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Groundwater of Karakalpak Ustyurt as a Resource for Development of the Region

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ABSTRACT: In the article, the authors consider the vast territory of Karakalpak Ustyurt. For the timely and complete development and development of large-scale industrial facilities on the territory of Ustyurt, a large amount of both drinking and technical water is required. As is known, in this territory there are no local open reservoirs suitable for water supply, watering and oasis irrigation. In this regard, the relevance of the problem lies in a comprehensive study with subsequent identification and comprehensive assessment of regional resources of low-mineralized groundwater. The distribution of groundwater mineralization both in depth and in space from north to south increases the value of mineralization. In the study area, in the direction of groundwater movement, mineralization varies from 7-10 g/l and uplifted parts of the territory to 25 g/l and more. These conditions are violated when the territory consists of a flat low relief. Mineralization of underground waters in wells and wells of these territories is 0.5-1 g/l. They are associated with fresh water lenses formed as a result of takyr runoff and atmospheric precipitation.

KEY WORDS: oil and gas fields, groundwater, mineralization, Ustyurt Plateau, hydrogeological studies, water-bearing rocks, Barsakelmes trough, zone of active water exchange, groundwater lenses.

I.INTRODUCTION

At present , with the discovery of deposits of oil, gas and other solid minerals (iron, manganese, copper, etc.), as well as highly mineralized healing mineral and thermal waters, Ustyurt has become one of the important industrial regions of the Republic of Uzbekistan. The prospects in relation to the above minerals of the Ustyurt plateau, the geological and structural position largely coincide with the conditions of Mangishlak. Geological and hydrogeological studies of deposits

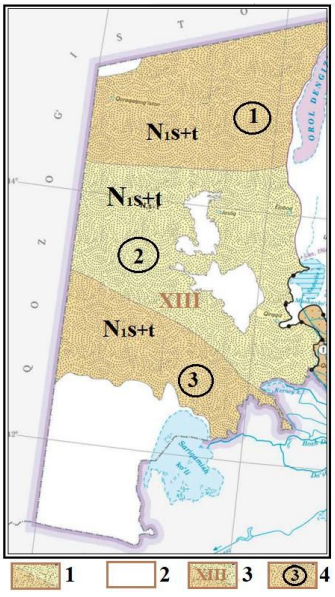

Fig. 1 Clipping from the Reservoir Map drinking and slightly salted underground of the Republic of Uzbekistan: 1 - artesian basins; 2 - unpromising territories; 3 - Ustyurt plateau 4 -1. Northern Ustyurt, 2. Central Ustyurt, 3. Southern Ustyurt;

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II. LITERATURE SURVEY

Ustyurt was accompanied by a sharp increase in the rate of geological, geophysical and hydrogeological surveys and the implementation of a large volume of prospecting and mapping, structural, operational and exploratory and special hydrogeological drilling. The results obtained make it possible to clearly present the structure of the Ustyurt Plateau and assess the prospects for the use of its resources, including groundwater in the areas of modern water exchange (Fig. 1) . Prospects for the development of the Ustyurt Plateau and its eastern part are currently determined, on the one hand, by the development of animal husbandry, and on the other, by the extensive construction of industrial oil and gas producing facilities and the development of therapeutic thermal and mineral underground waters.
Thus, for the timely and complete development and development of large-scale industrial facilities on the vast territory of Ustyurt, a large amount of both drinking and technical water is required. As is known, there are no local open reservoirs in the study area suitable for water supply, watering and oasis irrigation. In addition to the remoteness of the study area from large river resources, the task of a comprehensive study with subsequent identification and comprehensive assessment of regional resources of low-mineralized groundwater for its subsequent use is an urgent problem.

III. METHODOLOGY

Distinguished by its peculiar geological and tectonic structure, peculiar forms of relief, the presence of deep drainless depressions and other natural oases, it has attracted the attention of researchers since ancient times. As is known from historical data on geography, the first land description of the territory of the Ustyurt plateau was compiled by Claudius Ptolemy in the second century. And information about the groundwater of the area was obtained much later.
A major turning point in the study of the Ustyurt plateau occurred in 1950-60. During these years, a number of important generalized studies were carried out and published in the Karakalpak part of Ustyurt, including hydrogeological conditions in the monographs of G.N. Kamensky, M.M. Tolstikhin and I.N. Tolstikhin “Hydrogeology of the USSR” (1959). And the analytical description of O.K. Lange "Underground waters of the USSR" (1963).
Large hydrogeological studies accompanied by a large amount of exploration work, pilot operation and scientific and applied research, such as (1977-79 A.V. Pakhomova, N.I. Bykov, Sh.K. Nabiev) State hydrogeological survey at a scale of 1:200 000, (1978-81 T.N. Djumamuratov), repeated State hydrogeological survey at a scale of 1:200,000 covering more extensive territories with the inclusion of Southern Ustyurt. And also (2014-18 N.P. Samenderov, T.B. Allaniyazov) a regional hydrogeological study within the Central Ustyurt artesian basin in order to assess the predicted groundwater resources of Neogene and Cretaceous deposits.
Based on the results of the above sources and personal research, an assessment is made of the role of groundwater in the development of Ustyurt and modern hydrogeological studies.

IV. EXPERIMENTAL RESULTS

According to the geological structure, aquifer series of Cretaceous deposits have been identified, which have become widespread throughout the study area. In the hydrogeological conditions of the Cretaceous deposits, one of the most powerful water-bearing series was revealed in the territory of Karakalpak Ustyurt. Studies have identified two series of Cretaceous deposits: Neocomian-Aptian and Albian-Turonian [1,2].
Water-bearing rocks of the Neocomian-Aptian aquifer complex are widespread in the study area. Depending on the structural position of the sites, the roof of the aquifer complex is exposed at various depths. In the consolidated parts of the structures of the Central Ustyurt system of uplifts, the water-bearing rocks of the complex occur under the Albian and Neogene formations at a depth of 230- 250 м. In the North Ustyurt basin, the Barsakelmes trough, the Shakhpakhtystep and the Assakeaudan trough, they are exposed at a depth of 1400-1700 to 1620- 1990 m. Also, within the Aktumsukuplift zone, they were discovered at a depth of 970- 1000 м. Within these limits, the thickness of the aquifer complex, depending on the number and thickness of collectors, varies from 180-195 m (Barsakelmas and Assakeaudan troughs) to295- 410 м with a total thickness of the complex from 460- 640 м[1,2]. Despite, but the fact that the porosity of the water-bearing rocks is from 12 to 32%, low flow rates of up to 0.4-0.7 l / s were obtained from the wells. On the structures confined to the Aktumsuk zone, there is a deterioration in the reservoir properties of water-bearing rocks and a decreasein water abundance. And also, the highest position of the piezometric position of the groundwater of the complex was established in the deeply lowered part of the Barsakelmas trough, and somewhat lower, in the southeast of the Assakeaudan trough, at the points of its closure and confluence with the Amu-Darya depression.

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Vol. 9, Issue 10, October 2022

In general, groundwater is a highly concentrated brine. Their lowest mineralization is noted in the Central Ustyurt zone, where it is 26-45 g/l, in the Barsakelmas trough 167-198 g/l. Anological mineralization is observed in groundwater in the North Ustyurt and South Ustyurt troughs.

Of the salts in the composition of waters, sodium chlorides predominate. The content of chlorine is 115-121, and sodium 55-65g/l. The waters are slightly sulphate, the sulphate coefficient fluctuates between 0.23-2.0. They are mostly sodium chloride water. And the content of microcomponents increases with the growth of formation water salinity and is: iodine from 2-4 to 18 mg/l, bromine up to 462-543 mg/l, boron from 10-14 to 76-80 mg/l. It should be noted that the most submerged parts of the Ustyurt waters of the complex have a temperature reaching up to 100-109 o C (Alambek). And the areas with the smallest immersion of the layers of the complex are characterized by a water temperature of 44-73ºC.

The aquifer complex of the Albian-Turonian deposits correspond to a new transgressive cycle of sedimentation and is widespread in the Karakalpak Ustyurt. According to literary sources [1,2], it is established that both Albian and Cenomanian and Turonian deposits are defined as aquifers. This position is not observed within the Central Ustyurt system of uplifts, where the upper layers of the section of the aquifer complex are either eroded (Karabaur uplift) or drained in the Aibugir area due to the conditions of occurrence [1, 2]. Formation waters of the complex above the marked areas are highly metamorphosed (chloride-sodium coefficient 0.75-0.8), sulfate-free, rarely weakly sulfate, sodium chloride. They contain trace elements: iodine up to 15 mg / l, bromine 208-547 mg / l, with a temperature of up to 71°C.

On the territory of Karakalpak Ustyurt , deposits of the Neogene and Quaternary systems are very widespread . The water-bearing rocks of these deposits differ sharply from the water-bearing rocks of the underlying deposits. These are unaltered and undislocated rocks occurring almost horizontally on a thick Paleogene-Lower Miocene aquiclude. Forming the uppermost part of the hydrogeological section (Fig. 1). In the study area, groundwater is under the direct influence of climatic factors, i. an area of active water exchange and differ from the underlying ones not only in their qualitative and quantitative characteristics, but also in the conditions of formation.

The conditions for the accumulation of the aquifer complex occurred in various facies conditions with repeated alternation of transgressions of sea regressions. Different conditions of sedimentation, which determined the diversity in the lithological composition of the rocks, determined their hydrogeological heterogeneity both in the vertical section and in the development area.

In most of the study area of the described aquifer, the base is the Paleogene marl-argillaceous stratum, and only in the structurally elevated areas of the territory is the Upper Cretaceous marl. The thickness of these deposits varies from 18-22 to 56-60 m, an increase is observed in the direction of the general subsidence of the reservoir. In connection with this Miocene sequence and the location of drains, the direction of groundwater movement changes (Fig. 2). In the north of the plateau, their movement occurs to the north-west of the Aktumsuk rampart towards the Samsky solonchaks and chinks of the plateau, in the central part the underground runoff is directed to the Barsakelmes depression, in the south from the Central Ustyurt zone of uplifts to the Assakeaudan depression, in the east to Sarykamysh (Fig. 2). The slopes of the surface of the aquifer in most of the study area are insignificant and amount to 0.001-0.005, while in the central part of the Central Ustyurt zone it increases to 0.05.

In general, this circumstance i.e. the deep occurrence of groundwater, mainly marl composition and moderate gypsum content of water-bearing rocks and, as a result, the deterioration of the conditions of the recharge area, and their circulation caused an increased and high mineralization of groundwater almost throughout the entire territory of Karakalpak Ustyurt. Thus, the lowest mineralization of groundwater from 2.3-6.3 to 7.6-12.1 g/l was found in the areas with the most elevated plateaus (Central Ustyurt, Aktumsuk uplift zones).

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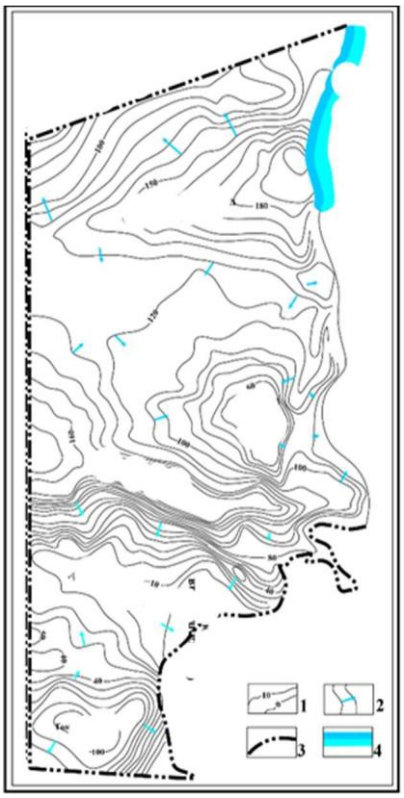

Fig. 2. Scheme of groundwater hydroisohypses of Miocene deposits of the Karakalpak Ustyurt (based on the materials of A.S. Vishnyakov et al.) : 1 -lines of groundwater isohypse; 2 - direction of groundwater flow; 3 - state border; 4 - border of the Aral Sea

The value of total mineralization in these areas ranges from 2.3 to 12.1 g/l. Further along the direction of movement, a rapid increase in mineralization occurs and in most of the trough the mineralization of the waters of the complex is 15–20 g/l, and in the southern half it reaches 30–35 g/l, and in the central parts of the study area of the Assakeaudan depression and the Sarakamysh depression, its values are often reaches up to 100-110 g/l. According to the values of the mineralization of the groundwater of the complex, a noticeable increase with depth is observed. In the central part of the Central Ustyurt zone at a depth of 20-25 m, mineralization is 3.2-6 g/l, at a depth of 55 m it increases to 9.3-10.0 g/l, at a depth interval of 83-113 m an increase is noted from 10.8 to 25 g/l and in the interval of 101-135 m it reaches 21-33 g/l [2-7].

Less mineralized groundwater (3-9 g/l), common in the study area in the areas of runoff formation, has a sulfate or chloride-sulfate sodium composition. The content of sulfates ranges from 52-75% eq, chlorine 20-46% eq and alkali content reaches up to 60% equiv. With an increase in mineralization by more than 10 g / l, the concentration of chlorine increases to 70% eq, and the sulfate ion moves to the second place. In such cases, sodium cations with a concentration of up to 75-80% eq comes first.

The water abundance of the deposits of the complex is not the same in different parts of the study area. According to the results of pumping out wells, the flow rates vary over a very wide range: from tenths and even hundredths of a liter per second with a decrease in the level of groundwater by 7-12 m, and, accordingly, at a flow rate of 10-14 l / s, the decrease is 2-5 m. these deposits, the filtration coefficient, according to test pumping data, varies from 1.5-1.9 to 50-90 m/day, while for marls from 0.8 to 9 m/day.

Thus, less mineralized waters are confined to surface sediments compared to waters of deeper sediments. But they are also characterized by diversity of mineralization and chemical composition. Fresh and slightly brackish underground waters with salinity up to 3 g/l are usually confined to the vaults of anticlinal uplifts with relatively higher elevations, to the causal drained strip of the northern and northwestern parts of the Ustyurt plateau. In the North Ustyurt depression, groundwater is brackish with mineralization from 3-5 to 10 g/l. Where the increase in mineralization is connected by the wings of the depression to its central part [3-6].

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Vol. 9, Issue 10, October 2022

V. CONCLUSION AND FUTURE WORK

Considering the distribution of groundwater mineralization both in depth and in space, a decrease in the amount of precipitation from north to south is noted, in the same direction the mineralization value increases. In the study area, in the direction of groundwater movement, mineralization varies from 7-10 g/l and uplifted parts of the territory to 25 g/l and more. At the same time, the change of groundwater of various mineralization occurs abruptly, at short distances, in contrast to the northern half, where the increase in mineralization is gradual.

The above conditions are violated in those areas where a flat low relief is common. In boreholes and wells in these areas, groundwater salinity is 0.5-1 g/l. They are associated with fresh water lenses formed as a result of takyr runoff and atmospheric precipitation.

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