CONTRIBUTIONS TO THE MINERALOGY OF NORWAY

No. 10. On synchisite in Norway

By

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A b s t r a c t. Synchisite is described from Kongsberg, Norway. X-ray powder data are reported. Optical and physical constants are given. The synchisite from Kongsberg shows some differences from the synchisite from Narsarsuk, Greenland.

Introduction

During investigations of anatase in Norway (SÆBØ and DIVLJAN, 1960) the anatase material from Kongsberg (NEUMANN, 1944) was reexamined. These investigations revealed the presence of a hexagonal mineral, which was previously unreported. X-ray work and optical measurements done at the X-ray laboratory, Mineralogisk Geologisk Museum prove that the mineral is synchisite, $CeFCO_3.CaCO_3$. This mineral has previously not been found in Norway.

Synchisite and its paragenesis

During his investigations of the famous native silver deposits at Kongsberg, southern Norway, one of us (H.N.) came across one old specimen from these mines, labelled "Kristians søndre stoll, 1856". This specimen contains anatase in small brilliant crystals, together with albite, quartz, chlorite, small cubes of pyrite, and synchisite. The sequence of the minerals are quartz and albite, then anatase rather simultaneously or in some cases slightly earlier than synchisite, then

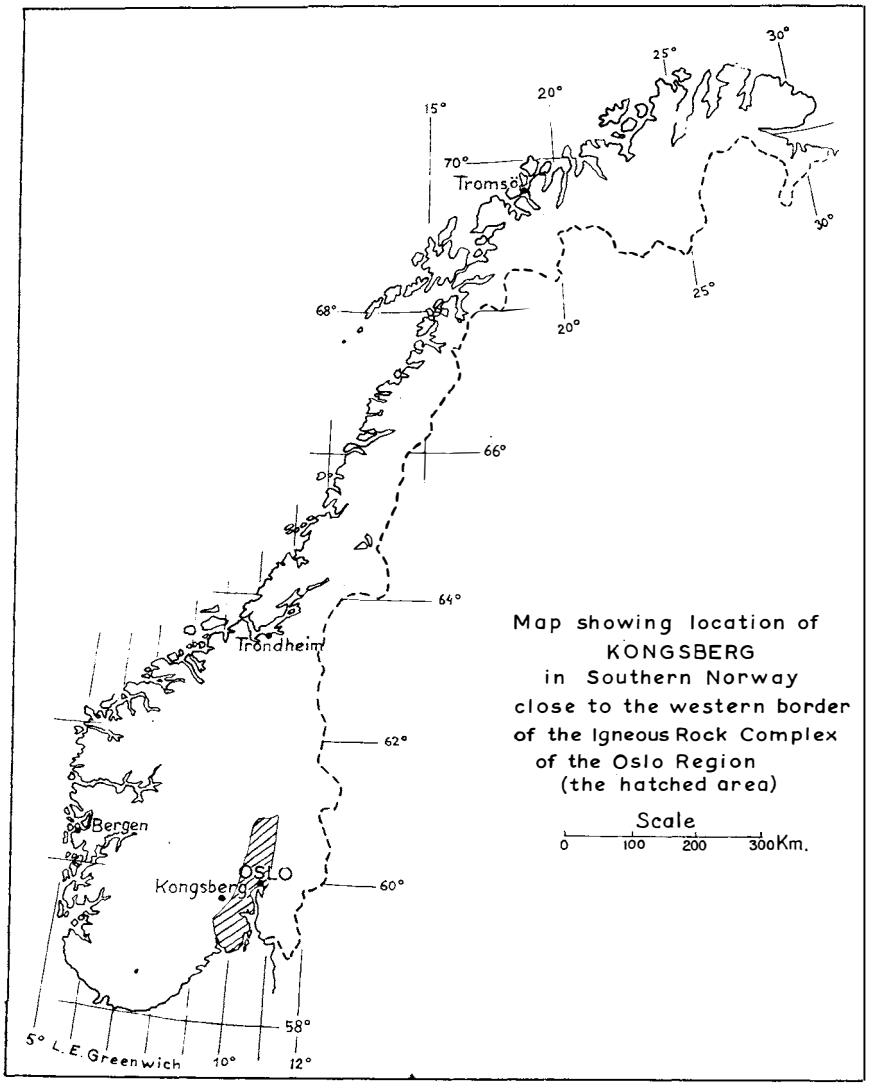


Fig. 1. Situation map.

pyrite and finally chlorite (NEUMANN, 1944). Synchisite occurs as very small, light yellow, hexagonal prisms, 0.2 mm long, slightly modified by small pyramidal faces. The base is well developed and brilliant, the other faces being dull and slightly altered.

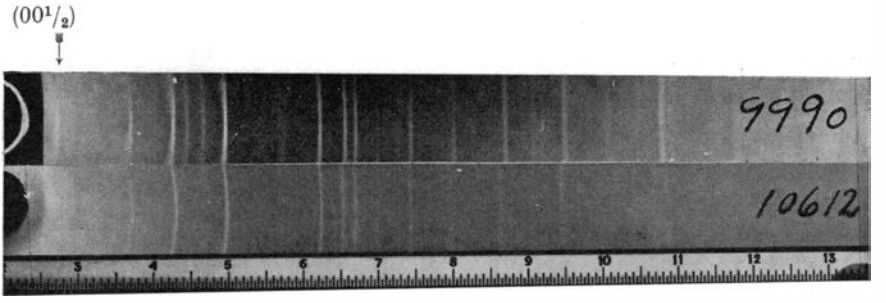


Fig. 2. Reproduction of the X-ray powder patterns. a. Synchisite from Kongsberg. Note the presence of the (00½) reflection. X-ray film no. 9990. Geologisk Mineralogisk Museum, University of Oslo. b. Synchisite from Narsarsuk, Greenland. (00½) reflection is absent. X-ray film no. 10612. Geologisk Mineralogisk Museum, University of Oslo.

The mineral is slowly dissolved in strong HCl with weak effervescence. The crystals are rather brittle, showing no preferred cleavage; fracture conchoidal.

The X-ray powder pattern shows clearly that the mineral belongs to the bastnäsite-synchisite group of minerals. In order to get the exact identification, the powder pattern was indexed on the basis of hexagonal symmetry; and the lengths of the a' and the c''' of the pseudo-cell, as defined by DONNAY and DONNAY (1953), were calculated.

The values of the crystallographic constants and the axial ratio show that the mineral is synchisite. The data of the powder pattern are given in tables I and II.

Small variations in the unit-cell dimensions and physical properties of the members of the bastnäsite-synchisite group are often found (DONNAY and DONNAY, 1953; JANSEN et al., 1959; SVERDRUP et al., 1959). These variations are partly dependent on the (OH:F) — ratio in the minerals. As a rule, however, the OH content is low.

The X-ray powder pattern of synchisite from Kongsberg differs slightly from that of synchisite from Narsarsuk by the presence in the former of a rather strong reflection with d = 9.03 Å, which is absent in the latter. Otherwise the films are identical apart from spacing variations caused by a small difference in the size of the pseudo-cells. The indices of the 9.03 Å reflection are (00½) when indexed on the basis of a pseudo-cell with a_0 = a' and c_0 = c'''. It

seems, therefore, that the structure of the synchisite from Kongsberg as different from other synchisites is characterized by a pseudo-cell with twice the normal length of the c-axis, namely with a = a' = 4.07 Å and c = 2c''' = 9.08 Å, which is also the morphological cell of synchisite as stated by DONNAY and DONNAY (1953).

X-ray powder patterns of the synchisite from Kongsberg and Narsarsuk are reproduced as fig. 2.

Optical data

Several immersion slides were studied under the microscope. The mineral is strictly uniaxial (+); any possible cleavage is not observed. The following values for the indices of refraction were found.

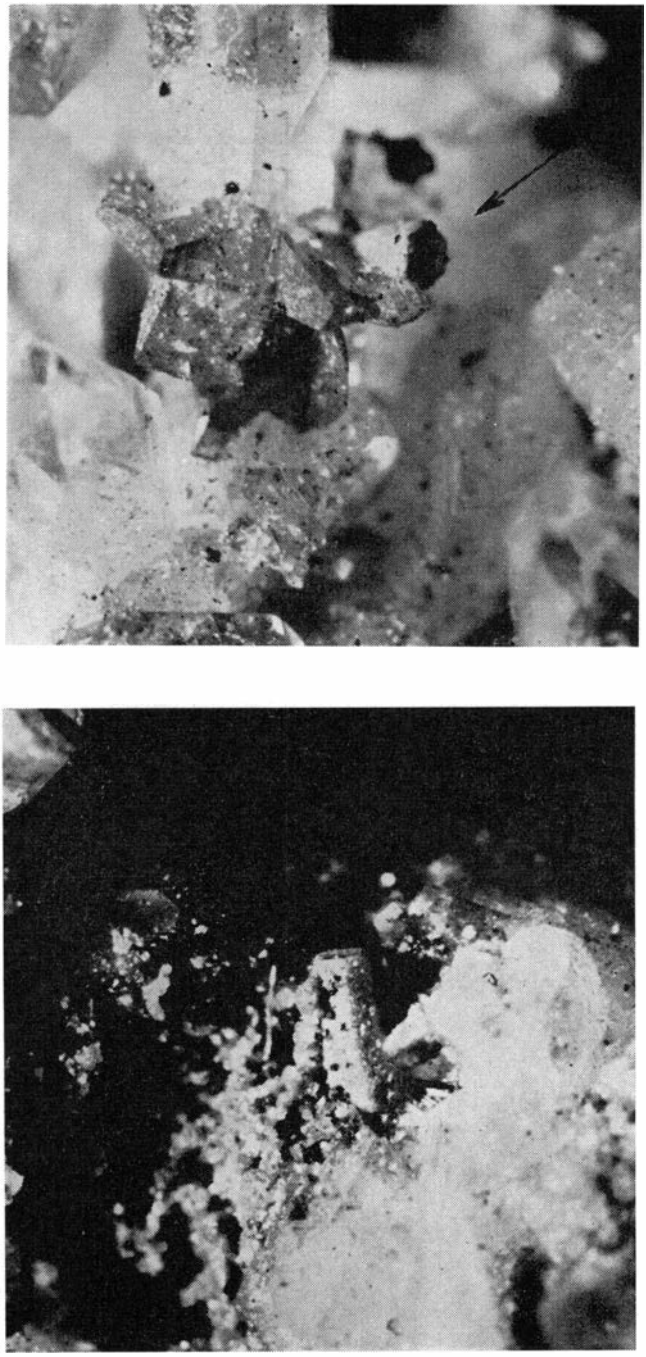
$\omega > 1.653$ for yellow light; $\omega = 1.653 \pm 0.005$ for blue light.

$\varepsilon = 1.745 \pm 0.005$; $\varepsilon - \omega = 0.084$.

The exact value of ε is difficult to obtain because of lack of properly oriented grains in the slides.

Genesis of the synchisite

The old label which is glued on to the synchisite specimen gives the only available information about it, namely that it was found in the southern part of the "Kristian adit" in the year 1856. The "Kristian adit" is the main transport adit for the whole complex of silver mines at Kongsberg, running through and sub-parallel to the foliation of the banded gneisses which are the bedrock of the argentiferous veins. The adit passes through a number of the silver mines, but the specimen is hardly found in any of these as in that case the name of the mine would most certainly have been given on the label and not the name of the adit. The specimen is a small slab of rock 3 cm × 6 cm × 10 cm, covered with minerals on three sides, and has characteristically an "upper side" and a "lower side", one of them being covered with scores of crystals of anatase and quartz while the other is not. In all probability this specimen has nothing to do with the native silver veins: it has no calcite which is the dominating gangue mineral of those veins, nor any of the characteristic silver vein minerals, and last but not least, it lacks that undefineable but nevertheless typical general appearance of the vein specimens. One of us has earlier tentatively



a

b

Fig. 3. Photos showing the synchisite from Kongsberg. a. Synchisite crystal (marked by an arrow) together with several anatase crystals. b. Synchisite crystal on quartz. The synchisite is partly overgrown by chlorite.

listed anatase amongst the minerals of the native silver veins (NEUMANN, 1944), this is hardly correct, neither anatase nor synchisite seem to belong to that mineral assemblage.

Most probably the albite-quartz-anatase-synchisite specimen originates from a cavity in the banded gneisses, and its formation may be more or less closely related to that of similar parageneses in alpine veins.

Acknowledgements

We are indebted to Professor I. Oftedal for valuable discussions during this work, and to Dr. P. H. Reitan for correcting the text. Miss D. Engelsrud has prepared the map, and M. Brynhildsrud has taken the photographs.

Table 1.

Synchisite, Kongsberg, Norway. Cam-diam. 9 cm Fe-rad.
a' = 4.07 ± 0.01 Å, c''' = 4.54 ± 0.01 Å, c'''/a' = 1.115

Nr.	Intensity	(hkl)*	θ	d(Å)
1	M		6.16	9.03
2	M	(001)	12.41	4.51
3	V.V.W		14.46	3.88
4	S	(100)	15.99	3.52
5	M		17.20	3.28
6	M		18.60	3.04
7	V.V.S	(101)	20.46	2.77
8	W		25.09	2.29
9	W		25.40	2.26
10	V.S	(110)	28.53	2.03
11	V.W.		29.33	1.977
12	S	(102)	30.67	1.899
13	S	(111)	31.56	1.848
14	W	(200)	33.48	1.756
15	V.W		34.15	1.725
16	V.W.		35.14	1.683
17	M	(201)	36.99	1.640
18	M	(112)	39.92	1.510
19	M	(202)	44.33	1.386
20	W		46.66	1.332
21	M	(211)	49.34	1.277
22	W+		53.10	1.211
23	W		55.53	1.175
24	S	(212)	57.54	1.148
25	W		58.34	1.138
26	W+		63.83	1.079
27	W+		67.95	1.045
28	M		75.32	1.001

V.S = very strong, S = strong, M = medium, W = weak. Intensities estimated visually.

* Hexagonal indices.

Table 2.
X-ray data for synchisite.

a' (Å)	c''' (Å)	c'''/a'	Locality	Author
4.10	4.57	1.114	Narsarsuk	Oftedal (1930)
4.10_3	4.560	1.111	—»—	Donnay and Donnay (1953)
4.07	4.54	1.115	Kongsberg	Sæbö & Neumann 1960

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