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Author(s)	Yagi, Kenzo; Sato, Fumio
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DATOLITE FROM FURANO MINE, HOKKAIDO

by

Kenzo YAGI and Fumio SATO

(with 1 plate)

(Contribution from the Department of Geology and Mineralogy, Faculty of Science, Hokkaido University. No. 1075)

Abstract

Recently datolite was found in the skarn at Furano Mine, Hokkaido. The physical properties and chemical composition are given. Compared with datolites from many other localities, the datolite is probably one of the purest ones ever reported. Its genesis is briefly discussed.

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Introduction

Occurrence of datolite has been reported from several localities in Japan, of which Obira and Iwato Mines near Sobosan granodiorite mass in Kyushu are especially well-known. Veins of datolite, associated with quartz, feldspar and calcite have been found in the crystalline schist in Shikoku. Rarely it also occurs in the drusy cavities of mafic volcanic rocks.

During the survey of skarn minerals at Furano Mine near Furano, central Hokkaido in summer of 1966, we noticed the presence of thin white veins among the skarn masses composed mainly of hedenbergite and garnet. Upon optical and X-ray investigation the mineral of these veins was determined as datolite. Since this is the first occurrence of this mineral in Hokkaido, a note is warranted here.

Mode of Occurrence

Along the upstream of the Shirikishimanai River which runs into the Sorachi River at Shimanoshita to the northwest of Furano, the Shimanoshita Shale Formation of the Cretaceous is well-developed, intercalating thin layers of orbitolina-bearing limestone beds (HASHIMOTO, 1953). This formation is thermally metamorphosed by the intrusion of trondhjemite which forms several dykes about 10–20 m in width, or small irregular bodies (SUZUKI, 1935), resulting in the formation of hornfelsic rocks (SUZUKI et al., 1959). In some parts of this hornfels sulfide minerals such as pyrite, chalcopyrite, or pyrrhotite, are impregnated in the skarn, and an explolation adit was dug in such part more than ten years ago at a place about 8 km due west of Furano, along the Shirikishimanai River (SAKO et al., 1957). This was called Furano Mine, but was soon abandoned because of the poor quality of the ore deposits. In this paper the name " Furano Mine " is retained.

The datolite veins are found on the wall of the old adit or on the cliffs exposed along the river. They form white veins, 5–20 mm in width, and 10–30 cm in length, within the skarn composed mainly of garnet and hedenbergite (SATO, 1967). Datolite crystals are white in color, and crystal faces are not well-developed. Rarely in the small drusy parts, however, euhedral crystals with glassy luster are observed. Main minerals associated with datolite include hedenbergite, garnet, calcite, chlorite, pyrite and pyrrhotite.

Physical Properties

The datolite crystals are white in color and translucent or opaque. No cleavages are observed, but fractures are concoidal. The best crystals available were observed on the two-circle goniometer, and the following faces were noticed, though most of them gave only poor reflections.

a (100) and m_x (011): dominant
x (102), t (013), g (012) and m (110): present.

Specific gravity measured by a pycnometer is 2.994 ± 0.006. The refractive indices determined by an immersion method are:

α 1.623 β 1.653 γ 1.664, 2 V (−) 72°–74°.

The X-ray powder data obtained on the following condition (FeKα 35 KV, 7 mA, scanning speed 1° per minute) are given in Table 1, compared with the data of some datolites from Japan. In their crystallographic analysis of datolite, ITO and MORI (1953) represented the shortest axis of a unit cell by *a* and the longest by *c*. Based on this study YOSHIMURA et al. (1966) determined the indices (hkl), which are given in the table. The different samples show fairly close agreement.

Table 1. X-ray Powder Data of Datolites

(1)			(2)		(3)		(4)	
d(Å)	I	hkl	d(Å)	I	d(Å)	I	d(Å)	I
5.97	5	011			6.02	5		
4.84	15	100,002	4.83	30	4.84	10	4.80	20
3.76	43	$11\bar{1}$,111	3.75	90	3.77	40	3.74	42
3.41	30	$10\bar{2}$,102	3.41	50	3.41	30	3.40	31
3.11	100	$11\bar{2}$,112	3.11	80	3.12	100	3.10	100
2.988	40	120,022	2.99	50	3.00	50	2.98	26
2.856	55	$12\bar{1}$,121	2.86	100	2.86	50	2.850	59
2.524	30	$11\bar{3}$,113	2.52	60	2.52	30	2.521	33
2.409	5	004					2.404	13
2.297	10	014			2.29	10	2.295	11
2.245	38	130,032,$21\bar{1}$	2.24	50	2.24	50	2.239	68
2.188	40	$12\bar{3}$,131,123	2.19	50	2.19	60	2.185	41
2.158	13	$10\bar{4}$	2.16	40	2.16	10	2.153	16
2.077	7	212,$11\bar{4}$			2.08	10	2.074	8
2.038	5	$13\bar{2}$					2.038	9
1.997	18	$22\bar{1}$,221	2.00	40	2.00	20		
1.992	16	033					1.992	23
1.904	5	040					1.899	7
1.872	25	$21\bar{3}$	1.88	40	1.875	20	1.870	46
1.769	10	042					1.770	11
1.747	5	034			1.748	5	1.739	9
1.719	10	025					1.719	9
1.708	7	$20\bar{4}$						
1.662	10	214					1.663	23
1.644	20	232,$13\bar{4}$						

(1) Ananai Mine (YOSHIMURA et al. 1966).
(2) Furano Mine (This paper). Intensity is given by the height of each peak.
(3) Hoino (KATO et al. 1957).
(4) Somi, Takachiho (MIYAHISA and ISHIBASHI, 1965).

Chemical Composition

The crystals were crushed into fine grains, which were picked up by hand under the binocular microscope. The pure sample was chemically analysed with the result given in Table 2. Composition of several datolites from other localities in Japan is given in the same table for comparison. It is noticed that the contents of Al_2O_3, Fe_2O_3, MgO and alkalis are the lowest among the datolites from Japan. Compared with the chemical composition of datolites from other parts of the world (DEER et al., 1962), this is probably one of the purest datolites ever reported.

The chemical formula obtained on the basis of (O, OH)=20.000 is as follows:

Table 2. Chemical Composition of Datolites

	(1)	(2)	(3)	(4)	(5)	(1-a)		
SiO_2	36.65	37.52	37.64	36.56	36.56	Si	3.923	3.957
TiO_2	tr.	n.d.	n.d.	tr.	tr.	Al	0.033	
Al_2O_3	0.26	0.38	0.32	0.48	0.45	Fe^{3+}	0.001	
Fe_2O_3	0.01	n.d.	n.d.	0.006	0.22			
FeO	n.d.	0.31	0.22	tr.	0.10	Mg	0.002	4.068
MnO	tr.	n.d.	n.d.	tr.	0.13	Ca	4.057	
MgO	0.01	0.65	0.60	6.004	0.01	Na	0.006	
CaO	35.37	33.44	34.90	36.22	34.80	K	0.003	
Na_2O	0.03	0.13	n.d.	0.07	0.04			
K_2O	0.02	0.12	n.d.	0.10	0.03	B	3.971	3.971
H_2O+	5.83	5.70	5.66	5.86	5.99			
H_2O-	0.14	0.20	n.d.	0.29	0.05	OH	4.161	20.000
B_2O_3	21.52	21.53	21.31	20.24	21.56	O	15.839	
Total	99.84	99.98	100.65	99.83	99.94			

(1) Datolite from Furano Mine: Analyst; K. AOKI (This paper).
(2) Datolite from Iwato Mine: Analyst; K. ISONO (HARADA, 1950).
(3) Datolite from Obira, Mine: Analyst; N. TANAKA (MIYAHISA et al. 1961).
(4) Datolite from Somi, Takachiho: Analyst; K. ISHIBASHI (MIYAHISA and ISHIBASHI, 1965).
(5) Datolite from Ananai Mine: Analyst; M. OZAKI (YOSHIMURA et al. 1966).
(1-a) Atomic ratios on the basis of O, OH=20,000.

$$(Ca_{4.057}Mg_{0.002}Na_{0.006}K_{0.003})_{4.068}B_{3.971}$$
$$(Si_{3.923}Al_{0.033}Fe_{0.001})_{3.957}(O_{15.839}(OH)_{4.161})_{20.000}$$

This is in close agreement with the ideal formula of datolite $CaBSiO_4(OH)$.

Microscopic Observation on Datolite and Associated Minerals

Under the microscope the datolite is observed to form euhedral to subhedral crystals, 0.2–2.0 mm in size. Sometimes large crystals are embedded in mosaic aggregates of finer granular crystals of datolite. The minerals associated with it include andradite, hedenbergite, calcite, and ore minerals. Andradite has n 1.882–1.886±0.003 and a_o 12.050–12.054 Å and the composition is estimated to be very high in andradite molecule (KOZU et al., 1940). Hedenbergite has the following properties: α' 1.730, γ' 1.760, 2V(+) 54°–64°, c∧Z 46°–50°. Pleochroism X′ . . . colorless to pale yellow, Z′ . . . pale green to grass green. Bluish green hastingsitic hornblende is rarely observed. It is noticeable that slender prismatic crystals of calcite are enclosed in large datolite crystals. Sometimes large, euhedral calcite crystals are embedded with mosaic aggregates of small granular datolite crystals. Contrarily boron-bearing minerals such as axinite, damburite or tourmaline, which are sometimes associated with datolite from other localities are not observed in this locality.

Genetic Significance

The modes of occurrence of datolite are grouped into the following three categories:

1. Skarn mineral in contact metamorphosed rocks.
2. Druse mineral in mafic volcanic rocks.
3. Vein mineral in crystalline schists.

The first category is the most common occurrence in Japan. Datolites from Obira and Iwato Mines, Kyushu (HARADA, 1939, 1950, MIYAHISA et al., 1961), Ananai Mine, Shikoku (YOSHIMURA et al., 1966), or Hol Kol Mine, Korea (KINOSHITA and NISHIHARA, 1934, WATANABE, 1935) are the examples. Sometimes datolite has been reported to occur in the calcareous xenoliths enclosed in the granodiorite (Somi, Sobosan, Kyushu, MIYAHISA and ISHIBASHI, 1965) or in diorite (Hajikano, Yamanashi Prefecture, IMAYOSHI and SAKURAI, 1950). Occurrence of datolite in the drusy parts of volcanic rocks or tuffs was reported only from Okuzure, Shizuoka Prefecture (IMAYOSHI and SAKURAI, 1950), although this occurrence is the most prevalent one in other countries.

Small veins composed mainly of datolite, associated with quartz, feldspar, or calcite, have been found in the Sambagawa crystalline schists in Shikoku (KATO et al. 1957). In some cases datolite is associated with other boron-bearing minerals such as axinite, damburite or tourmaline, but this is not the case with the present locality.

From the mode of occurrence the datolite from Furano Mine is interpreted to have been formed by the addition of boron from the invading trondhjemite magma at a stage later than the contact metamorphism of the country rocks, and probably nearly simultaneous with or slightly prior to the deposition of hydrothermal solutions.

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Dr. M. GOTO of our Department made goniometric observation on some crystals and Dr. K. AOKI of Tohoku University made the chemical analysis of the mineral. Messrs. M. HIRAMA and S. TERADA prepared the photomicrographs. Furano Forestry Office offered facilities for us during our field survey. We are very grateful to all of them for their kind co-operation. Part of the cost for the present study was defrayed by the Grant for Scientific Researches by the Ministry of Education of Japan.

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PLATE 23 AND EXPLANATION

Explanation of Plate 23

Fig. 1 Large subhedral crystals of datolite, surrounded by mosaic aggregates of smaller crystals of datolite in the upper right and lower left corners. Black crystals are pyrrhotite. Open nicol, × 20.

Fig. 2 ditto. Crossed nicols, × 20.

Fig. 3 Large euhedral crystals of calcite, embedded in mosaic aggregates of small crystals of datolite. Parallel nicols, × 20.

Fig. 4 ditto Crossed nicols, × 20.

Fig. 5 Datolite crystals fill the interstices between long acicular crystals of calcite, sometimes completely enclosing the smaller crystals. Black crystals are pyrite or pyrrhotite. Parallel nicols, × 50.

Fig. 6 ditto. Crossed nicols, × 50.

Plate 23

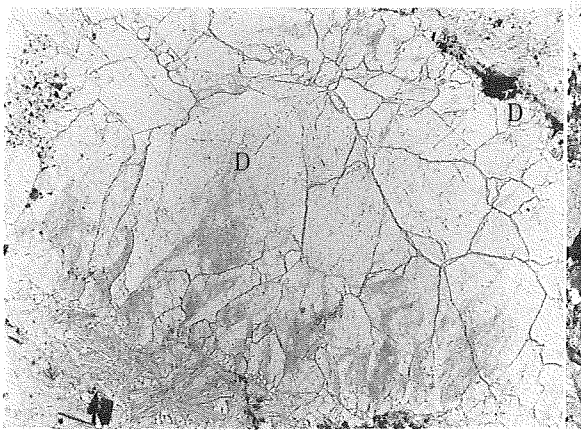

Fig. 1

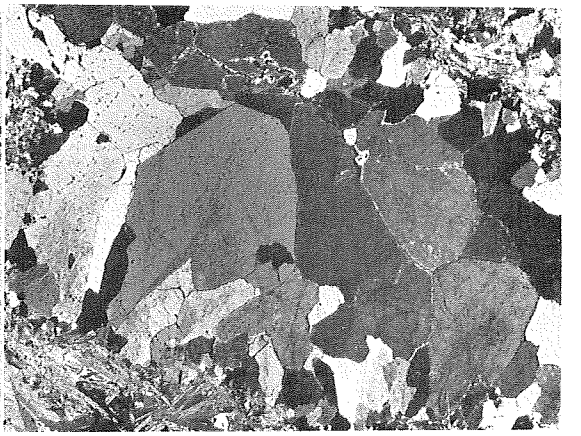

Fig. 2

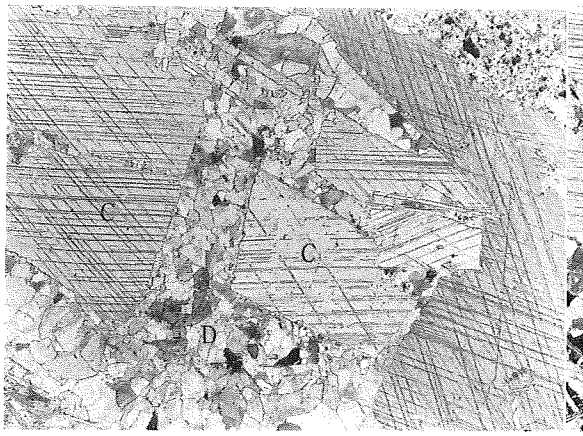

Fig. 3

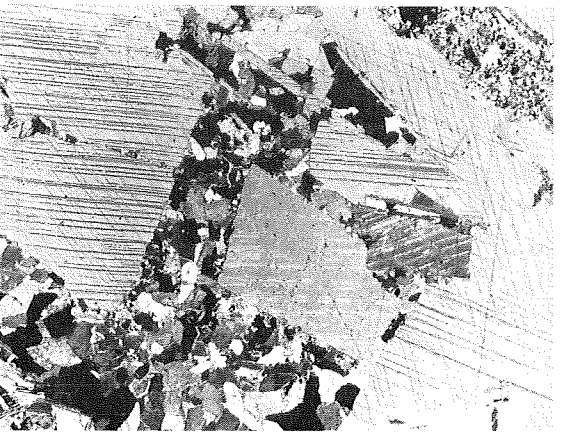

Fig. 4

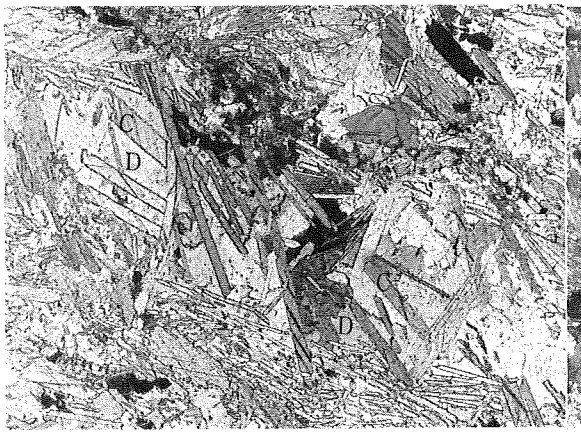

Fig. 5

Fig. 6