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MINERALOGY

FERSMITE, A NEW CALCIUM NIOBATE FROM THE PEGMATITES OF THE VISHNEVYE MTS., THE CENTRAL URALS

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In the northern part of the Vishnevye Mts., in the region of Lake Buldym, two pegmatite veins of the syenite type have been found to contain large quantities of a black calcium niobate of orthorhombic syngony, which is a new mineral. We suggest for it the name of «fersmite»* in honour of the best authority on pegmatites and their rare-earth minerals, A. E. Fersman.

One of the two fersmite veins has been opened up only by some test ditches, while the second (No. 37A) has been opened along the strike over a large distance. The vein has a variable thickness: at places it becomes narrow, pinches out, then reappears, sometimes branching, and sometimes forming swells up to 1.5—2 m. Its contact with the underlying hornblende syenites is a sharp one; in the hanging wall an alternation of light-coloured quartz syenites with biotite-quartz syenites is observed, as well as the presence of thin quartz veins stretching in a direction parallel to the general, strongly pronounced bedding of the rocks.

The light-reddish rock of the fersmite veins is composed of feldspars, microcline and plagioclase (No. 18). The latter surrounds as a fine-grained mass the larger grains of microcline. Fersmite usually forms segregations with irregular outlines, up to 1—1.5 cm; it is confined to oligoclase and always contains numerous ingrowths of the latter. Sometimes individual grains of fersmite are disseminated through the feldspar-rock. Occasionally it forms fine-grained accumulations and is associated with another black niobate. Accumulations of biotite are of common occurrence. The vein carries a small amount of pyrochlore; alkali hornblende, apatite, sphene, quartz are of some significance; accessories are pyrite (to a considerable extent replaced by limonite), magnetite, muscovite and small crystals of zircon and xenotime; under the microscope, orthite was observed.

Crystals of fersmite are very rare. A measurement of some small crystals with a two-circle goniometer showed it to belong to the orthorhombic syngony. The crystals are imperfect, the measurements could not be made with necessary precision, and the axial ratio as estimated can be considered only as an approximate one. For a face p (111) $\varphi=69°19'$, $\rho=45°13'$, whence $a:b:c=0.377:1:0.356$. Considering the inaccuracy of the

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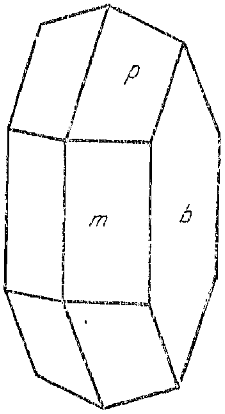
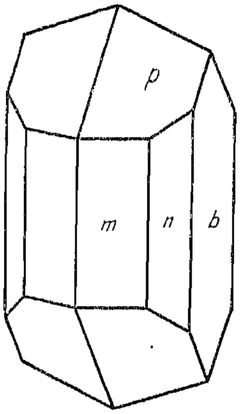
* The name of «fersmanite» has been given by A. N. Labuntzov to a niobo-titano-silicate of sodium and calcium from the Khibiny tundras.

measurements, this ratio approaches that given by Brögger (¹) for euxenite-polycrases 0.379 : 1 : 0.353, and also that of the axial ratio of columbites 0.4023 : 1: 0.3580 (²).

The fersmite crystals are somewhat stretched along the vertical axis. The main forms are *b* (010), *m* (110) and *p* (111); *n* (130) is rather common;





in addition *r* (131) and *k* (021) have been observed (see figure).

Fersmite is black-coloured, with a characteristic resinous lustre and an uneven to subconchoidal fracture. Cleavage absent. In thin-sections, brownish-black; powder, greyish-brown. Hardness, 4.5. Specific gravity, 4.69. In the sections slightly transparent. Translucent areas, dark reddish-brown. The mineral is always distinctly anisotropic; birefringence, medium; biaxial, with a large 2 *V*; probably, positive. Refractive index, about 2. In polished sections in reflected light, grey, like ilmenite, strongly anisotropic. Not luminescent either in cathode or ultra-violet rays. When recalculated to an equivalent of U_3O_8 its radioactivity is 0.845 per cent.

Fersmite decrepitates before the blow-pipe. Upon ignition it becomes brown, translucent, assuming a vitreous lustre. The specific gravity of the ignited mineral is higher than that of the natural mineral. Sparingly attacked with H_2SO_4. A sample of the mineral (0.3—0.4 g) was treated with hydrofluoric and sulphuric acid. The mass decomposed was evaporated to dryness and fused with potassium pyrosulphate; the melt was dissolved in oxalic acid. The precipitate was found to contain rare earths, thorium and partly calcium; the solution, Nb, Ta, Ti, Fe, Al, Ca and Mg.

The next day the rare-earths precipitate was filtered off, burnt and ignited to the oxides. The ignited oxides of the rare earths were dissolved in $HNO_3 + H_2O_2$ and then precipitated by ammonia as hydrates to be purified from calcium. The hydrate precipitate was retreated with oxalic acid to purify the rare earths from iron, aluminium, niobium and titanium. The precipitate of rare-earths oxalates was filtered off, burnt and ultimately ignited to the oxides.

The combined filtrates from the rare earths were neutralized with ammonia until calcium oxalate was precipitated; the latter was filtered off, burnt and ignited to the oxide. By a further addition of ammonia, sesquioxides were separated from the filtrate. The precipitate of the latter (Nb, Ti, Fe, Al) was burnt, ignited, weighed and fused with $K_2S_2O_7$. The melt was dissolved in tartaric acid, the iron separated out with ammonium sulphide, and Nb, Ta and Ti were precipitated with cupferron upon acidulating the filtrate (with HCl or H_2SO_4). Aluminium was determined in the filtrate from the cupferron precipitate after the destruction of the organic matter. The earth-acids were separated from titanium with tannin in a hydrochloric acid solution (³).

F and SiO_2 in fersmite were determined by the method of Berzelius; alkalies, by Smith's method; water, in the Penfield tube. Magnesium was determined as the pyrosulphate in an oxalic acid filtrate after the separation of the sesquioxides with ammonia.

In this way was made a complete chemical analysis of a sample of fersmite carefully sorted out from the main fersmite-vein (37 A, analysis I). For the sake of comparison some determinations were made for fersmite from the neighbouring vein 37B (analysis II). The composition of the minerals is given in the table.

	I	II	Recalculation of analysis I		
	Vein 37A	Vein 37B	Molecular quantity	Atomic quantity	
SiO_2	0.715	—	0.012	Si . . 12	
Nb_2O_5	70.12	71.51	0.264	Nb . . 528	
Ta_2O_5	traces		—	—	
TiO_2	3.21	2.94	0.040	Ti . . 40	628:2 = 314
Fe_2O_3	1.71	1.25	0.011	Fe··· . 22	
Al_2O_3	1.28		0.013	Al . . 26	
TR_2O_3 . . .	4.79*	3.98	0.016*	Th . . 2	
$+ ThO_2$ . . .				Y . . 4	
CaO	14.49	15.53	0.259	Ce . . 24	
MgO	0.98	0.97	0.024	Ca . . 259	334
MnO	0.48		0.007	Mg . . 24	
Na_2O	0.46		0.007	Mn . . 7	
H_2O	0.72		0.040	Na . . 14	
F_2	1.87		0.098	OH . . 80	
				F . . 98	2015:6 = 336
				O . . 1837	
Total	100.86				
$O = F_2$	0.79				
	100.07				
Spec. gravity . . .	4.69				

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* According to the approximate X-ray-chemical data of I. B. Borovsky this precipitate consists of 80 per cent rare earths of the cerium group, 40 per cent of the yttrium group, and 10 per cent of thorium.

A qualitative X-ray-chemical study of the material of analysis I, made by I. B. Borovsky, showed the content of Ta to be about 0.4 per cent; Nb, over 30; Th~0.6; Al~0.1; Y~0.6; Mn~0.8; Fe~3; La~0.8; Ce~1.0; Pr~0.2; Nd~0.4 per cent.

The formula calculated from analysis I is (Ca, Ce, Na) (Nb, Ti, Fe, Al)$_2$ (O, OH, F)$_6$, in which 80 per cent is made up by $CaNb_2O_6$. This formula is analogous to those of columbites-tantalites YZ_2O_6 and of euxenite-polycrases XZ_2O_6 after Machatschki (4), where X =Ce, Y, U, Th, Ca, Na, &c.; Y =Fe, Mn, Mg; Z =Nb, Ta,Ti, Fe···, Al.

Euxenites and polycrases, however, along with Nb_2O_5, show a considerable content of TiO_2 (20—30 per cent); among the cations of great significance are rare earths (16—30 per cent) and uranium (6—14 per cent), while calcium is contained in an insignificant amount. From its niobium content fersmite approaches columbite, but is sharply distinguished from the latter by the nature of the cations. Fersmite should therefore be considered a representative of a new calcium-niobium series among the orthorhombic niobates of the formula AB_2O_6.

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