

# Taneyamalite, $(\text{Na,Ca})(\text{Mn}^{2+}, \text{Mg}, \text{Fe}^{3+}, \text{Al})_{12}\text{Si}_{12}(\text{O}, \text{OH})_{44}$ , a new mineral from the Iwaizawa mine, Saitama Prefecture, Japan

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**ABSTRACT.** Taneyamalite,  $(\text{Na,Ca})(\text{Mn}^{2+}, \text{Mg}, \text{Fe}^{3+}, \text{Al})_{12}\text{Si}_{12}(\text{O}, \text{OH})_{44}$ , is a  $\text{Mn}^{2+}$ -dominant analogue of howieite, and has been found in the metamorphosed bedded manganese ore deposit of the Iwaizawa mine, Saitama Prefecture, Japan. It is triclinic,  $P1$  or  $P\bar{1}$ ,  $a$  10.198(1),  $b$  9.820(1),  $c$  9.485(1) Å,  $\alpha$  90° 30(1)',  $\beta$  70° 32(1)',  $\gamma$  108° 34(1)',  $Z = 1$ . The strongest X-ray powder diffractions are: 9.29(80)010, 7.99(35) $\bar{1}$ 10, 4.62(50)020, 3.65(40)120, 3.273(100) $\bar{1}$ 30, 3.081(50) $\bar{1}$ 31, 2.790(35) $\bar{2}$ 31, 2.630(28)023, 2.216(35)014, 4 $\bar{2}$ 3. Taneyamalite occurs in association with minor bannisterite as small seams in a caryopilite mass or as a fissure mineral cutting a hematite-quartz mass. It is greenish grey-yellow, lustre vitreous. Streak light yellow. Cleavage {010}, perfect. H. (Mohs) about 5. Calculated sp. gr. 3.30 (on unit cell data and normalized empirical formula), 3.25 (after the Gladstone-Dale Law using the revised data of Mandarino, 1976). It is optically biaxial negative,  $2V_x$  about 70°. The refractive indices:  $\alpha = 1.646(2)$ ,  $\beta = 1.664(2)$ ,  $\gamma = 1.676(2)$ . Extinction is nearly parallel, sign of elongation positive. Pleochroism distinct:  $\alpha = \beta$  nearly colourless,  $\gamma$  pale yellow. Absorption:  $\alpha \approx \beta < \gamma$ .

In 1977 the author collected a greenish grey to yellow fissure mineral in manganese-iron ores from the dump of the Iwaizawa mine, Saitama Prefecture, Japan. The X-ray powder study and microprobe analysis proved it to be an Mn-dominant analogue of howieite and identified it with a howieite-like mineral from the Taneyama mine, Kumamoto Prefecture, Japan, studied by Aoki and Isono (1968), whose revised wet-chemical analysis and X-ray powder study corroborated the identity (Aoki and Akasako, 1978). Therefore, the new mineral name taneyamalite was proposed after the first locality. The mineral and name have been approved by the Commission on New Minerals and Mineral Names, IMA. Type materials are preserved at the National Science Museum, Shinjuku, Tokyo, Japan.

**Occurrence.** The Iwaizawa mine is situated near Agano, Hanno city, Saitama Prefecture, or about 60 km west-north-west of Tokyo. The bedded manganese ore deposit is developed in Triassic

weakly metamorphosed chert associated with a greenstone belonging to prehnite-pumpellyite metagraywacke facies. Taneyamalite is found as small seams in caryopilite masses up to 1 cm across or as a fissure mineral cutting quartz-hematite aggregates. In thin section the seams are composed of crinkled flakes of taneyamalite with small patches of bannisterite (fig. 1). The other minerals found in the dump of the mine include braunite, rhodochrosite, calcite, albite, cinnabar, and pyrite.

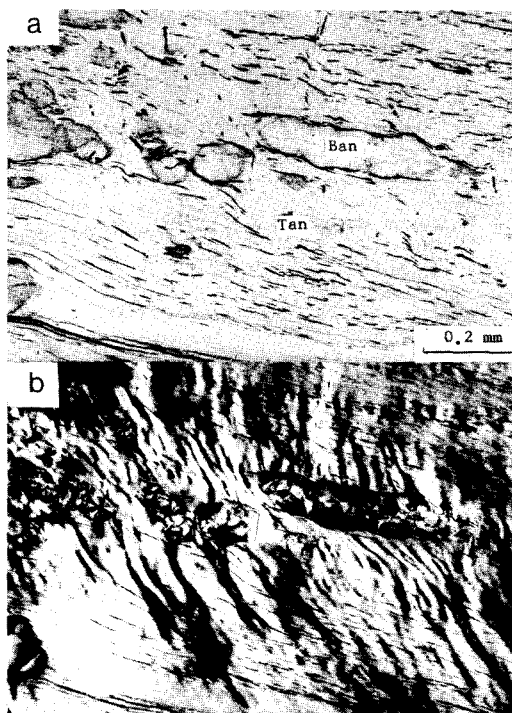


FIG. 1. Photomicrograph of taneyamalite (Tan). Note the crinkled texture and small patches of bannisterite (Ban). (a) One polar; (b) crossed polars.

*Physical and optical properties.* Taneyamalite from the Iwaizawa mine is greenish grey-yellow with a vitreous lustre. Streak is light yellow. Cleavage is perfect on {010}. Hardness of aggregate is about 5 in Mohs' scale. The calculated specific gravity is 3.30 from the unit-cell data and normalized empirical formula, and 3.25 from the Gladstone-Dale Law using the revised data of Mandarinò (1976). Direct measurement was impossible due to minor bannisterite inclusions. It is biaxial negative with  $2V_\alpha$  about  $70^\circ$ . Refractive indices are:  $\alpha$  1.646(2),  $\beta$  1.664(2),  $\gamma$  1.676(2) by the immersion method. The extinction is nearly parallel and the sign of elongation is positive. Pleochroism is distinct:  $\alpha = \beta$  nearly colourless and  $\gamma$  pale yellow. Absorption is  $\alpha \approx \beta < \gamma$ .

TABLE I. Electron-microprobe analysis of taneyamalite

	1	2
SiO <sub>2</sub>	43.42	12
Al <sub>2</sub> O <sub>3</sub>	1.25	0.41
TiO <sub>2</sub>	0.75	0.16
Fe <sub>2</sub> O <sub>3</sub> *	6.39	1.33
MnO†	30.97	7.20
MgO	6.25	2.58
CaO	0.02	0.01
Na <sub>2</sub> O	1.80	0.96
K <sub>2</sub> O	0.00	0
H <sub>2</sub> O	(7.61)‡	14.02
Total	98.46%	

1. Weight per cent.

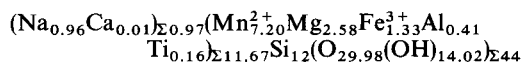
\* total Fe

† total Mn

‡ calculated.

2. Molecular numbers on the basis of Si = 12 and O + OH = 44.

*Chemical composition.* The electron-microprobe analysis was made using the following standards: analysed kaersutite for Fe, Mg, Ti, Al, Si, Na, Ca, and K, and rhodonite for Mn. No other elements with atomic number greater than 11 were detected. The result shown in Table I leads to the empirical formula



on the basis of Si = 12 and O + OH = 44. Total iron is calculated as Fe<sup>3+</sup> and total manganese as Mn<sup>2+</sup>, respectively. This is an Mn-dominant analogue of howieite due to the dominance of Mn<sup>2+</sup> in the octahedral sites, the size of which permit the substitution of Mn<sup>2+</sup> for Fe<sup>2+</sup>, etc. (Wenk, 1974).

The ideal formula can be written as (Na,Ca)(Mn<sup>2+</sup>, Mg, Fe<sup>3+</sup>, Al)<sub>12</sub>Si<sub>12</sub>(O,OH)<sub>44</sub> where Na > Ca; Mn<sup>2+</sup> > (Mg, Fe<sup>3+</sup>, Al) and O > OH.

*X-ray powder study.* The crinkled nature of the mineral only allows X-ray powder study, from which the unit-cell parameters were derived after reference to those of howieite by Wenk (1974):  $a$  10.198(1),  $b$  9.820(1),  $c$  9.485(1) Å,  $\alpha = 90^\circ 30(1)'$ ,  $\beta = 70^\circ 32(1)'$ ,  $\gamma = 108^\circ 34(1)'$ . This cell includes one molecule of ideal formula. The indexed X-ray powder diffraction pattern by the diffractometer method using Fe/Mn radiation is given in Table II.

TABLE II. X-ray powder diffraction pattern of taneyamalite ( $b = \text{broad}$ )

hkl	$d_{\text{obs.}}$	$d_{\text{calc.}}$	$I$	hkl	$d_{\text{obs.}}$	$d_{\text{calc.}}$	$I$
010	9.29	9.25	80	032	2.678	2.674	22
$\bar{1}10$	7.99	7.94	35	023	2.630	2.629	28
$\bar{1}20$	4.84	4.83	15	132	2.514	2.511	5
020	4.62	4.63	50	240	2.408	2.413	8b
012	4.18	4.19	8	401			
$\bar{1}21$	4.11	4.12	5	023	2.380	2.380	10
220	3.99	3.97	25	014	2.216	2.216	35
211	3.77	3.81	10	423			
211		3.73	342	2.129	2.129	5	
120	3.65	3.66	40	314	2.071	2.071	12
210	3.60	3.62	12b	5 $\bar{1}2$	2.018	2.018	8
$\bar{1}12$		3.57		622	1.698	1.698	20
212	3.39	3.39	12	044		1.698	1.698
222	3.35	3.33	20	261	1.612	1.612	8
$\bar{1}30$	3.273	3.273	100	$\bar{1}60$			
321	3.151	3.156	10	523	1.583	1.583	6
$\bar{1}31$	3.081	3.082	50	601			
022	3.049	3.044	15	135	1.569	1.569	5
322	2.900	2.915	8	245	1.450	1.449	5
212	2.833	2.835	12	5 $\bar{1}6$	1.431	1.431	10b
031		2.821		653			
231	2.790	2.795	35	721	1.430	1.430	

*Discussion.* According to the definition of taneyamalite, some howieite from Brezovia, Yugoslavia (Schreyer and Abraham, 1977), and from Ward Creek, Cazadero, Russian River, and Pacheco Pass, California (Muir Wood, 1979) are to be included in the compositional range of taneyamalite.

The original Fe<sup>2+</sup>-dominant howieite from California is considered as the product of glaucophane-schist facies metamorphism (Agrell *et al.*, 1965), whereas the present taneyamalite is the product of prehnite-pumpellyite metagraywacke facies metamorphism. These facts support the possibility of a transposition of the stability range of howieite

toward lower pressures and temperatures due to substitution of  $Mn^{2+}$  for  $Fe^{2+}$  as already pointed out by Muir Wood (1979).

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## REFERENCES

- Agrell, S. O., Bown, M. G., and McKie, D. (1965). *Am. Mineral.* **50**, 278. (Abstr.)  
Aoki, Y., and Akasako, H. (1978). Annual Meeting Abstr. Mineral. Soc. Japan, 31. (In Japanese.)  
— and Isono, K. (1968). *J. Geol. Soc. Japan*, **74**, 136. (Abstr.) (In Japanese.)  
Mandarino, J. A. (1976). *Can. Mineral.* **14**, 498-502.  
Muir Wood, R. (1979). *Mineral. Mag.* **43**, 363-70.  
Schreyer, W., and Abraham, K. (1977). *Neues Jahrb. Mineral. Abh.* **130**, 114-33.  
Wenk, H. R. (1974). *Am. Mineral.* **59**, 86-97.  
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