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GEOLOGICAL STRUCTURE AND OIL FIELD OF THE AMUDARYO BASIN

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ABSTRACT

The article provides information on the geological structure and oil and gas content of the Amudarya sub-province, mainly the formation and composition of bedrock and sedimentary rocks, as well as oil and gas complexes and the laws of their distribution.

The article provides a brief description of the composition and associated tectonic elements of the Amudarya synclise.

In the 1960s, the eastern part of Turkmenistan and the south-eastern part of Uzbekistan became the focus of geologists. This area is also known as the Amudarya oil and gas sub-province [1] (Figure 1). It is the second largest province after Western Siberia in terms of sub-province size and importance of oil and gas reserves and resources.

At present, all areas of the province are covered by regional seismic surveys, large-scale 2D and 3D seismic surveys have been carried out at the boundaries of the largest oil and gas fields, as well as full-scale gravimetric and magnetic reconnaissance surveys have been completed. All these complex geological exploration activities allowed to determine the main features of the deep structure of the sedimentary cover and foundation structures of the study area.

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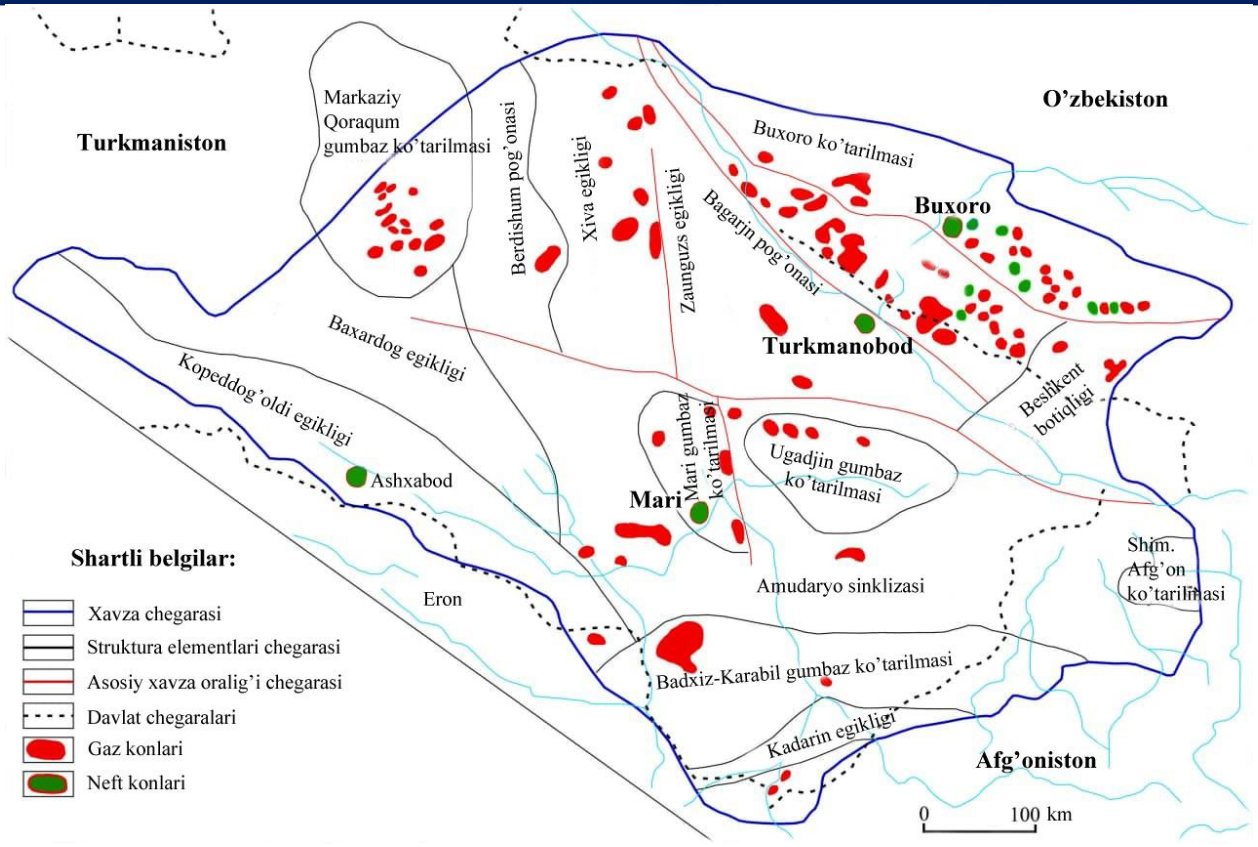

Figure 1. Tectonic scheme of the Amudarya province *(Adapted by S.D.Maksimova and N.P.Chepova on graphic materials by S.D.Gorbachev).*

The Amudarya oil and gas sub-province is divided into a number of principal elements that define UV distribution zones across the region and shear — mainly titanium-period gaurdak formations in the upper part of the evaporite rock complex, productive complexes of Upper Jurassic reef bodies and carbonate Jurassic deposits, as well as Cretaceous terrigenous deposits; the parent rocks that produce oil and gas at the provincial boundary, such rocks may be represented in the Lower and Middle Jurassic terrigenous deposits with intermediate layers of coal.

The first Setelantepa gas field in the Amudarya sub-province was discovered in 1950-1953 on the northeastern edge of the sub-province. The discovery of this field was the impetus for the intensification of exploration work in the region. As a result of subsequent geological exploration, a number of deposits were discovered, such as Tashkuduk, Kimerek, Yangikazgan, Uchkir, and in 1956 a giant gas field was discovered.

The Amudarya sub-province is tectonically bounded on the south-western side by the Kopetdag Mountains, which are joined by a chain of Jurassic and Cretaceous carbonate and terrigenous complexes that are tectonically deformed and incompatible with the Triassic and Paleozoic deposits.

The southern border of the province runs along the Bandi-Turkeston mountain range and stretches for 300 kilometers. The rocks in the composition of this structural element are composed of metamorphic deposits of the Paleozoic period, which lie incompatibly on the

Permian-Triassic complexes, and in turn the Jurassic and Paleogene deposits have undergone deformation and compression.

Triassic deposits were mainly accumulated during the riftogenesis, which occurred in the late Triassic, in the marginal rear of Eurasia (behind the magmatic ring of the Hindu Kush and Parapomiz mountain chains). The primary processes of burma formation and the formation of mountain ranges began in the late Triassic, and subsequent Jurassic-Paleogene deposits took place under conditions of weak marginal margins.

The final phase of the newly formed bends and mountain-bending structures began in the Oligocene and was part of the processes of formation of the alpine-Himalayan fold belt, the general structural elements reversing this process in accordance with the structural-tectonic elements of the Toyura period.

From the east, the Amu Darya province joins the Afghan-Tajik basin. Until the Miocene, the province formed a single basin, with associated Jurassic-Oligocene deposits and geological structure being the same. From the Miocene period to the present day, the Afghan-Tajik basin has been deformed due to the migration and movement of the Pamir fold system. As a result of this pressure, large anticlinoria and synclinorium were formed in the province, and on the basis of these anticlinorium and synclinorium, fractures were formed on the sliding surface scattered along the length of the upper salt deposits. In the later depression zones, synclinors began to form in the layer of Neogene-Quaternary deposits, which today are several kilometers thick. It should be noted that the process of formation of large depth fractures in the Amudarya sub-province had almost no effect.

The Amudarya sub-province is bounded on the north by metamorphic and igneous rocks of the Kyzylkum uplift Paleozoic deposits (in some places these rocks are exposed, often covered by shallow layers of Mesozoic-Tertiary deposits). Paleozoic deposits extend along the Kyzylkum ridges to the Tien Shan branches. The Kyzylkum and Tien-Shan ranges belong to the Hercynian period of folding and are the result of the collision of the Karakum (mid-late Carboniferous) and Tajik (early Permian) microcontinents with the southern edge of the Kazakh Caledonian continent. In turn, the processes of early primary mountain formation and intrusive formation belong to the early Permian period.

Like the Karakum Uplift from the northwest of the Amudarya sub-province, the Paleozoic rise of the foundation rose to the surface and formed a narrow bend with a height of 2,2 km. Oil and gas fields have been identified in the southern and eastern parts of this confluence, while no oil and gas fields have been identified in the northern and western parts of the Karakum Uplift. This allows to determine the principal direction of hydrocarbon migration and the principles of their detection in this region [2].

The Amudarya oil and gas province represents a large depressed region formed in the Jurassic period. The basis of the Hercynian fold (late Paleozoic), Triassic riftogenesis, as well as a new period of orogeny associated with the formation of the alpine-Himalayan fold zone is a structural-tectonic element of the Amudarya basin. The Amudarya sub-province is a large basin in the region of the

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Turan epigertsin plate. The deep part of the structure of the studied region has not yet been sufficiently studied, and the location of the foundation in the peripheral zones of the sub-province allows us to estimate the tectonic complex structure of the foundation in the central part of the Kandym uplift area [3].

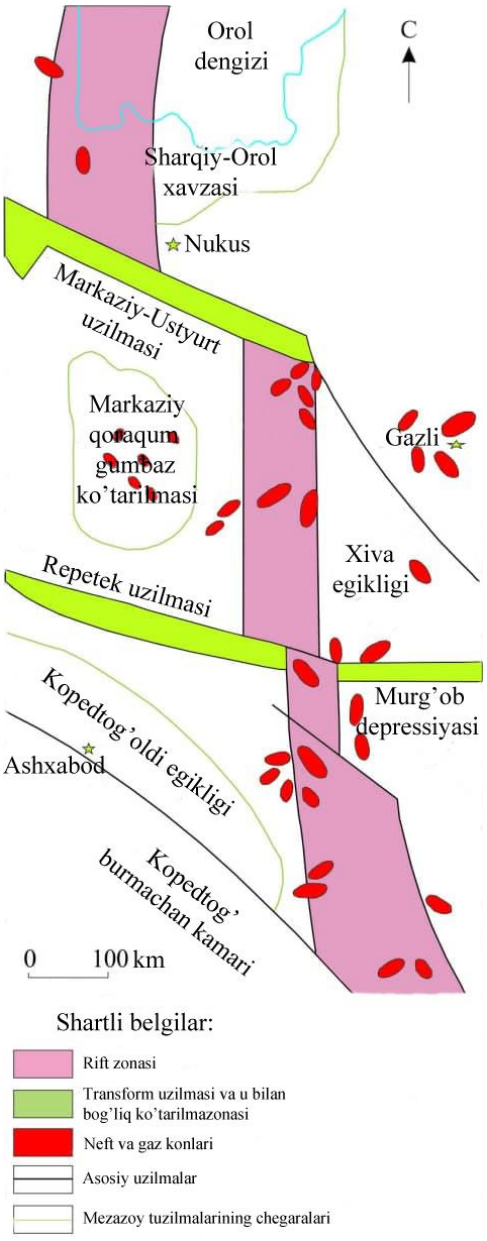

Figure 1. Aral-Murgab rift system.

The northern part of the Karakum massif has been explored through drilled wells, and in the Mesozoic period, Jurassic-Cretaceous deposits lie incompatibly with metamorphic Paleozoic deposits. The enclosed metamorphic and sedimentary rocks are amphiobolitic shales (age 585 ± 25 million years) and the entire base massif is filled with Silurian (435 million years) - carbon (302 million years) granite intrusions.

The tafrogenic stage of development of the Amudarya sub-province coincided with the late Permian

and Triassic periods, this stage of development goes from the Hercynian stage of mountain formation in the Central Chorji region and the relief is peneplenized (flattened). A large amount of terrigenous material has accumulated, the foundation of which is divided into parts along the rift systems and again formed rift valleys. Due to the large thickness of sedimentary deposits, the localization of the rift system is complicated.

The next stage of development of the Amudarya province is associated with the development of high-thickness sedimentary cover. At this stage, it was found that the sedimentary cover of the province lay inconsistently on the surface of the foundation and on the complex of deposits that had undergone metamorphism. From the Jurassic to the Eocene, the process of sedimentation took place in continental marginal conditions. Early-late Jurassic deposits were explored through exploration wells in the remote parts of the province, while in the central parts these deposits were not explored adequately through wells. In general, the Early and Middle Jurassic deposits in the Amudarya Basin are composed of continental terrigenous rocks.

Ocean deposits are represented at the top of the bat-bayos complex, their thickness increasing in a southerly direction. Large-grained terrigenous deposits and deposits belonging to the Middle Jurassic complex of coal are represented in the shear. Intermediate layers of coal above the ridge are rare and have a very small thickness. The amount of tuffs and diabases in the shear is found in some wells located in the northeastern part of the province near deep fractures. This zone is a large graben filled with lower and middle Jurassic deposits.

In the Amudarya sub-province, large-scale transgress began with the formation of small-thickness clay deposits during the bat-kellow, while large-thickness carbonate deposits accumulated during the Oxford period. The Amudarya sub-province was divided into several parts during the Keloveo-Oxford period by palaeogeographic conditions of sedimentation - the south-eastern part of the basin was occupied by a deep-water sea zone, shallow water zones were formed in the periphery of the basin. . The thickest part of the reef body in terms of oil and gas potential and oil and gas potential (formation of reservoirs and traps) is formed in the middle and late oxfords - this reef complex contains half of all hydrocarbon reserves of the Bukhara-Khiva oil and gas region. The total thickness of the Upper Jurassic deposits is 500-600 meters, the reef part decreases to 100-150 meters, the posterior part of the reef slopes towards the edge of the basin. In the shelf part of the basin, kelovoy-oxford deposits are composed of different types of carbonates (oolithic, detrital and aquatic), as well as in the middle and upper parts of oxford deposits there are intermediate layers of dolomite, marble, anhydrite. Terrigenous deposits are found mainly in the northern parts of the basin.

The Upper Jurassic deposits are located on the eastern border of the province in the south-eastern part of the Gissar ridge. The kellovoy part of the shear consists of thin-middle layers of 50-100 m dark gray clayey limestones.

In the Amudarya sub-province, corals (corals) and algae are the main reef builders. Along the length of the

semicircular reef bodies, the boundary between the shelf and deep water basins was crossed, and sections of inflow channels with a depth of 50–100 m were crossed.

Titanium-era evaporite deposits (gaurdak formations) lie in the upper part of the Upper Jurassic carbonate deposits in the central part of the Amudarya Province, with a thickness of 900 meters and more [5]. In the central parts of the Chordji plateau, the gaurdak suite consists of two salt layers separated by anhydrite intermediate layers, with 15-meter anhydrite intermediate layers lying at the top of this formation. The lower anhydrite intermediate layer varies from 10 m to 30 m in the area where the reef bodies are located, and grows to 100-200 m in the marginal parts. At the depth of the Paleo basin, the anhydrite pack decreases by 50 m. Thus, the change in the thickness of the anhydrite bundle serves as a good indicator for conducting exploration work on reef bodies in this zone [6].

The Gaurdak Formation overlaps evaporite rocks with carabil Formation deposits composed of red terrigenous deposits with a thickness of 100 m to 300 m (northern part of the province — XIV productive horizon). These deposits can be considered alluvial-lagoons by origin. The probable age of the deposits was late titon-berias, with sedimentation observed in the outskirts of the province [7].

Lower Cretaceous deposits lie incompatibly with Paleozoic and Upper Jurassic deposits; however, this discrepancy is less pronounced or completely absent in the central part of the basin [8]. Neocomian period deposits (berias-barrem) were formed during the transition from marine to continental conditions. Marine carbonates are the main deposits in the Kopetdag mountain range.

During the Barem sveta, a sea transgression led to the complete sinking of the Amudarya sub-province. Apt-alb deposits are represented by marine shales and sandstones, carbonates in local zones, and mainly belong to the apt layer. the total thickness of the lower Cretaceous deposits is 1,200 meters (in the zones of the Murgab Depression and the Pre-Kopetlogh Basin) and gradually decreases in the marginal parts of the sub-province.

The Upper Cretaceous deposits are composed mainly of marine sediments, with red lagoons and anhydrites prevalent only in the southeastern part of the Chorji Basin. The herd is mainly composed of limestones, and in the areas of the Karakum uplift and the Kopetdag basin, the senoman deposits are composed of sandstones. Along the eastern direction, the carbonate layers are replaced by terrigenous rocks (shales and siltstones in the central part, the largest granular materials in the eastern and near the periphery of the basin). High-thickness limestone and marble layers can be found in the Kampan and Maastricht deposits.

Paleogene deposits (Paleocene-Middle Oligocene) complete the formation of the geological sheath of the Amudarya subprovincess. The Lower Paleocene deposits are composed of sandstone and carbonate rocks and are localized in the western and southern parts of the region due to the strong peneplacement of the relief in all areas except the western and southern parts of the subprovoence during the Middle Paleocene. The middle and upper Paleocene deposits (Bukhara Formation) are mainly composed of fine-

grained carbonate rocks with small layers of sandstone and anhydrite. In the shear, the amount of sandstone increases in the northern and north-western directions. At the same time, the thickness of the anhydrite layers increases in the southern part of the subprovinces. The Eocene-Middle Oligocene part of the cliff is composed mainly of gray and clays and siltstones of various colors, the sandstones being mainly distributed along the southern boundary of the subprovinces. Carbonates and marbles are found in the western part of the Chargi Plateau. The thickness of the Paleocene deposits is more than 2 km in the foothills of the Kopetdag, 500-800 meters in the Murgab Depression and tens or hundreds of meters in the suburbs.

All tectonic formations (covering the period from the Jurassic to the Paleogene) that occur during the formation of the Amudarya sub-province are characterized by platform-type tectonics. Structural uplift zones (small elements of the Karakum uplift, northern Afghanistan elevation, and other dimensions) have gradually subsided as a result of simultaneous positive movements, leading to the formation of inconsistent surfaces in some local zones. The maximum decrease occurred in the zones of the Murgab basin and the Kopetdag foothills. The process of Alpine tectogenesis affected the areas around the Amudarya sub-province and formed the first mountain chain during the Oligocene, which led to the rapid movement of the Indian and Arabian subcontinents on the Eurasian lithosphere plate — beginning in the Pliocene and continuing to the present day.

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