

## MINERALOGY

## VISHNEVITE, AND NOT SULPHATIC CANCRINITE

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In 1916 Larsen and Steiger (4) described under the name of sulphatic cancrinite a most peculiar mineral from Colorado, in its hexagonal crystallization and chemical composition somewhat similar to cancrinite, but essentially differing from the latter in that a part of  $\text{CaCO}_3$  in its chemical formula is equivalently replaced by  $\text{Na}_2\text{SO}_4$  (Table 1, 1).

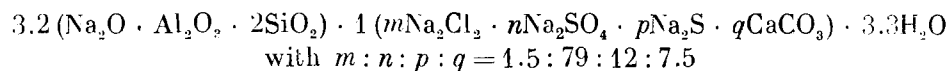
Later on, a similar mineral was discovered by Kazakova and Zavaritsky (1929) (2) in the Ilmen Mts. in the Urals (Table 1, 3 and 4), and still later, by the present author (1931) (1, 3) in the Vishnevye Gory (Mts.), also in the Urals (Table 1, 5).

In the two Uralian cases the material analysed was not quite monomineral but contained a certain amount of admixtures: in the Ilmen case, of natrolite and cancrinite, and in the Vishnevye Gory case, of scolezite and hydrargillite.

From a detailed calculation of the chemical analysis of the material from Vishnevye Gory the following results were obtained by the author:

1. Weight per cent of the individual components: sulphatic cancrinite—89.0; scolezite—8.6; hydrargillite—2.4.

2. The chemical formula of sulphatic cancrinite:



In accordance with the extreme predominance of  $\text{Na}_2\text{SO}_4$  over  $\text{CaCO}_3$  in the Uralian sulphatic cancrinite as demonstrated by the formula and the analyses given in Table 1, it is evident that as a matter of fact we have to do here with no cancrinite, be it even a sulphatic one, but rather with an obviously new mineral for which the present author has suggested the name of «vishnevite». In its ideally pure state vishnevite should have the composition:  $3\text{Na}_2\text{Al}_2\text{Si}_2\text{O}_8 \cdot \text{Na}_2\text{SO}_4 \cdot 3\text{H}_2\text{O}$  (the vishnevite molecule), but in practice it contains an admixture of the cancrinite molecule,  $3\text{Na}_2\text{Al}_2\text{Si}_2\text{O}_8 \cdot \text{CaCO}_3 \cdot 3\text{H}_2\text{O}$  in its solid solution.

More recently, «sulphatic cancrinite» has been described by Stewart (5) from the Loch-Borolan deposit, Scotland (Table 1, 2).

In Table 1 which shows the chemical details of all the above-listed cancrinites, the greatest interest is attached to the  $\text{CO}_2$  and  $\text{SO}_3$  contents, corresponding to the relative content in each of the cancrinite and vishnevite molecules. If the sum of these molecules in each particular case be put at 100, the following ratios of the said molecules are obtained: 1) 55:45; 2) 34:66; 3) 23:77; 4) 20:80; 5) 8:92.

It will be seen that the discrepancy here is rather large, the Uralian cases being relatively poor in the cancrinite molecule as compared to those from Scotland and Colorado. How will this be reflected by the respective names of our mineral mixtures?

Table 1  
Chemical Composition of Sulphatic Cancrinite from Different Deposits: 1—Colorado, 2—Scotland, 3, 4—Ilmen Mts., 5—Vishnevye Gory (Mts.)

	Weight per cent					Molecular quantities				
	1	2	3	4	5	1	2	3	4	5
$\text{SiO}_2$	33.70	34.76	35.29	34.78	34.53	561	579	588	579	576
$\text{TiO}_2$	—	—	—	—	0.10	—	—	—	—	001
$\text{Al}_2\text{O}_3$	29.40	30.81	28.79	28.77	29.06	289	302	282	282	285
$\text{Fe}_2\text{O}_3$	—	—	—	—	0.56	—	—	—	—	003
$\text{FeO}$	—	—	—	—	0.11	—	—	—	—	001
$\text{MnO}$	—	—	—	—	0.09	—	—	—	—	001
$\text{MgO}$	—	—	—	—	0.09	—	—	—	—	001
$\text{CaO}$	4.18	3.87	4.49	4.27	4.48	075	069	027	023	026
$\text{SrO}$	0.08	0.32	—	—	—	001	003	—	—	—
$\text{Na}_2\text{O}$	18.52	18.90	15.65	15.59	16.51	299	305	252	252	266
$\text{K}_2\text{O}$	4.45	4.29	4.15	4.90	5.11	015	014	044	052	054
$\text{Cl}_2$	—	—	—	—	0.09	—	—	—	—	001
$\text{SO}_3$	4.65	5.93	5.76	6.25	5.02	058	074	072	078	063
$\text{S}$	—	—	—	—	0.30	—	—	—	—	009
$\text{CO}_2$	3.18	1.90	1.01	0.89	0.26	072	043	023	020	006
$\text{H}_2\text{O}^+$	4.24	2.30	7.67	7.01	5.35	275	139	423	389	373
$\text{H}_2\text{O}^-$	0.72	0.20	—	—	1.36	—	—	—	—	—
Total	100.19	100.28	100.05	99.68	100.02					

If cancrinite and vishnevite, being, as it seems at first sight, bodies ideally isomorphous with respect to each other, were naturally miscible at any ratio, such a perfectly mechanical attack of the question advanced would be possible, indeed. Putting the conventional boundary between mixtures of the series rich and the one poor in the cancrinite molecule at 50 per cent of either component, it may be recommended to retain for the former case Larsen's name of «sulphatic cancrinite», and for the latter to use the more natural name of «carbonate vishnevite», or simply «vishnevite», as proposed by the present writer. The actual state of things, however, suggests a different solution.

As a matter of fact, no complete isomorphous miscibility of vishnevite and cancrinite is observed. While vishnevite dissolves readily cancrinite, the latter does not at all take in the molecule of vishnevite. In the majority of the numerous chemical analyses of cancrinite known, the value of  $\text{SO}_3$  is not given at all, and if shown, then—at least in the more recent and reliable analyses—it does not exceed 0.1 per cent [cf., for example, the cases of cancrinite from Iron Hill, Colorado, cited by Stewart (5) after Larsen and Foshag, 1926 (0.03 per cent  $\text{SO}_3$  corresponding to 0.3 per cent in the molecular sum of  $\text{CO}_2 + \text{SO}_3$ ) and of cancrinite from Dodo, Korea, after Kozu, 1931 (0.08 per cent  $\text{SO}_3$  or, which is the same, 0.7 per cent in the sum of  $\text{CO}_2 + \text{SO}_3$ )]. The demarkation line between cancrinite and vishnevite is thus quite different, and even in the case of the sulphatic cancrinite of Larsen and Steiger (4) it lies on the side of vishnevite.

In good agreement with the absence of a complete isomorphism between vishnevite and cancrinite is also the fine twinning lattice of the microcline type observed by the author in the Vishnevye Gory mineral (polymorphism or, at least, polysymmetry). Characteristic in this connexion is also the anomalous biaxiality shown by Stewart in the Scottish sulphatic cancrinite (that is, vishnevite).

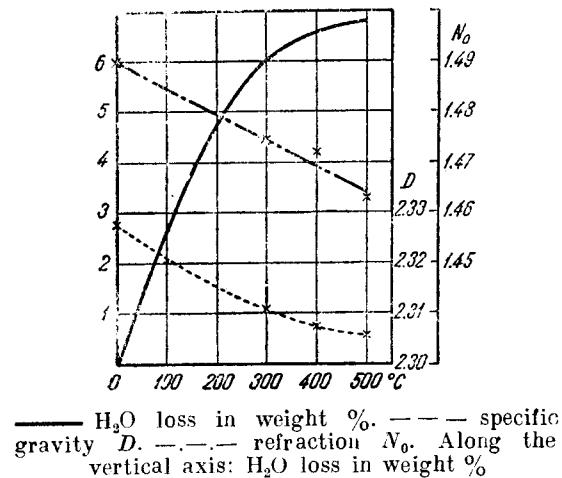
To sum up, all the cases of sulphatic cancrinite described above should be referred to vishnevite.

In addition to the characteristic of the Vishnevye Gory variety of this mineral as given by the author in his previous work, we shall cite here unpublished data of his, in collaboration with Nikogosian, on hydrous silicates showing among other things the zeolitic type of the water in vishnevite (Table 2 and figure).

Table 2  
Loss of Water, Refraction ( $N_0$ ) and Specific Gravity ( $D$ ) of Vishnevite from Vishnevye Gory at Various Temperatures

Temperature °C	Loss of H <sub>2</sub> O, weight %	Refraction $N_0$	Specific gravity $D$	Note
15	—	1.489	2.328	At all temperatures the same extremely slight refraction is retained as in raw vishnevite: $N_0 - N_e \leq 0.004$
150	3.51	—	—	
200	4.99	—	—	
250	5.53	—	—	
300	6.01	1.474	2.310	
350	6.41	—	—	
400	6.61	1.472	2.308	
450	6.71	—	—	
500	6.71	1.463	2.306	

In the light of these data, of considerable interest is the question as to the temperature conditions of the formation of the vishnevite from Scotland, with its 2.50 weight per cent of water, parallel to the water content of the Uralian vishnevite upon being heated to about 200° C. That these conditions could actually have



been rather high-temperature ones, may be inferred from the information by Stewart, that his vishnevite did not only form one of the chief components of the pegmatite bodies dissecting the borolanites, but occurs also as a rather common component in the schliers of the borolanites themselves. The same is evidenced, finally, by the paragenesis of vishnevite in pegmatites with orthoclase, melanite and black mica with a total absence of any indication to its secondary nature in this particular instance.

#### REFERENCES

- <sup>1</sup> Д. С. Белянкин, Изв. гл. геол. управл., вып. 47, 747 (1931). <sup>2</sup> А. Н. Заварицкий, Зап. Мин. о-ва, 58, 201 (1929). <sup>3</sup> D. S. Beljankin, Zbl. f. Min., Abt. A, No. 6, 190 (1931). Misprints absent in the Russian text: 1) in the analysis (p.193) Al<sub>2</sub>O<sub>3</sub> 26.09 for 29.06 and an omission S 0.30; 2) p. 194, m : n : p : q = 5 : 73 : 12 : 7.5 for 1.5 : 79 : 12:7.5. <sup>4</sup> E. S. Larsen and G. Steiger, Amer. Journ. Sci., ser. 5, 42, 332 (1916). <sup>5</sup> F. H. Stewart, Min. Mag., No. 172, XXVI, 1—8 (1941).

#### MARMOT HYBRIDS

(ON THE QUESTION OF INTERSPECIFIC HYBRIDIZATION IN NATURE)

By V. S. BAZHANOV

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When examining large lots of marmot furs on stock at the Kuybyshev, Chkalov, West-Kazakhstan and Aktiubinsk districts, we occasionally ran across such individuals as combined characters of *Citellus major* Pall. = *C. rufescens* with those of *C. pygmaeus* Pall. In a number of localities these species inhabit the same places. Those furs made us think of a hybrid origin of the individuals. Sviridenko (<sup>5</sup>) has already reported of a hybrid between the marmot *C. pygmaeus* and *C. suslica* caught by him.

In the light of these data our attention was attached to a rather small marmot resembling *C. rufescens*; the animal was met on June 20, 1931, near village Verkhnyaya Dneprovka of the Chkalov district, 120 km eastwards the town Chkalov, on the left bank of the Ural river, at the boundary between a wormwood pasture and a steppe overgrown with various cereals and grasses. The animal had a highly piercing squeak uttered in two times, which is not peculiar to this species; when closely examined, it was found to show characters both of *C. rufescens* and *C. pygmaeus*.

The size of the rodent was an intermediate one between the two species. The colour of its back and tail, as well as the fluffiness of the latter were like those of *C. rufescens*. The «cap» on its head was no silvery one, but with separate silvery hairs. Its squeak resembled that of *C. rufescens*, though somewhat higher and shriller; but occasionally it was uttered in two or three times, strongly reminding the voice of the small marmot, called the «whistler».

When kept in a cage under observation, the animal showed a livelier behaviour than that typical of *C. rufescens*, reminding *C. pygmaeus* again.

According to all its peculiarities this marmot was an obvious hybrid between the two species, with a prevalence of the characters of the larger one. After a few days the animal escaped, which prevented us from proceeding in the analysis of its biological and taxonomical characters.

A comparison of the intermediate heredity between *C. rufescens* and *C. pygmaeus*—the dominance of the characters of the former—with palaeontological evidence for *Citellus major* (<sup>2-4</sup>) points to a more remote age and, consequently, a greater primitivity of *C. major*.

The case of natural hybridization points to a close genetic relationship between *C. major* and *C. pygmaeus*. Isolated hybrids may probably be met in nature between other species of marmot, occupying common areas of habitation.

In 1943 I found that in the northern part of the Gurjevsk district (village Karakul of the Makat region) *C. major* lives together with *C. fulvus* Licht. It should be noted, besides, that the southern boundary of the area of distribution of the