TEINEITE,[1] A NEW TELLURATE MINERAL FROM THE TEINE MINE, HOKKAIDŌ, JAPAN

By

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I. INTRODUCTION AND ACKNOWLEDGMENTS

Recently Professor ZYUNPÉI HARADA collected some beautiful crystals of a blue mineral from the Takinosawa[2] vein of the Teine mine,[3] Hokkaidō, Japan. Though they resemble in several respects the crystals of caledonite, which the author has just described in the preceding paper, the chemical composition is quite distinct from that of caledonite. It has proved to be hydrated tellurate-sulphate of copper. Also optically and crystallographically, it is not a mineral of the caledonite group, nor can it be identified with any other known mineral. The author proposes the name "Teineite" from the Teine mine where this new mineral has first been found.

In the following pages will be presented the description of "Teineite", specimens of which have been given to the author by Prof. Z. HARADA, by Dr. T. WATANABE and again by the staff of the Teine mine, to whom are due the author's sincere thanks.

II. MORPHOLOGY

Teineite is found generally as fine prismatic crystals, often as long as one centimeter. Some crystals are double-terminated, the crystal-habit being not hemimorphic (Fig. 5). The crystal belongs to the rhombic system, with the axial ratios;

$$a : b : c = 0.705_1 : 1 : 0.786_0$$
$$110 \wedge 1\bar{1}0 = 70° \ 27' \ (\pm 5')$$
$$011 \wedge 0\bar{1}1 = 76° \ 20' \ (\pm 10')$$

(1) 手稲石 (pronounced "téiné-ait"). (2) 瀧之澤. (3) 手稲鑛山.

Crystal forms measured on the two-circle goniometer are as follows (Figs. 1 and 2);

b (010)
m (110)
e (011)
f (073)

$$073\wedge0\bar{7}3 = 123^\circ\ 0'\ (\pm 30') \ldots\ldots\ \text{measured,}$$
$$,, \quad = 122^\circ\ 48' \ldots\ldots\ldots\ \text{calculated.}$$

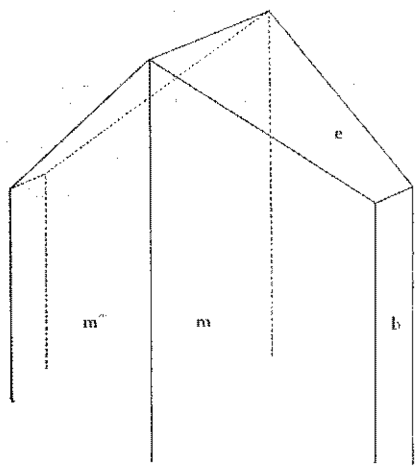

Fig. 1. Crystal of teineite; Type A.

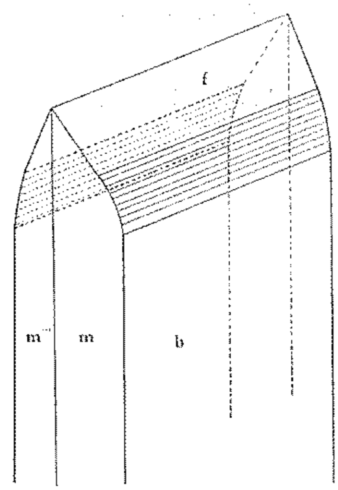

Fig. 2. Crystal of teineite; Type B.

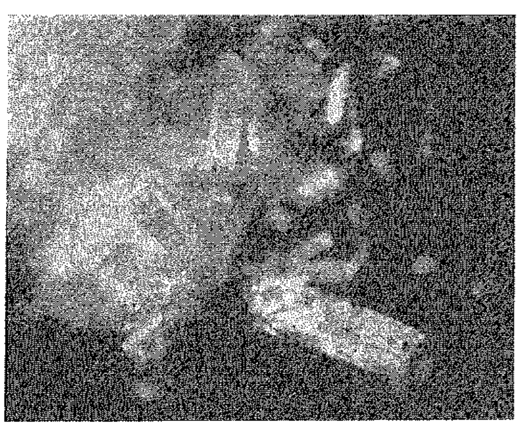

Fig. 3. Teineite crystals in a druse: Type B. ×13.

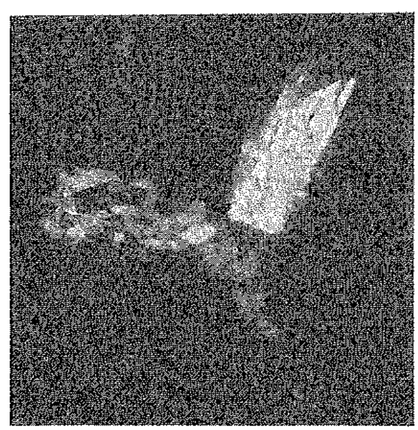

Fig. 4. Figs. 4-6. Teineite crystals showing natural etchings: Type A (twinned?). ×17.

Natural etchings are very common on nearly all faces (Figs. 4–6).

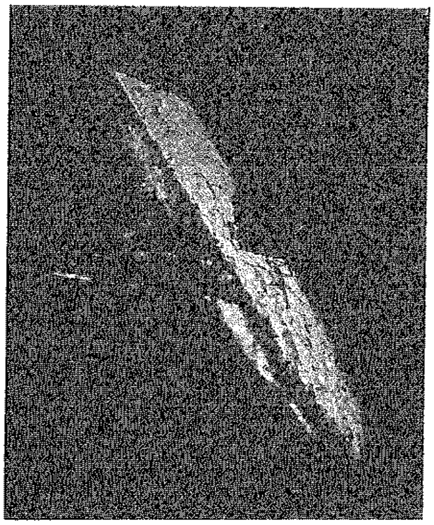

Fig. 5.

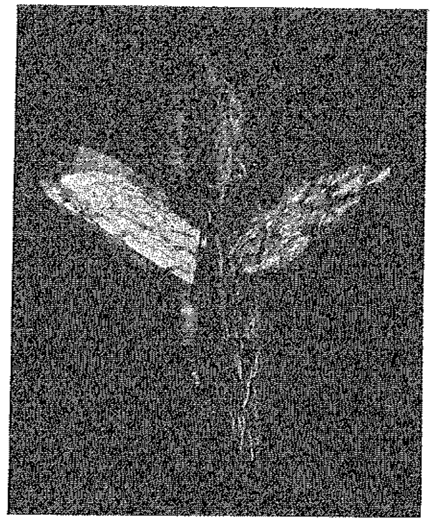

Fig. 6.

III. PHYSICAL PROPERTIES

Cleavage; (010) good, (001) (100) weak.
Hardness; H = 2½. Brittle.
Specific gravity; $d_{4^\circ}^{20^\circ} = 3.80$.
Fusibility; F = 2, gives black bead before the blow-pipe.

The optical orientations are shown in Figure 7. The optic axial plane is parallel to 010: $X = a$, $Y = b$, $Z = c$. Indices of refraction were determined by immersing in the iodides-piperine-melts.

$$\alpha = 1.767 \qquad \gamma - \alpha = 0.024^{(1)}$$
$$\beta = 1.782 \qquad \alpha_F - \alpha_C = 0.012$$
$$\gamma = 1.791$$

Optically negative, (−)2V = 36°.0. Colour beautiful cerulean-blue (58 1B), often cobalt-blue or bluish-grey especially when somewhat altered. Streak bluish-white. Under the microscope it is bright blue to greenish-blue, being distinctly pleochroic in thick slices.

(1) Moderate birefringence is characteristic of hydrated normal sulphate of Cu etc., and is in contrast with the strong birefringence of basic sulphate of similar metals. Teineite has added an another example of the normal sulphate mineral. (See the table in the next page)

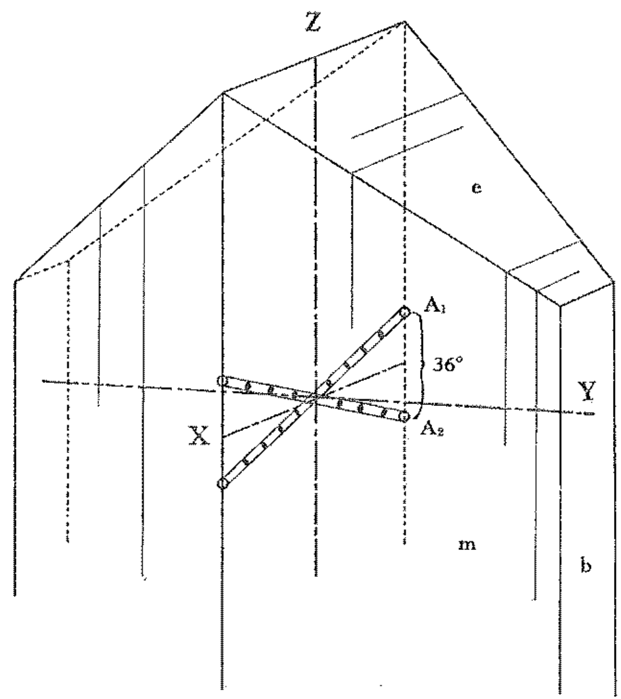

Fig. 7. Optic orientations of teineite.

X .... greenish-blue,
Y .... blue,
Z .... indigo-blue.

Adsorption; $Z \geq Y \geq X$.

Hydrated basic sulphates etc.

Linarite: $PbO \cdot CuO \cdot SO_3 \cdot H_2O$	$\gamma - \alpha = 0.050$
Caledonite: $5PbO \cdot 2CuO \cdot CO_2 \cdot 3SO_3 \cdot 6H_2O$	,, 0.091
Herrengrundite: $3CuO \cdot 2SO_3 \cdot 6H_2O$	,, 0.075
Brochantite: $4CuO \cdot SO_3 \cdot 3H_2O$	,, 0.073
Langite: $4CuO \cdot SO_3 \cdot 4H_2O$	,, 0.090

Hydrated normal sulphates etc.

Morenosite: $NiSO_4 \cdot 7H_2O$	$\gamma - \alpha = 0.025$
Goslarite: $ZnSO_4 \cdot 7H_2O$	,, 0.031
Zu-Cu-melanterite: $(Zn, Cu) SO_4 \cdot 7H_2O$	,, 0.009
Chalcanthite: $CuSO_4 \cdot 5H_2O$	,, 0.030
Chalcomenite: $CuSeO_3 \cdot 2H_2O$	,, 0.022
Teineite: $Cu(S, Te) O_4 2H_2O$	,, 0.024

IV. CHEMICAL COMPOSITION

A small but carefully picked sample was available which, except for a slight admixture of gangue, was pure and homogeneous. Teineite is easily soluble in hydrochloric acid to a greenish-yellow solution and in nitric acid to a blue solution. Before complete dissolution telluric oxide remains for a time as a white insoluble residue, which disappears at once on heating. In a closed tube it gives off water completely without decomposition of the tellurate. Tellurium was weighed as TeO_2 after dehydration with acid, and was again weighed as Te after reducing the oxide by the sulphurous acid method. The results of the analysis are given in Table 1.

TABLE 1. Analysis of teineite

	wt. %	Mol. ratio.	
CuO	28.0	35.2	1
TeO_3	48.0	27.3	1
SO_3	6.6	8.2	
H_2O	12.2	71.5	2
Insoluble	6.1		
	100.9.		

Te : S = 3.32

CuO : (TeO_3+SO_3) = 1 : 1

The chemical analysis corresponds closely to the composition 10 $CuTeO_4 \cdot 3CuSO_4 \cdot 26H_2O$.

V. OCCURRENCE AND GENESIS

The Takinosawa vein belongs to one of the most promising workings of the Teine mine, and is noted for being the home of native tellurium and sylvanite.[1] The vein is composed mainly of chalcedonic quartz and barite, with a variable quantity of pyrite, tetrahedrite and zincblende. Veinlets of native tellurium traverse the main ore body and in the oxidized part of the tellurium veinlet blue crystals

(1) T. WATANABE: Jour. Fac. Sci., Hokkaidō Imp. University, Ser. IV, Vol. **3** p. 101–111 (1936).

———— : Jour. Geol. Soc. of Japan, Vol. **43** 787–799, (1936).

of teineite are found associated with quartz and barite forming a druse. Teineite occurs near the surface, where oxidation by the percolating water is still active, but if it is exposed to subaerial weathering it is unstable and is transformed into malachite and azurite. Teineite is accompanied by pretty yellow crystals of tellurite TeO_2 and green crusts of a kind of tellurium mineral. All these three minerals are apparently the product of secondary oxidation of tetrahedrite and tellurium-rich ores.

(September, 1936)