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On the Deposition of Halite in Kara-Bogaz-Gol

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Abstract

Full Text

CHEMISTRY

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On the Deposition of Halite in Kara-Bogaz-Gol

(Presented by Academician G. G. Urazov, 12 XI 1956)

The present article gives data characterizing the chemical composition of the brine of Kara-Bogaz-Gol at the moment of its saturation with halite.

As is known, the year 1939 proved critical for the life of Kara-Bogaz-Gol: the continuous increase in the concentration of salts in its brine led to the separation of halite into a solid bottom phase on the floor of the gulf. Universal deposition of halite in the gulf began in the first days of August and proceeded so intensively that the propellers of steamships cruising the gulf at that time were quickly covered with a thick layer of cemented crystals of common salt. Analysis of brine samples taken during a voyage in Kara-Bogaz-Gol on 8-9 VIII 1939 (see Fig. 1) showed that, at the moment

Table 1

Chemical characterization of the brine of Kara-Bogaz-Gol at the initial moment of its saturation with halite

(voyage in the gulf, 8-9 VIII 1939)

Date	Station No.	Depth	Specific grav-ity	Specific				Sum			
				Ca(HCO ₃) ₂	MgSO ₄	MgCl ₂	(+KCl)	NaCl	of salts	MgSO ₄	MgCl ₂
8 VIII	I	surf.	1.234	0.085	0.014	5.45	3.29	19.39	28.23	1.65	7.32
8 VIII	I	bottom	1.236	0.035	0.014	5.79	3.05	19.45	28.40	1.90	7.25
8 VIII	II	surf.	1.234	0.088	0.041	5.64	3.13	19.90	28.80	1.80	7.42
8 VIII	II	bottom	1.236	0.086	0.020	5.69	3.21	19.41	28.41	1.77	7.20
8 VIII	III	surf.	1.235	0.086	0.020	5.75	3.09	19.99	28.94	1.86	7.40
8 VIII	III	3.5 m	1.238	0.085	0.020	5.65	3.25	19.43	28.43	1.74	7.20
8 VIII	III	bottom	1.237	0.688	0.007	5.68	3.17	19.92	28.87	1.79	7.36

Fig. 1

Figure 1: Fig. 1

Date	Station No.	Depth	Specific gravity	Specific grav-				Sum of			
				Ca(HCO ₃) ₂	MgSO ₄	MgSO ₄	MgCl ₂	NaCl (+KCl) salts	MgSO ₄ /MgCl ₂	Cl'/Mg''	
8 VIII	IV	surf.	1.234	0.090	0.014	5.70	3.13	19.87	28.81	1.82	7.37
8 VIII	IV	3.5 m	1.237	0.085	0.020	5.65	3.25	19.41	28.41	1.74	7.20
8 VIII	IV	bottom	1.235	0.086	0.003	5.68	3.17	19.97	28.91	1.79	7.38
9 VIII	V	surf.	1.237	0.085	0.013	5.69	3.25	19.33	28.37	1.75	7.15
9 VIII	V	3.5 m	1.237	0.085	0.020	5.66	3.29	19.26	28.31	1.72	7.14
9 VIII	V	bottom	1.236	0.077	0.012	5.73	3.09	20.00	28.91	1.85	7.40
9 VIII	VI	surf.	1.234	0.084	0.017	5.59	3.29	19.79	28.77	1.70	7.32
9 VIII	VI	3.5 m	1.237	0.085	0.020	5.57	3.41	19.23	28.31	1.63	7.11
9 VIII	VI	bottom	1.237	0.084	0.020	5.64	3.33	19.30	28.37	1.69	7.13
9 VIII	VII	surf.	1.237	0.089	0.003	5.75	3.21	19.84	28.89	1.79	7.29

of saturation of the brine with halite, the sum of salts in it was 28.5%, with ~19.7% NaCl. The average value of the chlorine-magnesium coefficient (Cl'/Mg'') was about 7.25, and that of the metamorphization coefficient (MgSO₄/MgCl₂) 1.77. Comparison of the composition of the brine along a vertical section reveals no great difference in the hydrochemical characteristics of the brines at the surface, in the middle, and near the bottom of the gulf (Fig. 2). The actual composition of the Kara-Bogaz brine at the moment

its saturation with halite is in good agreement with the results of earlier experimental work (1-5).

In samples of bottom sediment that were taken at the hydrochemical stations, a crystalline solid phase was found. Individual crystals, raised from the bottom of the bay together with silt, were rhombic dipyrramids. The optical constants: (N_g = 1.982) ((±0.002)), (N_m = 1.477) ((±0.002)) and (N_p = 1.470) ((±0.002)), as well as the angle of the optical axes ((2V)), close to (90°),

Fig. 1

Fig. 2

Figure 2: Fig. 2

Fig. 2

Fig. 1. Layout of the hydrochemical stations during the voyage of 8-9 VIII 1939.

Fig. 2. Hydrochemical section of the vertical column of brine in the central part of Kara-Bogaz-Gol in August 1939.

left no doubt that the crystals under study were thenardite. A crystalline crust, raised at the same time from the bottom of the bay, was an accumulation of small cemented grains of thenardite with a slight inclusion of very fine-grained calcite ($(N_g = 1.658)^*$).

The formation of thenardite was a consequence of the dehydration of mirabilite under the influence of a favorable temperature regime ($(27.6^{\circ})^{**}$) in the zone of contact between the surface bottom deposits of the bay and the Kara-Bogaz brine, saturated with halite.

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* The crystallo-optical analysis was carried out in 1939 by L. O. Anshles and Ya. Yarzhemskii.

** Mean temperature of the bay brine at the bottom (from 7 determinations made during the voyage of 8-9 VIII 1939).

Note: Figure translations are in progress. See original paper for figures.

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