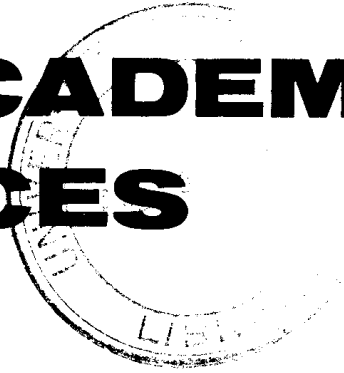


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A NEW MINERAL, TIKHONENKOVITE $\text{SrAlF}_4(\text{OH}) \cdot \text{H}_2\text{O}$

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Abstract: A new fluoride mineral from Tannu-Ola Ridge, Tuva is described and named tikhonenkovite; its chemical composition is $\text{SrAlF}_4(\text{OH}) \cdot \text{H}_2\text{O}$. The unit cell constants and X-ray powder pattern are reported.

In studying the composition of an iron-ore showing at Karasug in the western part of Tannu-Ola Ridge, Tuva, one of the authors (A. P. Khomyakov) detected an unknown fluoride which, on further investigation, proved to be a new mineral. We call it tikhonenkovite after Igor Petrovich Tikhonenkov (1927-1961), the talented investigator of alkaline rocks and minerals.

The iron-ore bodies in which the tikhonenkovite occurs are confined to steeply dipping fault breccia zones. The ore mineralogy is very complex, with an uneven distribution of non-coeval mineral associations. The principal mineral associations are: ankerite-calcite, fluorite-barite-siderite, fluorite-barite-celestite-hematite and celestite-strontianite. The ores of the first three mineral associations contain smaller amounts of quartz, pyrite, magnetite, sphalerite, galena, molybdenite and other minerals.

The ore showing is covered by a thick oxidation zone whose geology has been described by A. S. Mitropol'skiy [1]. According to him, the lower limit of the oxidation zone is at a depth of 100 to 300 m. Most highly oxidized are the most common, rich, siderite-bearing ores. The principal hypergene minerals are limonite and hydrohematite. Less abundant are gypsum, pyrolusite, psilomelane, barite, celestite, strontianite, jarosite, malachite, fluorite, gerskutsite, etc.

Tikhonenkovite occurs in two parts of the oxidation zone. In one of them it was found on the dump of an adit cutting through limonite-hydrohematite ores. Here, tikhonenkovite occurs as small lenticular crystals in cracks in shale, highly pigmented by hydrohematite and limonite. At the surface, on the dump of a trench situated 50 m above the adit, a fissure in hematite-limonite ore reveals druses of large pinkish tikhonenkovite crystals, accompanied by gerskutsite and hypergene celestite.

In the other section, tikhonenkovite was found on the dumps of an adit undercutting limonite-hematite ores, whose cracks show incrustations of goethite, gerskutsite and hypergene fluorite and crystals of celestite, strontianite, barite and tikhonenkovite.

Tikhonenkovite appears only as crystals and intergrowths. Most abundant are simple crystals of isometric or, where flattened along (001), lenticular habit up to 5 mm across (Fig. 1). Flat radial intergrowths occur less commonly, as rosettes up to 2 cm across. Frequent are drusy incrustations--intergrown irregular rosettes, consisting of scalariform split crystals. The results of a study of tikhonenkovite with a goniometer will be published in a separate paper. Tentative information indicates that the crystals have monoclinic symmetry and are a combination of several rhombic prisms with the pinacoids (100) and (001).

The crystals of tikhonenkovite are colorless and transparent, sometimes with a slightly pinkish hue. The luster is vitreous. The Mohs hardness is 3 1/2. The cleavage is perfect along pinacoid (001). The fracture is conchoidal to rough. Ye. P. Pogodina determined the specific gravity of one sample by the method of hydrostatic weighing; it proved to be 3.26 ± 0.01. In thin section, tikhonenkovite is colorless and transparent. Perfect cleavage in one direction is conspicuous. The refractive indices found by the method of focal screening were: $N_g = 1.458$, $N_m = 1.454$, $N_p = 1.452 \pm 0.01$. The mineral is optically negative and biaxial. The axial angle measured on a Fedorov universal stage was $(-) 2V = 70^\circ$.

V. A. Moleva made a chemical study of the tikhonenkovite. Alkalis were determined by flame photometry (G. Ye. Kalenchuk). In recalculation of the analysis H_2O and (OH) were estimated from the 12% H_2O^+ determined analytically. Fe_2O_3 was deducted as 0.58% goethite. From the chemical analysis a theoretical formula of $(\text{Sr}, \text{Ca})\text{AlF}_4(\text{OH}) \cdot \text{H}_2\text{O}$ was deduced for tikhonenkovite (Table 1).

Spectral analysis of tikhonenkovite, performed in the Laboratory of Spectral Analysis, Institute

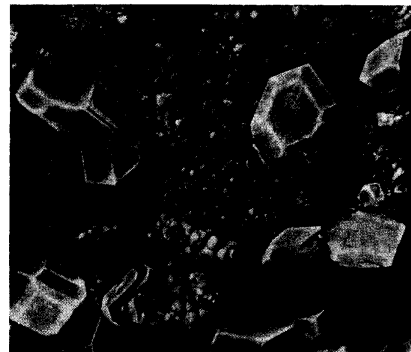


Fig. 1. Tikhonenkovite crystals in a limonite incrustation. Dusted with MgO . 20 x. Reproduction 9 : 10.

Table 1

Calculations of the Chemical Analysis of Tikhonenkovite

Component	wt. %	Atomic quantities	Content of impurities, atomic quantities	Mineral content, atomic quantities	Ratio of atomic quantities
TR	Not detected	—	—	—	—
Fe_2O_3	0.52	(0.002256)	0.003256	—	—
Al	12.10	0.448466	—	0.448466	1.01
Sr	36.74	0.419253	—	0.419253	0.94
Ca	0.93	0.023204	—	0.023204	0.05
Cs	Not detected	—	—	—	—
Rb	Not detected	—	—	—	—
K	0.017	0.000304	—	0.000304	} 0.001
Na	0.007	0.000304	—	0.000304	
SO_2	Not detected	—	—	—	
P_2O_5	Not detected	—	—	—	—
F	33.88	1.783158	—	1.783158	4.00
(OH)	(7.62)	0.448030	—	0.448030	1.01
H_2O^+	[7.97]	(0.442994)	0.003256	(0.439138)	0.99
H_2O^-	Not detected	—	—	—	—
Total	99.78				

of Ore Geology, Petrography, Mineralogy and Geochemistry, Academy of Sciences of the USSR, showed in addition that there was 0.01% La; 0.0n% Mg, Ba; 0.001% Si; and 0.001% Be, Ce, Y, Cu. The differential heating curve of tikhonenkovite was plotted at the Laboratory of Thermal Analysis of the same institute, as was its synchronous weight loss-curve (Fig. 2). Weighed portions were heated in a platinum crucible.

Z. V. Pudovkina X-rayed the tikhonenkovite. The monoclinic symmetry of tikhonenkovite was established with a RKOP camera by the Laue and swing methods. The cell constants were $a = 8.73 \pm 0.03 \text{ \AA}$, $b = 10.62 \pm 0.04 \text{ \AA}$, $c = 5.02 \pm 0.02 \text{ \AA}$; $\beta = 102^\circ 43' \pm 10'$; $a:b:c = 0.8220:1:0.4727$. The X-ray powder pattern was obtained with chromium radiation in a RKU-114 camera. The interplanar spacings were revised with NaCl as the internal standard. The intensities were

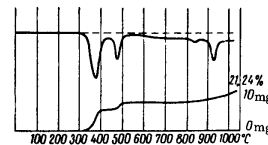


Fig. 2. Differential heating curve for tikhonenkovite plus its synchronous weight-loss curve.

measured from the scale of blackening marks (Table 2).

The X-ray data for tikhonenkovite differ from those for other minerals, including gerskutsite,

¹Translated from: Novyy mineral--tikhonenkovit $\text{SrAlF}_4(\text{OH}) \cdot \text{H}_2\text{O}$, Doklady Akademii Nauk SSSR, 1964, Vol. 156, No. 2, pp. 345-347.

Table 2

Results of Calculations from X-Ray Data for Tikhonenkovite

Tikhonenkovite		Gearsutite		Tikhonenkovite		Gearsutite		Tikhonenkovite	
<i>l</i>	<i>d_α</i>	<i>l</i>	<i>d_α</i>	<i>l</i>	<i>d_α</i>	<i>l</i>	<i>d_α</i>	<i>l</i>	<i>d_α</i>
3	4.92	3	4.98	—	—	1	1.962	3	1.375
10	4.89	—	—	3	1.941	—	—	2	1.325
3	4.50	10	4.50	—	—	7	1.922	3	1.275
5	4.44	—	—	3	1.899	—	—	3	1.268
2	4.28	—	—	2	1.886	6	1.889	2	1.264
9	3.64	—	—	3	1.817	2	1.815	2	1.256
—	—	4	3.47	3	1.805	—	—	2	1.249
5	3.33	4	3.33	2	1.772	—	—	3	1.237
8	3.27	3	3.27	—	—	4	1.733	2	1.222
5	3.14	7	3.15	4	1.749	—	—	3	1.217
3	2.993	—	—	3	1.703	3	1.697	2	1.211
5	2.831	—	—	2	1.679	—	—	2	1.202
3	2.741	—	—	3	1.664	3	1.665	2	1.188
—	—	4	2.51	2	1.645	2	1.639	3	1.178
5	2.379	4	2.36	3	1.625	—	—	2	1.165
6	2.299	8	2.28	2	1.612	—	—	—	—
4	2.257	3	2.24	2	1.596	1	1.593	—	—
3	2.215	—	—	2	1.578	2	1.580	—	—
3	2.192	1	2.20	3	1.555	3	1.535	—	—
4	2.162	7	2.15	—	—	1	1.506	—	—
7	2.095	2	2.10	—	—	3	1.486	—	—
4	2.075	—	—	2	1.453	4	1.456	—	—
5	2.058	6	2.06	2	1.448	—	—	—	—
2	2.055	—	—	2	1.437	4	1.433	—	—
4	1.982	2	2.00	1	1.424	—	—	—	—
—	—	—	—	3	1.413	3	1.390	—	—

Survey conditions: tikhonenkovite (Karasug) $\lambda\text{Cr-K}\alpha$, $2R = 114$ mm; gearsutite (Baynazar, central Kazakhstan) $\lambda\text{Fe-K}\alpha$, $2R = 90.7$ mm.

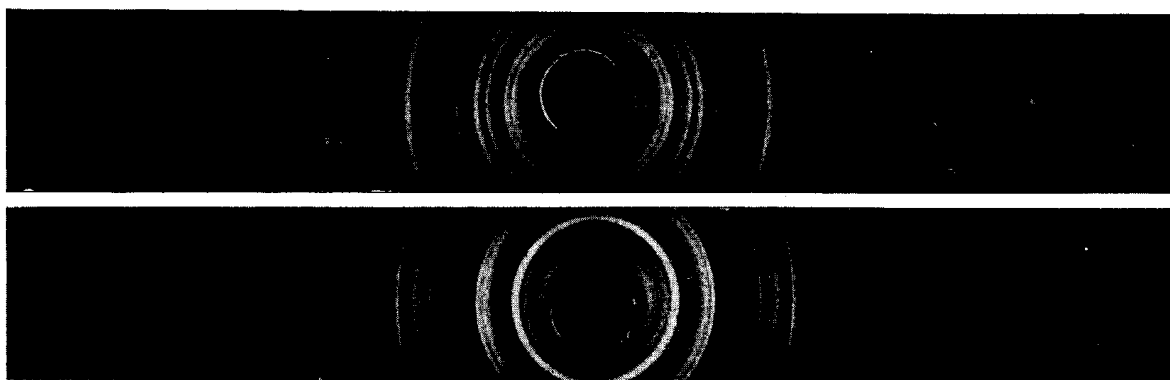


Fig. 3. X-ray powder patterns of tikhonenkovite (top) and gearsutite (bottom). Survey conditions: λCu , Ni filter.

$\text{CaAlF}_4(\text{OH}) \cdot \text{H}_2\text{O}$, which has a similar chemical formula (Fig. 3).

The facts presented show that tikhonenkovite differs from other minerals and can be justifiably considered a new mineral species.

In conclusion, the authors would like to thank V. G. Feklichev and Ye. G. Proshchenko for their substantial assistance in the data processing.

The specimens studied have been sent to the Mineralogical Museum, Academy of Sciences of the USSR; the Mineralogical Museum, Moscow Geological Survey Institute; and the Museum of

the Mineralogy and Geochemistry of Rare Elements, Institute of the Mineralogy, Geochemistry and Crystal Chemistry of Rare Elements.

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