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ҚАЙЫРЫМДЫЛЫҚ ҚОРЫ HALYK CHARITY FOUNDATION

«ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫ» РҚБ
«ХАЛЫҚ» ЖҚ

# ХАБАРЛАРЫ

# ИЗВЕСТИЯ

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

# N E W S

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## 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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# SOME ASPECTS OF GEOLOGICAL STUDY OF SUBSALT SEDIMENTS OF THE SOUTHERN URAL-VOLGA INTERFLUVE OF THE CASPIAN BASIN

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**Abstract.** The subsalt sediments of the southern part of the Ural-Volga interfluve are poorly studied by seismic exploration, except for the Imashevskoye, Imashevskoye Yuzhnoye and Novobogatinskoye uplifts, where 2D and 3D work traced reflecting horizons to depths of 8.0 km and identified promising targets in the Lower Permian-Carboniferous-Devonian sediments. Carbonate deposits of the Carboniferous were penetrated by single wells. Most of the drilled wells did not reach the projected depth, and there is a discrepancy between seismic and drilling data. Given the geological risk and high cost of drilling wells 6500m and more deep, it is necessary to clarify the structural features of these sediments on the basis of full-fledged MOGT-3D data and a more realistic velocity model of the medium,

and to map the zones of development of potentially highly productive fracture-hypergene reservoirs in the Paleozoic strata using 3D seismic data.

**Keywords:** the Ural-Volga interfluve, prospects for the oil and gas potential of subsalt deposits, the Imashevskoye Yuzhnoye uplift, Novobogatinsk

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## КАСПИЙ МАҢЫ ОЙПАТЫНЫҢ ОҢТҮСТІК ЖАЙЫҚ-ЕДІЛ САҒАСЫНЫҢ ТҰЗАСТЫ ШӨГІНДІЛЕРІНІН ГЕОЛОГИЯЛЫҚ ЗЕРТТЕУДІҢ КЕЙБІР АСПЕКТІЛЕРІ

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**Аннотация.** Имашев, Оңтүстік Имашев және Новобогат көтерілімдерін қоспағанда, Жайық-Еділ аралықтарының оңтүстік бөлігінің тұзасты шөгінділері сейсмикалық барлаумен нашар зерттелген, мұнда 2Д және 3Д жұмысы 8,0 км тереңдікке дейін шағылыстыратын горизонттар және төменгі пермь-карбон-девон шөгінділеріндегі объектілер анықталған. Карбонның карбонатты шөгінділері жалғыз ұңғымалармен енген. Бұрғыланған ұңғымалардың көпшілігі жобаланған тереңдікке жете алмады, сейсмикалық барлау мен бұрғылау мәліметтері арасында сәйкессіздік бар. Тереңдігі 6500 м

және одан жоғары ұңғымаларды бұрғылаудың геологиялық тәуекелі мен жоғары құнын ескере отырып, бұл кен орындарының құрылымдық ерекшеліктерін жан-жақты ЖТНӘ-3Д деректері және қоршаған ортаның неғұрлым шынайы жылдамдық моделі,. 3Д сейсмикалық барлау материалдарын пайдалана отырып, ықтимал жоғары өнімді жарықшақты-гипергенді коллекторлардың даму аймақтарының палеозой қалыңдығында картаға картаға түсіру негізінде нақтылау қажет.

**Түйін сөздер:** Жайық-Еділ сағасы, тұз асты шөгінділерінің мұнай-газдылығы перспективалары, Оңтүстік Имашев көтерілісі, Новобогат

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## НЕКОТОРЫЕ АСПЕКТЫ ГЕОЛОГИЧЕСКОГО ИЗУЧЕНИЯ ПОДСОЛЕВЫХ ОТЛОЖЕНИЙ ЮЖНОГО МЕЖДУРЕЧЬЯ УРАЛ-ВОЛГА ПРИКАСПИЙСКОЙ ВПАДИНЫ

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**Аннотация.** Подсолевые отложения южной части междуречья Урал-Волга изучены плохо сейсморазведкой, за исключением поднятий Имашевское, Имашевское Южное и Новобогатинское, где работами 2Д и 3Д прослежены

отражающие горизонты до глубин 8,0 км и выявлены перспективные объекты в нижепермско-каменноугольных-девонских отложениях. Карбонатные отложения карбона вскрыты единичными скважинами. Большинство пробуренных скважин не достигли проектируемой глубины, наблюдается расхождение данных сейсморазведки и бурения. Учитывая геологический риск и высокую стоимость бурения скважин глубиной 6500м и более, необходимо уточнение структурных особенностей этих отложений на основе полноценных данных МОГТ-3Д и более реалистичной скоростной модели среды, картирование в палеозойской толще зон развития потенциально высокопродуктивных трещинно-гипергенных коллекторов с использованием материалов сейсморазведки 3Д.

**Ключевые слова:** междуречье Урал-Волга, перспективы нефтегазоности подсолевых отложений, поднятие Имашевское Южное, Новобогатинское

**Introduction**

In the subsalt complex of the southeastern rim of the Caspian Depression during the years 1980-2000, significant and moderate hydrocarbon deposits were discovered - Tengiz, Kashagan, Aktoty, Kayran, Ansagan, Tolkyn. These areas of oil and gas accumulation are known for their well-explored carbonate reservoirs lying at depths of 4000–5500 meters, and invaluable geological insights into their structure and hydrocarbon content have been gained. Additionally, limited oil and gas reserves have been found in certain traps within this territory, such as the Tortay, Ravinnoye, and Saztobe deposits.

The subsalt sediments in the Ural-Volga interfluve remain less studied due to their deep occurrence and complex structure. The study of pre-salt sediments here began in the 1980s with seismic exploration by MOU and CDP. The adjacent territory with the Astrakhan uplift was mainly studied. Thus, in 1980-81, the Caspian Geophysical Survey of the Caspian Sea was carried out by the Caspian Geophysical Survey. In 1980-81, the Caspian Geophysical Expedition (GE) together with NVNIIGG (Saratov) carried out experimental-methodological work along two profiles in order to improve the methodology of tracing the basement and subsalt horizons. The studies were carried out by the method of wide profile CDP with the use of overhead charges in combination with electrical survey MTZ, high-frequency gravity survey, non-longitudinal profiling of MPW and geochemical studies in special boreholes. As a result of the works performed along the line Astrakhan arch – Zavolzhsky trough - Kobyakovskiy shaft the main reflecting horizons (RH) were traced: F, $P_3$ ($PP^1$ ), $P_2$ ($IP^1$ ), $P_1$ , characterizing the structure of the basement, the lower horizons of the Middle Iranian sub-basin of the Upper Devonian, the roof of the Bashkirian deposits of the Middle Carboniferous and the bottom of the saline deposits of the Kungur - the roof of the Lower Permian. The foundation in the southwestern part of the Pre-Caspian depression in the vaulted parts of the Astrakhan and North Caspian uplifts is traced at depths from 7.5 to 8.0 km.

**Materials and methods**

During the same years, the Guriev Geophysical Expedition (GGE) conducted detailed seismic surveys in the Kazakhstani part by CDP, as a result, a significant uplift named the Imashevsky was identified along the subsalt reflecting horizons P1-P2. This uplift stretches from northwest to southeast, measuring 35 by 3.5–7.0 kilometers. It is further complicated by local structures such as the Corduan, Kotyaevskaya, and Shortanbayskaya.

In 1984–1990, CDP seismic studies were continued in this area, and structural maps were constructed for the reflecting horizons $P_3$ (roof of the Dodevonian complex) and $P_D^2$ , (roof of the Eifel- Lower fran Devonian complex), $P_2$ - roof of the Middle Carboniferous sediments, which made it possible to illuminate the internal structure of the Devonian-Lower Permian complex of rocks and estimate its thickness. A number of subsalt rises were identified along these horizons - Taskuduk (on the territory of the Russian Federation), Kyzyloba, Kum Northern, Shyl Southern, Kazan Eastern (Fig. 1). Simultaneously studied and Mesozoic-Cenozoic sediment complex. The identified structures along the $P_3$ horizon on the Astrakhan uplift lie at depths from 6.0 to 6.4 km, and on the eastern slope much deeper, from 6.6 to 6.8 km.

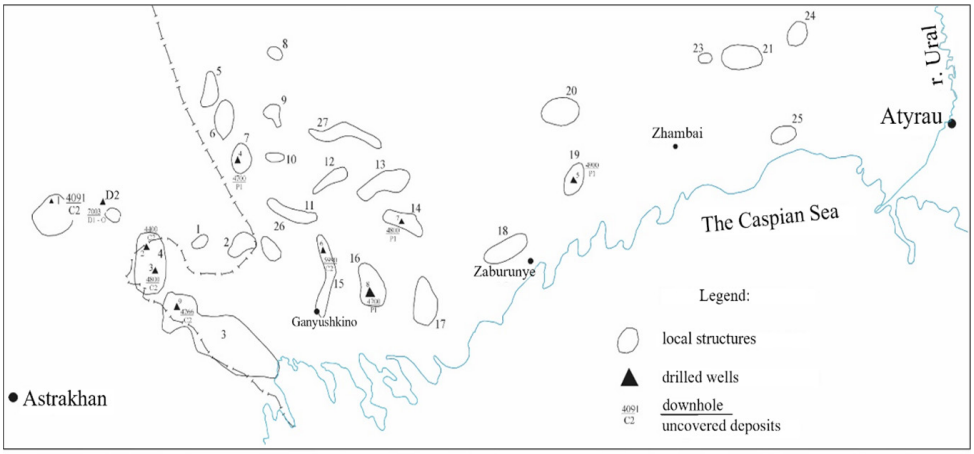


**Figure 1. Map of local structures of the subsalt complex of the Ural-Volga interfluve**

*Local structures:* 1 – Taskuduk, 2 – Kazan, 3 – Imashevskaya Southern, 4 – Imashevskaya, 5 – Koksazdy, 6 – Kumtobe, 7 – Kum Northern, 8 – Murynshyk, 9 – Karakuduk, 10 – Shil Northern, 11 – Shil Southern, 12 – Zhanatok, 13 – Peschanoye, 14 – Saryshagyl, 15 – Kobyakovskoe, 16 – Alga, 17 – Oktyabrskoye, 18 – Khaburunye, 19 – Manash, 20 – Mynteke Northern, 21 – Novobogatinsky, 22 – Western Novobogatinsky, 23 – Sugur, 24 – Tegen, 25 – Kamyshitovy, 26 – Kazan Eastern, 27 – Cliff.
*Wells drilled:* 1 – 26 Astrakhanskaya, 2 – G-4 Imashevskaya, 3 – P-1 Corduan, 4 – P-1 Kum, 5 – P-1 Manash, 6 – P-1 Kobyakovskaya, 7 – P-1 Saryshagyl West, 8 – P-1 Alga, 9 – IYUB Imashevskaya Southern.

In the same years and in the following years the subsalt sediments of the southern part of the Interfluve were also studied. Regional and site works of CDP revealed structures Manash, Saryshagyl, Peschanoye, Kobyakovskaya, Alga, Oktyabrskoye, Zaburunye, Manash, Mynteke North, occurring along the reflecting horizon $P_3$ at depths from 6.3 to 6.6 km, and in flexed parts - from 7.0 to 7.6 km.

Particular attention was paid to studies of the Ural-Volga interfluve on the $P_1$ and $P_2$ reflecting horizons. The structures identified on the $P_3$ horizon were also traced on the overlying subsalt horizons. According to seismic data (reflecting horizons $P_1$ - $P_2$ ) and drilling, the carbonate bed in the vault of the Astrakhan Rise lies at depths of 3.7–4.0 km, dipping gently to the east; in the south of the Interfluves, the reflecting horizon $P_2$ is recorded at 5.2–5.4 km.

**Results**

On the territory of the Republic of Kazakhstan the search for carbonate deposits and associated oil and gas deposits by drilling deep wells deeper than 4000 meters began in the 80s. In 1984–1987 deep and parametric wells were drilled near the coast: Kazan East P-1, Korduan P-52, P-2, Imashevskaya G-4, Kobyakovskaya P-1, G-2, Manash P-1, Sarshagyl Zap. P-1. Not all of them fulfilled the tasks set at that time.

An analog of the productive horizon of the Astrakhan field was penetrated in the G-4 Imashevskaya well at a depth of 4012–4088m. The rocks are composed of dark gray organogenic-clastic, detrital limestones of the Bashkirian stage of the Middle Carboniferous. In the lower parts of the horizon the sediments are represented by clayey limestones and dolomites. The section also contains limestones of fine-olithic, biogenic (biohermic by algae), lumpy, clotted, recrystallized and denuded, with rare foraminifera, and intensely bituminous. The thickness of the Bashkirian-age sediments on the Astrakhan arch varies from 130–290 m, on the eastern slope – from 156 m (well 4 Imashevskaya) to 224 m (well P-2 Korduan). The remaining wells penetrated subsalt terrigenous Assel-Sakmar sediments to a shallow depth or were stopped in the lower parts of the Kungurian age. Thus, Lower Permian rocks were uncovered in the Kazanskaya East P-2 well (Yatskevich, 1991), carbonate-terrigenous Assel-Sakmar age sediments were revealed in well P-2 Korduan at the depth of 4050–4187m, and above - Artinsk sediments 58 m thick. The section is represented below by bituminous clayey-siliceous, spotted-limestone deep-water rock of dark gray, almost black color, dense, firm, intensely fractured with abundant inclusions of the smallest radiolarians and clusters of the finest spiculiforms, with rare foraminifera. Further there is an alternation of limestones, clay-siliceous carbonate rocks and mudstones. Limestones are dark gray to black with greenish tint, dense, enriched with bituminous and pyrite material, with veins filled with gypsum. The argillites are light gray, thinly layered, slightly bituminous. Further up the section is composed mainly of clays and siliceous-clayey rocks. Clays are gray, dark gray with a greenish tinge, silty, calcareous, micaceous, dense, layered, strongly fractured, with inclusion of charred plant remains and siliceous formations (radiolarians). Siliceous-clayey rock of dark to black color, bituminous, dense, strong, rare low thickness interlayers of sandstones and siltstones of fine-grained, micaceous on clay-carbonate cement with ORO inclusions. In places there is an alternation of dark gray dense mudstones and dark gray fine-grained siltstones with numerous accumulations of black carbonaceous plant detritus (Iskuzhiev et al., 1987 :25–29).

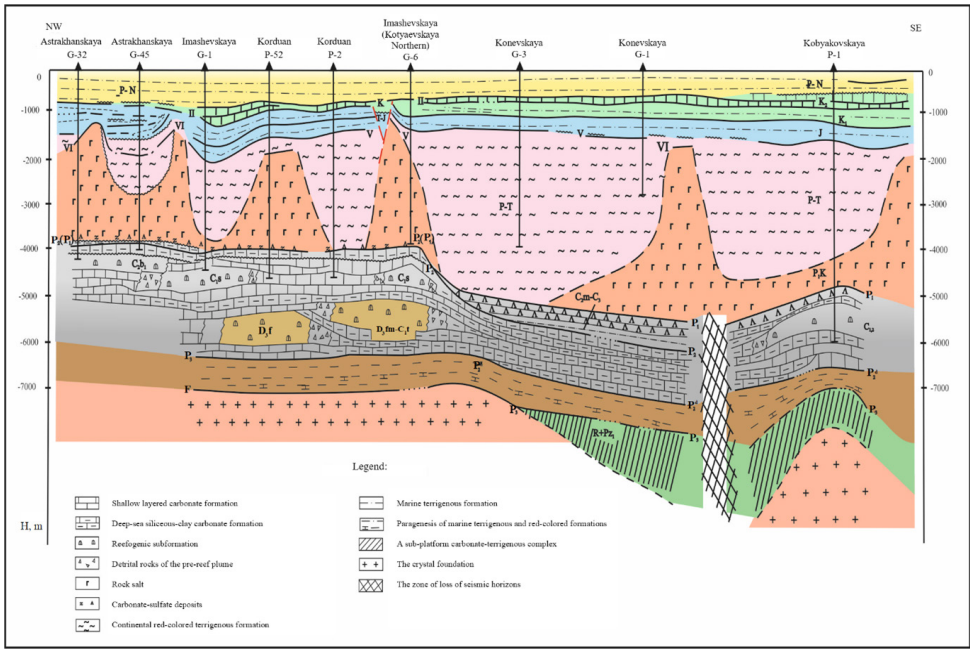


Figure 2 - Geologic-geophysical profile along the line Astrakhansky arch - Kobyakovskoe uplift (Iskuzhiev et al., 1987 :25–29).

Wells G-2 Kobyakovskaya, G-1 Alga, G-1 Manash uncovered low thickness deposits of the Assel-Artinskian Stage (from 60 to 137 m), composed mainly of siliceous-clayey rocks. For various reasons, the drilled wells did not reach the designed depths and horizons, which turned out to be much deeper. The wells were subsequently abandoned. Thus, in the southwestern part of the Ural-Volga interfluve in the subsalt sediments there are two types of section - "Astrakhansky" and "Mezhdurechinsky" (Daukeev, 2002: 19–20).

In 1990–96, parametric well P-1 Novobogatinsky was drilled on the Novobogatinsky Paleozoic uplift, Liman section. The design depth of the well was 7000 m, the design horizon was Middle Devonian. However, the actual depth of the well is 6094 meters, the horizon at the bottomhole is Kungurian Lower Permian. Due to technical and economic reasons the well did not penetrate pre-salt deposits and remained bottom-hole in saline deposits. The well was liquidated for technical reasons.

Thus, the sediments of the subsalt complex in the study area remained unstudied.

Commercial gas content was established only at the Imashevskaya structure in 1986, when a commercial inflow of gas and condensate was obtained in well G-4 from the 4012-4088 m interval in the North Keltmen horizon of the Bashkirian stage. Gas flow rates at 10 mm diaphragm reached 316 thousand $m^3$/day, condensate flow rates – 89.9 $m^3$/day. Stable gas condensate yield amounted to 240 $cm^3/m^3$. During

drilling of well P-52 Corduan, signs of oil and gas content were noted in the depth interval of 3715–3789 m and below the depth of 3954 m along the entire borehole. Methane (up to 24 %) and carbon dioxide (up to 18.7 %) were noted in the gas. The reservoirs in the oil-and-gas bearing complexes composed of carbonate rocks are limestones and dolomites; the reservoir type is fractured. In well P-2 Corduan the core material from the depth of 4174 m showed condensate odor and luminescent glow of light bitumoids. In the interval of 4424-4448 m, limestone with weak oil impregnation was lifted.

Seismic exploration in the Ural-Volga interfluve was intensified after 2001. During this period, parametric wells Volodarskaya-2, Devonskaya-2, Pravoberezhnaya-1 with a depth of 6.0–7.0 km were drilled on the Astrakhan uplift in Russia (Yu et al., 2008: 221).

The deepest well in the southwest of the Caspian depression Devonskaya-2 was drilled in 2003 to a depth of 7003 m, which penetrated conglomerates, gravelites, sandstones with argillite interbeds in the lower part of the section in the interval 7001–7003 meters. Above, sandstones of different color with inclusion of pyrite and glauconite were identified. The rocks are probably of Lower Devonian-Ordovician age [4]. In the lower part of the borehole section carbonate-terrigenous sediments of the Lower, Middle and Upper Devonian with a thickness of 900 m are revealed. The carbonate stratum of the Middle Franian-Bashkirian age with a thickness of 2160 m lies above it. During testing of reservoir beds composed of sandstones in the interval of 6450–6522 m, a gas inflow of 10 thousand m3 /day was obtained using 1.98–1.58 mm diameter fittings (Yu et al., 2008: 221). The gas is sulfurless. As it is known, the Astrakhanskoye field is a gas-condensate field, productive are organogenic carbonate deposits of the Bashkirian stage, occurring at depths from 3740 to 4130 meters. The deposit is controlled by the isohypsis of -4200 meters. The percentage of gas varies from 75 to 85 %, condensate - from 10 to 15 %, oil - from 5 to 10 %. The hydrogen sulfide content in gas reaches 21 %. Small oil deposits are expected to be found in some wells of the Astrakhan arch. An example is the Volodarskaya well No. 2, where oil inflows were obtained from the Upper Devonian (Famennian) sediments from the depth of 5960 m (Yu et al., 2008: 221). The works on search for oil and gas deposits in Devonian sediments in the Astrakhan uplift did not lead to major discoveries, but they proved that the Devonian section is promising.

The Lower Carboniferous Serpukhov-Visean sediments have also been studied in detail in the Astrakhan uplift. The rocks are characterized by variability of filtration-capacity properties of rocks over the area and section. Thus, in the Zavolzhskaya-3 well during testing of the Aleksin sediments in the depth interval of 4250–4304 m a gas inflow of up to 20 thousand $m^3$ /day was obtained. The reservoir is represented by dolomites and limestones with open porosity varying from 9.1 to 27.9 % and permeability from $32x10^{-15}$ to $210x10^{-15}$ $m^2$. In the neighboring wells the reservoir is characterized by lower qualities.

On the eastern slope of the Astrakhan Uplift in pre-salt sediments in 2006–2008,

reflecting horizons $P_3$, $P_2d$, $P_2'$, $P_2$ ($P_1$) revealed the large South Imashevskoe uplift, complicated by the summits "A", "B", "C", "D", "E". The obtained materials confirmed the earlier assumptions about the continuation of the Astrakhan carbonate platform to the southeast (Iskuzhiev et al., 1987: 25–29; Daukeev, 2002: 19–20; Yu et al., 2008: 221). The Imashevskoye and Imashevskoye Yuzhnoye uplifts are located 12 km apart; these two structures are separated from each other by a low-amplitude trough traceable through Paleozoic sediments.

In 2012, re-processing and re-interpretation of 2D and 3D MOGT seismic data were carried out for the South Imashevskaya exploration area, as well as analysis of drilling results at the neighboring Imashevskoye and Astrakhanskoye fields. As a result, the geological structure of subsalt sediments was clarified up to a depth of 6500 m, and promising targets were identified.

For drilling of the prospecting well IY-1 the top "B-1" was chosen, which is limited by the isohypsis of minus 4050m at the $P_2$ horizon and has the form of a brachyantiocline extending in the north-west direction. The vault of the structure, judging by structural constructions, is located at minus 3825m. The dimensions of the structure are 2.6 x 1.5 km, amplitude - 75m. The IUB-1 well, drilled in 2013, was placed in the north-western, pre-salt part of the structure. The roof of subsalt sediments in this well was penetrated below, at a depth of 4104m, which indicates a discrepancy between the drilling and seismic data.

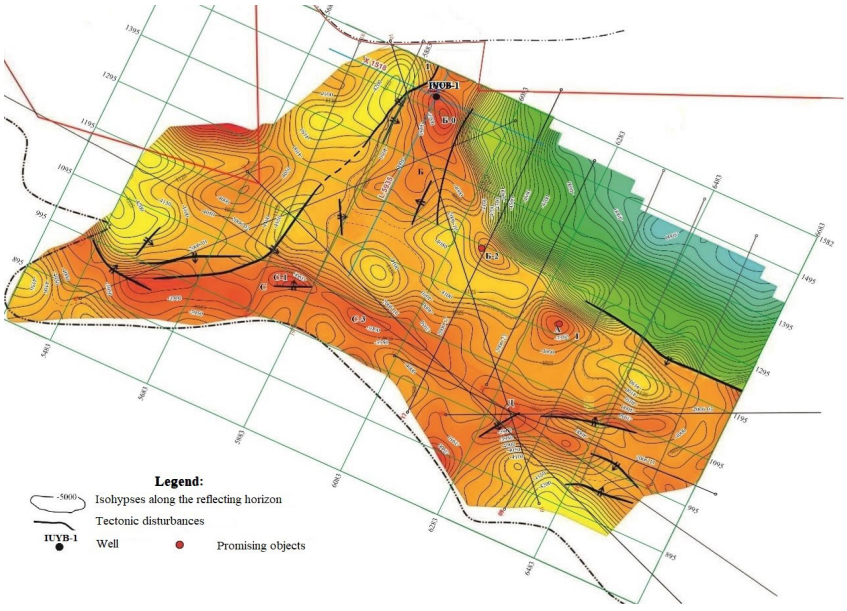


Figure 3 - Structure map by $P_2$ ($P_1$) reflecting horizon

As a result of drilling and testing of Bashkirian deposits of the Middle Carboniferous from the interval 4102–4266 m (bottomhole) the inflow of gas and

formation water with flow rate at 11.11 mm socket 5446 m³/day was obtained (Podkolzin, 2015: 124–131). In the process of drilling complications in the form of seizures and catastrophic mud absorption were observed, high gas shows and gas occurrences were noted during liquidation of drilling mud absorption. The total volume of mud absorption amounted to more than 4000 m³ of drilling mud, in connection with which drilling was stopped at a depth of 4266m. The well penetrated the target subsalt Bashkirian sediments 132 m below the design mark. The error is probably due to the imperfection of the geologic-velocity model, quality of 3D data and uncertain correlation of horizons. Analysis of geological and geophysical materials showed that the well was located on the wing of the structure in the GWC zone. According to the logging data, several gas saturated formations were identified in the Bashkir carbonate sediments. The results of the study of gas composition showed that it is classified as carbonic-sulfur-hydrocarbon, with methane content equal to 45 %, hydrogen sulfide content - 38.2 %, carbon dioxide - 16.2 %. The results obtained testify to the prospectivity of the Imashevskaya Yuzhnaya uplift and the need to continue further prospecting here.

In the south of the Interfluves, the Novobogatinskoye uplift is the most relief in the basement, where 2D and 3D seismic surveys in combination with electrical exploration were carried out in 2001–2012. These methods were used to study both subsalt and suprasalt sediments. In the Paleozoic strata, the reflecting horizons (RH) $P_1$ , $P_2$ , $P_3$ revealed large and small local structures and extensive troughs, and clarified the structure of previously identified structures. Among them are Sugur, Tegen, Kamyshitovy. As noted earlier, the subsalt complex rocks were not penetrated by wells in the study area, the tectonic structure of the study area is presented on structural maps by $P_3$, $P_2$, $P_1$ reflecting horizons (RH).

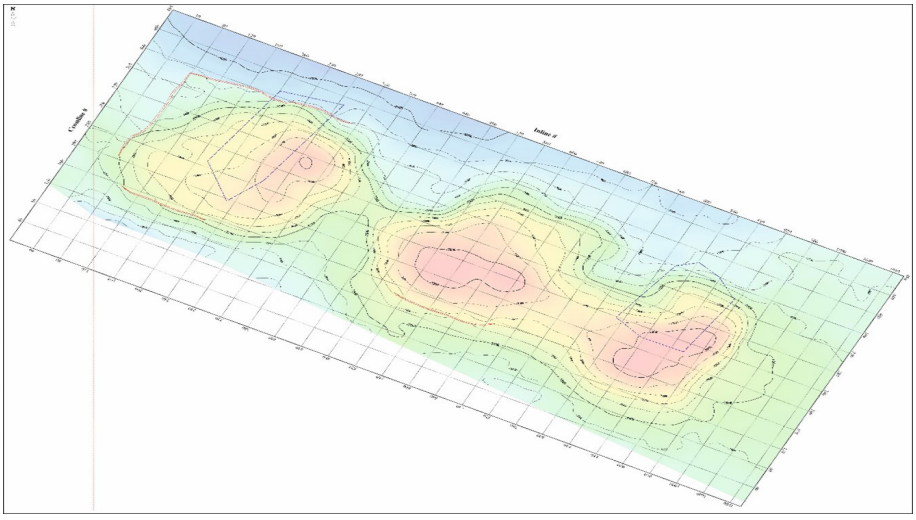

Figure 4 - Liman section. Structural map of the reflecting horizon $P_3$ - roof of terrigenous deposits of Lower Nefranian age (?).

The reflektive gorizon $P_3$, probably corresponding to the surface of the Lower Nefranian Devonian sediments, dips in the north-northeast direction, with depths varying from -7000 m to -8000 m (Figure 4). An anticlinal structure of northwest-southeast strike is identified in the plan along the isohypse of minus 7500 meters. This structure is complicated by three dome-shaped peaks - western, central and eastern, bounded by isohypses -7100, -7000 and -7000 m, respectively. Amplitudes of these peaks are from 400 to 500 m (Figure 4). Uplift along the reflecting horizons $P_2$ has a similar structure, the horizon corresponding, presumably, to the roof of Middle Carboniferous sediments, is marked at depths from 6.35 km in the south to 7.0 km in the northern part of the study area. In the troughs the horizon is recorded at 7.5–8.0 km. According to the P horizon$_1$ these structures are distinguished at the marks from 6.1 to 6.2 km. The prospectivity of subsalt structures is evidenced by oil and gas deposits in the suprasalt complex. It is known that in the Triassic-Lower Cretaceous sediments of the Novobogatinskoye uplift and adjacent territories oil and gas fields have been identified that are under development. Among them are Novobogatinskoye, Kamyshitovoye South_West, Rovny, Zhanatalap and others. In the south-western part of Mezhdurechye in the Mesozoic sediments the fields Tobearal, Oktyabrskoye, Zaburunye, Sazankurak, Burbaytal, Kumysbek have been identified. On the structures Zhantoka Severny, Kazansky East, Zhambai, Karatobe, Kotyaevskaya North. and Azau, located in the extreme southwestern part of the Interfluves, only signs of oil and gas were noted in the Triassic-Lower Cretaceous complex of rocks. The above-mentioned testifies to significant reserves of oil and combustible gas in subsalt sediments of the Interfluve.

**Conclusion**

The presence of signs of oil and gas content in subsalt and suprasalt sediments in the structures of the studied area, as well as the presence of commercial hydrocarbon deposits, gives grounds to associate certain prospects with this region. Similar to the Astrakhan Uplift, a shallow layered carbonate formation is predicted to develop at the Imashevskoe Yuzhnoye structure, where light biomorphic, biomorphic-detrital and organogenic-clastic limestones may have been widely developed in the section. The section is characterized by intraformational discontinuities, high primary porosity, noticeable catagenetic transformations, and the appearance of secondary dolomites. The study of reservoir properties of Devonian sediments in wells Devonskaya,1,2,3 showed that within the depths of 6046–6151m lie high-capacity and permeable fracture-pore-cavernous reservoirs, the leading role in the formation of which was played by secondary processes.

The subsalt sediments of the Novobogatinskoye uplift are also promising.

The results of oil exploration work in the marginal parts of the Caspian Depression indicate the presence of several hydrocarbon-bearing complexes within the subsalt deposits. These complexes are divided by regional and zonal fluid barriers. Each complex is characterized by its type of traps and patterns of distribution. Therefore, when developing a concept for exploration work, an individual approach is necessary for each complex.

Furthermore, considering the geological risk and the high cost of drilling wells deeper than 6500 meters, it is essential to refine the structural features of these deposits based on comprehensive CDP-3D data and a more realistic velocity model of the subsurface environment. This approach will enhance the accuracy of geological assessments and reduce the uncertainty associated with exploration and drilling activities.

In addition, given the geological risk and high cost of drilling wells 6500m and deeper, it is necessary to clarify the structural features of these sediments on the basis of complete CDP-3D data and a more realistic velocity model of the medium.

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**CONTENT**

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