CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

OTTAWA

MINES BRANCH INVESTIGATION REPORT IR 63-34

A MINERALOGICAL INVESTIGATION OF PEGMATITE SAMPLES FROM STEELE TOWNSHIP, ONTARIO, SUBMITTED BY CANADIAN JOHNS-MANVILLE COMPANY, LIMITED

by

E. H. NICKEL

MINERAL SCIENCES DIVISION

COPY NO. 22

MARCH 8, 1963

Mines Branch Investigation Report IR 63-34

A MINERALOGICAL INVESTIGATION OF PEGMATITE SAMPLES FROM STEELE TOWNSHIP, ONTARIO, SUBMITTED BY CANADIAN JOHNS-MANVILLE COMPANY, LIMITED

by

E.H. Nickel*

- - -

SUMMARY OF RESULTS

Three samples of pegmatitic rock from Steele Township, Ontario, submitted by the Canadian Johns-Manville Company, Limited, have been subjected to a mineralogical examination and to selected chemical analyses. All three samples consist of fine-grained aplite and coarse-grained pegmatite in varying proportions. Sample No. 1 contains 0.37% BeO and 0.48% Li_2O; it consists of a relatively high proportion of aplite, and contains an appreciable amount of beryl, but little spodumene. Sample No. 2 contains 0.07% BeO, 1.14% Li_2O and 5.79% Cs_2O, and is characterized by appreciable amounts of pollucite and spodumene. Sample No. 3 contains 0.19% BeO and 2.41% Li_2O, and is characterized by relatively high proportions of spodumene and microcline.

Brief descriptions are given of the minerals and their occurrences.

---

* Senior Scientific Officer, Mineral Sciences Division, Mines Branch, Department of Mines and Technical Surveys, Ottawa, Canada.

INTRODUCTION

On November 20, 1962, a shipment of 171 pounds of rock samples was received from the Canadian Johns-Manville Company, Limited. In a covering letter dated November 7, 1962, Mr. F.J. Evelegh, Senior Geologist, stated that these samples had been blasted from a sizeable showing on claims held by his company in Steele Township, in the Larder Lake Mining Division of Ontario. He requested that the samples be tested for beryllium and lithium to assist the company in determining whether or not the occurrence was of economic importance and warranted further work.

The samples were received in three large jute bags, labelled 1, 2, and 3. A preliminary examination revealed that, in addition to beryllium and lithium minerals, the samples contained some other minerals that might have a bearing on the economic assessment of the rock. For this reason, the investigation was carried somewhat beyond the original request, which dealt only with beryllium and lithium tests.

PROCEDURE

Sample Preparation

The samples consisted mostly of large rock fragments, some of which weighed over 5 lb. To ensure representative sampling while still retaining fairly large pieces for mineralogical work, each of the large fragments was broken into two pieces of approximately equal size, with one portion being reserved for mineralogical examination and the other being crushed for chemical and spectrographic analyses and for heavy-liquid separations.

Mineralogical Procedure

The large fragments were first carefully examined under a stereomicroscope to observe the mineralogical relationships. Samples of the crushed portions were subjected to a series of heavy-liquid separations using liquids with densities ranging from 2.96 to 3.70. The minerals in the heavy-liquid separates and in the large uncrushed fragments were then identified by X-ray powder diffraction analysis and by investigating their optical properties in oil immersion mounts under the petrographic microscope.

RESULTS OF INVESTIGATION

Chemical and Spectrographic Analyses

The results of semi-quantitative spectrographic analyses are shown in Table 1. The results of chemical analyses for BeO and alkalis are shown in Table 2.

TABLE 1

Semi-Quantitative Spectrographic Analyses

Sample No.	1	2	3
Si	PC	PC	PC
Al	PC	11	PC
Na	6	6	3
Li	0.5	1	4
Fe	0.3	0.5	0.5
Ca	0.3	0.09	0.06
Mn	0.08	0.09	0.09
Mg	0.08	0.05	0.05
Ta	0.08	0.5	Tr (?)
Nb	0.04	0.006	Tr
Be	0.01	0.006	0.01
Ti	0.02	0.005	0.004
Sn	0.002	0.003	0.003
Ga	0.007	0.01	0.01
Mo	0.006	0.01	0.009
Cu	0.003	0.003	0.008

PC = Principal constituent.

Numerical values indicate order of magnitude in per cent.

Analyst: Miss E.M. Kranck, Analytical Chemistry Subdivision.

TABLE 2

Chemical Analyses

Sample No.	1	2	3
BeO	0.37%	0.07%	0.19%
Li_2O	0.48	1.14	2.41
Na_2O	7.23	2.98	2.35
K_2O	1.03	1.43	2.58
Cs_2O	0.09	5.79	0.09
Rb_2O	0.09	0.16	0.21

Analysts: Mrs. D.J. Reed, Miss E.M. Penner, and J. Hole, Analytical Chemistry Subdivision.

In general, the composition indicated by the analyses are what would be expected of an alkali pegmatite. Several comments should be made on the spectrographic analyses, however. The iron content reported is, in all likelihood, due to contamination by metal during crushing and pulverizing, since a subsequent analysis revealed the presence of appreciable amounts of metallic iron. The semi-quantitative values for beryllium are much too low in comparison with the chemical values; the latter, of course, are to be regarded as the more reliable. It is also doubtful if the difference between the Ta and Nb shown for sample No. 2 is as great as indicated spectrographically.

The chemical analyses point up appreciable differences between the samples: The BeO and Na_2O contents are highest in sample No. 1; the Cs_2O content is highest in sample No. 2; and the Li_2O, K_2O and Rb_2O contents are highest in sample No. 3.

Mineralogical Characteristics of the Individual Samples

Since each of the samples has mineralogical characteristics that distinguish it from the others, the samples will be described individually here. The appearance, occurrence and other features of the minerals, themselves, are given in the subsequent section.

Sample No. 1

All of the samples contain both a coarse-grained pegmatitic mineral assemblage and fine-grained aplite. Sample No. 1, however, contains a much higher proportion of aplite than the other samples. A visual appraisal of this sample suggests that aplite may constitute as much as fifty per cent of the rock. The aplite is composed almost entirely of albite, which accounts for the relatively high sodium content of the sample.

Sample No. 1 is the only sample in which beryl was recognized. Beryl occurs primarily in the aplitic phase and, hence, it is to be expected that the beryllium content of this sample is higher than that of the other samples.

Spodumene occurs in only relatively small amounts; as a result, this sample has a lower Li_2O content than the other samples.

In addition to the minerals noted above, this sample also contains abundant quartz, appreciable amounts of muscovite and microcline, and minor amounts of apatite, garnet, and columbite-tantalite.

Sample No. 2

Sample No. 2 consists largely of coarse pegmatitic minerals, with only a minor amount of aplite. The principal minerals are quartz, spodumene and albite, but appreciable amounts of pollucite, microcline and muscovite are also present.

This is the only sample in which pollucite was detected, which accounts for the relatively high caesium content. No beryl or other beryllium minerals could be found, either in the hand samples or in the heavy liquid separates.

Accessory minerals include garnet, columbite-tantalite, pyrochlore-microlite, and zircon.

Sample No. 3

This sample also consists largely of pegmatitic minerals, with only a minor amount of aplite. The principal minerals are spodumene, quartz, microcline and albite. Both spodumene and microcline are more abundant in this sample than in the others, which explains the relatively high Li_2O and K_2O contents.

No beryl or other beryllium minerals could be found in the sample; this is rather surprising in view of the 0.19% BeO reported in the chemical analysis, and no adequate explanation can be offered for this discrepancy.

Accessory minerals include garnet, columbite-tantalite, pyrochlore-microlite, as well as a few grains of sphalerite.

Description of Minerals

Feldspar

Two varieties of feldspar are present--albite and microcline. Albite, the predominating feldspar, occurs in aplite and as cleavelandite. In the aplite, the albite consists of small equant to tabular grains, generally less than 1 millimetre in diameter, resulting in the aplitic phase having a granular, rather sugary texture. The cleavelandite occurs in its typical form of coarse-grained lamellar masses.

The microcline occurs as large block-like crystals up to several centimetres in diameter.

Both varieties of feldspar are white in colour, but can be distinguished in hand samples by their different modes of occurrence.

Quartz

This mineral occurs as single grains or as irregular masses, and is generally quite coarse-grained. In hand samples, it is transparent, has a vitreous luster, and is rather light grey in contrast to the white feldspar.

Spodumene

Spodumene occurs as elongated crystals up to several inches in length. The colour varies from pale green on fresh surfaces to creamy or tan on weathered surfaces. Some of the spodumene appears to be preferentially coated by a dark film varying in colour from steel-grey to brown, and probably composed largely of hydrated iron oxides. The spodumene can be distinguished from the other minerals by its crystal form, its pronounced prismatic cleavage, and its colour.

Muscovite

The muscovite varies from small thin flakes to larger flakes and "books" up to approximately an inch in diameter. Some flakes are practically colourless; others vary from light brown to yellowish-green. The refractive indices and optic angle correspond to those of normal muscovite, although the mineral may be expected to contain some lithium, as is commonly the case with micas from lithium-rich environments.

Beryl

Beryl was found only in sample No. 1, and predominantly in the aplitic portions of the rock. It occurs as individual crystals from about 1 mm to 1 cm in diameter. It is transparent, light green in colour, and has a vitreous luster. Broken surfaces exhibit conchoidal fracturing with no perceptible cleavage.

Pollucite

Pollucite, a caesium-sodium-aluminum silicate, was found only in sample No. 2. It occurs in the coarse pegmatitic portion as irregular masses interstitial to the other minerals. It is milky-white in colour, and is extensively fractured. It is distinguished from feldspar by the absence of cleavage, and from quartz by its milky appearance. The pollucite has a refractive index of 1.525, which corresponds to a composition of approximately 80 mole per cent of the $CsAlSi_2O_8$, and 20 mole per cent of the analcite end-member.

Garnet

The garnet occurs primarily as tiny euhedral orange crystals in the aplite, and to a minor extent as larger crystals in the pegmatitic phase. The refractive index of the garnet is 1.81, and the unit-cell parameter (determined by calculation from its X-ray powder diffraction pattern) is 11.59. These properties indicate a composition close to either spessarite or almandine.

Apatite

A small amount of apatite was found in sample No. 1. It occurs as small individual crystals in the aplite. It is transparent, has a vitreous luster and is bluish-green in colour.

Columbite-Tantalite

This mineral is present in both the aplite and pegmatitic phases. It is black in colour, and occurs as tiny individual crystals with tabular and prismatic shapes. It is not known whether the mineral is closer to columbite or to tantalite in composition, but columbite-tantalites from alkali pegmatites are generally closer to the tantalite end-member. The spectrographic analysis of sample No. 2 indicates a high Ta:Nb ratio; however, this feature is not indicated in the analyses of samples No. 1 and 3.

Pyrochlore-Microlite

This mineral was found only in very small amounts. It occurs primarily as tiny well-developed octahedral crystals, and varies in colour from light to bright yellow.

Zircon

Only a few grains of zircon were found as tiny chocolate-brown crystals with well-developed faces.

Sphalerite

This mineral occurs in only very minor amounts. It is reddish-brown in colour and occurs as isolated grains in the pegmatitic phase.

CONCLUSIONS

The minerals likely to be of the greatest current interest, at least from an economic standpoint, are beryl and spodumene. In the three samples examined, beryl is most abundant in sample No. 1, and spodumene is most abundant in sample No. 3. Other minerals that may prove to be of some economic interest are feldspar, pollucite, columbite-tantalite and pyrochlore-microlite.

The majority of the minerals are coarse-grained, and there is no reason to suspect that the beneficiation of this material would present any serious problems not encountered in the milling of similar pegmatitic assemblages.

- - - -

EHN:DV