Notes on Rock-forming Minerals (24)

Stilpnomelane from the Motoyasu Mine, Sikoku

by

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Introduction

Stilpnomelane occurs not rarely in crystalline schists in Japan (KOZIMA 1944, IWASAKI 1956, TAKEDA and SEKINE 1960). In the course of study on the bedded cupriferous pyritic deposit of the Motoyasu mine in Sikoku, southwestern Japan, the writer found stilpnomelane rich in ferrous iron which occurs in association with the ore in the Sanbagawa crystalline schist. Some chemical and optical data of the mineral will be given in this paper.

HUTTON's (1956) diagram on the relation between chemical composition and optical properties of stilpnomelane group minerals is based upon the data on varieties rather rich in ferric iron. It will be modified by the present writer's new data on ferrostilpnomelane.

Modes of occurrence

The Motoyasu mine is located 12 km. SSW. of the Bessi (Besshi) mine in Sikoku. The ore deposit of the mine is a bedded cupriferous pyritic deposit in the main green schist member of the Minawa formation, which belongs to the Sanbagawa crystalline schist (KOJIMA and others 1956). The grade of metamorphism of this area roughly corresponds to BANNO's zone Ib (BANNO 1959).

Four stilpnomelanes were separated from ores by means of the isodynamic separator and tetrabromoethane with the centrifuge. Their modes of occurrence are as follows.

No. 59025: Occurs in a thin seam, 2 cm. thick, with a small quantity of amphibole, in contact with a chalcopyrite-rich veinlet. 13th ore body S 28 100 m. stope.

No. 57053: Occurs in irregularly shaped and mono-mineralic pools or bands in copper-poor compact ore. 11th ore body S 23 W 6 75 m. stope.

No. 56034 a and b: Occurs as a gangue mineral in compact ore composed mainly of pyrite with a little amount of chalcopyrite. 10th ore body S 19 W 6 90 m. stope. Under the microscope, the color of the stilpnomelane is brown at contact with ore minerals and is more greenish with increasing distance from them. The samples a and b are lighter and heavier fractions of purified matter respectively. No. 56034 b, the heavier fraction, has some impurities of ore minerals.

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Chemical compositions and optical properties

Chemical compositions and some physical properties of these stilpnomelanes are shown in Table 1. Comparing the chemical compositions of No. 56034 a and

Table 1. Chemical compositions and physical properties of four stilpnomelanes.

	59025	56034 a	57053	56034 b
SiO ₂	45.34	45.43	44.60	41.99
Al ₂ O ₃	7.27	6.24	7.80	7.41
TiO ₂	0.16	0.09	0.07	0.10
Fe ₂ O ₃	2.07	4.69	4.56	9.42
FeO	26.71	25.64	26.74	22.69
MnO	0.36	0.38	0.27	0.28
MgO	5.66	5.76	4.21	4.75
CaO	0.76	0.29	<0.1	<0.1
Na ₂ O	0.62	0.51	0.60	0.49
K ₂ O	1.56	1.49	1.50	1.48
H ₂ O(+)	7.59	7.43	7.84	7.71
H ₂ O(-)	1.55	1.70	1.80	1.90
P ₂ O ₅	0.10	n.d.	0.08	n.d.
S	n.d.	0.29	n.d.	2.08
Total	99.75	99.94	100.07	100.30
-0 (less for S)		-0.07 99.87		-0.52 99.78
		(Analyst H. HARAMURA)		
specific gravity	2.74	2.76	2.74	2.78(2.72)*
α	1.554	1.554	1.556	1.560
γ	1.583	1.586	1.598	1.612
$\gamma - \alpha$	0.029	0.032	0.042	0.052
(-)2V	0°	0° (rarely biaxial, maximum 20°)	0° (rarely biaxial, maximum 28°)	0°
X	colorless	yellowish	pale green	pale brown
Z	pale green	pale green	green	brown
d(001) in Å	12.12	12.13	12.11	12.11

* Corrected for pyrite impurity corresponding to S of 2.08%.

Table 2. Chemical compositions shown in mol.%, excluding H₂O(-) and S along with the corresponding amount of FeO for impurity of pyrite.

	59025	56034 a	57053	56034 b
SiO ₂	41.46	42.25	41.43	41.34
Al ₂ O ₃	3.92	3.42	4.27	4.30
TiO ₂	0.11	0.06	0.05	0.08
Fe ₂ O ₃	0.71	1.64	1.60	3.49
FeO	20.42	19.68	20.77	16.76
MnO	0.28	0.30	0.21	0.24
MgO	7.71	7.98	5.83	6.97
CaO	0.75	0.29	0.10	0.11
Na ₂ O	0.55	0.46	0.54	0.47
K ₂ O	0.91	0.88	0.89	0.93
H ₂ O	23.14	23.04	24.28	25.31
P ₂ O ₅	0.04	n.d.	0.03	n.d.
Total	100.00	100.00	100.00	100.00
R ₂ O ₃ /R ₂ O ₃ + (Fe, Mn, Mg)O	} 14.3	15.5	18.1	24.7
Total Fe (atomic ratio)				
	} 398	415	429	401

b, the most striking difference is in ferrous-ferric ratio with nearly the same numbers of Fe atoms (Table 2).

HUTTON (1956) has already compiled the data on chemical compositions and optical properties of stilpnomelanes. New data by the present writer are shown with HUTTON's data according to his method in Fig. 1.

HUTTON's diagram (HUTTON 1956, Fig. 3) is based upon 3 analyses of the ferrous-rich stilpnomelane ($(\text{Fe, Mn, Mg})\text{O}/(\text{Fe, Al})_2\text{O}_3 < 0.3/0.7$) and 12 analyses of rather ferric-rich one ($0.3/0.7 < (\text{Fe, Mn, Mg})\text{O}/(\text{Fe, Al})_2\text{O}_3 < 0.7/0.3$). New data by the present writer are all of ferrous-rich stilpnomelanes ($(\text{Fe, Mn, Mg})\text{O}/(\text{Fe, Al})_2\text{O}_3 < 0.25/0.75$). The curves for γ and $\gamma-\alpha$ in the (Fe, Mn, Mg)O-rich part of Fig. 1 differ to some extent from the corresponding ones of HUTTON.

Discussion on paragenesis

A specimen of magnetite-bearing

Fig. 1. Chemical composition and optical properties of stilpnomelane.

Solid circle.....new data by the present writer.
Open circle.....data of HUTTON's (1956) paper.

Fig. 2. Photomicrographs of alternation of magnetite-green stilpnomelane layers and pyrite-brown stilpnomelane layers (No. 56033). Plane polarized light.

- Thin section. Magnetite-stilpnomelane layer (fine-grained part) and pyrite-brown stilpnomelane layer (coarse-grained part).
- The same, magnified. Scale: A $\times$ 5. Green stilpnomelane (white, upper half), brown stilpnomelane (grey, lower half) and ore minerals (black).
- Polished section. Pyrite (white), chalcopyrite (grey, around and in pyrite grains) and magnetite (grey, in gangue minerals).

ing ore (No. 56033) shows fine alternation of magnetite-green stilpnomelane layers and pyrite-brown stilpnomelane layers which are several mm. to 1 cm. thick respectively (Fig. 2). Refractive index on cleavage flakes ($\cong \gamma$) of green stilpnomelane is 1.587 and that of brown one is 1.626. Estimated (Fe, Mn, Mg)O mol. ratios are 15% and 26% respectively.

If the alternation was that of magnetite layers and pyrite layers or that of magnetite-brown stilpnomelane (richer in Fe_2O_3) layers and pyrite-green stilpnomelane (poorer in Fe_2O_3) layers, it might be explained as the result of change in environmental conditions, for example, in Eh-pH condition. Actually, however, in the present case, the paragenetic relation between ore minerals and stilpnomelanes is reversed, namely, the alternation is composed of magnetite- Fe_2O_3 -poor stilpnomelane layers and pyrite- Fe_2O_3 -rich stilpnomelane layers. The fact suggests that the diffusion of sulfur and oxygen is very limited and the alternation was formed mainly by a difference in chemical composition (especially sulfur content) as shown qualitatively as follows:

Magnetite+green stilpnomelane+sulfur
=pyrite+green stilpnomelane+oxygen
=pyrite+brown stilpnomelane.

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造 岩 鉱 物 ノ ー ト (24)

四国, 基安鉱山産スティルプノメレーン

由 井 俊 三

基安鉱山産の Fe^{2+} にとむスティルプノメレーンの化学組成と光学性を研究した。そしてそれに基づいて HUTTON の図表を修正した。各層の厚さ 1 cm 以下の、磁鉄鉱-緑色スティルプノメレーン薄層と黄鉄鉱-褐色スティルプノメレーン薄層との細い互層があるが、これは化学組成、特に S 量の相違によつて生じたものと考えられる。