

CONTRIBUTION TO THE MINERALOGY OF NORWAY

No. 11. On lanthanite in Norway

By

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Abstract. The first occurrence of lanthanite in Norway is reported. Physical and optical properties, and semi-quantitative and qualitative spectrographic determinations of the rare earth elements are given. Comments on the distribution of the rare earths in allanite and lanthanite are given.

Introduction

Lanthanite $(La_1Ce)_2 (CO_3)_3 \cdot 8 H_2O$ was first discovered at the famous mineral deposits at Bastnäs, Sweden, about 1820, by BERZELIUS (1825). The mineral occurred as an alteration product of cerite. The chemical composition was not well known until the mineral was found at Betlehem, Lehigh Co., Pa., U.S.A., in oxidized zinc ores. Good analyses that established the chemical composition were published by SMITH (1854) and GENTH (1857) on material from Betlehem, and LINDSTRÖM (1910) on material from Bastnäs. Additional literature from before 1900 will not be reviewed here.

According to PALACHE, BERMAN and FRONDEL (1951), the mineral has also been reported as an alteration product after allanite in pegmatite at Baringer Hill, Llano Co., Texas, and in a magnetite deposit, Sandford Mine, Essex County, New York.

More recently lanthanite has been found in some unique parageneses in the Bearpaw Mountains, Montana, U.S.A. (PECORA & KERR,

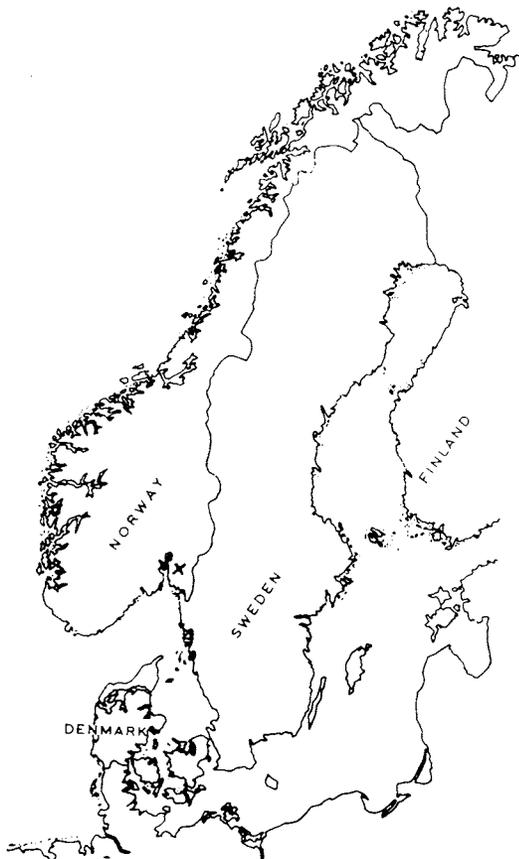


Fig. 1.
Map showing situation of the
lanthanite locality. x.

1953). Here lanthanite occurs together with the new, closely related, rare earth carbonate calkinsite, $(La_1Ce)_2 (CO_3)_3 \cdot 4 H_2O$ both formed as late alteration products after the new, rare earth carbonate, burbankite and ancylite.

In 1957 Mr. P. Lie brought some samples to the Mineralogisk-Geologisk Museum from his granite pegmatite prospect, Sæteråsen, in the neighbourhood of his farm, Mjærum, in Hobøl, Østfold County, ca. 40 km south-east of Oslo. During examination of these samples under the binocular microscope I discovered extremely small amounts of lanthanite, growing as crystals in small druses in the quartz-feldspar mass.

Acknowledgements

I want to thank Prof. T. F. W. Barth for doing the first optical measurements on only three small crystal fragments. These observations led to the identification of the mineral.

I am indebted to Prof. I. Oftedal who kindly performed the spectrochemical determinations. Thanks are due to Dr. H. Neumann whose suggestions during our discussions were of great help. Thanks are also due to Prof. F. E. Wickmann, Stockholm, Sweden, who, on Dr. Neumann's request, promptly sent us a sample of the original lanthanite material from Bastnäs Sweden. Further I want to thank cand. mag. B. Nilssen for her contribution to this work.

Dr. P. H. Reitan kindly corrected the English. Mr. Brynhilsrud at the Geologisk Institutt, University of Oslo has taken the photographs of the lanthanite crystals. At last I want to express my gratitude to Mr. P. Lie for bringing this valuable material to the Mineralogisk-Geologisk Museum, University of Oslo, enabling me to make this contribution to the mineralogy of Norway.

The material

The samples were taken from the rather fine-grained border facies of the pegmatite. They consist of ordinary microcline, quartz, muscovite, and some 4–6 cm long crystals of allanite, the peripheral parts of which are always altered to a reddish, metamict substance, which is completely X-ray amorphous. The rock contains numerous very small druses, some of which are filled with pink, small, well-formed, tabular crystals of lanthanite, growing in irregular fan-shaped aggregates.

The optical measurements done by Prof. T. F. W. Barth indicated that the mineral was lanthanite. This was verified by comparison of the X-ray powder patterns of the mineral from Hobøl and the original lanthanite from Bastnäs, Sweden. (NEUMANN and BRYN, 1958).

Morphology of the lanthanite

The most detailed investigations of the forms and symmetry were done by BLAKE (1853) who established the rhombic symmetry of the mineral; VON LANG (1863) and FLINK (1910) calculated the axial

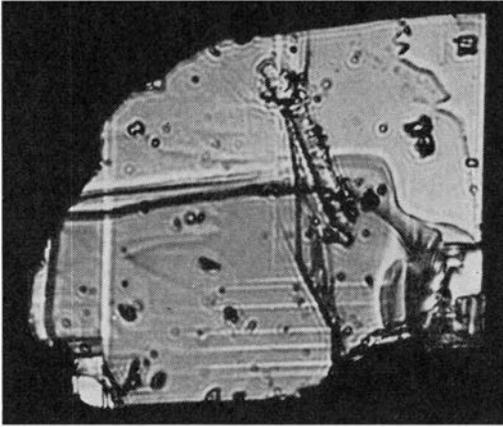


Fig. 2.

Fragment of a lanthanite crystal from Hobøl. Note the lamellar twinning along two directions parallel to the edge of {101}. About 120x.

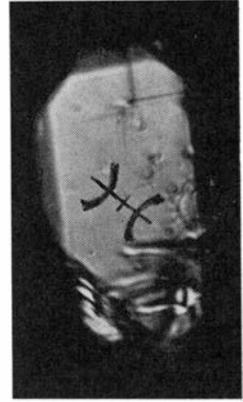


Fig. 3.

A typical well developed platy lanthanite crystal from Hobøl. Cross-shaped twinning is present. The crystal lays on (010) and shows the forms {100}, {101}, {111} and {101} well developed. The optic orientation is given. The optic plan is parallel to {001}. About 70 x.

ratios. Flink also described the twinning parallel to {101} and the characteristic lineations parallel the trace of {101} on {010}. PALACHE, BERMAN and FRONDEL (1951), based their description on the elements of the structural cell: $a_o = 9.50$ kX, $b_o = 17.10$ kX, $c_o = 9.00$ kX found by Wolfe and Frondel in 1947. (Stated in PALACHE, BERMAN and FRONDEL, 1951). This new orientation is used in this work¹. Under the microscope the lanthanite from Hobøl shows the same forms as the mineral from Bastnäs and Bethlehem. The crystals are tabular parallel to {010}. The mineral also shows the faint lineation on {010}, parallel the edge of {101} reported by FLINK (1910). This may represent normal submicroscopic twinning parallel {101}. Normal twinning parallel {101} is often found. The twins sometimes form cross-shaped intergrowths with each other as shown in figures 2 and 3. On account of the preferred orientation on (010), these twins resemble albite twins cut normal to the twin-plane.

¹ The old orientation was given by von Lang and Flink. Transformation: von Lang and Flink to Palache, Berman and Frondal (1951): 010/002/100.

Optical data

Determinations on many small crystals lead to the following values:

$$\beta = 1.586 \pm 0.004.$$

$\gamma = 1.615 \pm 0.005$. The optic plane is (001). The cleavage parallel to (010) is well developed.

α was not measured on account of the pronounced preferred orientation of the crystals on (010) in the immersion slides.

α probably does not deviate from the earlier published value (LARSEN and BERMAN, 1934) $\alpha = 1.520 \pm 0.01$ because the values measured for β and γ are in good agreement with those reported by LARSEN and BERMAN (1934).

The normal axial dispersion $r < v$, weak, given by LARSEN and BERMAN (1934) was not detected in the lanthanite from Hobøl. $2V(-) = 63 \pm 1^\circ$, measured on the universal stage. This is in agreement with earlier published data on lanthanite.

Table 1.

Locality	$2V(-)$	Author
Bethlehem	62°	Larsen & Berman, 1934
?	62°	Winchell, 1956
Montana	60°	estimated; Pecora & Kerr, 1953
Hobøl	$63 \pm 1^\circ$	Sæbø, 1960

The genesis of the lanthanite

Lanthanite formed as a late secondary mineral in small cavities in the surroundings of the altered allanite. The rare earths were evidently supplied from the decomposed allanite and brought into solution as hydroxides by the action of supergene solutions rich in alkalies and CO_2 . In principle the mode of formation is similar to that found experimentally by MELLOR (1924). He synthesized lanthanite and probably also calkingsite by the reaction of La and Ce hydroxides with NaHCO_3 — solution saturated with CO_2 . The precipitate crystallized by standing.

The lanthanite in nature probably precipitated from similar solutions, but also containing other elements, Al, Si, Fe, Ca, etc. The formation of lathanite took place at very low temperature.

Distribution of rare earths in allanite and lanthanite

Material from the core and the totally altered red coloured rim zone of allanite crystals was isolated for optical spectrograms and the results compared with that of the lanthanite.

Table 2.

Distribution of the elements in the allanite and lanthanite			
Material	Major elements	Minor elements <1%	Trace
Allanite, core	Mg, Ca, Al, Si, Fe, Mn	Th, Y, Ti	Yb, Pb, Be, V
Allanite, rim	Mg, Ca, Al, Si, Fe	Mn, Ti	Th, Y, Pb, V
Lanthanite	La		Y

Determinations by Prof. I. Oftedal.

Only very small amounts of material was used for the spectrograms. Ce has not been sought for.

The results, however, might indicate that La and also Ce are easily precipitated as lanthanite. Most of the other RE are probably carried away by the supergene, altering solutions.

Synthetical work on calkingsite and lanthanite

Cand. mag. B. Nilssen at Mineralogisk Museum, University of Oslo, carried out a few experiments in order to synthesize lanthanite. The procedure given by MELLOR (1924) was used. The precipitates were examined by the X-ray powder method. These experiments showed that calkingsite forms much more readily than lanthanite. Only by very careful drying of the crystallized precipitates, B. Nilssen was able to produce a mixture of calkingsite and lanthanite.

These experiments show clearly that Mellor and co-workers probably obtained a calkingsite-lanthanite mixture rather than pure lanthanite. No further work on the phase relationships between calkingsite and lanthanite has been carried out.

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