Akiho MIYASHIRO*: Notes on Rock-Forming Minerals (7) Garnet
of Borolanite with an Appendix

I. Borolanite

SHAND (1949, p. 460) states: "The *borolanite* of J. HORNE and J. J. H. TEALL, from Assynt, Scotland, is a melanite-biotite-syenoid (=feldspathoid-syenite), which typically holds no pyroxene at all. The rock exhibits white spots, of rounded or rudely polygonal outline, which may be "pseudo-leucite", set in a base of alkali-feldspar, melanite and biotite. The white spots consist of feldspar and zeolite,.....".

Recently, I examined the grandite garnet (melanite) in a KRANTZ specimen of borolanite from Loch Borolan, Assynt, Scotland. The results will be briefly given below.

The feldspar in the borolanite is a K-feldspar, commonly showing slightly moiré appearance, perhaps owing to very fine microcline twinning. The refractive indices are $\alpha=1.520$ and $\gamma=1.528$. The optic angle $2V_X$ ranges from 52° to 76° , and is variable even in a single grain. In the Geiger-counter X-ray diffractogram, the (131) and ($\bar{1}\bar{3}1$) reflections form an apparently single but too broad peak. These optical and X-ray data indicate that the K-feldspar has variable triclinicity, and a part of it may be truly monoclinic.

The biotite shows the following optic properties: $\gamma=1.633$, $2V=0^\circ$; X=pale yellow, Y=Z=dark brownish green.

II Grandite Garnet

The garnet occurs in rounded grains, up to 2mm in size. It is optically isotropic. The color in thin sections ranges from yellow to deep brown. Generally speaking, small grains, less than 0.2mm in size, are medium brown, and the periphery of big zoned grains also show a similar color. On the other hand, the core of such zoned grains is either deep brown or yellow**

The unit cell dimension of the garnet was

measured with the following result:

Indices	2θ for Cu $K\alpha_1$
(640)	54.84°
(642)	57.12°

Then, we obtain $a_0=12.06\text{\AA}$.

The peaks in the diffractogram are a little broader than those in ordinary cases, indicating inhomogeneity of the sample.

The garnet was separated by means of the isodynamic separator and Clerici solution. Minute inclusions of titanite, however, were not completely removed from the sample for analysis. Thus, the analyzed sample is a mixture of yellow and brown garnets together with a very small amount of titanite. The

Table 1. Grandite garnet from borolanite
(Analzed by H. HARAMURA)

Wt. %		Atomic ratios for O=12		
SiO ₂	33.94	Si	2.82	} 3.00
Al ₂ O ₃	3.89	Al	0.38	
TiO ₂	3.88	Ti	0.24	
Fe ₂ O ₃	23.02	Fe ⁺	1.44	} 1.88
FeO	1.23	Fe ⁺	0.09	
MnO	0.53	Mn	0.04	
MgO	0.24	Mg	0.03	} 3.10
CaO	32.99	Ca	2.94	
Na ₂ O	0.49	Na	0.08	
K ₂ O	0.21	K	0.02	
H ₂ O+	0.11			
H ₂ O-	0.00			
P ₂ O ₅	tr.			
100.53				

Note. Ca : Mn : Fe⁺ : Mg = 95 : 1 : 3 : 1.
Fe⁺/(Al+Fe⁺) = 0.79.

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** SHAND (1909) considered that the garnet is deep brown when fresh, and becomes yellow when altered. The color change was ascribed to a decrease in the Ti content.

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results are shown in Table 1. The atomic ratios calculated on the basis of $O=12$ (neglecting H_2O and P_2O_5) are also shown.

The garnet is mainly composed of andradite molecule with a subordinate amount of grossularite. It is noted that the Ti content is not so large, considering that the sample contains deep brown variety and also a little titanite.

For the genetical problem of garnet in alkalic rocks, see the preceding note (MIYASHIRO, 1959).

References Cited

- MIYASHIRO, A. (1959) Notes on rock-forming minerals. (6) Garnet in nepheline-syenite of the Fukushima-zan district. *Jour. Geol. Soc. Japan*, Vol. 65, pp. 171–172.
- SHAND, S. J. (1909) On borolanite and its associates in Assynt (preliminary communication). *Trans. Edinburgh Geol. Soc.*, Vol. 9, pp. 202–215.
- (1949) Eruptive rocks, 3rd ed. *Thomas Murby and Co., London*.

Appendix: Rapid Determination of the Unit Cell Dimension of Garnet

The unit cell edge a_0 of garnets lies within the range of 11.44–12.07 Å. In the powder diffraction pattern, two or three peaks (or

lines) are noticed in the range of $2\theta=54^\circ-61^\circ$ for $CuK\alpha_1$ radiation. They are the (642), (640) and (444) reflections in the order of decreasing 2θ and also in the order of decreasing intensity. When only two peaks are noticed, they are the (642) and (640) reflections. Table 2 gives the relation between the unit cell dimension and the 2θ values for $CuK\alpha_1$ radiation. By plotting the relation on a section paper, we can read within 30 seconds the unit cell dimension of a garnet from the powder diffraction pattern in the range of $2\theta=54^\circ-61^\circ$.

Table 2. Relation between the unit cell dimension and 2θ values of the (640) and (642) reflections for $CuK\alpha_1$ radiation.

a_0 (Å)	2θ for (640)	2θ for (642)
11.40	58.32°	60.75°
11.50	57.76°	60.16°
11.60	57.21°	59.59°
11.70	56.68°	59.03°
11.80	56.16°	58.48°
11.90	55.64°	57.94°
12.00	55.14°	57.41°
12.10	54.65°	56.89°