

ORAL

GEOLOGICAL AND GEOMORPHOLOGICAL STRUCTURE OF THE EASTERN FOOT OF THE YERGENI (preliminary results).

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Keywords: *Caspian Sea, palaeogeography, Pleistocene, lithology, malacofauna*

Eastern slope of Yergeni clearly expressed in the topography, gently descending to the flat surface of the Northern Caspian Plain. The slope is complicated by numerous well-designed balkas with wide bottoms and slopes covered with deluvium. The balkas bottom in some cases are complicated by permanent or temporary watercourses. In the widest balkas (Gryaznya, Almata, Arsha-Zel'men, Yashkul and Cangartsyk) with permanent watercourses high erosion outcrops developed in the meanders, in which the Caspian deposits with malacofauna and alluvial-proluvial column are revealed. During the field seasons 2014-2015 geological and geomorphologic studies of the balkas were conducted.

Balka Gryaznya

In the vicinity of the balka on a subhorizontal surface height of about 30m, which is adjacent to the slope of Yergeni, quarry with red-brown clays works out (fig.1).



Fig.1.

I. In this quarry sediments are revealed from the top (soil removed): 1). A thin layer of sand, 2-4 cm; 2). Chocolate clays, in the base of bed transition is gradual, 3-5 cm; 3). Sands light with brackish khvalynian fauna (*Didacna ebersini*, *Hypanis plicatus*, *Monodacna caspia*), about 1 m. The contact in the base of bed is clear; 4). Red-brown clays with gypsum, a capacity of about 2 m. Clays are dense, with gypsum crystals tabular and prismatic shape with size of 5-10 cm. The transition to the underlying layer is gradual; 5). The brown and yellow-grey thin-layered silt without fauna.

II. The outcrope in the left side of the balka Gryaznya is situated in 500 m to the south of the quarry, from the edge height of about 35 m abs. In the outcrop brownish-yellow, thin-layered silt is revealed. There are fragments and the whole shells of *Hypanis plicatus*, single *Monodacna caspia* and small *Didacna ebersini*. Below in the section there are laminated silty-pelitic sediments without shells of mollusks. The total thickness of silt is approximately 4 m. The deposits similar to the quarry ones - red-brown clays with gypsum complete the outcrop.

III. The outcrop in the left side of the balka Gryaznya, on the western edge of the village Tundutovo from the edge height of about 35 m abs. Large thickness (10 m) of balka alluvium – sand fine-grained and on the top of outcrop thin-layered sandy silt with rare fragments of mollusks *Hypanis plicatus* are revealed. In the lower part of this section gypsum concretions meets. Red-brown clays with gypsum and marine khvalynian sediments in the outcrop are missing.

IV. In the right side of the balka the absolute elevations of about 40m, in the quarries there are no khvalyn sediments and exclusively Neogene Yergeni sand appear directly from the surface.

In the outcrops red-brown clays with gypsum and brown and yellow-grey, thin-layer silt were formed in the pre-Khvalynian time (Khazar?). They transgressive overlie sand and chocolate clay of Early Khvalynian age composing the surface height of about 30-35 m. The lagoon was formed; the formation of the balka Gryaznya started later, when sea level was about 25 m, and brackish water of the Early Khvalynian Sea formed the terrace (outcrop II). It is interesting to note that in sections III and IV khvalynian sediments is not installed; the level of the Early Khvalynian Sea did not exceed 40 m. This is indicated by the absent of the higher terraces in the balka and the outputs of the Neogene sediments. The formation of the bank passed for a long time, with incised phases. We can talk about several stages of cutting and the existence of the incised valley.

Below on the plain, at a height of about 20 m abs. the coastline in the form of a bar is clearly visible with relatively steep seaward slope to a flat bottom of ancient lagoon.

Balka Yalmata

The balka is wide; the bottom is occupied by a low terrace (2m). Meandering channel with a width of 3-4 m is incised in it. In the left side of the bank a long outcrop is revealed. It was studied long ago by P. Pravoslavlev [1908]. The height of the surface, cut by the bank, is 35 m. In the outcrop, whose height is about 15 m, revealed fairly uniform sandy-silt and clayey fine-bedded strata. There are separate thin layers with small shells and detritus (*Hypanis plicatus*, *Didacna ebersini*, *Monodacna caspia*), as well as more coarse-grained material in the form of small layers and lenses. Layers meet where silty-pelitic cracked deposits on its sides were covered in a patina of manganese (fig.2).



Fig. 2

The entire strata of the sediments in the balka Yalmata are similar to the deposits in avandelta of large river with much load. Perhaps it was the Volga with a large capacity of loads and high speed of its accumulation. Given that these sediments are fairly uniform, we can assume that they were accumulated during the transgressive stage. The accumulation of sediment was due to the gradual rise of the sea-level that could accumulate approximately uniform material, i.e. the rate of rise was equal to the rate of accumulation.

The history of the balka, the stages of its incisions and filling are significantly different with the balka Gryaznya. The balka Yalmata is wider, that is why, perhaps, fragments of the marine terraces not preserved here. The temporary watercourses in the balka Gryaznya washed out marine and lacustrine sediments, and Yamata – large alluvial-marine column. Consequently, when at high altitude near Tundutovo was laguna, here at this same time was probably open shallow sea or avandelta.

Balka Arsha –Zel'men.

On the right side the outcrop was studied, its edge is at a height of 30 m abs. Directly under the soil lies: 1 Sand and silt brown color with large khvalynian shells of mollusks, thickness up to

0.3 m. (*Didacna ebersini*, *Hypanis plicatus*, *Dreissena rostriformis distincta*, *D. polymorpha*). The contact with the underlying sediments is clear; 2. Sand with pebbles, 0.1 m. 3. Sandy-silt thin-layer, 0.5 m. The lower part of the incision is closed by slope deposits; they have a lot of inclusions of gypsum of tabular and prismatic forms.

The outcrop is similar in structure to the sections I and II of the bank Gryaznya. In both cases, Early Khvalynian marine sediments situated at an altitude of about 30 m abs. and transgressive overlain on the more ancient sediments.

Balka Yashkul.

In the mouth part of the balka, in its left side, with the height of the edge approximately 33-35 m abs. large (18m) alluvial-marine strata of sediments is situated. M.V. Karandeeva [Geomorfologia..., 1952] studied it earlier. Under the soil and subaerial deposits opened: 1. Thin interbed (0.1 m) Early Khvalynian marine sands with detritus and malacofauna *Hypanis plicatus*, *Adacna*, *Adacna laeviuscula*, *Didacna ebersini*. Contact is clear; 2. Subaerial, alluvial and alluvial fan silt, 2m; 3. Grey layered sands, with brackish Khazar malacofauna (*Didacna subpyramidata*, *D. pallasi*, *D. cristata*, *Dreissena polymorpha*), 3 m; 4. A variety of alluvial and alluvial fan layered silt, different colors and lithology, 5 m. Such sediments are visible close by the river Yashkul.

According to their altitudinal position Khazar sediments, the roof of which is about 28 m abs. correspond red-brown clays with gypsum in section I, in a quarry near the village Tundutovo. If in the latter case lacustrine sediments are present, in this outcrop – it was open sea, the coastline was dedicated, probably, to elevations of about 30-35 m. Early Khvalynian sediments with brackish malacofauna transgressive overlie alluvial-proluvial clay and silt, forming a wide terrace. The balka Yashkul, apparently, was formed before Khazarian time. Thick stratum of alluvial-proluvial material in the base of section proves it.

Balka Cangartsyk

This balka is the part of balka Yalmta. The large branched gully is on its right side. The balkas top is confined to the flat terrace with a height of about 35-40 m abs. Its surface is smoothly lowered to the edge of the ravine (with a height of about 35 m abs.), where in the right side under the subaerial soil and silt there are: 1. The silt brownish-yellow, with thin layers of chocolate clays and sand and interbed of detritus and small rare shells of mollusks (*Didacna ebersini*, *Hypanis plicatus*, *Adacna laeviuscula*). Contact is clear. 2. Dark sandy silt changed in the roof by soil processes. The total thickness of this outcrop is small, about 3 m, below is talus.

The outcrop on its structure is similar to the upper part of the outcrop in balka Yashkul. Brackish-water sediments with the malacofauna of shallow Khvalyn Sea transgressive overlain subaerial sediments. In the bottom of the ravine fresh erosional incision (up to 2.5 m deep) captures the reactivation of erosion processes.

Conclusion

Field geological and geomorphologic studies of the western area of the Northern Caspian Plain allow making a number of new ideas about the history of the level fluctuations of the Caspian Sea in the Late Pleistocene. Thus, the maximum level of the Early Khvalyn transgression did not exceed 35-40 m in this territory. The level of the Khazar Sea during its maximum stage, may also have reached approximately the same marks. The deposition of the red-brown clays with gypsum was at this stage. It is important to note that the precipitation of endogenic mineral gypsum ($\text{CaSO}_4 \times 2\text{H}_2\text{O}$) occurs from a solution saturated with NaCl, at a temperature of 30 degree. It is formed in a shallow basin (lagoon, a shallow coastal sea) in a hot climate.

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shallow sea at 35-40 m abs. The cliffs on the Eastern slopes of Yergeni smoothed by deluvial sediments, formed, not in Early Khvalyn, but much earlier, most likely in Akchagyl-Absheron, M.B. Karandeeva [1952] had the same opinion.

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Reference.

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