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Research Article

GEOLOGY AND CHARACTERISTICS OF THE MATERIAL COMPOSITION OF THE SHORKUL SALT LAKE IN CENTRAL KYZYLKUM (UZBEKISTAN)

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ABSTRACT
This article discusses the geological structure and composition of the materials of the Shorkul salt lake. The main minerals of the salt are halite and gypsum, they are confined to the Eocene clays of montmorillonite composition. The source of their formation is Paleogene marine sediments.

Keywords: *Salt lakes, Halite, Gypsum, Central Kyzylkum, Uzbekistan*

INTRODUCTION
Central Kyzylkum is the most dissected region of Western Uzbekistan. Against the background of a sandy-loamy plain with absolute heights of 100-250 m, in the central part of it rise quite high (up to 922 m) mountain ranges of the Bukantau, Altyntau, Jetimtau, Tamdytau, Auminzatau and Kuldzhuktau ranges, extending for 50-100 km. The largest basins are located between the mountains and at their dives. Southwest of the Altyntau mountains, the Mingbulak basin stretches from northwest to southeast for more than 60 km (with a width of up to 20 km), in the central part of which the lowest point of the Central Kyzylkums is located (12 m below ocean level). To the east of the Mingbulak basin, 30 km south-east of the Altyntau ridge, there is a small salt lake Shorkul (Rubanov, 1978; Sharipov *et al.*, 2022). Many scientists have been studying the salinity of lakes in Uzbekistan and their application in industry (Rubanov, 1978, 1977, 1971).
Geologically, the outcrops of the Paleozoic base in the studied area are represented by the Altyntau granitoid massif, Cretaceous and Paleogene deposits (Akhmedov, 2000).
Shorkul Lake is located southeast of the Altyntau mountains, 40 km southeast of the village of Aytym, 22 km south of the village of Kokpatas, 30 km southeast of Uchkuduk. The absolute marks of the bottom of the basin range between 86.6 m and 87.0m, and the adjacent plains from the west and south and the foothills of the Aytymtau range from the north and east are 100-130m. The host rocks for the salt accumulation of Lake Shorkul are Eocene clays (Fig.1).
Shorkul Lake is located in a drainless depression. This depression in the south merges with the adjacent loamy-sandy plain. In the north, the depression is bounded by a rather steep scarpy slope of tertiary clays and loamy-sandy red-colored rocks. The lake area is formed along the southwestern fault zone and is about 3-4 km^2. Modern temporary and permanent watersheds are signs of faults.

MATERIALS AND METHODS
In order to determine the mineralogical potential, we conducted field work on the study of the geological structure with sampling along the side of the lake. In the summer months, the lake is covered with a crust of halite. In the southeastern part of the lake, the thickness of the halite reached up to 15 cm. There was brine under the salt crust, and silt up to 40-50 cm thick was found below, and then gray sand with gypsum (Fig. 2). The selected samples were studied by chemical analysis and ICP spectrometry.

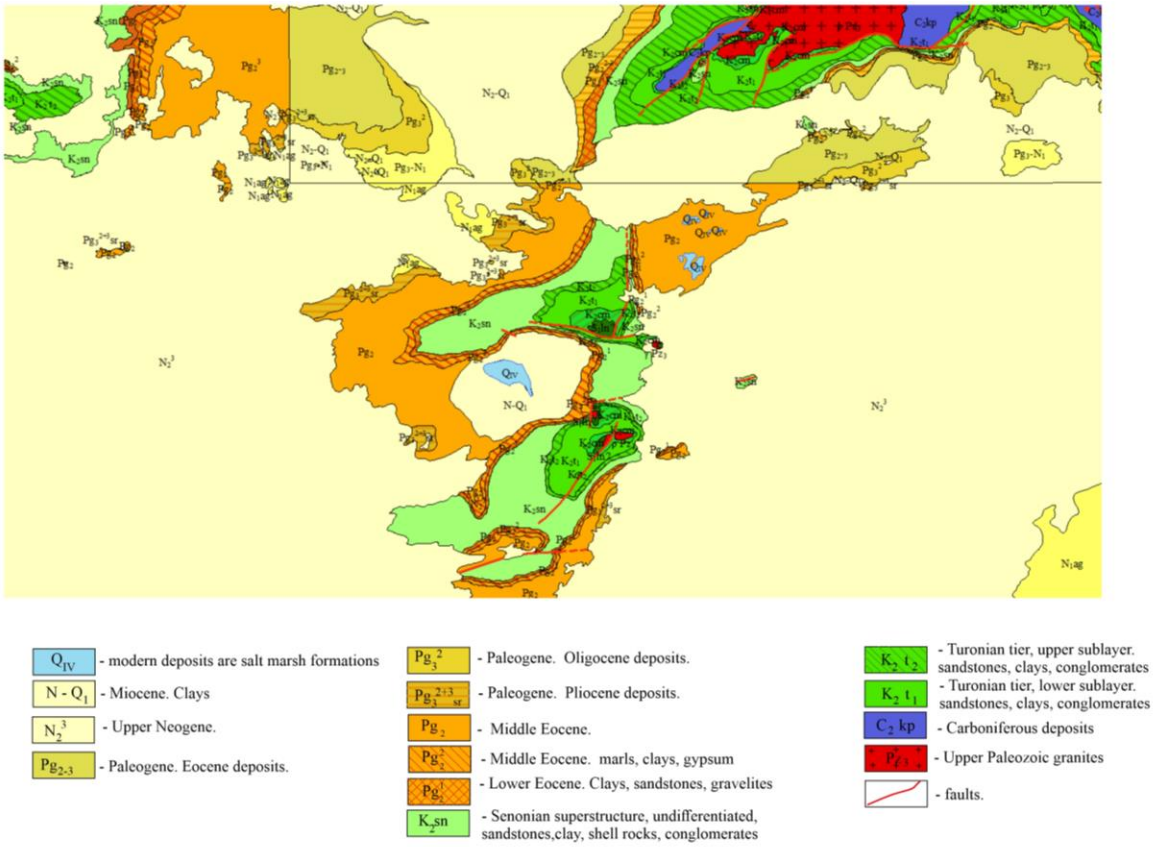


Figure 1: Geological map of the salt lake Shorkul

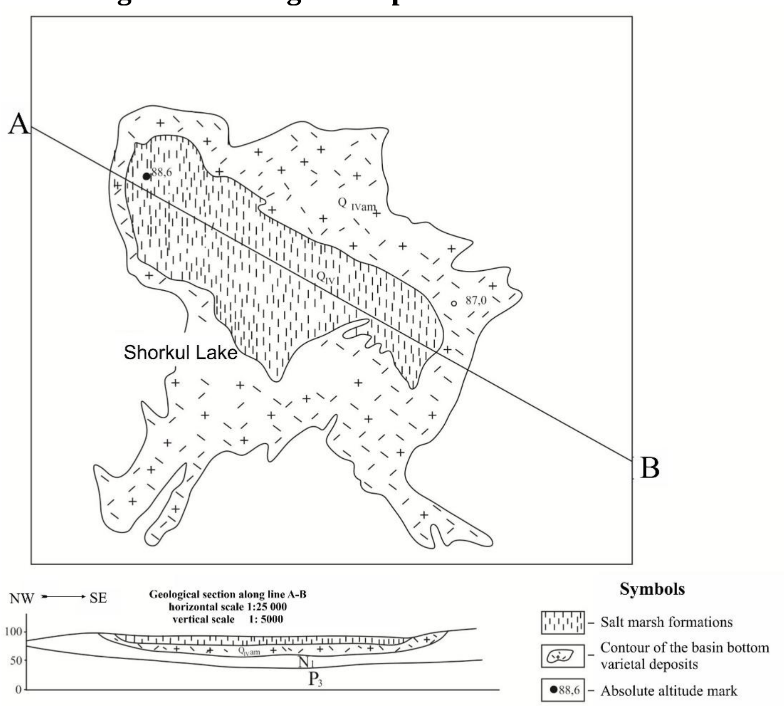
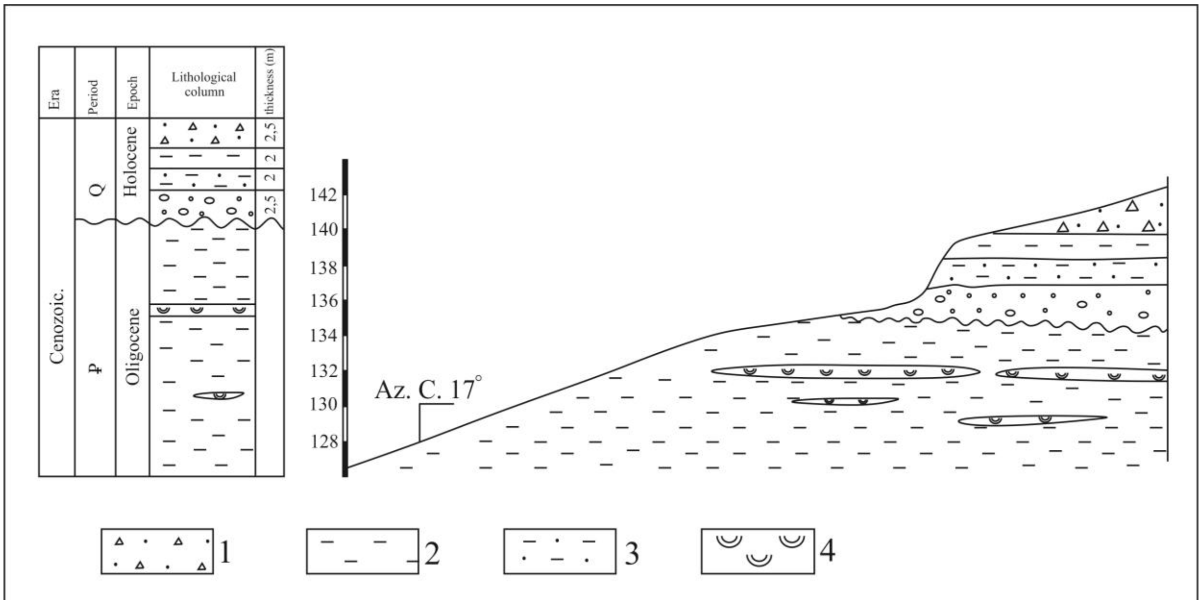


Figure 2: Schematic map and section of Lake Shorkul



Lithological-stratigraphic section of the northeastern side of Lake Shorkul
Scale 1 : 200

1 - deluvial deposits; 2 - clays; 3 - siltstone; 4 - gypsum.

Figure 3: Lithological and stratigraphic section of the northeastern shore of Lake Shorkul

RESULTS AND DISCUSSION

Table 2 shows the chemical composition of the selected samples. In the upper part of the lake side, during the preparation of the geological section, we found gypsum interlayers (Fig.4). The chemical composition of gypsum is shown in Table 3.

Table 2: Chemical composition of water-soluble salts of Lake Shorkul

Sampling location		**Shorkul Lake**
Identification of the sample		**Halite**
Insoluble residue		5.98
H_2O		1.62
CI	g/%	53.19
	g/eq	1499.95
S	g/%	3.7
	g/eq	77.03
Na	g/%	34.89
	g/eq	1518
K	g/%	traces
	g/eq	
Ca	g/%	0.72
	g/eq	35.99
Mg	g/%	0.28
	g/eq	22.99
Total, %		100.29


a


b

Figure 4: Photographs of gypsum (a) and gypsum interlayer (b) from the left side of Lake Shorkul

Table 3: Chemical composition of gypsum according to mass spectrometric analysis (ICP-Agilent 7500CX), Central Laboratory of Uzbekgeologiya JSC

Element	**Measure-ment range**	**Pr-45 gypsum**	**Pr-45\1 silicified rock (silicitolite)**	**Pr-45\2 bentonite clay**	**Element**	**Measurement range**	**Pr-45 gypsum**	**Pr-45\1 silicified rock (silicitolite)**	**Pr-45\2 bentonite clay**
Li	0.005-4000	11.0	20.0	27.0	**Sn**	0.10-10	0.270	0.590	1.60
Be	0.05-4000	0.170	3.20	1.50	**Sb**	0.10-4000	0.680	0.360	1.20
B	1.0-4000	4.20	24.0	6.70	**Te**	0.30-4000	<0.30	<0.30	<0.30
Na	0.004-11%	1700	3600	11000	**Cs**	0.02-4000	1.40	5.00	6.40
Mg	0.004-11%	1400	8300	10000	**Ba**	0.10-4000	46.0	150	210
Al	0.002-20%	7100	32000	43000	**La**	0.50-4000	3.00	55	15.0
P	1.0-4000	240	2500	360	**Ce**	0.04-4000	5.90	320	32.0
K	0.008-30%	2500	5600	13000	**Pr**	0.01-4000	0.620	48.0	4.40
Ca	0.005-28%	180000	7400	9500	**Nd**	0.01-4000	2.60	210	15.0
Sc	0.10-4000	3.40	11.0	10.0	**Sm**	0.01-4000	0.310	50.0	3.2
Ti	0.0006-9%	350	1200	3200	**Eu**	0.01-4000	0.130	11.0	0.710
V	0.10-4000	33.0	190	160	**Gd**	0.01-4000	0.34	0.46	2.30
Cr	1.0-4000	37.0	45.0	85.0	**Tb**	0.01-4000	0.040	7.00	0.320
Mn	0.10-4000	930	14000	430	**Dy**	0.01-4000	0.300	39.0	1.80

Fe	0.006-30%	8700	>30%	34000	**Ho**	0.01-4000	0.051	6.30	0.350
Co	0.10-4000	1.80	74.0	6.70	**Er**	0.01-4000	0.180	21.0	1.50
Ni	0.10-4000	9.60	380	31.0	**Tm**	0.01-4000	0.036	2.20	0.170
Cu	0.10-4000	15.0	35.0	>4000	**Yb**	0.01-4000	0.180	13.0	1.70
Zn	0.10-4000	19.0	290	55	**Lu**	0.01-4000	0.020	1.70	0.230
Ga	0.10-4000	1.20	4.30	9.30	**Hf**	0.05-4000	0.280	0.980	2.10
As	0.10-4000	73.0	72.0	13.0	**Ta**	0.04-4000	0.100	0.320	0.580
Se	0.50-4000	2.00	4.60	3.30	**W**	0.08-4000	0.240	1.60	1.30
Rb	0.10-4000	11.0	35.0	69.0	**Re**	0.01-4000	<0.01	<0.01	<0.01
Sr	0.10-4000	280	230	320	**Pt**	0.05-4000	<0.05	<0.05	<0.05
Y	0.10-4000	1.70	180	8.10	**Au**	0.05-4000	0.08	<0.05	<0.05
Zr	0.10-4000	8.90	60.0	74.0	**Tl**	0.01-4000	0.081	1.30	0.240
Nb	0.005-4000	1.20	4.40	9.90	**Pb**	0.1-4000	5.10	8.50	10.0
Mo	0.10-4000	5.00	120	9.40	**Bi**	0.01-4000	0.051	0.110	0.180
Ag	0.05-10.0	0.170	0.170	0.570	**Th**	0.01-4000	1.10	3.90	7.20
Cd	0.005-4000	0.100	1.10	0.051	**U**	0.01-4000	2.00	160	9.70
In	0.005-4000	0.014	0.095	0.052					

The spectral analysis performed (Table 4) allows to simultaneously determine the content of elements in gypsum (Figure 4), as well as the bentonites and silica covering it, obtained from the northeastern side of Lake Shorkul, It is expected that elements with higher anomalies compared to Clarke values will be promising for the study area.

Table 4: The results of the chemical analysis of gypsum

<table>
<tr><td colspan="6">Shorkul, Pr 45, Gypsum</td></tr>
<tr><td colspan="6">The results of the analysis in % for air-dry matter</td></tr>
<tr><td colspan="2">SiO_2</td><td>5.03</td><td colspan="2">Na_2O</td><td>0.16</td></tr>
<tr><td colspan="2">TiO_2</td><td>0.064</td><td colspan="2">K_2O</td><td>0.2</td></tr>
<tr><td colspan="2">Al_2O_3</td><td>0.93</td><td colspan="2">P_2O_5</td><td>0.021</td></tr>
<tr><td colspan="2">$Fe_2O_{3\ total}$</td><td>0.8</td><td colspan="2">$SO_{3\ total}$</td><td>42.28</td></tr>
<tr><td rowspan="2">parti-
cularly</td><td>Fe_2O3</td><td>0.8</td><td rowspan="2">parti-
cularly</td><td>SO_3 sulphide</td><td>42,22</td></tr>
<tr><td>FeO</td><td><0.25</td><td>$S_{sulphide}$</td><td><0,10</td></tr>
<tr><td colspan="2">MgO</td><td><0.50</td><td colspan="2">calcination losses</td><td>21.7</td></tr>
<tr><td colspan="2">MnO</td><td><0.010</td><td colspan="2">H_2O 320</td><td>19.29</td></tr>
<tr><td colspan="2">CaO</td><td>27.9</td><td colspan="2">CO_2</td><td>0.17</td></tr>
</table>

The analysis shows that gypsum has a high content of CaO and SO_3, which is typical for sulfate minerals. The presence of impurities and loss during calcination indicate the presence of minor inclusions of other minerals and organic substances. These data confirm the purity of gypsum and its suitability for industrial use (Table 4).
Most salinization zones are located at the bottom of various depressions and hollows, developed, most often, in Eocene clays.

CONCLUSION

As a result of the conducted research, thick deposits of green clays of Eocene age, with predominantly montmorillonite composition in the area of Lake Shorkul, were identified within the studied area. The salt accumulation of the sodium chloride composition is associated with the redeposition of these salts from Paleogene clays of marine origin and, consequently, enriched with sodium chloride.

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