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Title	Star-shaped Trillings of Enargite from the Kamikita Mine, Aomori Prefecture
Author(s)	Harada, Zyunpéi
Citation	Journal of the Faculty of Science, Hokkaido University. Series 4, Geology and mineralogy, 7(4), 319-323
Issue Date	1951-03
Doc URL	http://hdl.handle.net/2115/35847
Type	bulletin (article)
File Information	7(4)_319-323.pdf

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STAR-SHAPED TRILLINGS OF ENARGITE FROM THE KAMIKITA MINE, AOMORI PREFECTURE

By

Zyunpéi HARADA

Contribution from the Department of Geology and Mineralogy,
Faculty of Science, Hokkaido University. No. 394

Enargite is in Japan commonly found in copper vein as a primary constituent and associated with chalcopyrite, sphalerite, galena, pyrite etc. Also it occurs frequently in a peculiar sort of metasomatic copper deposit—"Kuromono" deposit—in the northeastern Japan.

The occurrence of star-shaped trillings of enargite from the Kamikita mine, Aomori Prefecture, is unreported hitherto, as far as the author knows, and seems to be rare from other localities in Japan. A note concerning a recent find may be in order for record.

The Kamikita mine is located in Kamikita County, Aomori Prefecture, 20km SSE of Asamushi hotspring near Aomori City and is owned by the Nippon Mining Company.

Several metasomatic deposits of pyrite and copper have been found in the Neogene Tertiary formation, consisting of green tuff, green tuff breccia and black shale. The Tateishi and Okunosawa deposits, which develop in the formation are now working. The pyrite ore contains 40 per cent S on an average, while the copper ore average 7.5 per cent Cu. Their outputs are 4000 ton and 1500 ton in a month respectively.

The pyrite and copper mineralizations at the mine are closely associated with igneous activities and clearly hydrothermal replacement in origin. The general geology and major events related to the formation of the ore bodies have been studied by I. ÔTA,* Chief mining geologist of this mine.

Recently two bodies of pyrite ore have been discovered in NE-SE structural zone, in which the Tateishi, Honkô and Kaminosawa ore bodies develop, by electrical prospectings and core borings.

* I. ÔTA : On Geology, Ore deposits and Prospectings at the Kamikita mine. Lectures at the Meeting of the Geological Section, Japan Mining Association, I. (1949) 19-33.

The discovered two ore bodies—the first and second Kaminosawa deposit—proved to be a "Kuromono" type replacement pyrite deposits, similar to other deposits in this mine. The first ore body, lying in North is set up in development.

Enargite was discovered at the outer fringes of the first Kaminosawa ore body. The specimens were all taken from vugs and solution cavities of massive pyrite in the host rock—tuff breccia of the Neogene Tertiary formation.

All the collected twinned enargite was minute prismatic crystals, and they terminated at the unattached end by the bright basal plane.

They are arranged in stellate twinned groups, whose twinning plane is x (320), of three individuals intercrossing at approximately 60°. (Fig. 1)

Only two forms c (001) and m (110) are observed.

The form m (110) is deeply striated vertically.

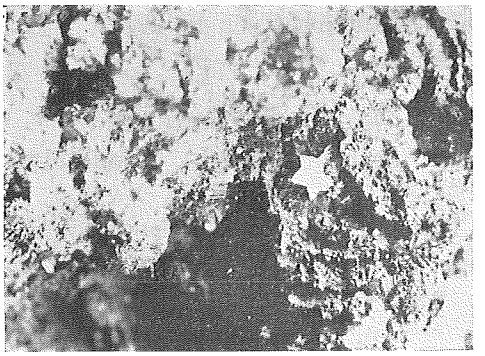

Fig. 1. Photograph of Enargite trillings from the Kamikita mine. × 4

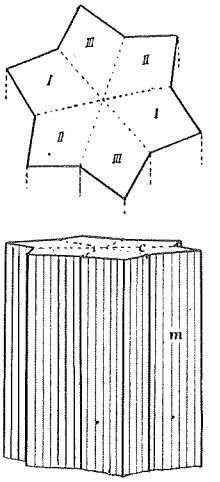

Fig. 2. Crystal of Enargite trillings from the Kamikita mine.

L. J. Spencer* pointed out that the twin crystals nearly always show only the c (001) and m (110) faces with sometimes narrow h (120) and a (100) planes, but apparently never any of the domes, though these are often present on the simple crystals. The author observed the same on the twinned crystals from the Kamikita mine.

D. Sato** had reported only the occurrence of enargite trillings at

* L. J. Spencer: Enrgite. Mineral. Mag. **11** (1892) 69, 79.

** D. Sato: Crystalline Minerals from the Abeshiro and Nishimata mine. Journ. Geol. Soc. Tokyo, **25** (1918) 459.

the Abeshiro mine, Aomori Prefecture. But no details on those trillings were obtained from his paper.

The following chemical analysis was made on the fresh crystals by S. KITAHAMA of this Department, but the specimen was of small size and has about 5 per cent of quartz as admixture. The analysis calculated to 100 per cent after deducting 5 per cent of SiO_2.

For comparison, chemical analysis of enargite from the Hanaoka mine, Akita Prefecture was taken by S. KITAHAMA. The values are given in the 2 column.

TABLE I. Chemical Compositions of Enargite

No.	1		2
Locality	Kamikita mine		Hanaoka mine, Akita Prefecture
Analyst	S. KITAHAMA	Recalculated	S. KITAHAMA
S	29.8 %	31.5 %	31.85 %
As	18.2	19.2	18.46
Sb	2.2	2.3	1.10
Cu	39.8	42.0	37.55
Fe	4.7	5.0	2.63
Pb	—	—	1.99
Zn	—	—	6.11
Mn	—	—	0.82
SiO_2	5.0	—	—
Total	88.7	100.0	100.51

The atomic ratios calculated from those analyses are given below:

TABLE II. Atomic ratios of enargite

No.	1	2
Locality	Kamikita mine	Hanaoka mine
Cu (Fe)	750 …… 2.72 …… 3	638 …… 2.50 …… 3
As (Sb)	276 …… 1.00 …… 1	255 …… 1.00 …… 1
S	982 …… 3.56 …… 4	994 …… 3.90 …… 4

The atomic ratios are in good accord with the formula $Cu(Fe)_3As(Sb)S_4$.

Enargite from the Hanaoka mine, Akita Prefecture, whose chemical

composition is given in the above, and from the Teine mine, Hokkaido, which were already identified as enargite by crystallographic and chemical examinations, were selected as comparison specimens for X-ray examinations.

Specimens of those three localities were prepared for X-ray examinations. Powder diffraction patterns were made with Cu–radiation, using a cassette of 30.28 cm radius.

Results are shown in the following table.

TABLE III. Comparison of X-ray Powder Diffraction patterns of enargite from different localities

Enargite from Kamikita mine		Enargite from Teine mine		Enargite from Hanaoka mine	
I*	d**	I*	d**	I*	d**
1	3.36			2	3.43
10	3.22	10	3.20	10	3.22
3	3.10	3	3.02	3	2.98
3	2.97	3	2.92	4	2.92
10	2.86	10	2.84	10	2.86
6	2.24	6	2.22	6	2.23
		3	2.06	3	2.11
2	1.93			2	1.90
10	1.88	10	1.86	10	1.87
2	1.82	2	1.80	2	1.81
9	1.74	10	1.73	9	1.71
8	1.61	8	1.60	8	1.61
1	1.57	1	1.55	1	1.57
1	1.44	1	1.48	1	1.44
		1	1.42		
		3	1.35	2	1.34
		2	1.32		
6	1.28	7	1.28	6	1.28
				1	1.23
				3	1.22
				4	1.20
2	1.19				
4	1.16	4	1.14	4	1.16

*I Estimated intensity. d** Measured interplanar spacing in AU.

All of the patterns of these specimens have the same arranagement of lines with approximately the same variation in intensity and proved to be identical.

Summary

The star-shaped trillings of enargite from new locality were described. Two new chemical analyses of enargite were made and the results agree closely to the formula $Cu(Fe)_3As(Sb)S_4$. X-ray diffraction patterns of enargite from three different localities in Japan are shown to be identical.

The author hearty thanks to Mr. S. KITAHAMA for his helps in chemical analyses and X-ray examinations and also to Mr. I. ÔTA and Mr. S. NAKAZIMA of the Nippon Mining Company to collect the specimens.

The work here reported was made possible in part through aid of the Grant in Aid for Fundamental Scientific Research, Ministry of Education. The author is very grateful for this assistance.