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Abstract

Full Text

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CHEMISTRY

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CARNALLITE AND SYNGENITE IN THE DEPOSITS OF THE SALT LAKE DZHAKSY-KLYCH (PRIARALIE)

(Presented by Academician I. I. Chernyaev, 1 XI 1957)

Potassium-bearing minerals are very rarely found in the deposits of modern salt lakes.

The presence of carnallite ($KCl \cdot MgCl_2 \cdot 6H_2O$) and kainite ($KCl \cdot MgSO_4 \cdot 3H_2O$) was noted by G. G. Urazov et al. in the salt deposits of the coastal zone of Kara-Bogaz-Gol.

During a physicochemical investigation of the salt lakes of the northeastern coast of the Aral Sea, we discovered syngenite ($K_2SO_4 \cdot CaSO_4 \cdot H_2O$) and carnallite in the deposits of the salt lake Dzhaksy-Klych.

This lake is situated 20 km northeast of the Aral Sea. Along with brines, the lake contains salt deposits in the form of astrakhanite ($Na_2SO_4 \cdot MgSO_4 \cdot 4H_2O$), mirabilite ($Na_2SO_4 \cdot 10H_2O$), thenardite ($Na_2SO_4$), magnesium sulfate hydrates ($MgSO_4 \cdot 7H_2O$, $MgSO_4 \cdot 6H_2O$, $MgSO_4 \cdot 5H_2O$, $MgSO_4 \cdot H_2O$), glauberite ($Na_2SO_4 \cdot CaSO_4$), and gypsum ($CaSO_4 \cdot 2H_2O$).

The total thickness of the beds in the lake reaches 4.5–5 m ([1]).

Beneath the upper layer of common salt (thickness up to 2 m) there is a bed of astrakhanite (thickness up to 1.5 m), and in some zones of the lake mirabilite and thenardite occur.

In the lower layer of the astrakhanite bed, crystals of magnesium sulfate hydrates (6-, 5-, and 1-water) and gypsum are encountered.

Between intergrowths of astrakhanite crystals, we discovered syngenite in the form of fine-crystalline white inclusions having the following chemical and mineralogical composition (Table 1).

The presence of syngenite was confirmed by crystalloptical and thermographic methods of investigation.

Fig. 1. Heating curve of syngenite

Figure 1: Fig. 1. Heating curve of syngenite

Fig. 2. Heating curve of carnallite

Figure 2: Fig. 2. Heating curve of carnallite

Table 1

Salt	Content, wt. %	Mineral	Content, wt. %
$CaSO_4$	9.27	Syngenite ($K_2SO_4 \cdot CaSO_4 \cdot H_2O$)	33.72
$MgSO_4$	24.85	Astrakhanite ($Na_2SO_4 \cdot MgSO_4 \cdot 4H_2O$)	42.97
Na_2SO_4	18.25	Pentahydrate $MgSO_4 \cdot 5H_2O$	16.39
K_2SO_4	17.89	NaCl	2.83
NaCl	2.83	Residue insoluble in water	4.40
Residue insoluble in water	9.11*		
Σ ...	82.19	Σ ...	100.31

* For syngenite, 4.71% $CaSO_4$ was taken from the insoluble residue.

The crystal-optical constants of syngenite, natural and synthetic, proved to be as follows: synthetic syngenite N_g 1.518, N_p 1.501; natural syngenite (from Lake Dzhaksy-Klych) N_g 1.519, N_p 1.500.

Fig. 1. Heating curve of syngenite

On the heating curve of a sample of natural salt from Lake Dzhaksy-Klych (Fig. 1) there are thermal effects characteristic both of syngenite and of hydrated magnesium sulfate and astrakhanite contained in the sample.

Fig. 2. Heating curve of carnallite

The effect at 245° corresponds to dehydration of syngenite, that at 432° to its decomposition, and that at 590° to the transformation of potassium sulfate.

The thermal effects at 80, 155, and 360° correspond to dehydration of magnesium sulfate hexahydrate and kieserite, and that at 220° to dehydration of astrakhanite.

The formation of syngenite occurs, in all probability, as a result of the interaction of lake brines containing up to 2% KCl with gypsum, ···

deposits of which are present in significant quantity in the salt lake.

It should be noted that syngenite occurs very rarely in nature. It was first discovered in the salt deposits of Kalush (Stanislav oblast, Ukrainian SSR) and was named kalushite ([2]).

Another potassium salt that we found in the salt deposits taken from the surface of Lake Dzhaksy-Klych is carnallite.

Crystallization of carnallite occurred from brines during their evaporation in the summer period. In addition to carnallite, crystals of magnesium sulfate hydrates and bischofite ($MgCl_2 \cdot 6H_2O$) form from the brines.

Table 2

Salt	Content, wt. %	Mineral	Content, wt. %
$MgSO_4$	19,85	Carnallite($KCl \cdot MgCl_2 \cdot 6H_2O$)	58,52
$MgCl_2$	21,11	Hexahydrate($MgSO_4 \cdot 6H_2O$)	37,15
KCl	15,71	Bischofite($MgCl_2 \cdot 6H_2O$)	2,24
NaCl	1,88	NaCl	1,88
Σ ...	58,55	Σ ...	99,79

Table 2 gives the chemical and mineralogical composition of a salt sample taken by us from the surface of Lake Dzhaksy-Klych (northern basin).

The heating curve of this salt sample is shown in Fig. 2. The thermal effects on the curve correspond to: at 60 and 80°—dehydration of hexahydrate; at 160, 230, and 400°—dehydration and decomposition of carnallite.

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