, 26-Tuarkyr uplift, 27-Samur-Peschanomyssky block); 3 – regional faults (I – North Ustyurt, II-Central Ustyurt, III – Takubai, IV-Aral – Kyzylkum, V - North-Karatau); 4 – isogypses along the foundation top, km; 5 – post-collision trans-regional shifts; 6 – state border

The foundation is composed of Riphean-Proterozoic and Lower Paleozoic formations, which are widely developed in the mountain structures of Bolshoy and Malyi Karatau, Bukantau, etc. (Zholtayev, 1997: 2–7). The formations were uncovered by single wells in the area northeast of the Shalkar trough (Zhaksybutash ledge). Green-colored metamorphosed sandstones and conglomerates are isolated in the section of the zone Basoi – Akkulkovskaya - Kyzylloi. Also, both presumably Precambrian and Paleozoic rocks have been established in the section. According to the data of wells G1 Kyzylloi, G-16 Bazayskaya, amphibolites and various metamorphic and crystalline shales were attributed to the Upper Proterozoic. The main geological formations are clearly visible on the given regional profile of the Arystanov stage – Shalkar trough (Fig. 2).



According to the available data, the territory and section of the North Ustyurt system of deflections and uplifts are characterized by high values of the propagation time of refracted waves (6000–6300 m/sec) and a mosaic pattern of the distribution of magnetic and gravimetric field anomalies. It can be assumed that the mosaic pattern of anomalies of potential fields is in good agreement with certain patterns in the areal distribution of basement rocks, characterized by variegation and change of lithological composition, their various genetic associations.

According to the results of high-precision aeromagnetic studies (Akchulakov et al., 2013: 260) in the section of the territory under consideration the main magnetoactive surface (hereinafter referred to as GMAP) is substantiated. The selection of this boundary contributed to a clearer interpretation of the section enclosed between the reflecting boundaries of F and V. As a result, a stable seismic boundary has been confidently identified in the section of the western part of the Turan plate – the reflecting seismic horizon "PZ", which was one of the main results of the Project of the RK CIOB and the systematic study of the region in recent years. In the context of the Northern Ustyurt, the mark of the roof of the Paleozoic complex varies from 3.5–5.0 km in the deflections to 0.8–2.5 km on the protrusions of the bedrock (Bozashinskoye and Aktumysykoye uplift) (Fig. 3).

The important features of the internal structure of the entire Lower Paleozoic-Triassic strata are the active manifestation of fault tectonics, the inherited development and the nature of the structural plan of the Paleozoic (PZ) and Triassic (V) strata. At the same time, it is noted that large deflections, mulds and raised areas, taking into account the general regional, mainly north-western strike at the level of the reflecting horizons PZ and V, will "inherit" the mosaic pattern of the structural plan from the foundation.

In paleotectonic terms, the area of joint of the large blocks formed in the Paleozoic, the Northern Ustyurt, the Urals and the Kazakhstan continent (the zone of the Akkulkovskiy and the Aral-Kyzylkum tectonic "seam") determines the position of the northern periphery of the western part of the Turan plate. In the south, the development of Mangyshlak was determined by intense stretching and compression deformations in the sublatitudinal rift zone along the ridge of the Karpinskiy and Mountain Mangyshlak.

Along the northern edge of the Ustyurt block, an extended South Embinsky rift was formed, the amplitude of which increased from west to east, from the area of the modern position of the Caspian Sea towards the Ural Paleocean (Zholtaev, 1997: 2–7).

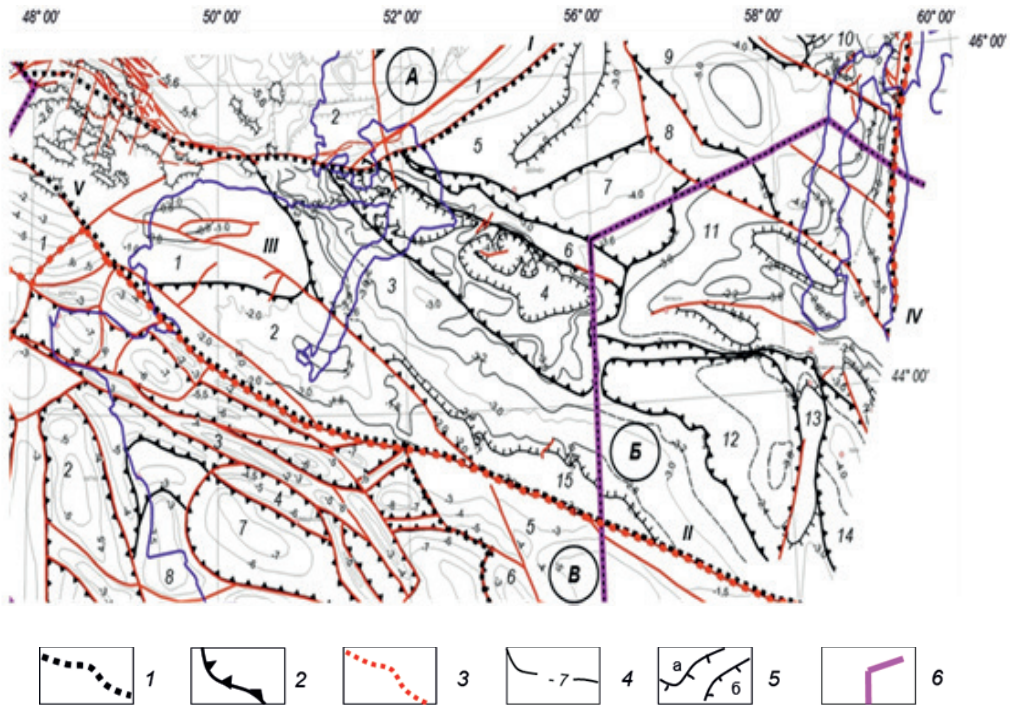


Figure 3. Structural diagram of the Ustyurt-Bozashinskiy basin on the surface of Paleozoic sediments (according to Akchulakov et al., 2009–2013)

1 – boundaries of elements of the I-th order / basins (A – Caspian, B – Ustyurt-Bozashinskiy, C – Mangyshlak); 2 – regional structures of the II-th order: the Caspian basin (1 – South Embin uplift, 2 – Kashagan-Tengiz uplift zone); Ustyurt-Bozashinskiy basin (1 – Bozashinskiy uplift, 2 – Yuzhno-Bozashinskiy deflection, 3 – Arystanovskaya step, 4 – Kolytk-Kulazhatskiy deflection, 5 – Mynsualmasskaya step, 6 – Amanzholskaya saddle, 7 – Samskiy deflection, 8 – Churukskaya saddle, deflections: 9 – Kosbulakskiy, 10 – Shalkarskiy, 11 – Aktumysk uplift, 12 – Barsakelmesskiy deflection, 13 – Kuanysh-Koskalinskiy (Alambeksky) shaft, 14 – Sudochiy deflection, 15 – Bashagyrskiy ledge); Mangyshlak basin (1 – Makhambet monocline, 2 – Peschanomysskiy trough, 3 – Beke-Bashkudukskiy shaft, 4 – Zhetybai-Uzen stage, 5 – Assake-Audanskiy trough, 6 – Tuarkyr uplift, 7 – Zhazgurlinskiy trough, 8 – Shell uplift); 3 – regional faults (I – North Ustyurt II – Central Ustyurt, III – Takubai, IV – Aral-Kyzylkum, V – North Karatau); 4 – isohypses on the roof of the Paleozoic complex / OG "PZ" (km); 5 – shaft-like uplifts (a) and muldy (b); 6 – state border.

In the Late Devonian-early Carboniferous, a trough of the same name formed over the rift, which was subsequently filled with a grauvac formation (D3-C1v1) up to 5 km thick. Presumably, these deposits form a section of the junction zone of the Caspian basin and Northern Ustyurt (areas of the Mynsualmass stage, Kosbulak and Shalkar trough). To the south, taking into account the widespread regional immersion of Jurassic-Cretaceous sediments, a single Upper Paleozoic-Triassic strata is distinguished in the section of the Northern Ustyurt. The preservation in the southern direction and the unity of the sedimentation conditions of the Upper Paleozoic-Triassic sediments accompanied the formation of the Samskiy, Barsakelmesskiy and Sudochiy trough. The

area of distribution of these deep deflections in the Northern Ustyurt and the territory to the south, on the eastern side, is limited by the meridional band of the AKSD (see Fig. 1, 2, 3). Directly, the AKSD is a complex combination of the Central Aral (Kulandinskiy), Zherlepesskiy, Karakol faults, which, in turn, form and are associated with linearly elongated projections of the foundation. According to the Paleozoic and Mesozoic complex, a significant tectonic shaft of the same name (the Arkhangelsk shaft) was formed in the AKSD strip.

Triassic deposits in most of the Northern Ustyurt (central, eastern and southern regions) characterize the orogenic stage of development and are the filling thickness. The overlying Jurassic-Cretaceous deposits are characterized by a platform formation. Regionally, the Jurassic deposits have a very similar lithological-facies composition and formation appearance throughout the basins of Western Kazakhstan. In the context of the Northern Ustyurt, this allows us to consider them as potentially oil and gas complexes (formations), which significantly expands both the list of promising structures and the range of various criteria for their justification.

Taking into account the position of the actual oil and gas accumulation zones (hereinafter – ZNGN), the general geological prerequisites and the scale of sedimentation in the Northern Ustyurt, quite high generation capabilities are expected in the "core" of large deflections (Kosbulakskiy, Koltyk-Kulazhatskiy, Shalkarskiy, Samskiy, etc.), with which the position and development of probable foci of HC generation can be associated (Sapozhnikov et al., 1990: 26–35).

These forecasts, in general, have been confirmed in recent years by the results of search operations in the Koltyk-Kulazhatskiy, Shalkarskiy, Barsakelmesskiy, Sudochiy deflection and at the Mynsualmasskiy stage. The analysis of seismic survey data and time sections in the Northern Ustyurt indicates a fairly high rate of sedimentation in the pre-Jurassic period. In the context of the Koshkaratinskaya mulda and the Kosbulak trough, the thickness of the Pre-Jurassic complex is 2–3 km and 4–5 km, respectively. Accordingly, these zones are distinguished by a wide stratigraphic range of productivity of the sedimentary section (Paleozoic, Jurassic, Cretaceous, Paleogene) and ZNGN Kyzyl-Akkulkovskaya, Kulbas, Bazayskaya, Shagyrlly-Shomyshty, Urga Severny, Karachalak, Akchalak, etc.

### **Result and discussion**

The nature of the location of the deposits and the identified structures in the plan indicates that they are confined to pronounced trends that determine the strike of large faults. The sections of the deposits are characterized by a multi-tiered placement of productive horizons, especially at the level of the Jurassic and Lower Cretaceous. With this in mind, for the territory under consideration, the zonal nature of the formation and placement of hydrocarbon accumulations differentiated by area and section is determined, with their confinement to structures of the II-th order. It is assumed that the processes of vertical migration and redistribution of hydrocarbons have a dominant influence on the formation of oil and gas deposits. Taking into account the spatial position, we note that a number of deposits in the west of the Turan plate contain very significant and gigantic volumes of hydrocarbons (Uzen-Karamandybas, Kalamkas,

Karazhanbas, Tenge-Zhetybai, Shagyrly-Shomyshy), which are "disconnected" from each other by large distances. In addition to the regional difference, attention is drawn to a separate case with a rather significant heterogeneity of HC clusters among themselves at the local level, i.e. within the same tectonic zone. So, on the example of the Bozashinskiy uplift, large accumulations with high-viscosity oil (Karazhanbas, Karazhanbas Severny, Bozashi Severniy) "coexist" with oil and gas accumulations (Kalamkas, Arman, Karaturun group). At the same time, these deposits differ sharply among themselves and in terms of hydrocarbon reserves.

The displacement and redistribution of significant amounts of HC as a result of lateral migration seems less likely. On blocks with deposits in Mesozoic and Cenozoic sediments, the probability of productivity of deposits of the Pre-Jurassic complex is high.

The possibilities of refining and forecasting prospective objects. The features of the location in the plan of the Koshkaratinskaya and Tobebulak mulda (the southern part of the Shalkar trough) determine the position of large shaft-like uplifts (Kyzyl-Akkulkovski, Bazayskiy and Kulandinskiy shafts), which, in turn, are "transitional" structural elements from the areas of deflection to uplifts in the contour of the main Shalkar trough. A more detailed analysis of the tectonic structure and the zoning of structures of the second order shows that this regular arrangement of shaft-like uplifts in the contours of deflections is, in general, characteristic of the entire Northern Ustyurt (Babasheva et al., 2022: 55–73) (Fig. 4). Similarly, the "transition" zone on the eastern slope of the Tobebulak mulda is characterized by a contrasting development of the Kulanda shaft along the isohypse minus 1.6 km, with an amplitude of 250 m. These geological-geophysical and structural-tectonic prerequisites allow us to consider the Kulanda shaft as a prospective object.

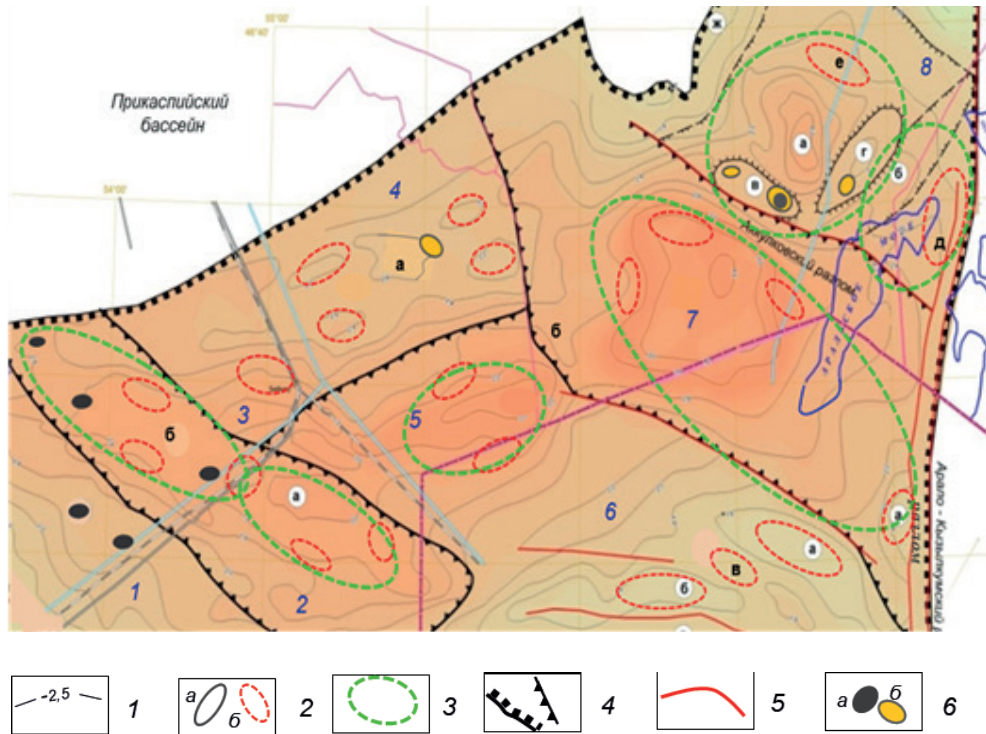


Figure 4 – Northern Ustyurt. Fragment from the structure map along the III reflecting horizon and geological and geophysical prerequisites for forecasting and formation of oil and gas accumulation zones

1 – isohypses along the III reflecting horizon, 2 – shaft-like uplifts (a – established by prospecting, b – forecast prospective), 3 – contour of the oil and gas collecting area (elementary zone of oil and gas accumulation), 4 – boundaries of upper-order elements, 4 - faults, 5 – deposits (a – oil, b – gas). Tectonic elements: 1 – Arystanov stage, 2 – Kolytk-Kulazhat trough (muldy: a – Kulazhat, b – Kolytk), 3 Amanzhol saddle, 4 – Mynsualmass stage (a – Shagyrlin uplift), 5 – Samskiy trough, 6 – Aktumysk ledge (shafts: a – Kassarminskiy, b – Kharoysky, b - Baiterek), 7 – Kosbulak deflection (a – Aral-Kyzylkum shaft, b – Churuk saddle), 8 – Shalkar deflection (a – Koshkaratinskaya mulda, b – Tobebulak deflection; shaft-like uplifts: b - Kyzyluy-Akkulkovskoye, g – Bazayskoye, d – Kulandy, e – Zhaksybot, w – Shoshkakul monocline)

The northern side of the Koshkaratinskaya mulda at the level of isohips minus 2.4–2.6 km is characterized by a minor structural complication in the form of a small-sized arch. At the same time, taking into account the general nature of the structure, at this site it is possible to assume the development of a large shaft-like uplift (Zhaksybot) along the isohypse minus 2700 m, by analogy with the Kyzyl-Akkulkovsky and Bazai shaft-like uplifts complicating the eastern and southern slopes of the mulda, respectively (see Fig. 4). In this regard, the shaft-like rise of the Zhaksybot, located together with the Kyzyl-Akkulkovsky and Bazaysky shaft along the contour of the Koshkaratinskaya mulda, should also be considered as a prospective search object, the amplitude of the rise can be 200 m or more. The Koshkarta mulda, in turn, determines the oil and gas collection

area for the formation of oil and gas accumulations (Kyzyluy-Akkulkovskoye and Bazayskoye). Similarly, it seems that the allocation of an oil and gas collecting area in the contour of the Tobebulak mulda, within which the trap was filled with hydrocarbons in the section of the Bazai shaft and, a deposit is predicted on the prospective rise of the Kulanda.

Regional structures controlled the conditions, thickness and composition of sediments, and the facies environment of sedimentation. The internal structure of large deflections, in turn, was complicated by variously amplitude faults of a lower order. Inside the deflections, especially in the central and near-axial parts, slightly "upturned" areas and zones of "subsidence of sedimentary strata" were formed, which, as can be seen, were initiated respectively by the processes of stretching and squeezing, presumably contributed to the formation of shaft-like uplifts along the perimeter of the deflection zones on the example of the Koshkaratinskaya mulda.

As can be seen from the materials of regional studies, to a large extent the pre-Jurassic stage of sedimentation is characterized by the inherited development of the structural plan for the reflecting horizons PZ, V and III. We believe that in the conditions of the Northern Ustyurt, the "through" nature of the formation of large structural elements influences and determines the genesis and development of shaft-like uplifts and local structures, the presence of the above-mentioned favorable structural and tectonic prerequisites determines the prospects of local structures and large shaft-like uplifts uniting them. In conditions of consedimentary and inherited development, an increase in the depth of occurrence can provide an expansion of the spatial parameters of objects. Accordingly, at the lower level of the section (Paleozoic, Triassic), while maintaining other geological characteristics, relatively more significant scales and volumes of oil and gas accumulation can be expected, in comparison with the upper intervals of the section (Jurassic, Cretaceous and Cenozoic).

In the section of shaft-like uplifts, shallow occurrence and significant thickness of Paleozoic deposits (Pre-Jurassic complex) are noted, which can be considered as an additional factor that increases the forecast and prospects of uplifts in the section of the Zhaksybot shaft, Kulanda and the Aral-Kyzylkum shaft.

To the south, in the north-western orientation, the Kosbulak trough stands out. Regional faults quite clearly define the contours of tectonic elements of the second order. The contour of this deflection in the northeast, east and southeast determines the position of the Akkulkovsky, the Aral-Kyzylkum shaft and the Chikuduk saddle, respectively.

In the south-west of the Northern Ustyurt (Eastern Ustyurt), the Kuanysh-Koskalinskiy shaft, located between the Barsakelmesskiy and Sudochiy deflection, stands out in the meridional orientation (Murzagaliyev, 2004: 28–31). This structural position of the Kuanysh-Koskalinsky shaft was obviously optimal and favored the formation of hydrocarbon deposits with industrial conditions and structures with direct signs of oil and gas potential.

Along the surface of the seismic horizons PZ and V, respectively, along the isohypse minus 6000 and 3200 m in the central part of the Northern Ustyurt, the Aktumysyk ledge

is isolated. In the relief of the Paleozoic strata, a large ledge, in turn, at the level of isohips minus 2400–2800 m is complicated by shaft-like uplifts (Kassarminskiy, Bayterekskiy, Kharoyskiy, Takhtakairskiy shaft). In the contours of these shaft-like elevations, local objects are predicted, the genesis of which may be associated with traps in places of structural complications on monoclines and sides of large deflections and elevations. Obviously, these traps will be characterized by a non-anticlinal type of structure and morphology, the study of which has become increasingly relevant in recent years.

### **Conclusions**

The analysis of the structural plan and features of the tectonic structure of the Northern Ustyurt allow us to draw the following important conclusions.

1. Taking into account the existing regional structural features noted by the results of exploratory studies of previous years, the territory of Northern Ustyurt remains a poorly studied territory due to the lack of full-fledged structural structures and sufficiently objective criteria developed to assess the prospects of the territory at the local level. In these conditions, in the future, new opportunities in the assessment of effective directions of exploration work are associated with an increased technical level of interpretation of geological and seismic materials and aggregation.

2. New drilling and seismic data and data aggregation, taking into account the existing uneven and sometimes weak knowledge, make it possible to clarify and generalize ideas about the regional structure and the main stages of the formation of the main structural elements of the second order. In order to clarify the regional and structural position and structure of elements of various orders, the possibilities of comparative analysis of individual zones are expanded, due to a differentiated and integrated approach in assessing the structure and prospects of the section at the pre-Jurassic stage of development.

3. The Paleozoic complex as part of the Pre-Jurassic deposits of the Northern Ustyurt is justified as a new direction of exploration. The forecast of oil and gas deposits in the Paleozoic complex is based on the results of the refinement of the internal structure and features of the structural and tectonic plan, the allocation of large search objects associated with the uplifts of the inherited consedimentary nature of development. The pre-Jurassic stage of development was characterized by the formation of the North-Ustyurt system of deflections and uplifts, which ensured the development and structural growth of large local uplifts.

4. The development of large blocks of the North-Ustyurt system of deflections and uplifts was Samskiy, Barsakelmesskiy and Sudochiy deflection. The areas of predominant oil and gas and oil accumulation correspond to the Bozashinskiy uplift and the Yuzhno-Bozashinskiy trough. By analogy with the Bozashinskiy uplift, oil and gas and oil deposits are predicted within the Aktumysk uplift. The forecast of mainly oil deposits is associated with the Koltyk-Kulazhat trough and the Arystanov stage. In the context of the Shalkarskiy (Koshkaratinskaya and Tobebulakskaya mulda) and the Kosbulakskiy trough, deposits of gas and oil and gas composition are expected separately.

5. The available factual material allowed us to substantiate favorable structural-tectonic and geological-geophysical prerequisites that allow us to expand the range of

prospective local objects and clarify the directions of prospecting and exploration for the coming years. According to the Meso-Cenozoic complex of sediments, shaft-like uplifts and non-structural objects on monoclines and sides of large deflections will have the main distribution among prospective objects. Shaft-like uplifts are also of interest, in the context of sediments that encase and complicate the slopes of the protrusions of the basement and Paleozoic. In the context of the Paleozoic complex, oil and gas prospecting interest is associated with large uplifts of a massive consedimentary style of development.

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