

## Manganese-poor axinite from Hata, Moji, Fukuoka Prefecture, Japan

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## Manganese-poor axinite from Hata, Moji, Fukuoka Prefecture, Japan

By

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### Introduction

The MnO content of common axinites is generally more than 3 weight percent. SIMONEN and WIIK (1952) describes two manganese-poor axinites, one from Jokioinen, southwestern Finland, and the other from Petsamo, U.S.S.R., both of which are notably low in MnO content (0.69 and 0.75 percent respectively) and remarkably high in FeO (9.36 and 9.56 percent). This paper is a mineralogical note on the pale purplish gray axinite from Hata, Moji, Fukuoka Prefecture, Japan, which is identified here as one of the axinites having the lowest manganese contents known so far.

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### Occurrence

The axinite from Hata, Moji, Fukuoka Prefecture, Japan is found as a vein-mineral in the greenish tuffaceous slate of the Paleozoic formation which

Table 1. Optical and physical properties of axinites

	( 1 )	( 2 )	( 3 )
$\alpha$	1.671	1.677	1.676
$\beta$	1.678	1.684	1.684
$\gamma$	1.682	1.688	1.689
$2V_{\alpha}$	—	72°	76°
S. G.	3.261	3.28	3.299

- ( 1 ) Pale purplish gray axinite, axinite-quartz-calcite-epidote veinlet cutting greenish tuffaceous slate, Hata, Moji, Fukuoka Prefecture, Japan (OZAKI, this paper).
- ( 2 ) Brownish gray axinite, axinite-quartz-calcite vein cutting amphibolite, Jokioinen, southwestern Finland (SIMONEN and WIIK, 1952).
- ( 3 ) Violet axinite, axinite-fluorite-pyrite vein in dioritic and granitic gneiss, Kongsberg, Norway (NEUMANN, 1944).

consists mainly of black slate, tuffaceous slate and siliceous sandstone. It associates with calcite, quartz and a small amount of epidote, and these minerals make veinlets of 10 to 20 millimeters in width. The main constituents of the tuffaceous slate are albite, quartz, epidote and chlorite.

### Optical and physical properties

The axinite forms tabular, needle-like or axe-like crystals, up to 3 millimeters in length. Color is pale purplish gray. In thin section it is colorless. Pleochroism is observable in thick section: pale brownish violet to colorless. The refractive

Table 2. Chemical composition of axinites

	(1)	(2)	(3)
SiO <sub>2</sub>	42.05 wt. %	42.95	42.40
TiO <sub>2</sub>	0.19	0.14	—
B <sub>2</sub> O <sub>3</sub>	6.22	6.54	6.05
Al <sub>2</sub> O <sub>3</sub>	16.87	17.69	18.22
Fe <sub>2</sub> O <sub>3</sub>	2.11	0.24	0.53
FeO	6.99	9.36	5.83
MnO	0.45	0.69	4.42
MgO	2.37	1.59	0.83
CaO	19.94	19.69	19.72
Na <sub>2</sub> O	0.18	0.33	0.14
K <sub>2</sub> O	0.06	0.06	0.03
H <sub>2</sub> O <sup>+</sup>	1.65	0.64	1.60
H <sub>2</sub> O <sup>-</sup>	0.78	0.00	—
Total	99.86	99.92	99.77
B	2.026	2.138	1.968
Si	7.937	8.135	7.995
Al	3.753	3.948	4.048
Fe <sup>3+</sup>	0.300	0.034	0.075
Ti	0.027	0.020	—
Mg	0.667	0.449	0.233
Fe <sup>2+</sup>	1.103	1.483	0.919
Mn	0.073	0.111	0.706
Na	0.066	0.121	0.051
Ca	4.033	3.996	3.985
K	0.014	0.014	0.007
OH	2.077	0.809	2.008

(1) Axinite from Hata, Moji, Fukuoka Prefecture, Japan.  
Anal. OZAKI (this paper).

(2) Axinite from Jokioinen, southwestern Finland.  
Anal. WIIK (SIMONEN and WIIK, 1952).

(3) Axinite from Kongsberg, Norway.  
Anal. NEUMANN (NEUMANN, 1944).

indices were measured by the immersion method, and the specific gravity was determined by a precision balance using carbon tetrachloride. The results are given in Table 1, Column 1, together with two earlier data on axinite. The relatively low refractive indices and specific gravity of this axinite are maybe caused by the chemical compositions described below.

Table 3. X-ray powder data of axinites

(1)		(2)		(1)		(2)		(1)		(2)	
$d(\text{\AA})$	I/I <sub>1</sub>	$d(\text{\AA})$	I/I <sub>1</sub>	$d(\text{\AA})$	I/I <sub>1</sub>	$d(\text{\AA})$	I/I <sub>1</sub>	$d(\text{\AA})$	I/I <sub>1</sub>	$d(\text{\AA})$	I/I <sub>1</sub>
6.32	9	6.30	7	2.557	10	2.564	6			1.744	1
5.87	4	5.87	0.5			2.526	3	1.726	5	1.732	3
		5.15	0.5			2.489	2	1.721	3b	1.721	3
4.94	3	4.99	1	2.479	3	2.474	2	1.701	2b	1.704	2
4.80	3	4.80	2	2.468	3					1.691	1
4.54	3	4.53	3	2.441	8	2.444	5			1.680	1
4.00	2	3.99	2	2.418	4b	2.424	5	1.664	6b	1.668	4
		3.80	3			2.396	1	1.661	5		
3.68	7	3.68	6	2.359	8	2.363	5	1.647	5b	1.652	4
3.49	5					2.318	0.5	1.632	6	1.636	5
3.46	44	3.46	8			2.292	1	1.628	5		
3.42	5	3.42	0.5	2.271	1	2.271	3	1.621	4	1.623	3
		3.39	0.5	2.260	2			1.613	3	1.608	2
3.35	4			2.244	2	2.250	3	1.594	3b	1.597	3
3.28	7	3.28	6			2.226	1	1.577	8	1.580	4
		3.23	0.5	2.203	4	2.206	3			1.570	2
		3.19	0.5	2.187	10b	2.190	6	1.533	3b	1.538	3
3.16	100	3.16	9	2.177	4b	2.179	2	1.514	2b	1.516	2b
3.08	10	3.08	4b	2.159	12	2.163	7	1.508	2b		
3.01	13	3.02	5			2.134	3b	1.491	5	1.495	3
2.992	11	2.998	6	2.085	1			1.476	3b	1.478	2
2.963	10	2.968	5	2.055	7	2.060	5	1.464	2	1.460	4b
2.928	4	2.931	3	2.033	4	2.040	5	1.456	3		
2.890	12			2.008	6	2.014	3b	1.441	2	1.442	1
		2.874	3	2.003	6			1.439	2	1.435	1
2.866	6			1.998	7b	1.998	3b	1.423	3	1.426	3
2.834	8	2.839	4	1.987	7	1.989	5			1.420	3
2.822	42					1.973	0.5	1.402	4	1.405	5b
		2.812	10	1.955	3b	1.955	4			1.374	2b
2.786	12	2.792	4	1.948	3b					1.359	4
2.755	4	2.760	4	1.923	4	1.926	5			1.348	1b
2.662	3	2.667	4			1.895	1b			1.327	5
2.644	4	2.643	4b			1.808	2			1.323	3
2.589	2			1.788	3	1.788	4			1.314	1b
		2.575	5	1.780	5					1.301	1

b, broad line.

- (1) Axinite from Hata, Moji, Fukuoka Prefecture, Japan (OZAKI, this paper). FeK $\alpha$  radiation. Scanning speed, 1° per minute.
- (2) Axinite from Bourg d'Oisans, Dauphine, France (MILTON and others, 1953). FeK $\alpha$  radiation. Camera radius 57.3 mm.

### Chemical composition

The axinite sample was purified with the heavy-liquid and a magnetic separator, and chemically analysed by the standard wet-chemical techniques except boron, which was determined by the titrimetric method. The result is shown in Table 2, Column 1, where this analysis has also been calculated on the basis of 32 (O, OH). The result agrees closely with the ideal axinite formula,  $H(Fe, Mn)Ca_2Al_2BSi_4O_{16}$ , and is notably low in manganese content compared with the axinites known so far.

### X-ray pattern

The X-ray powder patterns taken by the J.E.O.L. X-ray diffractometer have been compared with those of axinite from Bourg d'Oisans, Dauphine, France (MILTON and others, 1953). The data are shown in Table 3. They show slight differences mutually, a part of which may be due to some chemical variations.

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