CONTRIBUTIONS TO THE MINERALOGY OF NORWAY

No. 25. Pyrophanite in the Southern Part of the Oslo Area

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To Professor Ivar Oftedal with kindest regards and congratulations on the occasion of his 70th birthday.

Introduction

Routine *X*-ray powder examination of unidentified material in the collections of Mineralogisk-Geologisk Museum in Oslo proved the existence of pyrophanite in specimens from the nepheline syenite pegmatites in the Langesund-fiord area. Pyrophanite can therefore be added to the long list of minerals from those famous deposits. (BRØGGER 1890 and NEUMANN 1960).

One of the old specimens concerned was found by W. C. Brøgger in 1889 in the island of Stokø, and labelled by him as "Unidentified mineral (polymignyte?)". Another specimen, which was found in Stoksund, was bought from the collector Ole Amundsen in 1915 and labelled "Melanocerite??". The pyrophanite content of this specimen was sufficient to give ample material for a chemical analysis.

In 1959 and 1960 we also found pyrophanite in the islands of Øvre Arø and Låven in the Langesund-fiord area, and later also in the acid facies of nordmarkite pulaskite rocks as well as in quartz bearing pegmatite veins in these rocks at Andersbotn between Kodal and Lågendalen in the county of Vestfold. OFTEDAL and SÆBØ (1963) observed pyrophanite as "fairly abundant" in a nepheline syenite pegmatite about 7 kilometers North of Bommestad Bridge near the city of Larvik, and we can add that there are several related occurrences around Lysebø East of the Farris Lake.

Pyrophanite, therefore, appears to be a fairly common and widespread[1] mineral occurring in rather varied geological settings at least within this part of the Oslo area.

Chemical composition.

Pyrophanite from Stoksund, Langesund-fiord was crushed to — 90 mesh. Impurities were removed with a Frantz isodynamic separator and by treatment in heavy liquids. It was analyzed by B. Bruun with the following results (Table 1).

Table 1.

	Weight per cent.		Mol per cent.
TiO_2	51.75	$MnTiO_3$	74.51
MnO	35.09	$FeTiO_3$	23.08
FeO[2]	13.23	Fe_2O_3	2.41
	100.07		100.00

An optical spectrogram kindly taken by Professor I. Oftedal showed traces of Al, Si, Ca, Mg, and V.

A semi-quantitative *X*-ray fluorescence analysis of pyrophanite from Stokø, performed by Bergstøl, gave the following results (Table 2).

Table 2.

	Weight per cent.		Mol per cent.
TiO_2	51.50	$MnTiO_3$	86.25
MnO	41.00	$FeTiO_3$	10.01
FeO	6.60	Fe_2O_3	3.74
	99.10		100.00

It would appear that the Stokø pyrophanite is closer in chemical composition to the pure Mn end member than is the Stoksund pyrophanite, which is also confirmed by measurements of unit cell sizes (see later).

[1] LEE (1955) has pointed out that pyrophanite is much more widespread in Japanese manganese ores than was anticipated.

[2] Total iron calculated as FeO is 13.23 per cent. Direct determination of FeO gives 10.10 per cent. FeO and, consequently, 3.47 per cent. Fe_2O_3. Because of the presence of great quantities of Mn in the sample these figures must be treated with caution. They may indicate a secondary oxidation of either Mn or Fe or both.

Physical properties.

Crystals have a platy habit with a thickness of 0.5—10 millimeters, the largest crystal obtains a length of 5 centimeters. The colour is black while thin plates and powders are dark red-brown. Under the microscope the mineral is very nearly opaque.

Measured specific gravity of the analyzed sample is 4.68, while a calculation from the chemical analysis and cell size data of this paper gives 4.66.

Cell sizes were measured with a Guinier focusing camera, 22.92 centimeters effective diameter, Fe radiation, and Mn filter, with the following result (Table 3):

Table 3.

		a_0	c_0
Stoksund	measured	5.127 ± 0.007 Å	14.24 ± 0.03 Å
	calculated[3]	5.136 Å	14.308 Å
Stokö	measured	5.131 ± 0.007 Å	14.29 ± 0.03 Å
	calculated[3]	5.140 Å	14.337 Å

The measured cell sizes are systematically smaller than the calculated ones, but available data are too scanty for a discussion of variation in unit cell constants as a function of chemical composition in the mixed crystal series concerned.

Cell sizes were not measured for pyrophanites that have not been analyzed. *X*-ray patterns of Arø and Kodal material are very nearly identical in spacings with the pattern of the analyzed Stoksund pyrophanite, and the pattern of the Låven material is similar to that of the pyrophanite from Stokø. In all probability the pyrophanites from Arø and Kodal have about the same chemical composition as the analyzed pyrophanite from Stoksund, and pyrophanites from Låven is also approximately identical to that of Stokø.

[3] Calculated from the dimensions of the end members as given by Barth and Posnjak (1934) ($MnTiO_3$ $a_0 = 5.14$ *kX*, $c_0 = 14.36$ *kX*; $FeTiO_3$ $a_0 = 5.09$ *kX*, $c_0 = 14.07$ *kX*; Fe_2O_3 $a_0 = 5.04$ *kX*, $c_0 = 13.77$ *kX*) under the assumption of the formation of mixed crystals exhibiting a linear relationship between composition (as given in Tables 1 and 2) and the lengths of the edges of the unit cells.

Mode of occurrence.

All Norwegian localities for pyrophanite known so far are in the permian igneous rocks of the Oslo area, and either in: 1) nepheline syenite pegmatite dykes, or in: 2) acid facies of nordmarkite-pulaskites and their quartz bearing pegmatites.

In all the specimens from the nepheline syenite pegmatite dykes of the Langesund-fiord area pyrophanite is found together with feldspar, nepheline, aegirite, lepidomelane and leucophane, and on the island of Låven the mineral is surrounded by catapleiite, thomsonite, gonnardite, and small needles of rosenbuschite. Amongst the numerous minerals reported from the Langesund-fiord dykes (BRØGGER 1890 and NEUMANN 1960) only helvite and pyrophanite carry manganese as a major component.

In the nordmarkite-pulaskites and their pegmatites the mineral association is feldspar, quartz, amphibole, pyroxene, sphene, and magnetite. Only a limited area has been searched for pyrophanite, but in this area the mineral appears to be rather widespread especially near the boundary to larvikite. It is of interest in this connection to draw attention to an analysis of the border facies of nordmarkite pulaskite from Tuft in Lågendalen, published by W. C. BRØGGER (1933) who reports an unusually high manganese content of 0.80 per cent. MnO.

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