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GEOLOGICAL FEATURES OF THE INDER SALT DOME BASIN OF THE INDER DISTRICT OF THE REPUBLIC OF KAZAKHSTAN

Annotation. *This article describes the Jurassic and Cretaceous deposits of the Inder salt dome basin of the Inder district of Atyrau region of the Republic of Kazakhstan. The material for the work was observations and samples found in the spring of 2023. The materials were studied using experiments and methods used in classical paleontology and geology.*

An important feature of the structure of the salt dome is Mesozoic deposits. Jurassic and Cretaceous marine deposits are characterized by abundant marls and limestones. On the slopes of the Koktau ridge, rocks of the Triassic period are represented on the surface by red clays, transverse sandstones and conglomerates. The following remains of invertebrates have been found in the fauna: bass clams Belemnitella mucronata, dioecious shellfish Gryphea dilatata, Sea urchin shell Echinocorys sp., the only scleractin coral Caryophyllum similotrochus.

Key words: *Atyrau region; paleofauna; sediments; Inder; member; formation; lake; Shellfish; mesozoic; uplift.*

Introduction

The Caspian lowland is a geographical region, one of the distinctive features of which is the significant influence of salt tectonics on the formation of landscapes. One of the largest salt dome landscapes of the Caspian lowland is the Inder salt dome zone. The surroundings of Lake Inder are located on the left bank of the Ural River (N48°36,139'E051°59,239') and represent a saline dome-shaped rise in the form of a plateau 20-25 m high above the surrounding desert.

The plateau of the Inder uplift consists of gypsum rocks with an area of about 250 square kilometers. It covers the territory, but the thickness does not exceed 50-60 m.

Research materials and methods

The material for the work was observations and finds made by the authors in May 2023 in the area of Lake Inder (Fig. 2). The materials were studied using the experience and techniques used in classical geology and paleontology.

The formation of the Inder salt dome area is associated with two large salt domes - the Inder and Bad Indus, between which is located the largest compensation (depression) trough of the Inder compensation trough in the Caspian basin.

This fluctuates at least 500 m at a rate of about 1 mm per year [1].

From a physical and geographical point of view, the Inderovsky solonchak-domolny district is distinguished as a separate landscape region within the Ural-Embinsk plain desert province.

Like the five major salt dome landscapes of the Caspian Lowland, the Indera Salt Dome region consists of the heavily karstic Inder Mountains, which corresponds to a large diapiric uplift, and the Inder Salt Dome region consists of the Inder Mountains and 115 km^2 it is a paradynamic interface consisting of the large ellipsoidal lake Inder. And the edge of the water is below sea level - 23.5 m. The lake is mainly fed by meltwater and rainwater, springs and ground water from the Inder

Mountains. The lake stretches from northwest to southeast. Its northern and eastern banks are steep it reaches more than 20 m in height and is cut by short gullies and gullies in the form of ditches and ditches. In the ravines of the northern shore of the lake there are mineral waters and springs. Their total number reaches 80 and is used for balneological purposes, including on the north-eastern shore of Lake Ashytuzbulak. The average annual flow rate of spring sources is 78.2 l / s, ranging from 33 to 144 l/s in a wide range. The northern coast consists of gypsum, on which quaternary deposits lie. The lake flows into two north-western currents - Beloe Rostoshye and Aksai, which expose Jurassic and Cretaceous deposits. The western and Southern banks are cut by flat wide gullies [2].

According to K. M. Akhmedenov et al. [3] Karst of the Inder mountains the plain is the largest in the Caspian lowland.

The total number of karst forms exceeds 5000. The density of surface karst forms reaches 200-300 pcs/km^2. The total amount of surface shortening caused by karst processes is 1.87

mm / year. There are four types of karst pits: lamellar and conical, ponor

figurative ones and well-shaped. Lamellar depressions are common everywhere,

but most often located on the outskirts of the Inder Mountains. The diameter reaches 10-15 m, the depth is 2-3 m. The conical pits are 20 m deep and 30-40 m wide.

Ponor funnels have a conical shape with a narrow hole (ponor) at the base, which serves as a drainage channel. Karst wells are unique: small in size (up to 5 m in diameter), their depth reaches 15 m. Separate karst depressions and depressions are located to the south and southeast of Lake Inder.

An important feature of the dome design is the exposure of Mesozoic deposits on its southwestern and eastern sides (Fig. 1). In the West, in the Belaya Rostosh Gorge, Jurassic and Cretaceous marls and limestones with a rich marine fauna are found. On the slopes of the Koktau ridge there are rocks of the Triassic period, on the surface of which red clays, transverse sandstones and conglomerates are depicted [4].

In the Inder dome, the salt chain was divided by S. S. Korobov [5] into salt, Kyzyltau,

Kurgan, and Totzhal formations. The lower Sutpaitau formation consists of pure rock salt with an intermediate layer of anhydrite (up to 22 m) at the top.

It is assumed that its thickness is at least 700 m. The dairy-free layer of Inder is equal to the thickness of bottom rock salt found in other salt domes. The Kyzyltau formation consists of Lower (halopelite), middle (polyhalite-silvinite), and upper (halite)rocks Buda. The lower hybrid of red-brown halopelites consists mainly of carbonates and It is represented by anhydrites; only a quarter consists of clay-siltstone components. Buda is 100-150 m thick.

It consists of medium polyglytic silvinite. In some places, flocks often contain kieserite and kainite.

In the upper part of its section, silvinites were sometimes replaced by carnallites. Buda is 200 m thick. The upper halite of the Inder Kyzyltau formation is 150-200 m thick. The base of the Kurgan formation is formed from Buda of the anhydrite horizon, Lower halite, middle Shushak, and upper halite.

The anhydrite horizon passing through the base of the layer is represented by two closely spaced anhydrite layers, each up to 10-15 m thick.

Despite the separation of the salt layers, this horizon in Indera is a sign. The thickness of the lower halite Buda reaches up to 250 m. On its roof, N. K. Vorobyov et al. [6] were well diagnosed from the core gergate-halite marker defined the horizon.

The bottom of the middle Shushakau Buda (up to 100 m) consists of rock salt, above which lie two potash horizons separated by rock salt. At the bottom, the potash-bearing horizon (up to 40

m) is formed by halite, kieserite, and carnallite, and in some places bisophyte, and at the top (up to 20 m)-silvinite-halite rocks.

The thickness of the Shushakau Buda is about 200 m. contains salt clays (5-10 m) the upper halite element with a layer has a thickness of 650-750 m. The rust layer is represented by a layer of rock salt coating (250-300 m) and anhydrite coating (80-100 m).

The thickness of the salt beds in the Inder region is about 2500 m.

The Upper Jurassic Inder marine sediments section begins with a glauconite sandstone layer (0.2-0.45 m) filled with gravel and rounded phosphorite nodules, as well as rounded Callovian and Oxfordian fauna: Kosmoceras ex gr. Enodatum Nik., K. proniae Teis., Quenstedticeras lamberti Sow., Cardioceras cordatum Sow., Aspidoceras cf. perarmatum Sow. occurs. Gryphaea dilatata, Lucina fischeri Orb., Panopaea peregrina Orb., Pleuromya sp., Rhynchonella personata Buch., R. fischeri Orb. This phosphorite layer usually belongs to the Callovian and Oxfordian regions, but comparison with other areas of the Caspian Lowland shows that this opinion is incorrect. Salt domes and old rocks contain all eroded intermediate horizons with transgressive deposits of the Volga stage. A phosphorite layer with rounded phosphoritized fossilized cores is always found at the base of the fossils, and nearby horizons are preserved in adjacent dome depressions, possibly without phosphorites. Hence the formation of a phosphorite horizon and the formation of workings leached from rocks under the Inder phosphorylation Callovia To Oxford not applicable. It dates back to the beginning of the Volga transgression. This is directly confirmed by the ammonite discovered by V. V. Mokrinsky in the same layer with the Callovian and Oxford excavations, and by G. T. Pchelintseva Virgatites sp. defined as indet. Intermediate layers of gray and yellowish-gray, often sandy, slightly marl clays (14-17 m) and yellow-clay sands and sandstones are located above the belaya Rostosha phosphorite horizon. Its rocks contain various non-specific pelecypods, as well as Pachyteuthis (Simobetus) kirghisensis (Orb.), and Cylindroteuthis (Lagonibelus) cf. magnifica (Orb.), Belemnitella sp. 3) occurs according to Mikhailov and Gustomesov [7]. Pachyteuthis (Simobelus) kirghisensis (Orb.) occurs in Upper Oxfordian deposits and occurs in Kimmeridgian rocks, Cylindroteuthis (Lagonibelus) magnifica (Orb.) On the Eastern Europe platform

Dorsoplanites panderi it occurs in the sediments of the region. In addition, the microfauna found in clays, according to A. V. Fursenko, is known from deposits of the Volga stage of the Caspian lowland L. ornatissima(Furss. et Pol.) Lenticulina dofleini (Kasants.), L. ornatissima (Furss. et Pol.) characteristic forms.

The clays under consideration belong to the Doprsoplanites panderi zone of the Volga stage.

Figure 1-Geological diagram of the Inder salt dome rise (geological survey sheet M-39-XXXIV M 1:200000) [11].

Above (up to 30 m) are clays of dark, greenish-gray, yellowish-green and brown color, mainly bituminous, usually marl, in the lower part-separated marl nodes (up to 0.5 m in diameter) and above-clay sandstones with rare intermediate layers and one horizon of oil shales (0.4-0.7 l) there is one. Its rocks include Zaraiskites scythicus (Vischn.), Cylindroteuthis (Lagonibelus) magnifica (Orb.) and numerous pelecypods, and in the upper part of the section (above the oil shale) - Zaraiskites cf. zaraiskensis (Mich), Pavlovia pallasi (Mich) South Africa.

The upper part of the Volga stage in the white Heath is formed by a unit of light gray marl (17-22 g), only in its lower part there are several layers of yellow-gray and black clay. Zaraiskites zaraiskensis (Mich.) is still found in the lower part of the hybrid, and V. sosia (Vischn.) occurs Virgatites virgatus (Buch).

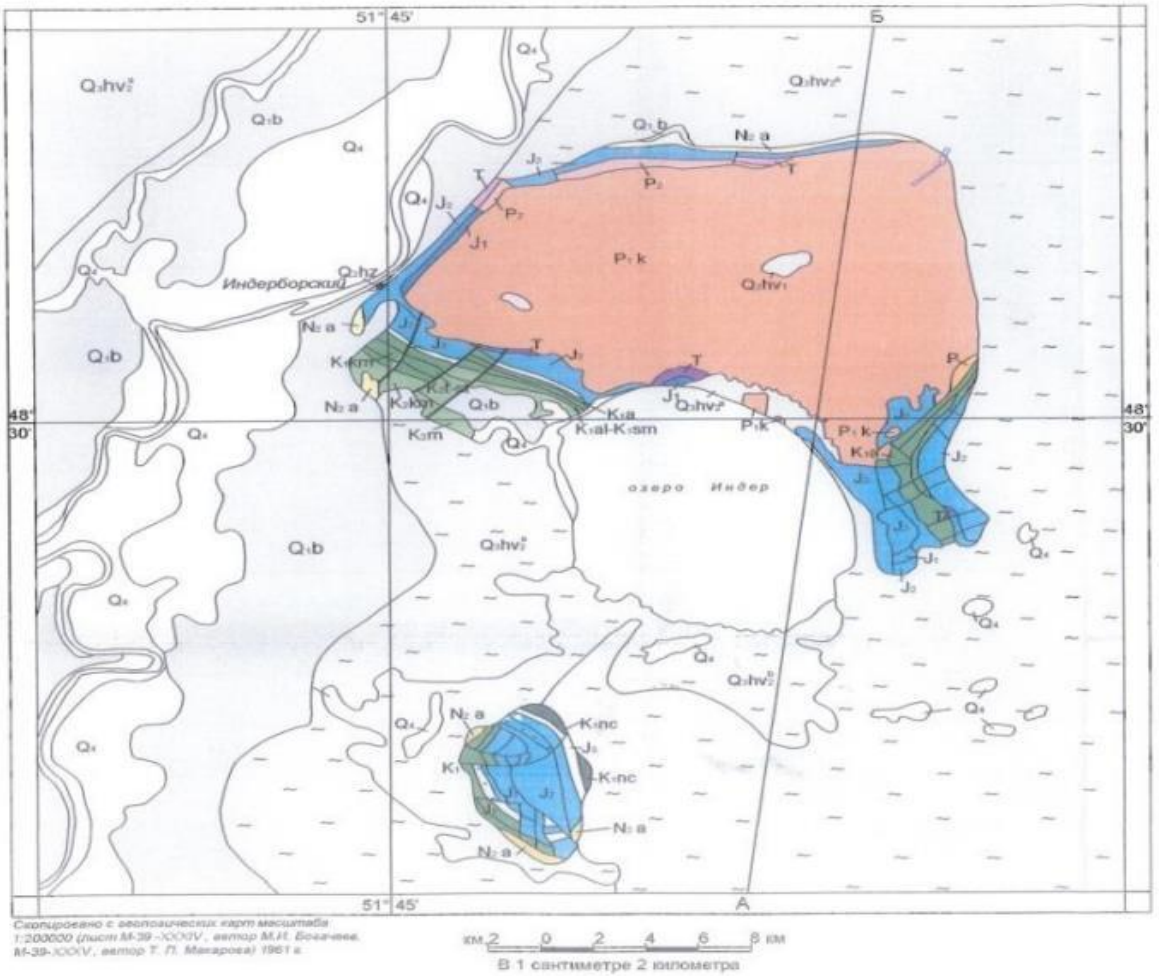

Figure 1 - Geological diagram of the Inder salt dome uplift (geological survey of sheet M-39-XXXIV M 1:200000) [11]

Figure 2 - View of Lake Inder from the northeast coast
(Photo by D. B. Yakupova)

The Volga deposits are relatively poor in ammonites and belemnites, but they are rich in various pelecypods, which are listed in many works [8-10].

In addition, sea urchins (Cidaris boloniensis Wright., C. coronatus Goldf., C. suevicus Quenst.) (Figs.4, 5), sea lilies (Pentacrinites amblyscalaris Thug., P. pentagonalis Quenst.), brachiopods (Rhynchonella pinguis Roem., R. triunca Quenst., Terebratula helmerseni Lem.6), various representatives of serpula worms and vertebrae of ichthyosaurs (ichtyosaurus trigonus Ow.) were found.

Toothless wickets Ostrea deltoidea Sw., O. expansa Sw., Exogyra bruntrutana Thurm. in the sedimentary layer, Virgatites virgatus form solid banks.

The total thickness of the Volga step deposits in Inder is estimated differently by different researchers: according to A.V. Khabakov (1937), 45-47 m, according to E. I. Sokolova (1939) -68 m, according to A.V. Fursenko– 75 m [12].

Figure 3-Belemnitella sp. (Photo by D. B. Yakupova)

Figure 4 –Sea urchin shell Echinocorys sp. (Photo by D. B. Yakupova)

Early Cretaceous deposits make up the eastern part of the Inder and the southern part of the Bad Inder and contain the ammonite fauna Deshayesites sp. the main part of the Late Cretaceous deposits was formed in the Campanian and Maastrichtian ages [13].

Figure 5 –Remains of a sea u (photo by V. N. Kurdukov) [13]

Figure 6-Single scleractin coral Caryophyllum Similotrochus (Photo by A.A. Kurmaniyazova)

Conclusion

Geological characteristics of the Inder district of Atyrau region, which are of considerable interest from the point of view of stratigraphy and tectonics, are carried out. Jurassic deposits cover the entire perimeter of the Inder dome and cover all the eras of the Jurassic period-early, middle and Late. From the Upper Cretaceous sediments, cephalopods Belemnitella sp., sea urchin shell Echinocorys sp., and scleractin corals, fossilized fauna of invertebrates such as Caryophyllum similotrochus were discovered.

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ҚАЗАҚСТАН РЕСПУБЛИКАСЫ ИНДЕР АЙМАҒЫНЫҢ ИНДЕР ТҰЗДЫ-КҮМБЕЗДІ БАССЕЙНІНІҢ ГЕОЛОГИЯЛЫҚ ЕРЕКШЕЛІКТЕРІ

Аңдатпа. Бұл мақалада Қазақстан Республикасы Атырау облысы Индер ауданы Индер тұзды күмбезді бассейнінің юра және бор шөгінділері сипатталған. Жұмыстың материалы болып 2023 жылдың көктемінде жүргізілген бақылаулар мен табылған үлгілер болды. Материалдар классикалық палеонтология мен геологиядағы қолданылатын тәжірибелер мен әдістерді қолдану арқылы зерттелді. Тұзды күмбез құрылымының маңызды ерекшелігі мезозой шөгінділері болып табылады. Юра және бор шөгінділері теңіз фаунасы мол мергельдер мен әктастарымен ерекшеленеді. Көктау жотасының беткейлерінде триас дәуірінің тау жыныстары бетінде қызыл саздармен, айқаспалы құмтастармен және конгломераттармен ұсынылған. Фаунадан омыртқасыз жануарлардың келесі қалдықтары табылды: басаяқты моллюскалар *Belemnitella mucronata*, қосжақтаулы моллюскалар *Gryphea dilatata*, теңіз кірпісінің қабығы *Echinocorys sp.*, жалғыз склерактин маржаны *Caryophyllum similotrochus.*

Кілт сөздер: Атырау облысы; палеофауна; шөгінділер; Индер; пачка; свита; көл; моллюскалар; мезозой; көтерілу.

Курманиязова А.А., Ахмеденов К.М., Якупова Д.Б.

ГЕОЛОГИЧЕСКИЕ ОСОБЕННОСТИ ИНДЕРСКОГО СОЛЯНОКУПОЛЬНОГО БАССЕЙНА ИНДЕРСКОГО РАЙОНА РЕСПУБЛИКИ КАЗАХСТАН

Аннотация. В данной статье описаны юрские, меловые отложения Индерского солянокупольного бассейна Индерского района Атырауской области Республики Казахстан. Материалом для работы послужили наблюдения и находки, произведенные весной 2023 года. Материалы были изучены с использованием опыта и методик, применяемых в классической геологии и палеонтологии. Важной особенностью строения соляного купола является обнажение мезозойских отложений. Юрские и меловые отложения представлены мергелями и известняками с обильной морской фауной. На склонах хребта Коктау на поверхность выходят породы триасового возраста, представленные красноцветными глинами, косослоистыми песчаниками и конгломератами. Были найдены остатки беспозвоночной фауны, такие как головоногие моллюски *Belemnitella sp.*, *панцирь* морского ежа Echinocorys sp., одиночные кораллы-склерактинии Caryophyllum similotrochus.

Ключевые слова: Атырауская область; палеофауна; отложения; Индер; пачка; свита; озеро; моллюски; мезозой; поднятие