ORIGIN, GEOLOGY, LITHOLOGY AND RELIEF OF THE ARAL SEA

Ismonov A. J*; Dusaliev A.T; Mamajanova U.Kh*****

*Candidate of Biological Sciences,
Ministry of Agriculture,
Institute of Soil Science and Agrochemical Research,
UZBEKISTAN
Email id: abduvahob60@mail.ru

**Doctoral Student,
Institute of Soil Science and Agrochemical Research,
UZBEKISTAN
Email id: dusaliev@mail.ru

*** Junior Researcher,
Institute of Soil Science and Agrochemical Research,
UZBEKISTAN
Email id: mamajanova-1783@mail.ru

DOI: 10.5958/2249-7137.2023.00028.9

ABSTRACT

The article presents ideas about the formation of the Aral Sea and the stages of relief manifestations formation. According to the researchers, in the second half of the Pleistocene and in the Holocene, these large rivers, after filling their beds with the listed sediments, turned to the island sediment, forming the Aral Sea. According to this, at the beginning of the Holocene period, the Aral Sea was shallow, since most of the Amu Darya water went into Sarykamysh Lake and fell into the Uzboy. However, since that period, the current channel of the Amu Darya and the coastal delta of the Aral Sea began to form. This process began more than 2500 years ago. The Amu Darya waters over the next hundreds of years steadily took off from their waters towards the Aral Sea.

KEYWORDS: *Amu Darya River, Aral Sea, Geology, Lithology, Climate, Relief, Geological Periods.*

INTRODUCTION

As a result of the negative impact of human activity on nature in the context of global climate change, the significant changes in the environment take place. Climate changes in the form of various natural disasters are felt at all latitudes of the land. As a result, the areas covered by natural forest are reduced, desertification and swamps are formed, the atmosphere, water and lithosphere are polluted. The change in the state of the natural environment under human influence, the strong impact on living and inanimate components has generated local, regional and universal environmental problems. In particular, as a result of such impacts, the "Problem of the Aral Sea" has arisen, which is considered the threat of the environmental crisis in our region [1].

Since the 1960s of the last century, the level of the Aral Sea has undergone the intensive reduction, its depths have fallen by 22 meters, the water area has decreased by more than 4 times, the volume of water has decreased up to 10 times, the salt content in the water has reached 188-280 g/l, sometimes up to 300 g/l (2022). The area of the dried bottom amounted to about 3.5-4.0 million hectares, which makes it a source of distribution of dust, sand-salt aerosols to the adjacent areas. Here, up to 80-100 million tons of dust rises into the atmosphere annually [1].

Objective of the research. Study of soil formation, geological and lithological structure and relief forms of the drained areas of the Aral Sea bottom.

Location and Methods of Research

The regions the Aral Sea free from water are considered to be the place of research. The research methods include the "Instructions for conducting the soil survey and drawing up soil maps for maintaining the state land cadastre" [2] (2013), "All-Union instructions for soil surveys and drawing up large-scale soil maps of land use" [3] (1973), "Soil mapping" [4] (1959) published in our republic, as well as comparative-geochemical, geographical, laboratory-analytical and mathematical-statistical methods of data analysis [5].

Research Results and their Discussion

With the drying of the Aral Sea, the process of soil formation began. For example, soil formation is associated with its geological, lithological structure and relief. The direction of these processes is directly related to the climatic conditions of deserts. The plain zones of our republic are located in the Turanian lowland and lie on the surface of the post-glacial plications platform. The emergence of the platform was caused by the long-term impact of denudation and tectonic movements of the Earth. Under the Turanian lowland, the indigenous bedrock of the Paleozoic era is constantly under the splits in which 50-80 m sediments of the Ordovician and Silurian systems are found. By the Devonian period, most of the territory was occupied by the sea basin, from some places the mountains in the form of islands were visible. In the Paleozoic era, large areas were uplifted and lowered relief, alternating with the sea, and then with land. At the Alpine stage, the relief forms originated in the Turanian lowland. At the end of the Mesozoic and the beginning of the Cenozoic era, the entire territory of Uzbekistan was covered by sea waters, and during this period an intensive deposition process took place in the relief. This sea left behind basins 1-2 m thick. These deposits led to some leveling of the relief of previous eras. With the beginning of the Alpine folding (the end of the Paleogene period), the process of relief formation accelerated due to the retreat of the sea. Rivers and lakes formed at the Oligocene stage of the Paleogene period also played the important role in the formation of the relief. In addition, residual lakes and erosion-denudation processes played the key role in the formation of the land relief [6].

The Quaternary period is characterized by the beginning of new tectonic forces on the Uzbekistan plains. By this period, the Amu Darya, Syr Darya and Zarafshan rivers were formed, and they pumped their waters into the Caspian Sea, but not into the Aral Sea, since the Aral Sea did not exist during this period. Some researchers point out that the Syr Darya and Zarafshan, the ancient Amu Darya, flowed towards the Caspian Sea. In the second half of the Pleistocene and in the Holocene, these large rivers, after filling their beds with sediments, turned to the Aral sediment, forming the Aral Sea. In the eastern parts of the drained bottom of the Aral Sea,

studies have been conducted to create saxaul forests. According to Z.B.Novitsky, the Aral Sea appeared 3,500 years ago [7].

The Central Asian plains arose mainly in the Quaternary period. The formation of relief on the surface of Quaternary sediments was carried out by derived factors and geomorphological processes as well as the climate change. The Amu Darya filled its channel with its sediments and turned north towards the Aral Sea called Akchadarya. It did not become the permanent drainage into the Aral Sea, even 10-13 thousand years ago, in the " Khvalynskiy period", passing through the Khorezm lakes, it fills the Sarykamysh and Asakaovdon marshes, resulting in the formation of the Novy (New) Uzboy River, and also pumps its waters into the Caspian Sea. At the beginning of the Holocene period, the Aral Sea was shallow, since most of the water of the Amu Darya went to Sarykamysh and Uzboy. However, as a result of the accumulation of sediments brought by the river, the new channel flowed out of the lowland between the Akchadarya River and the old Sarykamysh delta, into which the waters penetrated from the southwest of the island. From this period, the current channel of the Amu Darya and the delta along the Aral Sea begins to form. This process began more than 2500 years ago. But in the middle there were periods when the Amu Darya waters flowed towards the Caspian Sea (through the Uzboy), but over the next hundreds of years the Amu Darya constantly brought its waters towards the Aral Sea [8].

Lithology Structure and Relief

The geological and lithological structure of the dried bottom of the Aral Sea is characterized by its diverse stratification. The surroundings of Tokmak Heights and Uzunkayir Cape, near the Muynak town, are currently covered with (Aeolian) sandy deposits. Deposits of earlier bays, such as Azhiboy, Muynak and Sarbas at the bottom, where the waters of the sea recede, are characterized by the layered arrangement of sand, loam and clay (Size).

Size. The dry bottom of the Aral Sea. 2022

The complex lithological and geomorphological structure is composed of the brought marine alluvial rocks of Guzak, Urdabai and Okkala. Their mechanical composition is also found mixed

with various sediments, but the Amudarya avandelt is distinguished by its mechanical composition, the predominance of light loams. The Amu Darya current brought silty rocks in large quantities and sandstones in smaller quantities. Over the years, the Amu Darya flowed into the Aral Sea, dividing into several tributaries, for example: the old tributaries of Kuvonishzharma, Kegeyli, Churtambai, Erkindare, Kazakhdare, Kukhnyadare and modern tributaries of the Amu Darya of a later period are included. Since these tributaries flow, changing the channel, due to the fact that the channel in its course is filled with unconsolidated rocks, hills (shafts) and interstitial sediments (lowlands) have formed along the channel. As a result, it was noted in the studies that in the previous part of the delta it was overlain by a layered alternation of various rocks.

Since the 1960s, as a result of periodic opening of retreated sections of seawater and turning them into land, large particles settle in the former riverbeds under the influence of a large flow of water and a relatively small amount of dust (0.01-0.001 mm) and partially silt (0.01 mm) is deposited. There are pure sandy deposits in these riverbeds, and the sand in them is 95%. According to F.Khakimova, larger sands are found consisting of pulverized and clay particles, with sand particles accounting for 35-65%, dust - 30-60%, and silt - 7-8% [9;10]. The thickness of these channel rocks on average exceeds 30 meters.

When studying the soils of the drained bottom of the Aral Sea in field studies, alternation of the occurrence of rocks brought from the river was sometimes noticed, i.e. such a situation was noted in the southern regions of the Amu Darya adjacent to its former "living" delta. But, as the river moves away from its confluence with the sea inland, sedimentary and loamy rocks in the form of sands and clay rocks were deposited in the upper layers. It is believed that this situation is typical mainly for the north-western and northern side of the sea.

In the parts of the sea that are free of water, sand dunes are covered with 0.5-3.0 meters thick clay-sand brought rocks. Currently, it has been observed that the main distributed parts of sand dunes are distributed in the eastern parts of the seabed, but these sand dunes are shifting towards the receding part of the water, i.e. to the central and western parts. It was noted that in different parts of the Aral the brought rocks have different thicknesses, the gypsum and stony soils are common over large areas. Most typically, these rocks are located in the central regions of the sea. Small islands, now extinct, are mostly leveled on the surface as a result of erosion. On Renaissance Island, considered one of the largest islands, in addition to sandy soils, the formation of brown loams was observed, under which saline rocks of the Neogene period were deposited. Summing up, we can say that the dried bedrock of the Aral Sea as a result of long-term tectonic and denudation movements of epochs in the past consisted of a complex of geological rocks, such as the adjacent Ustyurt plateau [11; 12].

During the field expedition, it was noted the characteristic relief structure of the bottom on which the Aral Sea dried up, and that its bottom consists of several lowlands and sand hills. In the relief of the seabed there are characteristic manifestations, its conditions associated with salt marshes and settlements, i.e. the formation of residual salt marshes in low-lying areas of the relief, swollen salt marshes on tectonic shafts is noted. Also in the formation of the seabed relief, in addition to the former Amu Darya delta, in the southern parts, relief forms in the form of a "new delta" are noticeable, i.e. the former "living" form, as if continuing in the form of the Amu Darya delta. But these new orthographic manifestations are distinguished by several landscapes and lithological structures.

The forms of the seabed relief, manifested in its various areas, manifest themselves in different ways, i.e. the relief of the islands on the northern side (Vozrozhdenie) consists of the "former" high sand dunes and land. The eastern part includes the same appearance as the earlier "islands of the archipelago" in its relief due to erosion-leveling caused by winds, but the accumulation of sand dunes under the action of Aeolian winds led to the formation of sand dunes. As a result, sand dumps and hills were formed. These relief forms began to form earlier as a result of the seawater reliction, and it was noted that automorphic soils and xerophytic vegetation managed to form, albeit rarely, in the soil landscape of this area. The reason is that the phases (stages) of sea water reliction began primarily in the southeastern parts, which led to the formation of Aeolian sandstones, as well as xerophytic and halophytic vegetation in these parts. The predominance of dry (arid) climate in the south-eastern part continued mainly in the areas open for waters [13:14].

In general, the relief structure of the Aral Sea bottom has not yet been fully disclosed by any researcher, and the study of the relief in its various areas requires special research. But in our field studies, some types of terrain were mapped. As a result, the topography of the western part of the seabed, which is currently drained, as well as the relief structure were studied. According to this, the parts of the sea subsiding and exposing the waters towards Ustyurt, i.e. on the sides of the ledge, are the hills on the eastern side, and the areas near the ledge consist of low sediments. But studies have noted the presence of various elevations, gravelly hills (shafts) towards the center, i.e. to the middle part of the sea. As we move north from the Muynak town, the heights change, and newly formed sand dunes in the form of sand dunes are found in places, which, as it was found, are the sand dunes that move under the influence of winds, as a result of which part of their surface is not covered with any vegetation. In addition, scattered sands can be found in many areas around them. Another type of relief is a raised structure in the form of shafts of gypsum (limestone), stony and gravel formations at a great distance, extending from Renaissance Island towards the ancient islands of Konstantin and Lazarev [15;16]. Currently, these gypsum rocks are mined and used in road construction works, and quarries have been formed in their place.

It can be **concluded** that the tops of sand dunes, to a lesser extent covered with psammophytic and halophytic vegetation, under the influence of north-westerly and westerly winds cause further movement of sands, streams of salt dust particles, resulting in "temporary" new relief manifestations, intensively occurring in previously exposed seabed areas.

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