MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN

Kazakh National Research Technical University named after K. I. Satpayev

Institute of Geology, Oil and Mining named after K. Turysov

Department of Petroleum Geology

Orymbekova Aigerim

Title: Geology and oil and gas potential of the subsalt complex in the south of the Caspian basin, features of the reservoir properties of the Tengiz field

DIPLOMA WORK

Specialty: 5B070600 – Geology and exploration of mineral deposits

Almaty 2020

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Scientific adviser: master of technical sciences, lecturer

Urmanova D. E.

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Task
for completing the work

Student: Orymbekova Aigerim Nurlankyzy

Title of the diploma work: Geology and oil and gas potential of the subsalt complex in the south of the Caspian basin, features of the reservoir properties of the Tengiz field.

Approved by the №762-border of the rector of the University from January 27, 2020
The deadline of the completed work is " 27 " may 2020.
Initial data of the work: materials collected from stock data, collected from pre-graduate industrial practice, obtained by “GeoMunai” LLP.

List of issues considered in the diploma work:

1. Geological section
2. Stratigraphic column
3. Features of reservoir properties of the Tengiz field
4. Design and methodological section

List of drawing materials: Geological map and its cross section

THE TIMETABLE

for the preparation of the diploma work

Name of departments, list of issues under consideration	Terms of assistance to scientific supervisors and consultants	Note
Geological section	16.03.2020-25.03.2020	
Stratigraphic column	29.03.2020-9.04.2020	
Features of reservoir properties of the Tengiz field	12.04.2020-15.04.2020	
Design and methodological section	26.04.2020-12.05.2020	

Signatures
of consultants of sections of the diploma project and
the controller of norms for the completed project

Name	**Consultants**	**Date of signing**	**Signature**
Geological section	D. E. Urmanova	25.03.2020	
Stratigraphic column	D. E. Urmanova	9.04.2020	
Features of reservoir properties of the Tengiz field	D. E. Urmanova	15.04.2020	
Design and methodological section	D. E. Urmanova	12.05.2020	
Norm controller	Sanatbekov M.E	19.05.20	

Head of the diploma work, lecturer D. E. Urmanova

The student who received the task to complete A. N. Orymbekova
Date «25» may 2020

АҢДАТПА

Менің дипломдық жобамның негізгі мақсаты Каспий маңы бассейнінің геологиялық құрылысын, тектоникасын және мұнай-газдылығын зерттеу.

Зерттеу барысында соңғы жылдары Каспий маңы ойпаты шегінде мұнай және газ кен орнын іздестірумен, барлаумен және игерумен айналысатын жер қойнауын пайдаланушыларға жүргізілген іздеу-барлау және пайдалану ұңғымаларын бұрғылау материалдары мен ең жаңа геологиялық-геофизикалық материалдар және мүмкіндігінше іздеу-барлау және пайдалану ұңғымаларын бұрғылау материалдары тартылды.

Қолда бар ақпаратты талдау шөгінділер кешені бойынша, сондай-ақ тектоникалық бірліктер бойынша перспективалық бағыттарды бөлуге мүмкіндік береді, бұл одан әрі іздеу-барлау жұмыстарын жүргізу үшін өзекті мәнге ие.

АННОТАЦИЯ

Основной целью моего дипломного проекта является изучение геологического строения, тектоники и нефтегазоносности Прикаспийского бассейна**.**

В процессе исследований привлечены опубликованные и фондовые материалы прошлых лет и доступные новейшие геолого-геофизические материалы и, по возможности, материалы бурения поисково-разведочных и эксплуатационных скважин, проведенные в последние годы недропользователям, занимающихся поиском, разведкой и разработкой месторождения нефти и газа в пределах Прикаспийской впадины.

Детальный анализ имеющейся информации позволяет выделить перспективные направления по комплексам отложений, а также по тектоническим единицам, что имеет актуальное значение для проведения дальнейших поисково-разведочных работ.

ABSTRACT

The main goal of my diploma work is the study of the geological structure, tectonics, and oil and gas potential of the Pre-Caspian basin and substantiate the directions for further exploration for oil and gas.

The research involved the published and stock materials of past years and the latest available geological and geophysical materials and, if possible, drilling materials for exploration and production wells conducted in recent years by subsoil users engaged in the search, exploration, and development of an oil and gas field within the Caspian troughs.

A detailed analysis of the available information allows us to identify promising areas of sediment complexes, as well as tectonic units, which is relevant for further exploration.

CONTENT

INTRODUCTION

The studied territory occupies the southern part of the Caspian basin, covers the land zone and the water area of the Caspian sea (Pic. 2.1.1.).

The study area is 60,000 km2. The Caspian basin is the deepest area of deflection and sedimentary fill. The thickness of the sedimentary cover according to seismic data reaches about 20 km. A characteristic feature is a presence in the sedimentary cover of a powerful salt-bearing layer of lower Permian age, which divides the section into two structural and formation complexes (subsalt and suprasalt complex).

The study of the geological structure of the territory under consideration by geophysical methods dates back to the 30s of the last century.

Currently, the oil and gas content of this region has been identified in a wide stratigraphic range from the Paleozoic to the Meso-Cenozoic. According to the results of geological and geophysical research, a large number of prospective structures have been identified.

1 Geological section

1.1 Geological knowledge

The entire period of study of the Pre-Caspian basin can be divided into several stages. [1] The first stage dates back to 1720, when expeditions of military topographers and naturalists made a variety of observations of the territory, starting from the Ural, Mugodzhar, Mangyshlak mountains, Ustyurt, Inder, Elton, Baskunchak-B. Bogdo, ending with watershed elevations and outcrops of bedrock along the valleys of the Emba, Temir, Sagiz, etc.

The second stage - the recovery proceeded in the years 1920-1928. In the beginning, it created the Office of the oil industry of the Ural-Embaregion, in 1924 it was transformed into trust "Embaneft".

The third stage of the geological study of the territory of the Pre-Caspian basin (1929-1941) was marked by a significant scale of geological prospecting and exploration.

In 1929, the number of geological prospecting parties and the volume of deep drilling continued to grow. along with mapping, structural prospecting drilling was introduced with the Ganiel-Lug and Crelius machines. Researchers were engaged in the introduction of gravimetry of electric exploration, magnetometry, and well logging.

1.1Aeromagnetic knowledge

The region of the Caspian sea-the Caspian basin has long increased interest in connection with the prospects for the availability of hydrocarbon reserves. The beginning of its systematic geological study is attributed to 1929-1930. In the same years, for the first time in the Caspian basin, D. V. Kozhevnikov performed magnetic exploration with Schmidt and Lloyd variometers. As a result, they concluded that it was impossible to solve the set of geological tasks by magnetic exploration due to the non-magnetic nature of salt deposits.

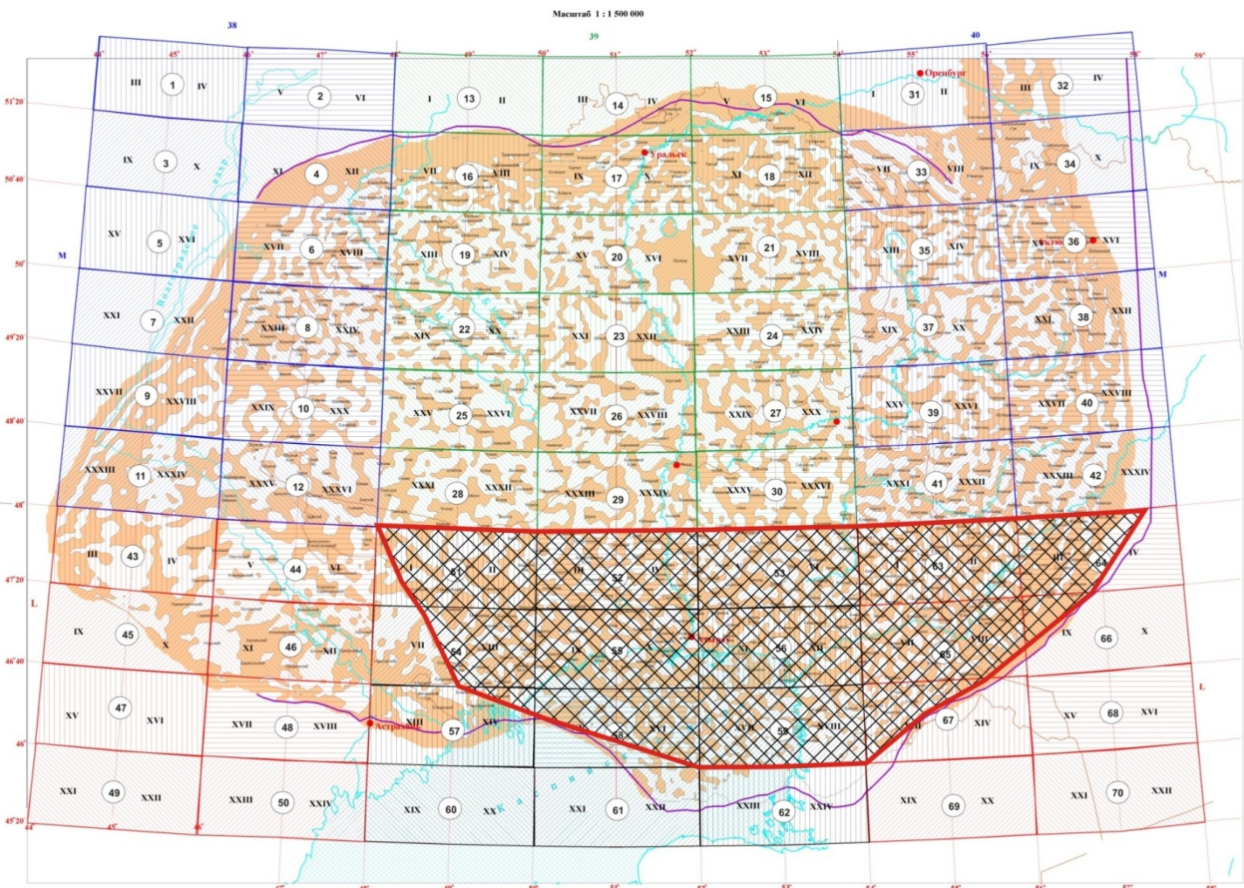
1.1 A gravimetric knowledge

The gravimetric method was applied for the first time in the Caspian sedimentary basin in 1925. Until 1930, techniques and methods of field observations and methods of interpretation of the obtained gravimetric materials were developed. Variometric surveys were accompanied by pendulum observations, which were carried out to create a uniform reference network.

During these years, gravimetric surveys revealed for the first time that salt domes are everywhere developed in the Caspian sedimentary basin and that the salt domes correspond to gravitational minima, and the basin separating them correspond to maxima.

1.5 Main stages of the region's geological development

The Caspian basin is confined to the Paleozoic complex and belongs to the South-Eastern part of the East European platform. The Foundation of this platform is associated with the formation of a three-ray rift system at the end of the Precambrian (Aralsorsky. Hordinski and Pachelma rift), which determined long and steady subsidence of the Central part of the basin. According to researchers the depression in the Central part is devoid of a"granite layer". To the South, a block of continental crust (the Astrakhan-Aktobe uplift system) has been preserved. This zone occupied an elevated position during the early Paleozoic and separated the Central part of the basin from the system of deflections formed in the early Paleozoic in the band of the southern and South-Eastern frames.[8].



Pic. 2.1.1.-Overview of the location of the study area

By the main features of the geological and tectonic development of the studied region, the following most important features of the structure are determined.

The modern southern border of the Caspian basin "passes" in the West along the front of the zone of the thrust of the Karpinsky ridge structures into the Caspian basin, in the East along the North-Ustyurt fault that separates the South Embin uplift and the North-Ustyurt block.

In the southern part of the basin, the basement is characterized by Archean-early Proterozoic age. The Foundation is significantly differentiated by the depth of the roof, the size of individual blocks, the configuration and extension of structural elements, and the degree of complexity of tectonic disturbances. Typical structural elements of the Foundation surface are blocks of the Aktobe-Astrakhan uplift zone (North Caspian, Biikzhal uplift, etc.) with a depth of 7.5-8.0 km to 9-13 km. The composition of the Foundation rocks is also significantly differentiated.

The slit is provided with 4 main litho-stratigraphic successions (pre-Devonian, Devonian-lower Permian Kungur-Kazan, and Mesozoic-Cenozoic part of the section).

In the southern part of the basin, pre-salt pre-Permian terrigenous rocks on carbonate structures were not opened by wells, but they may be present in middle Devonian deposits in the Astrakhan arch (Lopatin). The Karaton-Tengiz zone is composed of upper Devonian carbonates of the Bashkirian (middle Carboniferous) age that form the atolls height of several tens of meters. Outside of the atolls, the carbonate rocks pass into deep-water basin facies. On the tops of the atolls, the Lower Permian (mainly Artinian) black shales formed under conditions of oxygen insufficiency on uplifts submerged to a depth below the zone of organic carbonation are unconformably deposited. There is a gradual increase in the thickness of the layer to the slopes of the atolls. The zone expands in the marine part of the Board, where seismic data revealed several carbonate structures [5].

Throughout almost the entire basin, the Devonian-lower Permian deposits are overlain by a layer of Kungurian (late lower Permian) evaporites, which is mainly composed of salt but has layers of terrigenous rocks and anhydrides. Evaporites are absent only in the boundary zones adjacent to the Urals and along the southern border of the basin, where they are inconsistently overlain by late Permian or Jurassic deposits.

1.6 Stratigraphie of the subsalt section

The most ancient formations discovered by deep wells in the territory under consideration (Mynsualmas, Severny, Zhanasu, Turesay, etc.) are deposits of the upper Devonian.

The Devonian system

Deposits of this age were studied from sections of wells G-10, II-Zhanasu, G-7 Turesay, II-I, 2,3,4 North Mynsualmas. In the Devonian thickness, the rocks of the Famennian and Frasnian stages are established by age definitions. The deposits of the Fran stage are represented by an uneven interbedding of sand-silt rocks, mudstones, and the Dolomites. In the upper part of this thickness, Sandstone strata have a predominant value. The overlying thickness of the Famennian layer is composed of uneven interlayers of sand-siltstone and clay rocks. In the lower and upper parts of its section, clays and mudstones predominate. The maximum thickness of the Famennian stage is 1255m.

The Carboniferous system

Lower carbon

The Tournai stage. The study of the Tournai deposits for the South-East of the Caspian basin is fragmentary. This information can be attributed to the areas of carbonate and terrigenous sedimentation. It is assumed that the accumulation areas are consistent with those in the Visean and Serpukhov periods. The age of the tour is confirmed in the carbonate section of the Karaton-Tengiz zone.

Thus, in the Karaton 1, 3, 5, 7 wells, foraminifera complexes from four horizons of the Tournai stage were identified, in the Yuzhnaya 2 wells (interval 5434-5513 m) and Yuzhnaya 3 wells (interval 5493-5501 m) - foraminifera complexes of the Kizel horizon. In the sections of other wells in the Karaton-Tengiz zone, the Tournaisian deposits are not distinguished, which, apparently, tend to the Central arch parts of the uplifts, where there is a high probability of erosion. To the East of the Karaton-Tengiz zone, the Tournaisian deposits are distinguished mainly in terrigenousfacies, confirmed by single wells.

The Viseanstage. The Visean precipitation complex is distinguished in the section of the Karaton-Tengiz zone and the southern uplift. The lower part of the Visean deposits is absent in the North-East of Tengiz, which is associated with the release of the carbonate platform to the daytime surface. In addition to the zones of intensive carbonation accumulation, there are also areas where precipitation was formed in an active hydrodynamic environment, which is recorded by the presence of packstones and grainstones, less often ooliticgrainstones. However, there were areas where mudstones with clay layers enriched with pyroclastic material were accumulated in a calm hydrodynamic environment (Tengiz well 6, 22, 44).

Visean deposits are also confirmed in the section of areas in the vault and within the North-Western slope of the South Embinsky uplift (Tortay, Plain, Ushmola, etc.).

The formation of organogenic buildings was accompanied by periodic removal of their roofs in the tidal zone, partial destruction, and formation of plumes. Bioherm limestone characteristic of the massive and weakly brecciated structure. On the slopes of these buildings, gravel-bearing limestones were accumulated. Laterally into the basin, shallow shelf sediments in the South-East of the basin are replaced by a thickness of alternating terrigenous and carbonate-terrigenous deposits (100-200 m thick).

Serpukhov stage. Deposits of Serpukhov age are characterized by carbonate and terrigenous sedimentation. The Serpukhov accumulation period was characterized by the stabilization of transgression and the weakening of tectonic processes. In the interior, the introduction of terrigenous material is somewhat reduced.

Biohermic massifs with deposits of this age were studied in the East and North-East of Tengiz, as well as in the Bekbulat 1 and Tortay 12 wells. Biohermic arrays have a complex structure and consist of small bioherms bodies that grow on top of each other against the background of constant bending of the pool bottom. The second half of the Serpukhov sedimentation is characterized by the destruction of bioherms massifs and the formation of a plume of clastic limestones.

Medium carbon

The Bashkir period of accumulation in the South-East of the Caspian basin is characterized by three areas where the formation of a carbonate, terrigenous-carbonate, and transition type of section took place. The carbonate composition of deposits of Bashkir age in the Karaton-Tengiz and South Embin zones was noted.

Within the Karaton-Tengiz zone, Bashkir deposits are deposited on Serpukhov deposits with stratigraphic disagreement, which is expressed by precipitation from the section of upper Serpukhov deposits (found in single wells) and the Voznesensk horizon.

In more submerged areas, the Voznesensky horizon is represented by limestones, which differ in composition and according to the GC and NGC data from the underlying Serpukhov deposits by a reduced clay content, which is associated with the cessation of the receipt of clay material. The beginning of the Bashkir age is associated with the regression of the sea basin. At the same time, from the South Embinsky uplift, terrigenous material enters the inner zones.in the zone of the carbonate belt, this is indicated by the presence of layers of gravelites and conglomerates in the lower parts of the Bashkir deposits.

The formation of coarse-grained sediments with the late Bashkir fauna indicates that the sea level continued to fall in the second half of the Bashkir century and the basin was completely shallowed. The result is the destruction and redeposition of clastic deposits of the upper Devonian and lower Carboniferous Sensual massage subzones.

The terrigenous-carbonate type of the section outside the South Embin and Karaton-Tengiz zones is distinguished everywhere and is represented by an alternation of mudstones, limestones, and sandstones with varying degrees of silicification, with a total thickness of 20-70 m. These deposits accumulate in the submerged parts of the shelf, they are based on carbonate silt and detritus of lime secreting organisms, removed from the carbonate platforms. The sole of the Bashkir deposits coincides with the sole of the lower layer of dense rocks (limestones) against the background of underlying clay deposits.

On Tengiz, there are no Bashkir deposits in wells 41 and 43, which are located on the peripheral parts, as well as in the Karaton 1 well. This circumstance and the presence of re-deposited faunal complexes suggest the draining of the Karaton-Tengiz zone in the Bashkir century. The presence of complete sections of Bashkir sediments in the Central part of Tengiz in comparison with other paleopods of the Caspian region suggests the development of local negative structures against the background of General uplift (subsidence in the form of karst formation). The Central parts of Tengiz are characterized by carbonate deposits of facies of shoals and beaches. The majority of oil and gas fields of the Caspian basin, confined to the Bashkir deposits, are characterized by a primary granular type of reservoir.

Moscow stage. Deposits of the Moscow age in the South-East of the Caspian basin are developed everywhere.

Their absence was found in the section of the Karaton-Tengiz zone, which is presumably due to subsequent erosion. This is confirmed by the presence of remnant sites, similar to other paleopods of the Caspian Paleozoic basin (Astrakhan, Temirsky arch, etc.).

Upper carbon

The question of the presence in the section and stratigraphic division of upper Carboniferous deposits is debatable. The allocation of sediments within the South-East of the Caspian sea is also ambiguous.

In the section of the southern, Karaton-Tengiz, and South Embin uplift zones, upper Carboniferous deposits did not accumulate. Within the Turesay-Yuzhno-Molodezhny district, there is a predominantly carbonate and terrigenous-carbonate type of section. The nature of the distribution of upper Carboniferous deposits by the thickness and lithological composition, as well as the presence of re-deposited fauna of the Moscow age in their composition, indicate a significant eustatic drop in sea level at the turn of the middle and late Carboniferous epoch. Deposits of carbonate type of section are localized in the form of a narrow wedge-shaped strip in Turesi-South Youth and partly Ortinau-Sarybulak-Sarykolsky area. The deposits were opened by the Sarykum 1 and 2, Turesay 3, and 2A wells (Kasimov tier).

According to the conodont and fusulinid complexes, a wide development of the terrigenous-carbonate section in the volume of the Kasimov and Gzhel layers was established in the Matken-Ushmolinsky zone. This zone is also characterized by the presence of re-deposited fauna of the Moscow, Bashkir, and Serpukhov age in upper Carboniferous deposits on a large territory. This refers to the zone between the Karashungul (SLE P-1) and Sarykask (SLE 3) structures, which is remote from the areas of large paleopods. This may be due to local demolition sources and middle Carboniferous fauna. The emergence of areas of fauna and sedimentary material demolition, as previously noted, is associated with a regional eustatic drop in sea level. Due to the expansion of the boundaries of the shallow basin in the late Carboniferous, carbonatonic accumulation is more widespread than in the Moscow and Assel ages. Clay-carbonate deposits have a clearly defined logging characteristic (GC and NGC), as they include layers of dense limestone and clearly stand out against the background of more clay deposits of the Moscow and Assel age.

Lower Perm

Assel tier. The Assel stage of sedimentation is associated with the beginning of a major sea transgression caused by eustatic elevation (200-300 m) of its level. The Assel age is characterized by the arrival of a large amount of terrigenous material, the appearance of which is associated with the mountain formation of the Ural hercinids and the Karpinsky ridge outside the basin.

Assel deposits are characterized by three types of the section: carbonate biohermic-shallow shelf, clay-carbonate slope, and clay deep-water shelf. Carbonate deposits in the Assel age are formed as a strip along the Northern part of the South Embin (Karaoi and Urtatau-Sarybulak-Sarykum subzones) zone.

Compared to the middle and upper Carboniferous boundary of carbonitesetuplite displaced into the cavity. In these subzones, biohermic massifs with a thickness of 400-500 m to 900 m were formed in shallow water (Urtatau-Sarybulak 3). Odpowiedni with the growth of bio thermal massifs is their erosion, which is expressed by the presence among of bioherm limestone layers packstone. In areas with intensive penetration of coarse-grained terrigenous material into the basin, biohermslimestones with an admixture of clusters were formed, up to the formation of layers of coarse-grained rocks among the limestones. Such deposits were studied in the Tortay 23 well with a thickness of 690 m.

The clay type cut selected in Macken-Smolenskoi, Karaton-Tengiz, and the Atyrau-Chukotskoe zones and characterized by uniform clayey composition, which is reflected in a typical entry on the graphs GK, the COP and COG. The thickness of the clay Assel deposits varies from 50 m to 400 m.

The Assel thickness of the Karaton-Tengiz zone up to 10-140 m accumulated on an elevated area in shallow water conditions with limited input of clay material and is therefore characterized by a specific appearance. The main part of terrigenous material brings to the pool gravitational flows, which have been around paleodata. In the area of paleopods, thin clay material (suspension) was received, which did not allow widespread development of lime-producing organisms, but in the total volume of sedimentary material was a small fraction. Thus, in the conditions of admission of terrigenous material in the field of paleomagnetism, including the Karaton-Tengiz zone.

The Sakmar stage. The facies situation of accumulation of Sakmar deposits is very similar to the conditions of the Assel period. It has a few specific features. It is assumed that sedimentation in the Sakmar age forms a single sedimentary cycle with the Assel one. Highlighted in carbonate and clastic types of sediments of the Sakmar. The carbonate type of the section was established for the fusulinid complex in the wells Sarykum 1 and 2, Saztyube 2 and 4, Tynyshtyk 1 and presumably Karaoy P-2. Lithologically it is represented by limestones to varying degrees dolomitized and anhydrite.

The clay type cut Sakmarian deposits assumed in the Macken-Smolenskoj area. The thickness of the complex is more than 400m. Such areas are similar to the zone of distribution of lower Permian deposits in the Eastern part of the Caspian basin. In this zone, the Sakmar deposits have been reliably identified by conodont, fusulinid, spore, and pollen complexes.

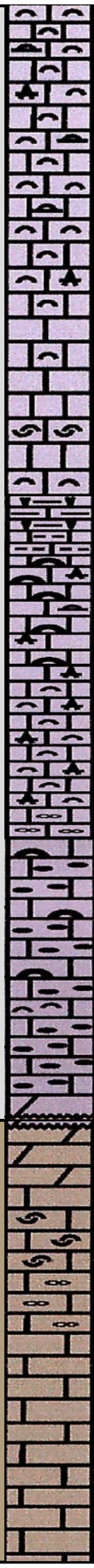
Artinskian. In the Artinian age, sea regression and salinization of the basin occur, as a result, the productivity of lime-producing organisms is significantly reduced. The Artinian deposits in the South-Eastern part are undeveloped, and deposits are observed in the areas of paleopods (the southern Embin uplift zone, the southern uplift, etc.).

There are no deposits in the section of the Karaton-Tengiz zone. Well understood Artinskian deposits in the slit Macken-Smolenskoy degree (Matkin, Karashungul, Torti, Alcantara South-West, etc.). Represented by the alternation of gravelites, sandstones, siltstones, and mudstones, the ratio of lithotypes in the different wells.

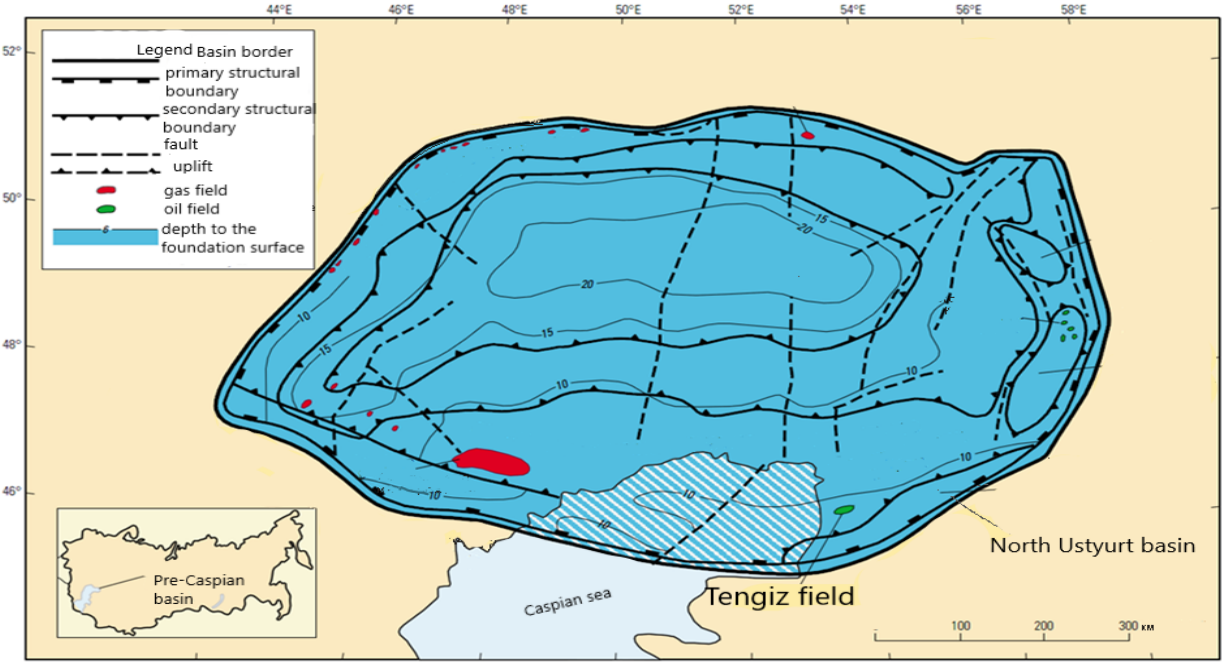
Table 2.2.2 section of well No. 16 of the Tengiz field

Litho-stratigraphic column

System/Period	Series/Epoch	Stage/age	Lithological column	Thickness	Lithological description
Permian	Lower	Kungurian		80-2100	Rock salt, in the lower part of the anhydrite and dolomite section. Limestones with relict stromatolite structure. Carbonatized tufargillite. Pre-mitigated carbonate sediments with tuff avenues. (gravelites)
		Asselian-Artinskian		0-350	
Carboniferous	Middle	Moscovian		0-30	Bioclastic graystones, algal and oolitic limestonesToltsy of algal (boundstones) and detrital (breccias of collapse) limestones. The rocks are unevenly distributed. Bioclastic grains, oolite limestones. Bioclastic packstones, grains and orestones. Thick strata of algae (boundstones) and clastic (breccia collapse) limestones. The rocks are unevenly recrystallized and dolomitized. Bioclastic (crinoid) and lithoclastic less often ore stones.
		Bashkirian		200-20	
	Lower	Serpukhovian		760-20	

		Upper-Visean			260-50	The rocks are unevenly recrystallized and dolomitized. At the bottom of the horizon there is an interlayer of tufogenic mudstones, bioclastic and oolitic grainstones. Thick strata of algal limestones (boundstony). The rocks are sometimes significantly recrystallized.
		Lower-Visean			460-10	
		Tournasian			250-60	
Devonian	Upper	Famenian			More than 600	Micro-fine-grained dalitized limestones, dolomites with inclusions of anidrite. Clot-lumpy and algal limestones with numerous calcispheres and a few shells of single-chamber foraminifera. Pellet pakstones.

Continuation of table 2.2.2



2.1.2-Scheme of oil and gas geological and tectonic zoning

1.7 Features of reservoir properties of the Tengiz field

Tengiz field. The Tengiz field is located in the Zhylyoysky district of the Atyrau region of the Republic of Kazakhstan, on the Eastern coast of the Caspian sea. The Deposit is confined to a carbonate platform consisting of carbonate massifs of early-middle Carboniferous age (Karaton, Tengizkayran, Kashagan) located on a common Devonian carbonate base.

Deep exploratory drilling on Tengiz square was started in 1976, and the field was discovered in 1981. Low-power terrigenous-carbonate rocks of the Artinskian stage of the lower Permian and a powerful carbonate layer from the Bashkir tier of the middle Carboniferous to the upper Devonian inclusive were discovered under the deposits of the Kungursky tier. The middle Carboniferous is represented in the volume of the lower and upper Bashkir sub-tiers. Upper Bashkir rocks can be traced only to the peripheral parts of the structure, they are absent in the vault. The lower Bashkir sub-stage is represented by the Krasnopolyansky, Severo-Keltmenskian, and Prikamsky horizons composed of algae, polydetrite, organogenic-clastic, oolitic, unevenly dolomitized limestones and the bituminous Dolomites. In the Visean thickness, among the carbonate formations, the middle Visean deposits are distinguished, consisting mainly of layers of black mudstones, siltstones with detritus of charred plant remains, and gray sandstones of fine-medium-grained, areas with a significant admixture of pyroclastic material: volcanic glass and fragments of feldspar crystals. In middle Visean, sediments encountered topoisomerase, litho-kristallografic tuffs. Upper Devonian Famennian deposits are represented by gray and brownish-gray limestone clumped and foraminiferous, interbeds of organogenic-clastic, algae. Rocks are unevenly dolomitized, recrystallized, and fractured. The total thickness of the carbonate structure according to seismic data is 3500m. The tablet shows the complex lithological structure of the reservoir, which is characterized by lithological variability. The grainstone, boundstone, and packstone facies are found here.

The industrial oil and gas potential at the Tengiz field is set at sq. 1, in which the oil flow rate from coal deposits in the range of 4050-4081m through a 21-mm fitting reached 430m3/day.

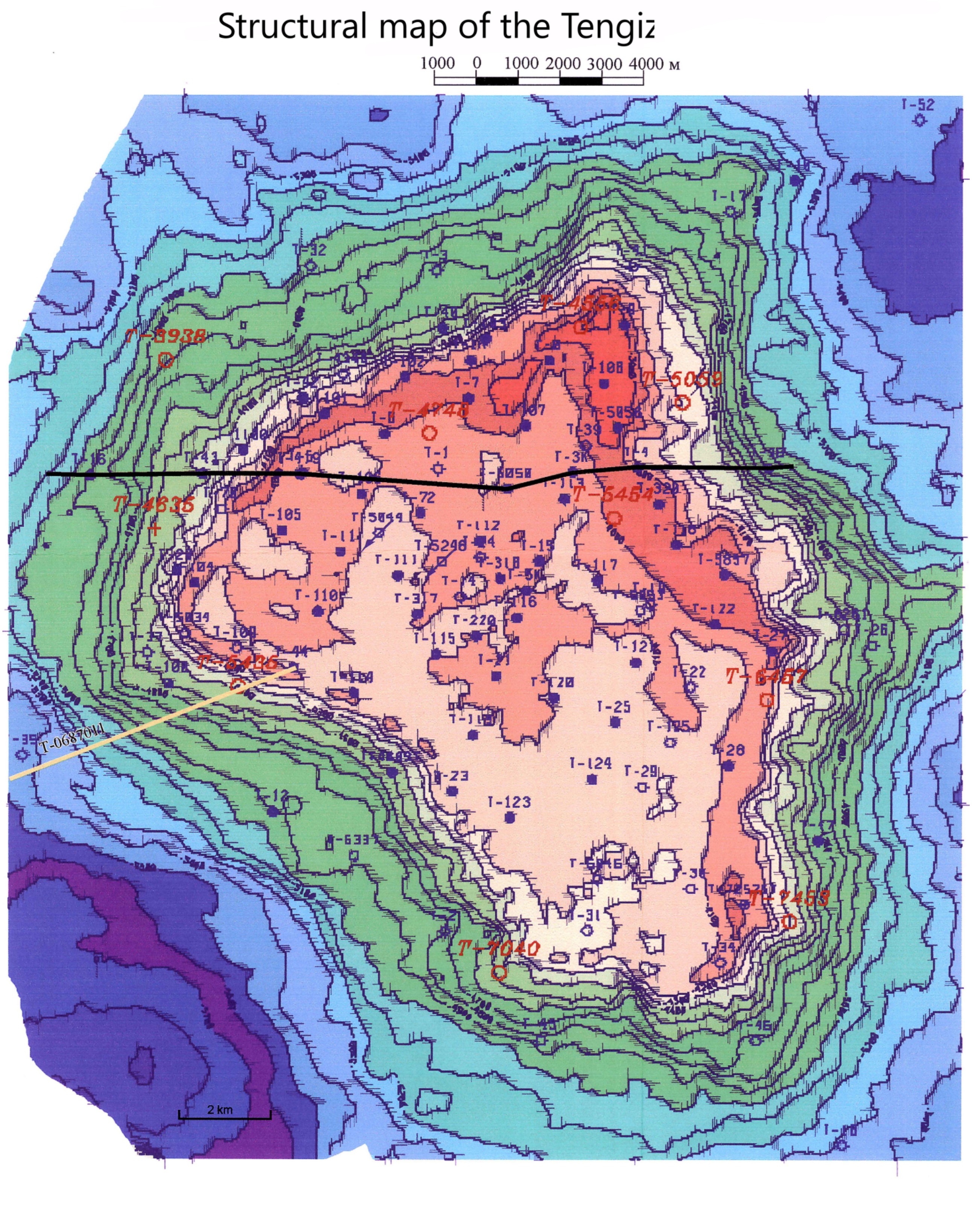
According to the calculated data, the conditional OWC of the Deposit is located at a depth of minus 5450 - 5461.8 m. Productive are the rocks of the middle Carboniferous, lower Carboniferous (Tournaisian, Visean, Serpukhovian) and the upper Devonian.

The initial flow rates of oil were 15.2-584m3/day, gas-6.5-252m3 / day. The Devonian deposits are under exploration.

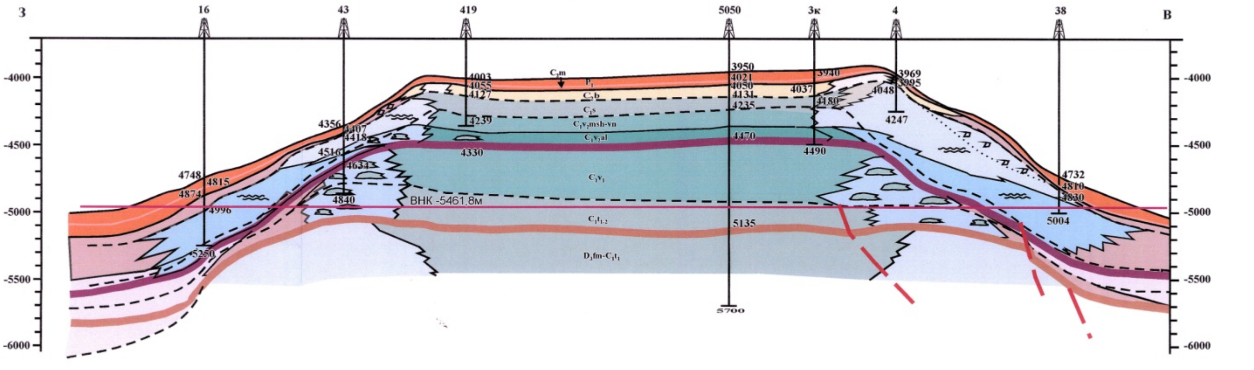
The Devonian-Carboniferous deposits are formed by limestone with an admixture of Dolomites. The collector type is fractured (voidness-less than 3.0%), pore-cavernous-fractured (voidness-3.0-7.0%) fractured-cavernous-pore (voidness-more than 7.0%). Porosity varies widely - from 0.1 to 24%, permeability from 1.0-30mkm2. Reservoir rocks are grainstones, packstones, and wackstones located in the inner part of the carbonate platform and boundstones - on the slopes and at the foot of the slopes of the platform frame and in a mixture of fragments of the above-mentioned lithological units in remote from the slope parts of the platform. Notable is the presence of a solid black bituminous substance in the upper part of the carbonate reservoir, which forms large accumulations in permeable rocks, performs on the periphery or completely fills the filtering volumes of the pore space-systems of cracks, caverns, large pores, significantly reducing the reservoir properties of rocks. The nature of this bitumen is still unclear. Attention is drawn to the high stage of catagenesis, reaching MK3-MK4, which was undergone by bitumen belonging to the class of higher kerites-impsonites and anthraxolites (R. A. Tverdova et al., 1990). Researchers assume that high-temperature gases from the lower parts of the section were introduced into the oil Deposit. The high stages of catagenesis that have affected the composition of oil are indicated by the results of the study of oil by chromatography-mass spectroscopy, described in Chapter 5.3.

The Tengiz Deposit is massive by type. The role of the fluid cover is performed by lower Permian deposits –salt-bearing deposits of the Kungursky tier and clay-carbonate deposits of the Artinskian stage up to 100 m thick.

Light oil, its density-790-815m3/kg, viscosity-2, 0 cm2/s, sulfur content - from 0.7 to 1.0%, paraffins - up to 4.0%, resins - up to 1.3%, the output of light fractions up to 300oC reaches 70%. Associated gas contains an increased content of hydrogen sulfide 16.6-25.1%, carbon dioxide 3.22-4.9%, nitrogen-0.93%, methane 47-52%, ethane-10-15%, propane 3.0-7.0%.



Structural map of the Tengiz field



Cross-section of the Tengiz field

The Deposit is located in the industrial development of the three objects:

The object I include deposits of the Bashkir-Serpukhov-Oka age, lying mainly on the slopes of the carbonate massif; object II combines the lower Visean-Tournaisian complex of rocks. Object III consists of upper Devonian deposits.

1.8 The distribution of reservoir formations and capping

Megareservers of oil and gas are associated, first of all, with carbonate Paleozoic structures, for which there should be reliable tires in the section, characteristic of the saline deposits of Kungur (South and South-East of the Caspian basin).

The regional oil and gas potential of the subsalt complex is still determined and controlled by the spread of the Kungur halogen-sulfate layer/ tire. However, the most important role in the formation of zonal oil and gas content is played by zonal-developed clay-argillite capping, which in some cases almost completely control the productivity of Paleozoic deposits.

One of the factors that have a special influence on the distribution of oil and gas content is a complex combination of terrigenous and carbonate rocks with characteristic types of local structural forms and reservoirs. The Caspian basin is represented by carbonate, terrigenous, terrigenous-carbonate, and carbonate-terrigenous types of sections based on subsalt deposits.

Unique carbonate massifs such as Karachaganak, Tengiz, Kashagan, and Astrakhan are huge natural reservoirs, the useful capacity of which is determined by a complex combination of reservoirs and rock screens. Natural reservoirs with high-capacity reservoirs and the presence of regional halogen-sulfate tires are also installed in the carbonate deposits of the Eastern side of the depression and within the boundaries of different age carbonate ledges along the perimeter of the depression. Carbonate complexes are also characterized by the development of karst zones, which was revealed during drilling in the South of the depression and separate intervals of the Karachaganak and Tengiz sections.

Comparative characteristics of sections of natural reservoirs with zones of development of terrigenous and terrigenous-carbonate thicknesses show that carbonate rocks have filtration-capacity properties that are more favorable both in terms of quantitative parameters and in terms of their degree of endurance in the section and area. The hydrocarbon deposits associated with the complexes under consideration also differ sharply. Traps associated with carbonate rocks are characterized in most cases by huge useful volumes, and oil and gas deposits are of the type of massive and massively-stratified with heights from the first hundred meters to 2 km. Deposits confined to terrigenous rock complexes are characterized by sharp variability of reservoir properties along the area and complex distribution of reservoir rocks. According to the actual materials, even within large local structures (Tortay, plain, Kenkiyak, Akzhar Vostochny, etc.), the volume of oil reserves is usually about 0.5-5.0 million tons[9].

In the subsalt complex, by the conditions of sedimentation, 2 main zones were formed throughout the upper Paleozoic in the West (predominant carbonatic accumulation) and the East (terrigenous and terrigenous-carbonate accumulation). In the first, Karaton-Tengiz zone, deposits concentrated in organogenic structures and rift formations of different genetic and morphological types are predominant. In the Eastern, South-Embin zone, deposits of usually limited size prevail in low-power (50-100m) terrigenous-carbonate deposits and traps of structural type (Sholkara South-West, Matken, Karashungul, Elemes West, Ulkentobe South-Zapadany, Urtatau-Sarybulak, etc.)[2].

1.9 Oil and gas potential

This region is characterized by various types of subsalt section, litho-stratigraphic complexes are characterized by heterogeneous composition, so the description of oil and gas complexes is given for separate zones.

In the southern and South-Eastern parts of the Caspian basin, Devonian deposits, as well as in the East, are practically not studied and, by analogy with the Northern side zone, the development of a promising middle-upper Devonian terrigenous-carbonate oil and gas complex is predicted here.

Within the Tengiz-Kashagan carbonate platform, this NGC is represented by carbonate-terrigenous deposits according to seismic data. The thickness of the Eifelian-Lower Franian sediments reaches 1.2-1.4 km. Deposits are expected here, mainly of the Plast-massive type.

Lies above the upper Devonian (upper Frasnian)-Tournaisian carbonate oil and gas complex. Which is associated with the prospects of the oil and gas potential of the Tengiz and Kashagan fields. To date, only the Tengiz field has received oil inflows from this complex. The area of distribution of carbonate reservoirs is limited by deep-water (clay-carbonate) deposits, which play the role of a reliable lateral fluid barrier. The role of a cover for the deposit is performed by the rock thickness of the lower Permian age, which includes clay-carbonate deposits of the Arta-Moscow age and sulfate-halogen deposits of the Kungursky tier with a thickness of 465-1655 m. The porosity of reservoir rocks varies from 0.3 to 0.18.

Litho-stratigraphic complexes of the subsalt Paleozoic of the Caspian Basin in the stratigraphic range from the middle Devonian to the lower Permian, inclusive, represent independent regional oil and gas complexes. Each of the complexes considered earlier contains industrial accumulations of hydrocarbons or their characteristics. Almost all major discoveries, including unique oil and gas deposits, in the subsalt deposits of the Caspian basin, are associated with Paleozoic reefs developed in a wide stratigraphic range from the middle Devonian to the lower Permian, inclusive.

Each of the considered lithological and stratigraphic complexes contains oil-bearing rocks, the main oil-producing ones among which are deep-water clay-siliceous-carbonate bituminous rocks, which are widely developed in the interior of the depression. The large stratigraphic range and a wide area of distribution of oil and gas-producing formations indicate the significant scale of the processes of generation and accumulation of hydrocarbons that took place here.

The depth range of hydrocarbon accumulations in subsalt deposits ranges from 1500-6200m. The capacity of productive deposits varies from several meters and tens of meters to several hundred meters, in some cases exceeding a thousand meters. Deposits are characterized by a complex phase composition of hydrocarbons, due to such factors as a high content of gas dissolved in oil, the presence of high content of condensate in the gas, which forms complex ratios of fluid and gaseous systems. A specific feature of the Caspian depression is the presence of zones with abnormally high reservoir pressure established for the subsalt part of the sedimentary cover, which undoubtedly had a significant impact on the formation of oil and gas accumulation zones, as well as on the conditions and mechanism of accumulation of hydrocarbon deposits.

On Tengiz, the upper Devonian-Tournaisian complex is fully productive throughout the entire and the volume of pore space.

The Upper Visean -Lower Bashkirian carbonate complex (C1V2-C2b1) contains the main proven reserves of the Caspian basin and is oil and gas-bearing in most fields, both in the basin and on its borders.

In the South and East of the basin, this complex takes part in the formation of massive reservoirs (Astrakhan, Tengiz, Kashagan, etc.).

The testing of productive deposits in Tengiz was carried out in 50 wells. The highest productivity is characterized by breeds of the Bashkir tier. A significant proportion is wells with an initial flow rate of 400 m^3/day to 500 m^3 / day or higher. The productivity of reservoirs of Serpukhov and upper vise deposits is slightly lower - from 200 m^3/day to 400 m^3 / day.

It should be noted that, along with high-capacity wells, there are wells with very low debits of 15-25 t/day or less, which indicates an uneven distribution of high-capacity reservoirs within the massive reservoir of the Tengiz field, composed mainly of rocks of reef Genesis.

The industrial oil content of the Korolevskoye field is established in the SLE. 9 in the range of 4554-4795m, including the lower Bashkir and Serpukhov deposits, where the oil inflow was received at a flow rate of 140m^3/day on a 6mm fitting.

In the Tazhigalinskaya area (Karaton-Tengiz zone), the productivity of carbonate deposits of Bashkir age was established by well 13, where an intensive inflow of oil and gas was received in the range of 3797-3819m.

In the South trench, square Saztube when tested in column SLE. 2 an industrial inflow of oil with a flow rate of 28 m^3/day and gas of 47 thousand m^3/day was obtained on a 3mm connection from terrigenous Assel deposits.

Analysis of the properties of oils, gases, and condensates allowed us to draw several conclusions about some regularities of their composition and distribution in terms and sections.

Oil subsalt deposits of the Caspian basin, regardless of their stratigraphic location, are characterized by a close group composition and belong to the methane-naphthene type of gasoline series. According to the content of non-hydrocarbon impurities, oil in terrigenous subsalt deposits is sulfur-free, and in carbonate complexes, it is more or less sulfurous. In the Eastern part of the basin, light (0.823-0.826 g/cm^3) oil with a high content of gasoline (35%) and naphthene-aromatic hydrocarbons in the oil topped off (up to 20%) and a small amount of alcohol-benzene resins and asphaltenes (up to 5%) was found. In the South-East of the basin, along with light, medium and heavy oils were found, with a reduced (5-26%) content of gasoline, a significant amount of methane-naphthenic (about 80%) and a small number of aromatic hydrocarbons (up to 12%) and alcohol - benzene resins (up to 3%) in the refined oil.

For oils associated with natural reservoirs of Carboniferous age, a regular change in the composition of oils, gases and condensates were found, both in the area of the depression and in the section.

Most of the hydrocarbon deposits in the subsalt deposits are characterized by a peculiar composition of fluids. They contain comparable amounts (under normal conditions) of gaseous and liquid hydrocarbons, i.e. they represent gas deposits with an exceptionally high gas condensate factor, passing into deposits of light extremely gas-saturated oil.

Tengiz oil is light (0,800-0.817 g / cm^3), with a gasoline content of 25-36%. Oil is characterized by a low content of acidic components (sulfur content up to 0.7%) with very few resins (less than 2%) and asphaltenes (less than 1%). Light oil is also found in the Tortaisk field and the Plain area, but its density is slightly higher (0.848-0.849 g / cm^3), the content of gasoline is 13-31%, and sulfur sometimes reaches 1%.

In the East and South-East of the Caspian basin, oil is light and medium (0.790-0.840), low-sulfur and sulfur (0.2 - 0.5), low - and medium - non-tar, paraffin. The high content of resinous and asphaltene components distinguishes Biikzhal area oil.

Devonian oil deposits are characterized by low density, light (0.752-0.838 g/cm3) with a high content of gasoline (37-48%), sulfur-free and low-sulfur (0.003%) in terrigenous and low-sulfur and sulfur in carbonate deposits (0.11-0.67%), paraffin and high-paraffin (4.38-13.9%), low-tar (0.32-4.18%).

In the South-East of the basin, oil in Devonian-Carboniferous carbonate deposits is light and medium (0.780-0.820 g / cm^3), the sulfur content varies from 0.45 to 1%, is characterized by a wide range of asphaltene-resinous substances (1-20%) and a high content of hydrogen sulfide in the dissolved gas (about 19.2%) and carbon dioxide (3.7%)[5].

2 Design and methodological section

2.1 Main research goals, stages, and methods of implementation

The main goals of the study was:

Assessment of oil and gas potential and ranking of objects by their degree of prospects.

Work on the project took place in several stages :

1. The collection of data.
2. Analysis of the history of maturation of oil and gas mother formations.

2.2 Petrophysical properties

Petrophysical properties of rocks are used to model heat exchange and fluid flows. They can be grouped into four categories that define:

- Rock compaction (changes in density and porosity with depth).
- Thermal characteristics (thermal conductivity, heat capacity).
- Permeability (absolute, horizontal, and vertical anisotropy).
- Hydrocarbon flows (relative phase permeability curves, capillary pressure)

Rock compaction and thermal characteristics

In the absence of information on petrophysical properties of rocks, rock compaction and thermal characteristics are determined based on the basic types of lithologies, taking into account the proportions (arithmetic or volumetric) of each type in the rock. The basic types (Sandstone, mudstone, limestone, marl, etc.) in the Temis Suite® software package are the types developed by the French Institute of petroleum-based on the accumulated information on the world's NGB.

Permeability

Reservoir permeability is determined by the Kozeni-Karmen formula.

$$\text{if } f>10\%: K = 0.2\ F^3 / So^2\ (1-f) \quad (1)$$

$$\text{if } f>10\%: K = 20\ F^3 / So^2\ (1-f) \quad (2)$$

where: K absolute permeability in m2 (1 Darcy = 1012 m^2), the surface area in m^2/m^3, And f porosity.

Absolute permeability is a General characteristic that does not take into account the probable anisotropy of the rock. Temis Suite® allows you to separate the horizontal (X) and vertical (Z) components:

$$\text{horizontal permeability } KX = Kh \bullet K \quad (3)$$

vertical permeability KZ = Kv•K (4)

Reservoir permeability is equivalent to specific surface area (So) values below or equal to 1E6 m^2/m^3. In the confining beds, the permeability corresponds to the values So the order of 1E7 m^2/m^3 and above.

To more accurately reflect the heterogeneity of the lithological composition within the layers, the coefficients of horizontal and vertical anisotropy were used.

Table 4.3.2. Lithotypes and permeability

	Lithology Name	Color	Enable Secondary Cracking	Specific Surface m2/m3	Perm. Hor. Multiplier	Perm. Ver. Multiplier
	limestone (late diagenesis)		✔	1300000.0	1	1
	salt		✔	1.0E8	0	0
	Litho_Cretaceous cpy		✔	1.37973E7	1	1
	Litho_Jurassic cpy		✔	4038427.0	1	1
	Litho_PT cpy		✔	1.620657E7	1	1
	Litho_P+ cpy		✔	2.626528E7	1	1
	Litho_P1ar cpy		✔	1.0E7	1	1
	Litho_P1s_P1a cpy		✔	2654992.0	1	1
	Litho_P1ss_C3 cpy		✔	3826323.0	1	1
	Litho_P2_P1m+b cpy		✔	3417860.0	1	1
	Litho_P2s_C1v+t cpy		✔	6611803.0	1	1
	Litho_P2ss_D3 cpy		✔	9769734.0	1	1
	Litho_D1+D2 cpy		✔	4720381.0	1	1

When modeling HC migration in Temis2D ® , the Darcy equation for multiphase filtration is used, which relates the relative phase permeability to the HC saturation:

$$= (-K \bullet kr_{hc}/ju_{hc}) \bullet grad[(P+Pc/p_{hc} \bullet g)-Z] \quad (5)$$

Where V_w and V_{hc} rate of filtration of water and hydrocarbon fluid (m/s), K the ratio of the absolute permeability of porous medium (m^2), k_{rw} and kr_{hc}relative permeability of water and hydrocarbon phase (m), M_w and M_{hc} the viscosity of the fluid (Pa.s), P the pore pressure (Pa) Pc capillary pressure (Pa), p_w and p_{hc} the density of water and hydrocarbon phase (kg/m^3) and g the acceleration of gravity (m/s^2).

► The relative phase permeability depends on the pore saturation with hydrocarbons and two constants set by the user during calibration:

The nature of the change in relative phase permeability is determined by the values of the exponent.

► Capillary pressure, a parameter that significantly affects the primary migration, depends on the impurity of the clay component. It is determined by the values of the phase pressures of water and HC fluid. Temis2D ® uses the following equation:

$$Phc = P + P_c \quad (6)$$

Where P_{hc} is the fluid pressure (P_a), pore pressure, and P_c is the capillary pressure.

Capillary pressure depends on the pore pressure of a particular lithotype. Lithotypes characterized by a small pore size (clay) have high capillary pressure (about 10^8 Pa). Lithotypes with pores of significant size (such as sandstones) will, on the contrary, be characterized by low capillary pressure (from zero to a maximum of 10^5 Pa). Capillary pressure also depends on the saturation of hydrocarbons. In this case, it can be expressed by the following equation :

$$Pc = Pc_{Phi} + Pc_{sat} \quad (7)$$

Where Pc_{Phi} is the fraction of capillary pressure, which is determined by the porosity of the rock (= 0 on the surface and = Pc_{Phi} at maximum compaction) and Pc_{sat} is the fraction of capillary pressure, which is determined by the HC saturation (= 0 if only water is present in the cell and = Pc_{sat} if the HC saturation has reached the values of the Sat coefficient)

$$Pc = Pc_{Phi} \qquad \text{if } S_w = 1 \quad (8)$$

$$Pc = Pc_{Phi} + Pc \bullet ((1 - S_w) / \text{Sat})^{SwPcEx} \qquad \text{if } S_w \text{ €] 1-Sat, 1} \quad (9)$$

$$Pc = Pc_{Phi} + \delta Pc \qquad \text{if } S_w \leq \text{1-Sat} \quad (10)$$

$$\text{at} Pc_{Phi} = Pc_0 \qquad \text{if } F > F_0 \quad (11)$$

$$Pc_{Phi} = Pc_0 + (Pc_{lim} - Pc_0) * [(\varphi_0 - \varphi) - (\varphi_0 - \varphi_{lim})]^{\Phi PcEx} \text{ if } S_w e\ [F_{lim}, F_0] \quad (12)$$

$$Pc_{Phi} = Pc_{lim} \qquad \text{if } F \backslash < Fc_{im}$$

Where $F$$P_c$Ex= change in capillary pressure as a function of porosity.

Pc_0= capillary pressure at the surface or the highest porosity in P_a.

Pc_{lim}= capillary pressure at the maximum depth of immersion or at

the smallest porosity in P_a.

δ Pc = increase in capillary pressure at maximum HC saturation

(Sat) in P_a

$S_w P_c$Ex = the change in capillary pressure, depending on the hydrocarbon saturation pressure.

Table 4.3.3-The lithotypes and the parameters of the capillary

	Lithology Name	Color	Enable Secondary Cracking	Pc(Phi) Liq.: Pc @ Phi Min MPa	Pc(Phi) Liq.: Curve Exponent	Pc(Sat) Liq.: Delta PC MPa	Pc(Sat) Liq.: Curve Exponent	Pc(Phi) Vap.: Pc @ Phi Min MPa
	limestone (late diagenesis)		✔	0.5	1.0	20.0	20.0	1.5
	salt		✔	1.0	1.0	20.0	20.0	3.0
	Litho_Cretaceous cpy		✔	0.48	0.5	15.29	17.41	0.48
	Litho_Jurassic cpy		✔	0.18	0.52	7.1	18.66	0.19
	Litho_PT cpy		✔	0.48	0.5	16.64	18.66	0.48
	Litho_P+ cpy		✔	0.69	0.5	23.13	18.66	0.69
	Litho_P1ar cpy		✔	0.33	0.5	11.97	18.66	0.33
	Litho_P1s_P1a cpy		✔	0.44	0.78	16.78	19.32	0.9
	Litho_P1ss_C3 cpy		✔	0.4	0.64	12.19	20.0	0.7
	Litho_P2_P1m+b cpy		✔	0.53	0.8	19.95	20.0	1.21
	Litho_P2s_C1v+t cpy		✔	0.52	0.66	19.29	19.32	0.81
	Litho_P2ss_D3 cpy		✔	0.93	0.57	20.84	18.66	1.16
	Litho_D1+D2 cpy		✔	0.39	0.64	13.16	18.66	0.67

2.3 Estimation of oil and gas potential

Based on the results of the simulation, a quantitative assessment of oil and gas potential was performed for five structures located within the study region. Table 9.1 provides a list of structures and the results of evaluating their prospects. The methodology used for this assessment of geological resources is discussed below.

Structure Id-the sequence number of the structure obtained during modeling (pic. 38-42), does not carry any semantic load, but simply defines the structure number for this version of the drainage area.

Migration Efficiency – the Efficiency of migration.

Volume in Place-Geological resources.

Table 9.1-Estimation of prospective geological resources of the Tengiz field

	Name of the structure	**Tengiz**
П1	**Sequential number of the structure**	**52**
	Migration efficiency	24,2%
	Geological resources ,m^3	1061,79
	Geological resources, barrels	6677,89
	Recoverable resources, million tons	361,12
П2	**Sequential number of the structure**	**38**
	Migration efficiency	20,0%
	Geological resources, m^3	637,17
	Geological resources, barrels	4007,34
	Recoverable resources, million tons	223,00
П3	**Sequential number of the structure**	**22**
	Migration efficiency	8,0%
	Geological resources, m^3	1125,88

	Geological resources, barrels	7081,01
	Recoverable resources, milliontons	394,06
Total	The average efficiency of migration	17,4%
	Geological resources m^3	2824,84
	Geological resources, barrels	17766,24
	Recoverable resources, million tons	997,00

Continuation of table 9.1

CONCLUSIONS

The urgency of constructing a basin model of the southern side of the Pre-Caspian sedimentary basin is due to the need for effective monitoring and planning of geological exploration. In the context of analysis and assessment of areas and basins with different degrees of study and prospects of oil and gas potential, as well as unexplored basins and areas with yet unproven oil and gas potential, the work on basin modeling becomes even more important. Applying the results of basin modeling can reduce both geological and economic risks when identifying oil and gas systems that include elements such as parent rocks, reservoirs, fluid barriers, and traps. It will be possible to take into account important factors such as the time of generation and displacement of hydrocarbons, petrophysical data, reservoir characteristics at the time of origin and migration of oil and gas.

In General, the southern instrument zone is one of the most studied regions of the basin, where a lot of areas have been drilled, subsalt deposits have been uncovered for various thicknesses, and large oil and gas deposits have been identified. The section of this zone is composed of Paleozoic and Mesozoic deposits. The main goal of modeling is to assess the structure and prospects of the oil and gas potential of subsalt deposits, which are associated with a significant amount of unrealized forecast resources. The urgency of constructing a basin model of the southern side of the Pre-Caspian sedimentary basin is due to the need for effective monitoring and planning of geological exploration. In the context of analysis and assessment of areas/ basins with different degrees of study and prospects of oil and gas potential, as well as unexplored basins and areas with yet unproven oil and gas potential, the work on basin modeling becomes even more important. Applying the results of basin modeling can reduce both geological and economic risks when identifying oil and gas systems that include elements such as parent rocks, reservoirs, fluid barriers, and traps. It will be possible to take into account important factors such as the time of generation and displacement of hydrocarbons, petrophysical data, reservoir characteristics at the time of origin and migration of oil and gas.

In General, the southern instrument zone is one of the most studied regions of the basin, where a lot of areas have been drilled, subsalt deposits have been uncovered for various thicknesses, and large oil and gas deposits have been identified. The section of this zone is composed of Paleozoic and Mesozoic deposits. The main goal of modeling is to assess the structure and prospects of the oil and gas potential of subsalt deposits, which are associated with a significant amount of unrealized forecast resources.

REFERENCES

1Абилхасимов Х. Б. Закономерности пространственного размещения природных резервуаров Прикаспийской впадины. Геология нефти и газа №6, 2007 г.

2Абилхасимов Х. Б. Условия формирования природных резервуаров подсолевых отложений прикаспийской впадины и оценка перспектив их нефтегазоносности. Автореферат диссертации на соискание ученой степени доктора геолого- минералогических наук. Москва, 2009 г.

3Воцалевский Э.С., Булекбаев З.Е., Искужиев Б.А., Камалов С.М., Коростышевский М.Н., Куандыков Б.М., Куантаев Н.Е., Марченко О.Н., Матлошинский Н.Г., Нажметдинов А.Ш., Филипьев Г.П., Шабатин И.В., Шахабаев Р.С., Шудабаев К.С. Месторождения нефти и газа Казахстана. Справочник. Алматы, 2005.

4Гамидова А.Р. Эволюция метода бассейнового моделирования и перспективы его применения в Южно-Каспийском бассейне. Институт геологии. Национальная Академия наук Азербайджана, (Республика Азербайджан, г.Баку)

5Камбаров Н.Ш. Геодинамика и нефтегазоносность Прикаспийского осадочного бассейна. Объединенный институт физики Земли РАН, г.Москва, 2000 г.

6Assessment of Undiscovered Oil and Gas Resources of the North Caspian Basin, Middle Caspian Basin, North Ustyurt Basin, and South Caspian Basin Provinces, Caspian Sea Area, 2010 Fact Sheet 2010–3094, November 2010.

7 Thaddeus S. Dyman, Vadim A. Litinsky, and Gregory F. Ulmishek. Geology and Natural Gas Potential of Deep Sedimentary Basins in the Former Soviet Union, US Geological Survey, Chapter C.

8Gregory F. Ulmishek. Petroleum Geology and Resources of the North Caspian Basin, Kazakhstan and Russia, US Geological Survey Bulletin 2201-B, 2001Brunet M.F. Geodynamic evolution of the pre-Caspian basin after subsidence analysis. In: ILP, 6-th, workshop “Origin of sedimentary basin”. Barcelona. 1995. P. 129.

9Brunet M.F., VolozhYu.A.,Lobkovsky L.I. et al. Subsidence modeling in the Precaspian Basin. // IGCP. Annual Meeting. Cairo. 1996. P. 369. Jackson M.P.A., Talbot C.J., 1994. Advances in salt tectonics. In: Hancock, P.L. (Ed.), Continental Deformation. Pergamon Press, Oxford, pp. 159-179.

10 Jackson M.P.A., Talbot C.J., 1994.Advances in salt tectonics. In: Hancock, P.L. (Ed.), Continental Deformation. PergamonPress, Oxford, pp. 159-179.

11 Камбаров Н.Ш. Геодинамика и нефтегазоносность Прикаспийского осадочного бассейна. ОбъединенныйинститутфизикиЗемлиРАН, г.Москва, 2000 г.

12 Ringwood A.E. Phase transformation and differentiation in subducted lithosphere: Implications for mantle dynamics basalt petrogenesis, and crustal evolution // J. Geol. 1982. V. 90. N6. P. 611–643.

13 Vail P.R. Seismic stratigraphy interpretation using sequence stratigraphy interpretation procedure. Atlas Stratigraphy // Amer.Assoc.Petrol.Geol. 1987. Vol.27. N1. P.1-10

14 Vail P.R., Audemard F., Bowman S.A., Eisner P.N., Perez-Cruz C.The Stratigraphic Signatures of Tectonics, Eustasy and Sedimentology – an Overview.In Cycles and Events in Stratigraphy.Einsele G., Richen W., Seilacher A. et al., (eds). Berlin, Heidelberg: Springer-Verlag, 1991. Chapter 6.P.617-659.

15 VolozhYu.A., Antipov M.P., Brunet M.-F., Garagash I.A., Lobkovskii L.I., Cadet J.-P. Pre-Mesozoic geodynamics of the Precaspian Basin (Kazakhstan) // Sedimentary Geology. Special Issue. 2003. V. 156. Is. 1–4. N 10. P. 35-58.

16 VolozhYu.A., Talbot C.,Ismail-Zadeh A. Salt structures and hydrocarbons in the Pricaspian basin // AAPG. 2003. V. 87. N 2. P. 313-334.

17 Walter P. How evaluate potential gas and oil source rocks. – World Oil, 1973. Art., p. 71-75.

18 Assessment of Undiscovered Oil and Gas Resources of the North Caspian Basin, Middle Caspian Basin, North Ustyurt Basin, and South Caspian Basin Provinces, Caspian Sea Area, 2010 Fact Sheet 2010–3094, November 2010.

19 Thaddeus S. Dyman, Vadim A. Litinsky, and Gregory F. Ulmishek.Geology and Natural Gas Potential of Deep Sedimentary Basins in the Former Soviet Union, US Geological Survey, Chapter C.

20 Gregory F. Ulmishek.Petroleum Geology and Resources of the North Caspian Basin, Kazakhstan and Russia, US Geological Survey Bulletin 2201-B, 2001.

21 Аксенов А.А., Гончаренко Б.Д., Калико М.К. и др. Нефтегазоносность подсолевых отложений / М.: Недра. 1985. 205 с.

22 Бабаев Д.Х., Гаджиев А.Н. Глубинное строение и перспективы нефтегазоносности бассейна Каспийского моря. Изд-во «NAFTA-Press», Баку: 2006, 305.

23 Волож Ю.А., Сапожников Р.Б. Строение фундамента Западного Казахстана // Советская геология. 1974. №12. С. 78-93.

24 Волож Ю.А., Сапожников Р.В., Циммер В.А. Строение земной коры Прикаспийской впадины // Советская геология. 1975. №11. С. 93–104.

25 Волчегурский Л.Ф., Владимирова Т.В., Капустин И.Н., Натапов Л.М. Эволюция Прикаспийской впадины в среднем - позднем палеозое // Отечественная геология. 1995. №3. С. 44–49.

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN

Kazakh National Research Technical University named after K. I. Satpayev

REVIEW

of the diploma work

Student Orymbekova A.N.
Specialty 5B070600 – Geology and exploration of mineral deposits
Institute of Geology, Oil and Mining named after K. Turysov
Department of Petroleum Geology
Title of the diploma work Geology and oil and gas potential of the subsalt complex in the south of the Caspian basin, features of the reservoir properties of the Tengiz field .

Scientific adviser:master of technical sciences, lecturerUrmanova D. E.

The diploma work of Orymbekova Aigerim Nurlankyzy written on a relevant topic "Geology and oil and gas potential of the subsalt complex in the south of the Caspian basin, features of the reservoir properties of the Tengiz field."

The main goal of student Orymbekova A.N. was: the study of the geological structure, tectonics, and oil and gas potential of the Pre-Caspian basin and substantiate the directions for further exploration for oil and gas.

The diploma work is developed based on the analysis of a large number of specialized literature and in accordance with current methodological recommendations and normative legal acts established by the legislation of the Republic of Kazakhstan.

The diploma work describes the general and geological and geophysical characteristics of the area and site of work, recommended methods, types and volumes of exploration geological and geophysical work to assess the operational reserves of oil and gas for the purpose of further oil supply. Summary tables of the main types and volumes of projected work on exploration and evaluation of operational oil and gas reserves are provided.

The work was carried out rhythmically and in accordance with the calendar schedule. Graphic material is designed carefully and in accordance with the requirements of the organization's Standard "General requirements for the construction, presentation, design and content of standards", ST RK 1.2-2013GSTR RK. ST KazNRTU – 09 – 2017.

The diploma project of Orymbekova A.N. corresponds to the technical task and is characterized by a deep study of the topic and is made with the use of modern progressive technologies.

I believe that Orymbekova A.N. has applied the methodology, types and volumes of exploration and geophysical work to assess the operational reserves of oil and gas for the purpose of further oil and gas supply, prepared for independent work in the specialty 5B070600– Geology and exploration of mineral deposits.

Scientific adviser:  master of technical sciences, lecturer Urmanova D.E.Ю

Протокол анализа Отчета подобия

заведующего кафедрой / начальника структурного подразделения

Заведующий кафедрой / начальник структурного подразделения заявляет, что ознакомился(-ась) с Полным отчетом подобия, который был сгенерирован Системой выявления и предотвращения плагиата в отношении работы:

Автор: Орымбекова Әйгерім Нұрланқызы
Название: Геология и нефтегазоносность подсолевого комплекса юга Каспийского бассейна, особенности коллекторских свойств месторождения Тенгиз

Координатор: Диляра Урманова
Коэффициент подобия 1:0
Коэффициент подобия 2:0
Замена букв:7
Интервалы:0
Микропробелы:0
Белые знаки:0
После анализа отчета подобия заведующий кафедрой / начальник структурного подразделения констатирует следующее:
☑ обнаруженные в работе заимствования являются добросовестными и не обладают признаками плагиата. В связи с чем, работа признается самостоятельной и допускается к защите;
☐ обнаруженные в работе заимствования не обладают признаками плагиата, но их чрезмерное количество вызывает сомнения в отношении ценности работы по существу и отсутствием самостоятельности ее автора. В связи с чем, работа должна быть вновь отредактирована с целью ограничения заимствований;
☐ обнаруженные в работе заимствования являются недобросовестными и обладают признаками плагиата, или в ней содержатся преднамеренные искажения текста, указывающие на попытки сокрытия недобросовестных заимствований. В связи с чем, работа не допускается к защите.

Обоснование:
Работа выполнена самостоятельно и не несет элементов плагиата. В связи с этим, работа признается самостоятельной и допускается к защите.

24.05.2020
Дата

Подписано цифровой подписью: Енсепбаев Т.А.
Дата: 2020.05.27 02:13:01 +06'00'

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Подпись заведующего кафедрой / начальника структурного подразделения

Окончательное решение в отношении допуска к защите, включая обоснование: *Дипломная работа допускается к защите.*

24.05.2020
Дата

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Подпись заведующего кафедрой / начальника структурного подразделения

Протокол анализа Отчета подобия Научным руководителем

Заявляю, что я ознакомился(-ась) с Полным отчетом подобия, который был сгенерирован
Системой выявления и предотвращения плагиата в отношении работы:

Автор: Орымбекова Әйгерім Нұрланқызы
Название: Геология и нефтегазоносность подсолевого комплекса юга Каспийского бассейна,
особенности коллекторских свойств месторождения Тенгиз

Координатор:Диляра Урманова
Коэффициент подобия 1:0
Коэффициент подобия 2:0
Замена букв:7
Интервалы:0
Микропробелы:0
Белые знаки: 0
После анализа Отчета подобия констатирую следующее:
☑ обнаруженные в работе заимствования являются добросовестными и не обладают
признаками плагиата. В связи с чем, признаю работу самостоятельной и допускаю ее к
защите;
☐ обнаруженные в работе заимствования не обладают признаками плагиата, но их чрезмерное
количество вызывает сомнения в отношении ценности работы по существу и отсутствием самостоятельности ее автора. В связи с чем, работа должна быть вновь
отредактирована с целью ограничения заимствований;
☐ обнаруженные в работе заимствования являются недобросовестными и обладают
признаками плагиата, или в ней содержатся преднамеренные искажения текста, указывающие на попытки сокрытия недобросовестных заимствований. В связи с чем, не
допускаю работу к защите.

Обоснование: *Работа выполнена самостоятельно и не несет элементов плагиата. Обнаруженные в работе заимствования являются добросовестными. В связи с этим, признаю работу самостоятельной и допускаю ее к защите перед государственной комиссией.*

24.05.2020
Дата *Подпись Научного руководителя*