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EUDIDYMITE AND EPIDIDYMITE FROM THE ILÍMAUSSAQ ALKALINE INTRUSION, SOUTH GREENLAND

CONTRIBUTION TO
THE MINERALOGY OF ILÍMAUSSAQ, No. 2

BY

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WITH 7 FIGURES AND 2 TABLES IN THE TEXT
AND 2 PLATES

С РУССКИМ РЕЗЮМЕ

KØBENHAVN
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Abstract

Eudidymite has been discovered as lamellar or spherulitic aggregates in veins of albitite in alkali granite and in poikilitic nepheline-sodalite syenite (naujaite) in the Ilímaussaq alkaline intrusion, South Greenland. In the veins in granite it is associated with microcline, quartz, albite, arfvedsonite, ægirine, polylithionite, narsarsukite, monazite and elpidite. In naujaite eudidymite is associated with albite, microcline, fluorite, analcime, tugtupite, epididymite, genthelvite, neptunite, schizolite, lithium mica, ægirine, katapleiite, etc.

Epididymite occurs as microcrystalline or fine-grained masses associated with analcime, albite, tugtupite, eudidymite leucophane, schizolite, etc. in veins of albitite in naujaite.

The optical properties of the two minerals are: eudidymite: $n\alpha = 1.545$, $n\gamma = 1.549$, $2\ V\gamma = 25°$; epididymite: $n\alpha = 1.540$, $n\gamma = 1.544$, $2\ V\alpha = 16–26°$ with a pronounced crossed axial plane dispersion.

Both minerals are polysynthetically twinned. Chemical analyses of the two minerals are recorded. The X-ray powder diagrams are identical with those of epididymite and eudidymite from Lovozero.

Eudidymite and epididymite were formed during late albitization of naujaite. Their mode of occurrence recalls that of these two minerals at Lovozero, the Kola peninsula.

РЕЗЮМЕ

Эвдидимит и эпидидимит Илимаусака

В щелочном массиве Илимаусак (Ю. Гренландия) обнаружены редкие силикаты бериллия и натрия – эвдидимит и эпидидимит.

Эвдидимит находится в пегматитах и гидротермалитах щелочных арфведсонитовых гранитов и пойкилитовых содалитовых сиенитов. В дериватах гранитов ассоциирует с кварцем, микроклином, монацитом, эльпидитом, нарсарсукитом, пирохлором, в дериватах содалитовых сиенитов – с альбитом, полилитионитом, лейкофаном, гентгельвином, эпидидимитом.

Эпидидимит является более низкотемпературным минералом и обычно встречается в гидротермалитах содалитовых сиенитов. Ассоциирует с анальцимом, натролитом, нептунитом. Часто эпидидимит находится в мучнистых скрытокристаллических выделениях или образует псевдоморфозы по чкаловиту.

Эвдидимит отличается от эпидидимита большей температурой удаления воды, большим 2 V и присутствием бора. Наиболее четко различаются минералы по дебаеграмме.

Приведны результаты химического и термического исследования минералов.

PREFACE

The present paper is based on observations made in the Ilímaussaq alkaline complex in South Greenland in the summer of 1964. Supported by a grant from "Rask-Ørsted Fondet", the Danish international scientific foundation, E. I. SEMENOV and V. I. GERASSIMOVSKY, Moscow, visited the complex together with a field party from Grønlands Geologiske Undersøgelse directed by H. SØRENSEN.

The writers wish to express their warmest thanks to "Rask-Ørsted-Fondet", the Presidium of the Academy of Sciences of the U.S.S.R. and to the director of G.G.U., K. ELLITSGAARD-RASMUSSEN, for kind support and invaluable help.

The laboratory work was carried out at IMGRE, Moscow, and at the Mineralogisk-geologisk Institut, Copenhagen. The writers wish to acknowledge the kind help of M. E. KAZAKOVA, A. DEMIN, H. BOLLINGBERG, O. V. PETERSEN, R. LARSEN and CHR. HALKIER.

C. PULVERTAFT kindly corrected the English of the manuscript.

Moscow, September 1965
IMGRE

Copenhagen, September 1965
Universitetets Mineralogisk-geologiske Institut

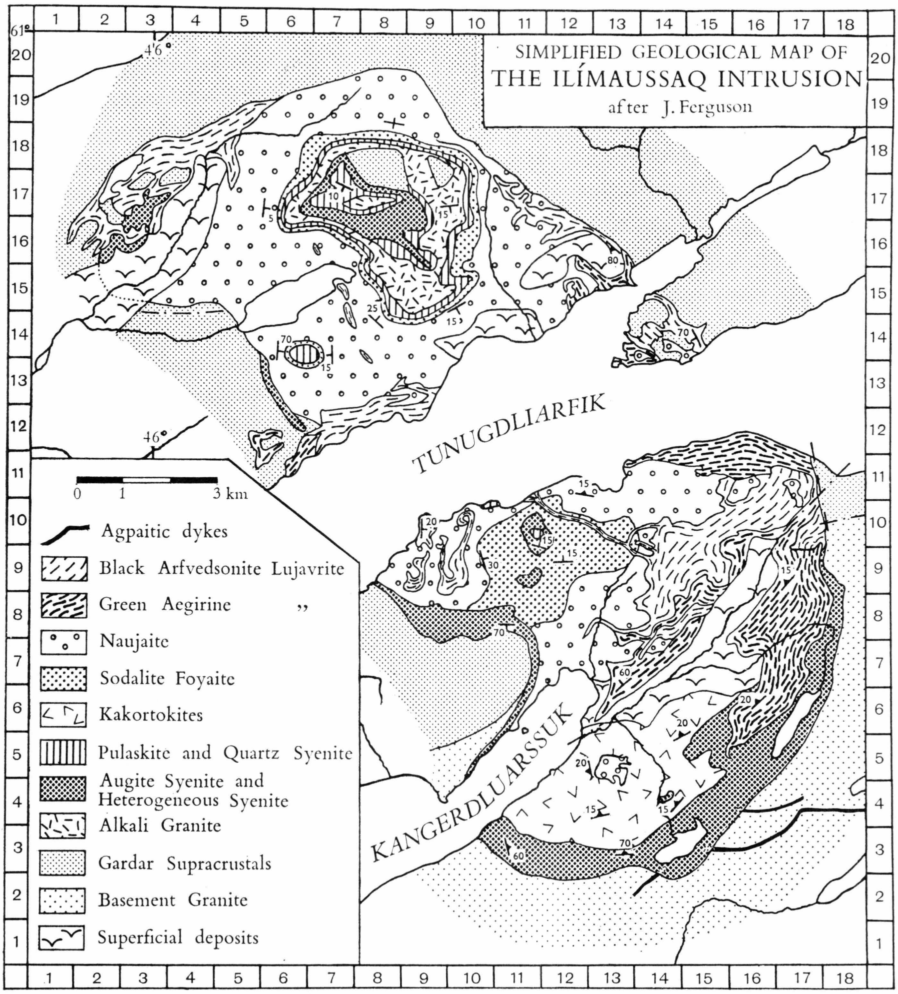

Fig. 1. Simplified geological map of the Ilímaussaq alkaline intrusion after John Ferguson (Medd. om Grønland, 172, 4, 1964).

INTRODUCTION

The two rare beryllium minerals eudidymite and epididymite were found at Narssârssuk in the Igaliko alkaline massif, South Greenland, long ago (FLINK, 1893, 1894, 1901), but were until recently unknown from the adjacent Ilímaussaq alkaline massif.

Epididymite has been found by HAMILTON (1964, p. 68) in thin sections of the alkali granite of Ilímaussaq. In the summer of 1964 E. I. SEMENOV discovered eudidymite and epididymite in thin hydrothermal veins in Ilímaussaq.

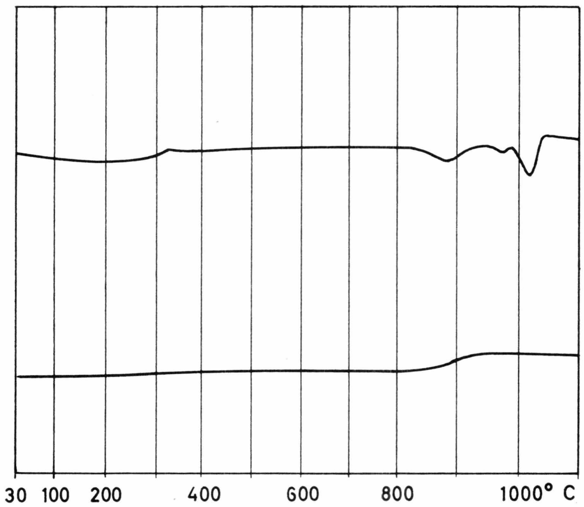

Fig. 2. Differential thermal analysis of eudidymite (upper curve) and thermogravimetric analysis (lower curve). N. S. Gorochova, analyst.

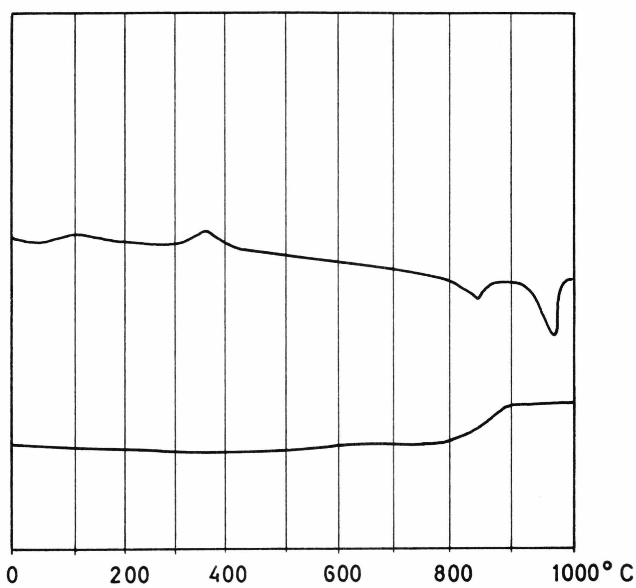

Fig. 3. Differential thermal analysis of epididymite (upper curve) and thermogravimetric analysis (lower curve). N. S. Gorochova, analyst.

MINERALOGY

Eudidymite: eudidymite occurs as lamellar aggregates up to $3 \times 2 \times 1$ cm in size in thin veinlets of albitite. It is semitransparent white or colourless with perfect cleavage. The X-ray powder diagram is identical to those of eudidymite from Langesundsfjord and Lovozero. The specific gravity is 2.56.

In thin section the mineral is colourless, and displays interference colours of the first order grey. There is a pronounced polysynthetic twinning (plate 1, fig. 1) and a distinct cleavage parallel to the composition planes of the twins. The mineral is biaxial positive, the axial-angle is 25°.

$$n\alpha = 1.545 \pm 0.001, \; n\beta = 1.546 \pm 0.001 \text{ and } n\gamma = 1.549 \pm 0.001.$$

The mineral is often dusty.

The D.T.A. diagram (fig. 2) displays endothermal reactions at 880°, 980° and 1020°. The first reaction is accompanied by a loss of weight, probably caused by a release of water.

The chemical analysis of the mineral (undertaken by M. E. Kazakova) is presented in table 1. The chemical data conforms well with the theoretical formula: $NaBeSi_3O_7(OH)$. B, Mn and Mg were determined spectrographically by N. V. Lizunov.

Epididymite: epididymite has been found in an albite-analcime veinlet intersecting naujaite in the lower north-eastern part of the slope of Nákâlâq (sample no. 77383) and on the Taseq plateau (sample no. 77282).

In the first-named locality it forms white earthy microcrystalline masses of irregular shape and up to 2 cm across. The electron micrograph (fig. 4) shows the presence of minute twins and triplets. In thin section the mineral is seen to form sinter aggregates of tiny practically isotropic grains. The average refractive index is about 1.540. The Debye-Scherrer diagram is identical to that of the Lovozero epididymite. The chemical analysis is presented in table 1.

The epididymite from the Taseq plateau occurs as fine-grained white masses in thin veins of albite which also contain eudidymite. In

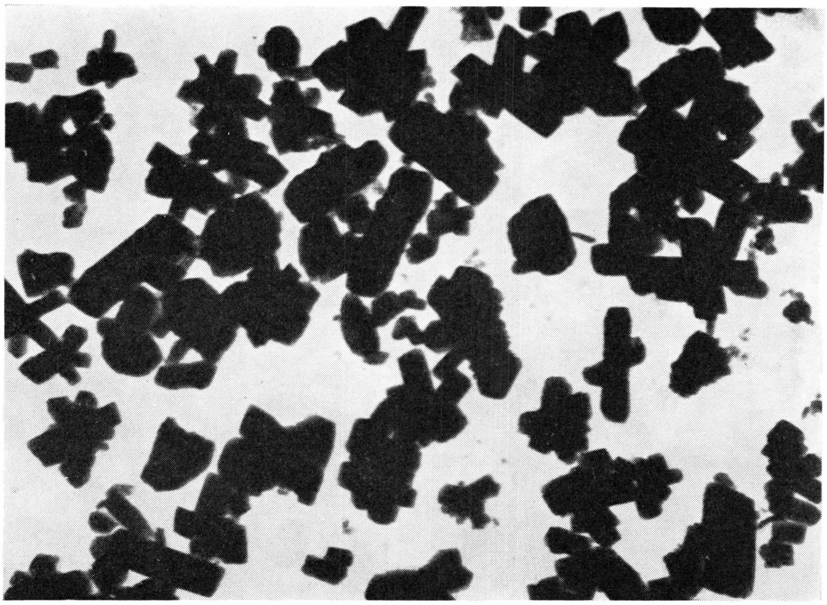

Fig. 4. Electron micrograph of epididymite. × 1500. (Analyst: I. D. BELYAEVA).

thin section the mineral is seen to form aggregates of small blades with an average length of 0.1 mm. The lath-shaped grains are intergrown in an irregular way. They have a few twin lamellae parallel to their elongation (plate 1, fig. 2) and the interference colours display an anomalous blue shade.

The principal indices of refraction were determined on a powder preparation (150–200 mesh) by means of the λ-T variation method

Table 1.
Chemical composition of eudidymite and epididymite from Ilímaussaq.

	Eudidymite Taseq	Epididymite Nákâlâq
SiO_2	72.53	72.73
Fe_2O_3	0.16	0.42
Al_2O_3	0.65	0.82
BeO	10.39	10.70
CaO	0.60	1.15
Na_2O	11.91	10.53
K_2O	0.20	–
H_2O	4.11	4.62
Total	100.55	100.97
Analyst	M. E. KAZAKOVA	

with optical glass as internal standard (MICHEELSEN, 1957). The principal indices of refraction for $\lambda = 589\ m\mu$ are:

$$n\alpha = 1.540 \pm 0.001$$
$$n\beta = 1.544 \pm 0.001$$
$$n\gamma = 1.544 \pm 0.001$$

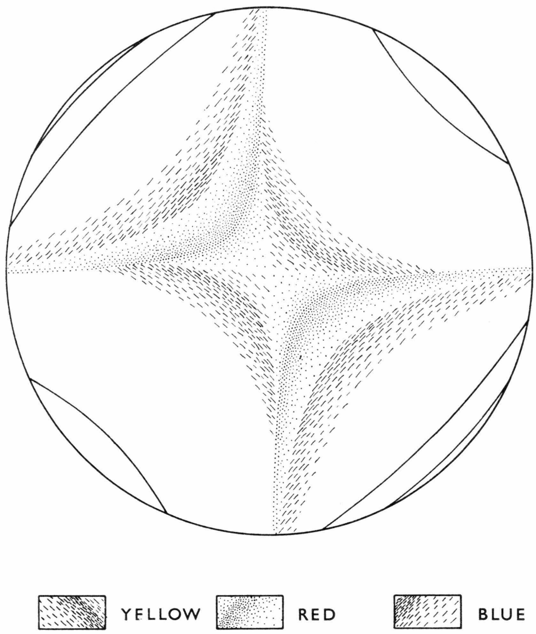

Fig. 5. Acute bisetrix figure, white light, showing the distribution of red, yellow and blue colours.

Epididymite shows a strong crossed axial plane dispersion (brookite type). Fig. 5 shows an acute bisectrix figure as seen in white light. This dispersion has been examined by O. V. PETERSEN (in preparation) and the results are presented in fig. 6. $2\,V\alpha$ was demonstrated to vary from 26° at $\lambda = 680\ m\mu$ over 0° at $440\ m\mu$ to 16° at $410\ m\mu$.

The chemical analyses of eudidymite and epididymite presented in table 1 correspond well with the formula $NaBeSi_3O_7(OH)$. The formula suggested by E. A. POBEDIMSKAYA and N. V. BELOV (1961), $NaBeSi_3O_7(OH) \cdot 1/2\,H_2O$, requires much higher quantities of water, about 7 %, than the 4.6 % obtained by the present writers.

As to chemical composition and physical properties eudidymite and epididymite are very similar. They are most easily distinguished by means of their Debye-Scherrer diagrams. The diagram for eudidymite is feldspar-like, in accordance with the fact that the framework struc-

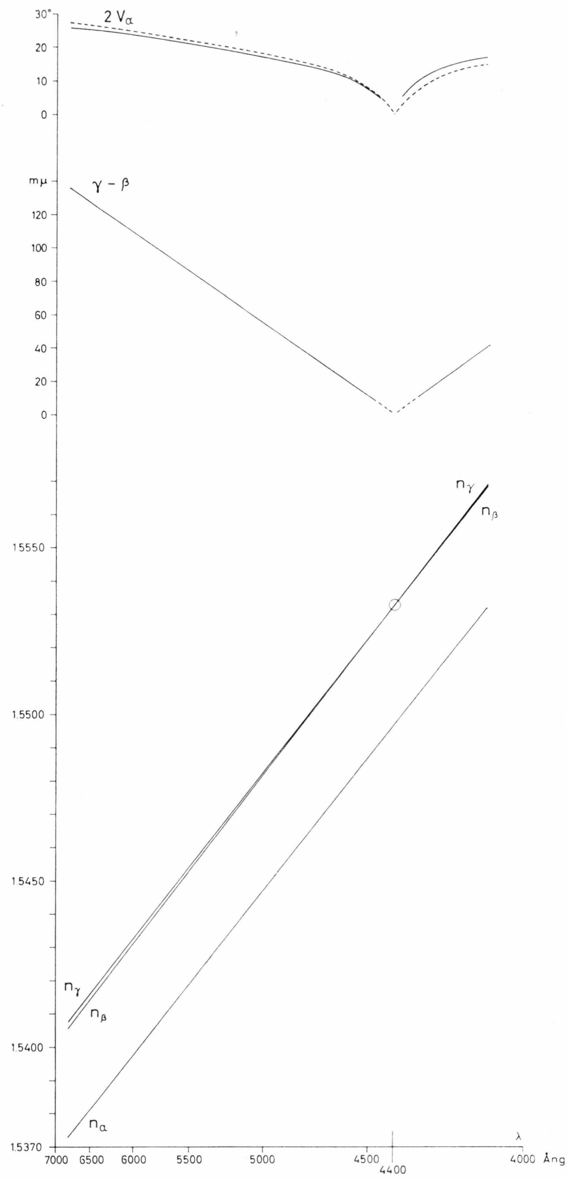

Fig. 6. The dispersion curve of $n\alpha$ drawn on the basis of the refractive index measurements. The known differences ($n\gamma$–$n\alpha$), ($n\beta$–$n\alpha$) and ($n\gamma$–$n\beta$) were used in the construction of the dispersion curves of $n\beta$ and $n\gamma$ respectively. The middle curve shows ($n\gamma$–$n\beta$). The two curves at the top represent $2\ V\alpha$ measured (full line) and calculated (dotted line).

tures of eudidymite and albite are of related types. The epididymite has a lamellar structure (POBEDIMSKAYA and BELOV, 1961).

According to CHRISTOPHE-MICHEL-LÉVY (1961) and ČERNÝ (1963) epididymite is almost uniaxial (2V = 2–3°), whilst eudidymite is biaxial

($2V = 25–30°$). As stated on p. 9 conditions are more complicated because of the crossed axial plane dispersion of epididymite, but we also found epididymite to have the smallest axial angle of the two minerals.

The refractive indices of epididymite are slightly lower than those of eudidymite.

The spectral analyses of eudidymite from Greenland, Norway and Kirghizia (Schilin and Semenov, 1957 and Kozlova, 1962) show the presence of boron, but the epididymites of Lovozero and Ilímaussaq are without boron.

Fig. 7a. The Nákâlâq mountain seen from the west. The plain in front of the mountain and the lower part of the western slope of the mountain are composed of naujaite, the upper part of sodalite foyaite. The slope towards the south (right side) is composed of sodalite foyaite, alkali granite, and augite syenite. The albite veins occur on the plain in the front.

MODE OF OCCURRENCE

No detailed study of the occurrence of epididymite in the lower part of the *north-eastern slope of Nákâlâq* (fig. 1, at the co-ordinate 8,19) has been undertaken so far. The epididymite occurs in albite-analcime veinlets intersecting naujaite.

Eudidymite has been found in thin veins cutting the alkali granite of the *summit of Nákâlâq* (fig. 1, at the co-ordinate 9,17), that is in the uppermost part of the Ilímaussaq massif, and in veins cutting the naujaite of the Taseq plateau (fig. 1, at the co-ordinate 5,15).

The veins in the granite are about 5 cm thick and up to several metres long. They are composed of microcline and quartz with arfvedsonite, ægirine, albite, polylithionite, narsarsukite, monazite and elpidite as subordinate components. The eudidymite forms pearly white spherulites up to 1 cm in diameter as well as radiating aggregates of lamellar crystals. Spherulites of eudidymite have also been observed in thin quartz albite veins (sample no. 77365).

On the *Taseq plateau* (fig. 7) eudidymite was found to the north of the western-most end of the lake, at an altitude of about 600 m.

Fig. 7b. The continuation towards the south of fig. 7a showing the Taseq lake. The small hills in the background are mainly composed of alkali granite. The background in the right side of the photo is composed of naujaite and lujavrite.

The naujaites of this plateau are in places strongly albitized, not only along fracture zones but also over large irregular areas. The albititic rocks are dense or sugary and very rich in small flecks of purple fluorite. No systematic study of this mineralization has been undertaken so far; the following discussion is based on a number of specimens collected by the authors in the summer of 1964.

The albititic veins in the naujaite are dense or fine-grained. They vary in colour from white or grey to pink and always contain purple fluorite which may form crusts on irregular fractures. Grains of neptunite and allanite can sometimes be seen in the hand specimen. The albititic rocks impregnate zones of crushing in naujaite. They often appear to be sheared with dark parallel stringers of arfvedsonite and acmite. In some of the veins there are coarse-grained patches containing analcime, chkalovite, lithium mica, felt-like ægirine, tugtupite, pyrochlore, and other minerals. In some veins eudidymite and epididymite have been found.

A few samples of the massive albitites were examined in thin section. The matrix is made up of very fine-grained albite with a grain-size less than 0.02 mm. Small irregular grains are intergrown in an intricate way; pigmentation is common. There are few or no twin lamellae. Scattered through this matrix are irregular and generally strongly pigmented grains of microcline and larger crystals of albite with few twin lamellae and of the kind previously described from albititic veins elsewhere in Ilímaussaq (plate 2, fig. 1 and SØRENSEN, 1962, p. 216).

The fluorite occupies intercrystal areas and cavities in the fine-grained albitite. The cavities are often lined with small crystals of albite which protrude into the fluorite. These albite crystals are larger than the tiny albite grains of the matrix and practically without pigmentation (plate 2, fig. 2). Similar grains of albite occupy fractures in the fine-grained albitite and in its inclusions of microcline.

The albititic matrix is generally without any preferred orientation, but in the sheared rocks the small laths show parallel orientation. These rocks contain stringers of fine-grained acmite and/or arfvedsonite.

Accessories in the albitite are: lithium mica, neptunite, altered schizolite, sphalerite, pseudomorphs after epistolite(?) containing igdloite and pyrochlore, allanite, a colourless mineral (with refractive indices around 1.70, high birefringence, length-slow, possibly uniaxial positive), biotite, and possibly needles of a secondary beryllium mineral.

Locally small amoeboid areas of tugtupite penetrate the microcline and albite of the veins. This tugtupite is associated with a strongly pigmented and very fine-grained analcime.

In one sample the analcime matrix contains scattered grains of chkalovite up to a few centimetres across. The chkalovite is surrounded and cut by thin zones of fine-grained tugtupite. The accessories include schizolite, neptunite, ægirine, ore, steenstrupine, lithium mica and an unidentified colourless mineral.

The albititic veins containing the eudidymite are sugary with dense white patches. There are streaks of neptunite, schizolite and fluorite and aggregates of fine scales of lithium mica. Along the borders of the veins there are broken prisms of ægirine. Eudidymite forms platy crystals and lamellar aggregates up to $3 \times 2 \times 1$ cm in size.

In some of the samples there are fine-grained patches of yellow and brown colour made up of schizolite, katapleiite, and other minerals. In one sample small yellow plates of leucophane have been observed. Small yellow grains of genthelvite have also been found in vugs. There are crusts of manganese oxides.

In thin section the purest parts of the albitite are of the type described from albititic veins elsewhere in Ilímaussaq by SØRENSEN (1962). They are composed of irregular intergrowths or of radiating groups of albite laths. There are patches of equidimensional grains of albite with few or no twin lamellae.

Scattered through the albitite are small grains and patches composed of many irregular grains of dusty microcline, and parts of the veins are composed of the dense type of albitite described above. The albite of the coarse-grained patches is deformed and partially crushed.

The microcline is partly replaced by albite. The fluorite penetrates the rock along irregular fractures.

Neptunite is very prominent in parts of the rock, being present in aggregates of small crystals associated with schizolite, ægirine and fluorite. The schizolite is generally altered and is often present as stellate aggregates of fine needles. Lithium mica occurs in aggregates of small flakes. Locally igdloite is present. In cavities there are small spherulites and needles of a length-fast strongly birefringent mineral. There are also length-fast needles of lower birefringence. The X-ray powder diagram indicates that some of these "needles" are katapleiite.

The *eudidymite* occurs as large plates in a groundmass of sugary albite and microcline (plate 1, fig. 1). It is cloudy and contains length-slow needles or flakes(?) of a mineral which displays anomalous blue interference colours (epididymite?).

The eudidymite appears to penetrate the albitite and contains inclusions of albite. It is penetrated by and generally separated from the albite and microcline by a strongly pigmented analcime. This strongly pigmented analcime also penetrates the albitite. Associated with this analcime are patches of tugtupite and in places numerous flakes of lithium mica.

Genthelvite occurs as small scattered grains in intercrystal areas between the laths of albite. It is colourless in thin section. The mineral has been identified by means of its X-ray powder diagram (see O. V. PETERSEN & H. BOLLINGBERG, in preparation).

One sample of a white fine-grained rock was seen in thin section to be composed of an intimate intergrowth of small lamellae of cloudy epididymite which display multiple twinning and anomalous blue interference colours (plate 1, fig. 2). This mineral is optically biaxial negative with a small axial angle, in contrast to the positive sign of the eudidymite. The identity of the *epididymite* was confirmed by means of the X-ray powder diagram (table 2).

The epididymite aggregate contains patches of cloudy analcime in which large plates of eudidymite are enclosed. The analcime has a very weak birefringence and contains patches of tugtupite.

Scattered through the epididymite there are small lath-shaped crystals of a length-fast mineral with parallel extinction, high birefringence (about 0.020) and refractive indices around 1.60. It is biaxial negative with $2V\alpha = 39°$. It could not be separated for a closer study but may well be leucophane, a mineral which has been identified in hand specimen.

The epididymite rock contains cloudy schizolite, lithium mica, patches of microcline and albite enclosed in analcime.

Table 2. *Debye-Scherrer diagrams of epididymite.*

Epididymite, Narssârssuk (CHRISTOPHE-MICHEL-LÉVY, 1961).		Epididymite, Narssârssuk (FLINK's material) Fe-radiation, Mn-filter, Camera diameter = 90 mm. Analyst: O. V. PETERSEN.		Epididymite, Taseq, Ilímaussaq Fe-radiation, Mn-filter, Camera diameter = 90 mm. Analyst: O. V. PETERSEN.		Epididymite, Lovozero (VLASOV et al, 1959).	
Int	d (Å)	Int	d (Å)	Int	d (Å)	Int	d (Å)
tf*)	6.8	–	–	2	6.77	–	–
m	6.3	4 B	6.32	3 B	6.35	3	6.43
> f	5.78	2 B	5.74	2 B	5.74	2	5.80
> f	4.64	4	4.62	4	4.62	5	4.65
—	–	3	4.12	3	4.12	1	4.07
m	3.65	4	3.66	4	3.65	7	3.65
–	–	2	3.41	–	–	–	–
i	3.40	10	3.37	10	3.40	8	3.40
tf	3.22	–	–	–	–	–	–
f	3.17	–	–	–	–	–	–
i	3.09	10	3.08	9	3.07	10	3.10
i	2.99	10	2.96	10	2.97	10	2.98
tf	2.88	–	–	–	–	1	2.88
–	–	–	–	–	–	1	2.75
f	2.60	3	2.59	3	2.59	6	2.60
m	2.49	5	2.48	4	2.48	7	2.48
f	2.40	2	2.39	2	2.39	3	2.41
f	2.26	3	2.25	3	2.25	5	2.26
m	2.13	4	2.11	4	2.12	8	2.13
tf	2.07	1	2.06	–	–	1	2.04
tf	2.023	1	2.01	–	–	–	–
tf	1.965	1	1.948	1	1.952	2	1.967
–	–	–	–	1	1.915	1	1.931
f	1.836	1	1.831	1	1.828	7	1.835
> m	1.799	6	1.790	6	1.792	9	1.797
tf	1.747	2	1.742	2	1.742	4	1.750
tf	1.703	3	1.688	3	1.692	3	1.700
> f	1.641	6	1.634	5	1.635	8	1.643
tf	1.589	1	1.580	1 B	1.581	1	1.590
> f	1.545	5	1.537	5	1.537	8	1.542
tf	1.475	2	1.473	–	–	2	1.480
tf	1.451	2	1.445	2	1.447	2	1.451
f	1.390	4	1.384	4	1.384	7	1.391
f	1.361	6	1.357	6	1.358	7	1.363
f	1.326	3	1.322	3	1.323	7	1.328
–	–	–	–	–	–	1	1.306
> m	1.284	6 B	1.279	6 B	1.280	9	1.280

*) i = intense, m = moyen, f = faible, tf = très faible.

DISCUSSION

Eudidymite and epididymite are generally associated with albite and zeolites in the occurrences at Langesundsfjord (Brøgger, 1890), Narssârssuk (Flink, 1901, Bøggild, 1953), the Kola peninsula (Schilin & Semenov, 1957), Khirgizia (Kozlova, 1962), Vězná, Czechoslovakia (Černý, 1963) and Seal Lake, Labrador (Nickel, 1963). Eudidymite generally occurs in a macrocrystalline state, epididymite in a microcrystalline one, which may indicate that eudidymite was formed at higher temperatures than the epididymite. This is in accordance with the occurrence of eudidymite in coarse-grained rocks, epididymite in fine-grained ones. Both minerals are clearly formed under pneumatolytic or hydrothermal conditions and may be secondary after other beryllium minerals. Epididymite replaces beryl at Vězná and chkalovite at Lovozero and Ilímaussaq. The last mentioned replacement is known from Qeqertaussaq where pseudomorphs of epididymite and spherobertrandite after chkalovite form up to 5 cm large masses.

At Narssârssuk eudidymite and epididymite are associated; in Lovozero both minerals are present, but epididymite is highly predominant. At Vězná only epididymite occurs, while at Langesundsfjord, Seal Lake and Khirgizia only eudidymite has been found.

In alkaline rocks, and especially those of agpaitic affinity, there is a characteristic suite of beryllium minerals, namely, in addition to eudidymite and epididymite, chkalovite, tugtupite (beryllosodalite), leucophane, karpinskyite, genthelvite-danalite, barylite, sorensenite, and hydrous minerals such as gel- and spherobertrandite and beryllite. With the exception of barylite and sorensenite all these minerals have been found in Lovozero, while karpinskyite, barylite and gelbertrandite have not yet been discovered in Ilímaussaq.

Of the beryllium minerals mentioned, eudidymite and epididymite are by far richest in SiO_2 (about 73 %). These two minerals are thus found in association with quartz and albite, but not with nepheline. They therefore occur in association with alkali granite and in albititic veins associated with nepheline-sodalite syenites. Both these types of occurrence are present in Ilímaussaq.

The veins associated with the alkali granite of Ilímaussaq are most probably genetically connected with that rock; no evidence has been found that they are formed from fluids expelled from the underlying nepheline-sodalite syenites. However, the relation of the granite to the agpaitic rocks has not yet been established with certainty (cf. FERGUSON, 1964 and HAMILTON, 1964).

The late veins in the naujaite have been described by SØRENSEN (1962) from selected areas. Similar veins have been found in the sodalite foyaite and augite syenite of the upper part of the intrusion. The late veins were considered in the paper mentioned to be formed from fluids expelled from the lujavrite. In a number of cases veins of this type are clearly connected with veins of lujavrite in naujaite and syenite. The veins are later than crusts of felt-like ægirine in zones of deformation in the naujaite and are therefore clearly later than that rock.

The naujaite of the Taseq plateau is intersected by thin dykes of lujavrite. A greater number of lujavrite dykes occur on the slope between the plateau and the Narssaq river.

The eudidymite-epididymite-bearing veins are therefore considered to be genetically connected with the lujavrite, representing material squeezed out from the lujavrite during the consolidation of that rock.

On the slope between the plateau and the river a number of veins, mainly composed of ussingite and analcime, contain crystals of chkalovite and an insignificant amount of tugtupite. Chkalovite and tugtupite have also been found in limited amounts on the plateau.

The occurrences of chkalovite and tugtupite already described by SØRENSEN (1960 and 1962) are found in veins of medium- to coarse-grained albitite with varying amounts of analcime and ocassionally ussingite (Tugtup agtakôrfia, Qeqertaussaq, the head of Kangerdluarssuk, Igdlúnguaq).

In the albitites chkalovite is always surrounded and penetrated by tugtupite which is generally associated with analcime. Only in some ussingite-rich veins is chkalovite without secondary beryllium minerals.

The eudidymite-epididymite of the Taseq plateau occur in dense- to medium-grained albitites rich in fluorite. The fine-grained albitites often contain patches of the type of albitite seen in the veins at Tugtup agtakôrfia and other localities mentioned above.

The coarse-grained albite and microcline of the fine-grained zones is often strongly deformed. The schizolite and epistolite of the veins is strongly altered, which is very probably a result of late fluids penetrating the naujaite and the earlier formed granular albitites through fractures and zones of deformation. These late fluids deposited fine-grained albite, fluorite and eudidymite-epididymite. The beryllium of the last-named minerals may be derived from chkalovite and tugtupite present in the original veins. Still later than the eudidymite-epididymite, leucophane and genthelvite were formed. Another way of interpreting this mineralization is to consider the fine-grained albite and the accompanying beryllium minerals as deposited from aqueous solutions as a result of release of pressure.

This late beryllium mineralization is then a manifestation of the latest stages of hydrothermal activity in Ilímaussaq. Whether this late mineralization is connected with the lujavrite, a late intrusive phase of which has so far been studied best at Kvanefjeld to the north of the area in question, or with the alkali granite cannot be definitely settled now.

The late development of eudidymite and epididymite in Ilímaussaq recalls that of these two minerals in Lovozero (VLASOV et al., 1959) where they are closely associated with fine-grained albite which represents the latest phases of replacement in complex pegmatites. This albite is later than the natrolite of the cores of these pegmatites. In Lovozero leucophane and genthelvite are also of very late formation.

The association of tugtupite, eudidymite and epididymite in Ilímaussaq poses a problem which cannot be definitely solved at the moment. In thin section the tugtupite and accompanying analcime appear to penetrate the eudidymite and epididymite. This is, however, difficult to reconcile with the established mode of occurrence of the tugtupite which is usually associated with analcime and probably formed at a higher volatile pressure than the fine-grained albite. According to this relationship eudidymite and epididymite should replace the tugtupite. The mutual relationship of eudidymite and epididymite is also uncertain.

The present paper only describes some new occurrences of the two rare minerals eudidymite and epididymite. A number of problems still have to be solved in the course of the continued studies of the Ilímaussaq intrusion.

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Plate 1.

Fig. 1. Large plate of eudidymite (top right) showing polysynthetic twinning. Bottom left albite. Taseq plateau. + nicols, $\times$ 46.

Fig. 2. Aggregate of epididymite. The small grains scattered through the epididymite are leucophane. Taseq plateau. + nicols, $\times$ 46.

(Photomicrographs by CHR. HALKIER).

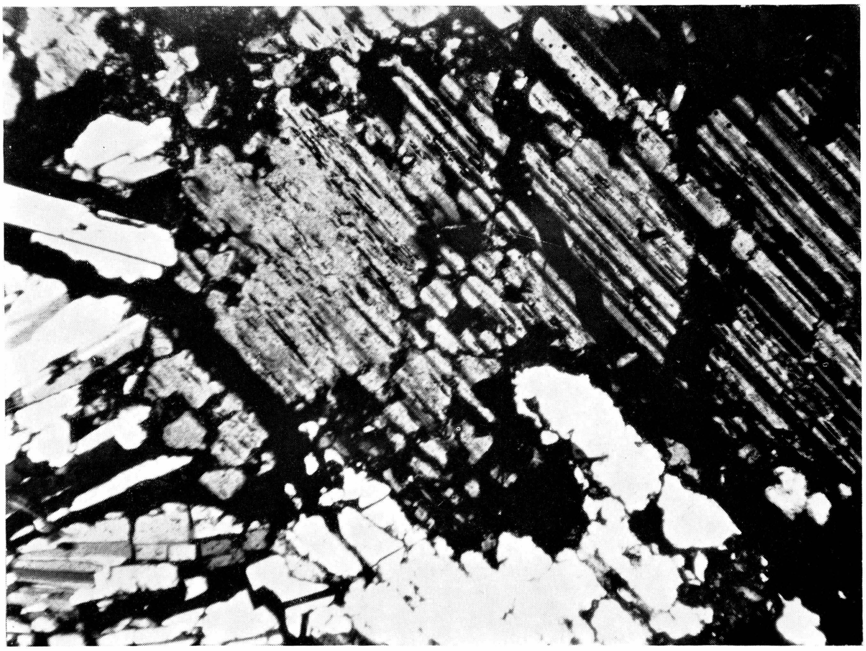

Fig. 1.

Fig. 2.

Plate 2.

Fig. 1. Albite with small (grey) crystals of neptunite (middle right). Taseq plateau. + nicols, $\times 46$.

Fig. 2. Vug of fluorite (black), lined by small crystals of albite in groundmass of dense albite. Taseq plateau. + nicols, $\times 91$.

(Photomicrographs by CHR. HALKIER).

Fig. 1.

Fig. 2.