HASTINGSITIC HORNBLENDES FROM THE AKAGANE DISTRICT, KITAKAMI MOUNTAINS, JAPAN

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In the Akagane district, Iwate Prefecture, bluish green hornblendes are frequently observed in the silicified parts of thermally metamorphosed dacitic tuff, forming small veins and clots. Three hornblendes separated from the TA-7 drill cores in the district were chemically analysed. They belong to ferrohastingsite, rich in Fe^{+2} and Fe^{+3} , with $\text{mg}=0.10$ – 0.30 .

INTRODUCTION

Although hastingsitic hornblendes are frequently found in alkaline to subalkaline igneous rocks, their occurrences are rather uncommon in the skarn zones or contact aureoles around the igneous rocks in Japan. They have been reported only from the contact aureoles of the Tabashine granodiorite mass, Iwate Prefecture (Watanabe & Yagi, 1953), from the Obira Mine, Ōita Prefecture (Miyahisa & Matsumoto, 1959, Matsumoto & Miyahisa, 1960), Kimbu Mine, Nagano Prefecture (Matsumoto, 1968), and Moji Mine, Fukuoka Prefecture (Matsumoto, 1969).

Hastingsitic hornblendes described in this paper were found as small veins or clots in the thermally metamorphosed dacitic tuff from the TA-7 drill core situated about 600 m away from the contact of the Hitokabe granodiorite.

The author wishes to thank Professor K. Yagi for critical reading of the manuscript and valuable advices. He is also grateful to the staff of the Metallic Mineral Exploration Agency of Japan, who gave him

opportunities to examine the drill cores.

OCCURRENCES OF HASTINGSITIC HORNBLENDES

The Akagane district is well-known for the development of many contact deposits of copper and iron, and detailed geological surveys have been carried out (Watanabe & Ko, 1942, Aizawa, 1966, Nambu *et al.*, 1970). The country rocks of the district is composed of andesitic to dacitic lavas and their tuffs of the Yonesato Formation, and of limestone and slate of the Shiba Formation, both of which belong to the Carboniferous. The Hitokabe granodiorite and other small stocks of diorite, gabbro, quartz porphyry and granite porphyry intruded into the Carboniferous formations.

Bluish green to greenish blue coloured hastingsitic hornblendes are widely distributed in the TA-7 drill cores which are situated to the west of the Sakae deposit, Akagane Mine, about 600 m away from the contact of the Hitokabe granodiorite (Fig. 1). Columnar section of the TA-7 drill core is shown in Fig. 2. The dacitic tuff and slate belonging to the Yonesato

Fig. 1. Simplified geological map of the Akagane district and the location of TA-7 drill hole.

Formation, and diorite-gabbro and quartz porphyry which intruded into them are observed in this column. All the rocks of the drill core suffered thermal metamorphism belonging to amphibolite facies and partly skarnization by the Hitokabe granodiorite.

Hastingsitic hornblendes are frequently concentrated in the silicified parts of dacitic tuff and sometimes andesitic tuff, forming small veins or heterogeneous clot, dark green to black in colour. Hastingsitic hornblendes are associated with large amount of quartz, subordinate amount of plagioclase, epidote, and sphene, and occasionally clinopyroxene, allanite, axinite, pyrrhotite, pyrite, tourmaline and calcite. They are hypidiomorphic granular and bluish green to greenish blue in Z-axial colour. Twinning on (100) is extremely rare. Their optical properties are listed in Table 1.

CHEMISTRY OF HASTINGSITIC HORN- BLENDES

Three hastingsitic hornblendes separated from the TA-7 drill cores at the depth of 219.7 m, 331.2 m and 433.8 m, respectively, were chemically analysed with the results shown in Table 2. It is clear that all hornblendes are very rich in Fe^{+2} and Fe^{+3} , and fairly rich in K_2O as compared with Na_2O , with $\text{Ca} + \text{Na} + \text{K} > 2.5$. Their FeO/MgO ratio exceeds 2.5 and Niggli's $\text{mg} = 0.10\text{--}0.30$. Therefore, these hornblendes are called ferrohastingsite by Billings' (1928) classification, though their Si content is slightly high. According to Leake's classification (1968), Nos. 1 and 2 hornblendes belong to ferro-edenitic hornblende and No. 3 hornblende to magnesio-hastingsitic hornblende, because they are comparatively rich in Si (6.39–6.64). $\text{Fe}^{+3} \rightleftharpoons \text{Al}^{VI} + \text{Ti}$ substitu-

Fig. 2. Columnar section of the TA-7 drill hole.

Table 1. Optical properties and associated minerals of analysed hastingsitic hornblendes from the TA-7 drill cores

No.	1	2	3
Depth(m)	219.7	331.2	433.8
Pleochroism	X greenish yellow	yellow	pale yellow
	Y deep green	deep green	green
	Z deep greenish blue	greenish blue	bluish green
Refractive indices	α 1.701	1.698	1.674
	γ 1.722	1.713	1.700
$2Y_X$	11°	6.5°	35°-51°
CAZ	11°	n.d.	20°
Associated minerals	quartz	quartz	quartz
	plagioclase	plagioclase	plagioclase
	clinopyroxene	epidote	clinopyroxene
	epidote	allanite	epidote
	axinite	leucocene	calcite
	tourmaline		sphene
	sphene		tourmaline
	pyrrhotite		
	pyrite		
	chalcopryrite		
	magnetite		

Table 2. Chemical analyses of hastingsitic hornblendes from the TA-7 drill cores, Iwate Prefecture

	1	2	3
SiO ₂	42.27	41.51	41.24
TiO ₂	0.44	0.55	0.68
Al ₂ O ₃	9.53	10.78	11.29
Fe ₂ O ₃	8.20	7.61	5.47
FeO	21.22	21.02	18.64
MnO	0.59	0.30	0.30
MgO	1.95	2.23	5.65
CaO	10.55	10.58	11.85
Na ₂ O	1.47	1.58	1.18
K ₂ O	1.42	1.49	1.42
H ₂ O+	2.02	1.85	1.92
H ₂ O-	0.11	0.05	0.00
Total	99.77	99.55	99.64

Numbers of ions on the basis of 24(O,OH)

Si	6.643	6.531	6.386
Al ^{IV}	1.357	1.469	1.614
Al ^{VI}	0.404	0.527	0.443
Ti	0.052	0.065	0.079
Fe ⁺³	0.967	0.899	0.636
Fe ⁺²	2.779	2.756	2.405
Mn	0.078	0.040	0.039
Mg	0.460	0.527	1.313
Ca	1.776	1.783	1.966
Na	0.447	0.481	0.353
K	0.285	0.300	0.281
OH	2.116	1.941	1.983
Z	8.000	8.000	8.000
Y	4.662	4.774	4.876
X	2.508	2.564	2.600
Fe ⁺³ /Fe ⁺²	0.348	0.326	0.264
mg	0.107	0.125	0.299

Analyst : S.Kanisawa

tion and $Mg \leftrightarrow Fe^{+2}$ substitution are recognized. TiO₂ content is lower than that of the igneous ferrohastingsites. When general formula of calciferous amphiboles is expressed as $X_{2-3}Y_6Z_8O_{22}(OH)_2$, hastingsitic hornblendes from this district are always deficient in Y site ions. This fact may be explained as the result of oxidation of some Fe⁺² in Y site. Thus, these hornblendes

become more deficient in Y site ions with increasing $\text{Fe}^{+3}/\text{Fe}^{+2}$ ratios.

Chemically, hastingsitic hornblendes of the district are close to that from the Moji Mine, Fukuoka Prefecture (Matsumoto, 1969).

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岩手県、赤金産ヘスティングス閃石質角閃石

蟹 沢 聰 史

赤金鉱山栄鉱床西方の TA-7 試錐孔から採取された石炭系米里層の石英安山岩質凝灰岩は接触変成作用を受けており、しばしば暗緑色の鉱物が脈状集合体をなして産する。これは鏡下では青緑色を呈する角閃石で、化学分析の結果、 $\text{Fe}^{+3}/\text{Fe}^{+2}$ 比の高い鉄ヘスティングス閃石であることが分った。