THULITE FROM MYÔZINZIMA,[1] SISAKAZIMA[2] ISLANDS, JAPAN.

By

Toyohumi YOSIMURA*

Contribution from the Department of Geology and Mineralogy, Faculty of Science, Hokkaidô Imperial University, Sapporo; No. 183.

I. INTRODUCTION

The Sisakazima Islands are situated in the middle part of the Inland Sea in southwestern Japan, and belong to Ehimé Prefecture. They are well known for the refinery of the Bessi Mine, established on Minosima, one of the Islands. On the eastern coast of Myôzinzima, the largest island of the Sisakazima group, an interesting occurrence of thulite was found by Prof. Dr. S. Kô and others. By the kindness of Prof. Dr. T. ITÔ of the Tôkyô Imperial University, the author was given some specimens of the thulite collected by Dr. N. KATAYAMA from this locality. The following is a brief report of investigations performed on these specimens. The author's sincere thanks are due to Prof. ITÔ and Dr. KATAYAMA for their generosity and encouragement and also to Prof. Z. HARADA and J. SUZUKI of the Hokkaidô Imperial University for their kind advice.

II. MORPHOLOGY AND PHYSICAL PROPERTIES

The thulites in the specimen are minute prismatic crystals, 0.2 mm. long or shorter. They are always elongated parallel to the crystallographic c-axis, with cleavage traces also parallel to the latter. Some of them fill up the interstices between quartz and feldspar, appearing as pink spots about 5 mm. in diameter, while the others form small veinlets about 1 mm. wide, penetrating the pegmatitic mother rock. Figure I shows the pink spots of thulite aggregates in

---

* Formerly Toyofumi YOSHIMURA.

(1) 明神島 (2) 四阪島

the marginal part of a leucocratic pegmatite, and figure 2a and figure 2b show the small thulite veinlets, magnified under the microscope.

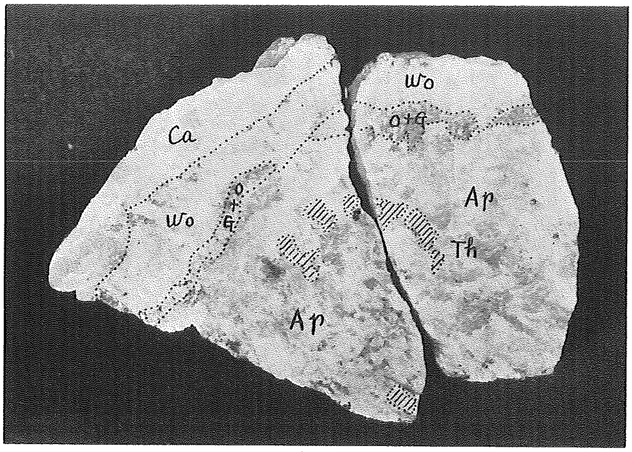

Fig. 1. Occurrence of thulite.

Ca............limestone (saccharoidal)
Wo ....wollastonite
O+G ....olivine, garnet, etc.
Th............thulite (pink spots)
Ap............aplite or leucocratic pegmatite

Natural Size.

Hardness, H = 6. Specific gravity $d_{4^\circ}^{14^\circ} = 3.23$, (the effect of impurities of 13.0% quartz and 5.7% calcite was corrected by calculation). Fusibility F = 4. Powder of thulite sinters easily. Lustre glassy or dull. Colour pink. Under the microscope it is colourless or grey, without pleochroism. The pink colour disappears readily on heating. With borax it hardly shows any reaction to manganese, while with soda it gives a bright green bead.

The plane of the optic axes lies perpendicular to the main cleavage, also to the crystallographic c-axis. X = b, Y = c, Z = a. This orientation shows that the thulite from Myôzinzima belongs to β-zoisite, or, failing that, to clinozoisite. The indices of refraction, measured by immersion in liquid, were as follows.

$\alpha = 1.705$	$\gamma - \alpha = 0.005$
$\gamma = 1.710$	$\alpha_F - \alpha_C = 0.008$
Optically positive.	(+) $2V$ moderate.

Between the crossed nicols the thulite shows weak birefringence with somewhat abnormally bluish interference colour.

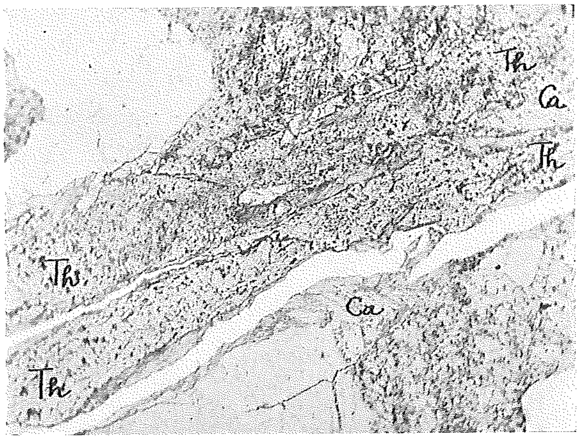

Fig. 2. a. Occurrence of thulite.
Th............thulite (pink veinlet)
Ca............calcite
Photomicrograph. Parallel nicols. ×45

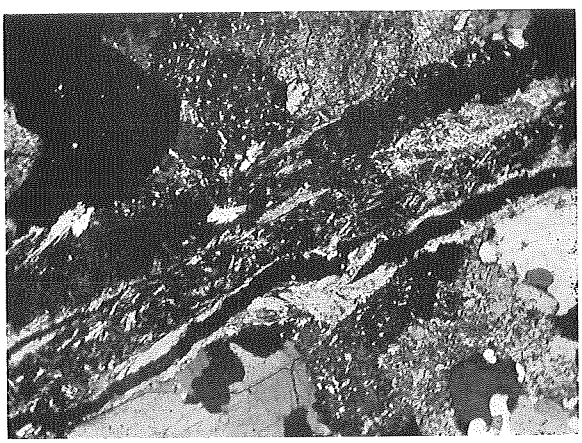

Fig. 2. b. The same as figure 2. a.
Photomicrograph. Crossed nicols. ×45

III. CHEMICAL COMPOSITION

Only the sample picked up by hand from the pink thulite veinlets was subjected to chemical analysis. Though it shows a considerable quantity of admixed quartz and calcite under the microscope, the chemical analysis was undertaken without separating such impurities. The results of the analysis are given in the following table (table 1).

* TABLE 1. Chemical composition of the thulite from Myôzinzima.

	wt%	molecular ratio I		molecular ratio II
SiO_2	44.69	744		88 × 6 216
TiO_2	—	—		—
Al_2O_3	26.04	258	263	88 × 3
Fe_2O_3	0.74	5		
FeO	3.30	47	417	88 × 4 65
MnO	0.24	3		
CaO	20.02	357		
MgO	0.48	10		
Ign. loss.	4.21			H_2O 88 CO_2 62
H_2O	0.15			
	99.87			

The chemical composition of the thulite from Myôzinzima, exclusive of impurities of calcite and quartz, is as follows;

$$H_{200}\,(Ca_{330}\,Mn_{3.5}\,Mg_{14}\,Fe^{II}_{53.5})\,(Al_{585}\,Fe^{III}_{14})\,Si_{600}\,O_{2600}$$

In table 2 the percentage composition of the pure thulite is given along with two other known analyses. It is characteristic of the thulite from Myôzinzima that it has a rather high content of ferrous iron.

Sesquioxides ($Al_2O_3 + Fe_2O_3$) were taken entirely in the zoisite molecule $H_2(Ca, Mn, Mg, Fe^{II})_4\,(Al, Fe^{III})_6\,Si_6\,O_{26}$, and the remnant, which were not taken in the above zoisite molecule, were calculated so as to form quartz (SiO_2) and calcite. The remnant base-and-acid ratio, $R^{II}O:CO_2$, to be embodied in calcite, was 65 :62, a result which agrees satisfactorily with the observation that the impurities consisted of calcite and quartz only.

* TABLE 2. Chemical composition of thulite.

	1	2	3
d	3.23	—	3.22
SiO_2	39.26	42.81	37.86
Al_2O_3	32.08	31.14	31.78
Fe_2O_3	0.92	2·29	0.90
FeO	4.06	—	—
MnO	0.29	—	0.47
CaO	20.83	18.73	25.36
MgO	0.59	1.63	0.11
Alkali	—	1.89	—
H_2O	1.97	0.64	3.80
	(100.00)	99.13	100.28

(1) Myôzinzima, Japan; anal. T. Yosimura; in the present article.

(2) Tellemark, Norway; anal. Gmelin; J. prakt. Chem. 43 84 (1848)

(3) Borzovka, Ural: anal. L. Shabynin; Mém. Soc. russe de Min., 63 456 (1934) Ref. in N. Jahrb. etc. (19.5) I

* TABLE 3. Percentage of thulite and impurities in the material analysed.

		mol. ratio	wt. %
Thulite	$H_2(Ca, Mn, Mg, Fe)_4(Al, Fe)_6Si_6O_{26}$	88	81.3
Quartz	SiO_2	216	13.0
Calcite	$CaCO_3$	63	5.7
			(100.0)

IV. OCCURRENCE AND GENESIS

The Sisakazima Islands lie in the region of injection gneisses developed extensively in the "Inner Zone" of southwestern Japan. Numerous limestone lenses and amphibolites are intercalated in the gneisses and are frequently penetrated by pegmatites and aplites, forming contact-metamorphosed zones rich in contact minerals. Dr. H. SATO, geologist of the Imperial Geological Survey of Japan, has described "mangandiopside" from a contact zone of Myôzinzima, close to where the thulite was found. A wealth of minerals of the epidote group is found in these contact zones, and some of them are found also in the pegmatite as captured crystals, (fig. 3).

(1) H. SATO: Proc. 3rd Pan-Pacific Sci. Congr., p. 803 (1926).

Fig. 3. Xenocrysts of epidote embedded in leucocratic pegmatite.
Photomicrograph. Parallel nicols. ×38

Such xenocrysts of epidote, especially those which accompany calcite, are often seen being metamorphosed into thulite gradually from their surface. Thus it is highly probable that the thulite is the product of the so-called "endogenous contact-metamorphism", which has taken place between the pegmatite and the epidote-rich basic rocks. Veinlets of thulite which penetrate the pegmatite itself, and are apparently the youngest in the genetical succession, contain no more relics of such xenocrystic epidote.

(March, 1937)