Aminoffite, a new mineral from Långban.

By

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Abstract

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Aminoffite, named in honor of Dr. G. AMINOFF, is found at Långban in veins cutting magnetite and limonite. It is tetragonal; a : c = 1 : : 0.7116. The crystals are clear and colorless with {111} and {001} the only forms. Imperfect (001) cleavage is present. H = 5.5. G = 2.94. Uniaxial negative $\omega = 1.647$, $\varepsilon = 1.637$. Dimensions of the unit cell: $a_0 = 13.8$Å, $c_0 = 9.8$Å, Space group: $I4/mmm$. Chemical analysis and unit cell determitation yield the composition

$$Ca_{24}Be_9Al_3Si_{24}O_{84}(OH)_3 \cdot 12H_2O.$$

Introduction: During an examination of the Långban specimens in the Harvard Mineralogical Museum in 1933, Dr. DAVID MODELL found what he thought to be a new species in FLINK'S undetermined mineral No. 494. He was unable to pursue the study, and it was not until recently that further work showed it to be, indeed, a distinct and new species. The writer takes great pleasure in naming this mineral aminoffite in honor of Dr. G. AMINOFF, who has added so greatly to our knowledge of the mineralogy of Långban.

Aminoffite is found in small (0.5—1.0 mm) well-formed crystals in veins and cavities in massive magnetite and limonite. It is one of a number of minerals coating the veins, chief of which is calcite. The calcite is of unusual habit, occurring in short prisms flattened parallel to the base. Fluorite and barite are also present in small amounts.

Morphology: Aminoffite is tetragonal. The crystals are extremely simple in habit with only two forms, the first-order pyramid p{111} and the base c{001} as shown in Figure 1. Each pyramid face on the larger crystals is made up of several vicinal faces differing in position from one another by a few minutes of arc. Because of the multiple reflections, it is impossible to make accurate goniometric measurements on them. Measurements of the pyramid faces on the smaller crystals, although not entirely satisfactory, are more consistent,

and were thus used in calculation of the axial ratio. Measurement of five crystals gave a mean value of p(111) : c(001) = 45° 11′. Using this value the axial ratio is a : c = 1 : 0.7116.

Physical and Optical Properties: Aminoffite is clear and colorless with a vitreous luster. A poor cleavage is present parallel to the base, but the mineral is brittle and breaks usually with a conchoidal fracture. The hardness is 5.5. The specific gravity determined by suspension in methylene iodide is 2.94.

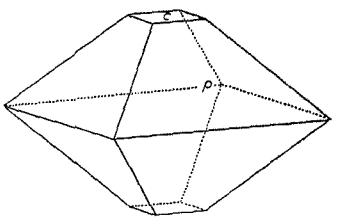

Fig. 1. Aminoffite.

When observed in polarized light, aminoffite gives a sharp extinction if cut parallel to the c[001] axis, but if cut parallel to the base (001) a wavy extinction is frequently observed. On those grains where extinction is not sharp, anomalous biaxial characteristics are shown with an axial angle varying from 0° to 15°. The optical elements of aminoffite are:

$$\left.\begin{matrix} \text{n(Na)} \\ \omega = 1.647 \\ \varepsilon = 1.637 \end{matrix}\right\} \pm 0.002 \text{ Uniaxial negative.}$$

X-Ray Measurements: A rotation photograph and Weissenberg photographs of the zero and first layer lines were taken of aminoffite with c[001] the axis of rotation. In order to obtain a more accurate measurement of the c[001] axis a Weissenberg photograph of the zero layer line was taken with a[100] as rotation axis. Measurements of these photographs give the dimensions of the unit cell as:

$$a = 13.8 \pm 0.02\text{Å}, \quad c = 9.8 \pm 0.05\text{Å}$$

Thus a ratio of a : c = 1 : 0.710 is obtained that is in good agreement with the morphological ratio, a : c = 1 : 0.712. The volume of the unit cell is 1866 cubic Å, the density 2.94, and hence the molecular weight of the unit cell M = 3325.

A study of the Weissenberg photographs revealed certain systematic omissions which lead to the space group — D_{4h}^{17} — $14/mmm$ from the space group criteria:

h + h + l	even, all present
h0l	all present
00l	present if l even
h00	present if h even
hh0	present when h + h even.

Composition: Aminoffite is infusible and insoluble in acids, and its refractory nature led to considerable analytical difficulties. The normal procedure was followed by the analyst, Mr. F. A. GONYER, for insoluble compounds. However, after the evaporation of silica with hydrofluoric acid, a residue was left that contained none of the elements normally expected. To determine the nature of this residue, Dr. G. A. HARCOURT made a spectroscopic analysis which showed the presence of beryllium. It was assumed, therefore, that the sodium carbonate fusion had not completely decomposed the mineral. A new analysis was undertaken, using 0.2386 gms. and the fusion carried out with potassium nitrate as well as sodium carbonate yielding the results given below.

Analysis of Aminoffite and Content of the Unit Cell.

	Per Cent[1]	Analysis reduced to 100 per cent	Molecular ratio		Atoms per unit cell
SiO_2	42.49	42.35	0.7058	Si	23.5
Al_2O_3	4.41	4.40	0.0432	Al	2.9
BeO	6.20	6.18	0.2480	Be	8.3
Fe_2O_3	0.31	0.31	0.0019	Fe	0.1
MnO	0.19	0.19	0.0027	Mn	0.1
CaO	40.27	40.14	0.7204	Ca	24.0
H_2O	6.45	6.43	0.3572	H	23.8
	100.33	100.00		O	95.8

If it is assumed from the above figures that the atoms per unit cell are Si = 24, Be + Al = 12, Ca = 24, H = 24, and Fe and Mn are neglected as impurities, the content of the unit cell can be written as $12[Ca_2(Be, Al_x)Si_2O_7(OH)_x \cdot H_2O]$, with $x = \frac{1}{4}$.

Aminoffite falls in the melilite group and is similar in many respects to meliphanite. A comparison of the two minerals brings out the relationship.

	Meliphanite.	Aminoffite.
Chemical formula	$(Ca, Na)_2Be(SiAl)_2(O, F)_7$	$Ca_2(Be, Al_x)Si_2O_7(OH)_x \cdot H_2O$
Crystal system	Tetragonal	Tetragonal
Cleavage	(001)	(001)
Axial ratio	a : c = 1 : 0.6584	a : c = 1 : 0.7116
Optical character	Negative	Negative
Index of refraction	$\omega = 1.612$	$\omega = 1.647$
Specific gravity	3.0	2.94

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[1] Analysis by F. A. GONYER.