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By

Yōhachiro OKAMOTO and Haruo SHIROZU

Introduction

There are several small manganese ore deposits in the crystalline schist of the Nishisonogi Peninsula, Nagasaki Prefecture. From one of these deposits at Ōishigō of Muramatsu Village were collected in 1941 light-brown chlorite, braunite, etc., and the morphological properties of the braunite were already reported (OKAMOTO and others, 1944). This paper is a mineralogical note on the light-brown chlorite, which is identified here as a manganoan leuchtenbergite, a mineral of the Mg-rich chlorite group.

Occurrence

The manganese ore deposit from which the chlorite in question has been collected forms a lenticular small ore body in the sericite-quartz schist and consists mainly of braunite, piedmontite, and quartz. The chlorite occurs as veins or massive aggregates sometimes containing fine crystals of braunite. The braunite crystals, up to 3 millimeters in diameter, have c (001), p (111), x (421), a (100), and d (201) faces, and are frequently twined on (101). Associating with the above-mentioned essential minerals, manganese dioxide ore, alkali-feldspar, barite, etc. are found in this deposit.

Physical properties

Color is light-brown with a pinkish tinge. Under the microscope it is pale yellow without noticeable pleochroism. Cleavage (001) perfect. It forms parallel or radial aggregates of tiny laths, up to 1 millimeter in length. Optically positive with 2V very small to 0°, $n_X = n_Y = 1.577$, $n_Z = 1.589$, $n_Z - n_X = 0.012$. Specific gravity 2.68 (picnometer method). The density calculated from the cell dimensions and the chemical formula is 2.675.

Chemical composition

The results of the chemical analysis of the chlorite free from impurities are shown in Table 1, Column 1. The chemical formula calculated from the analysis on the basis of 18 (O, OH) is:

$$\underbrace{(Mg_{4.72}Mn_{0.05}Fe^{3+}_{0.07}Al_{1.14})}_{5.98\ \text{atoms}}\ \underbrace{(Si_{2.72}Al_{1.28})}_{4\ \text{atoms}}\ \underbrace{O_{9.88}OH_{8.12}}_{18\ \text{atoms}}$$

This formula agrees closely with the ideal chlorite formula and falls in the field of sheridanite neighbouring that of leuchtenbergite in the latest classification of HEY (1954). Compared with earlier analyses, however, it is leuchtenbergite rather than sheridanite, two analyses of leuchtenbergite being given for comparison in Table 1, Columns 2 and 3. Columns 4 and 5 in the table are the analyses of "manganese chlorite" which faintly resemble this chlorite in the mode of occurrence, manganese content, color, etc.

On referring to its chemical composition and characteristic color caused by the manganese component, the chlorite described here may well be called "manganoan leuchtenbergite."

Table 1. Chemical analyses of some Mg-chlorites

	1	2	3	4	5
SiO_2	29.26	29.07	30.31	32.51	33.71
TiO_2	n.d.	0.32	—	—	—
Al_2O_3	22.06	21.82	21.72	16.17	13.80
Fe_2O_3	1.05	0.83	—	0.56	1.64
FeO	none	3.67	0.56	0.00	—
MnO	0.69	—	—	1.06	2.28
MgO	34.08	29.90	34.60	35.72	35.88
CaO	none	0.19	—	0.00	0.33
K_2O	n.d.	tr.	—	0.51	—
Na_2O	n.d.	tr.	—	0.96	—
H_2O+	13.11	10.76	13.30	12.59	13.11
H_2O-	0.08	2.76	—	0.12	
	100.33	99.32	100.49	100.20	100.75

1. Manganoan leuchtenbergite from Muramatsu, Nagasaki Prefecture, Japan. Color light-brown with a pinkish tinge. Analyst: H. SHIROZU (this paper).
2. Leuchtenbergite from the Wanibuchi mine, Shimane Prefecture, Japan. Analyst: T. SAKAMOTO (SUDO, 1954).
3. Leuchtenbergite from Midongy, Madagascar. Analyst: J. ORCEL (ORCEL, 1927).
4. Manganese-chlorite from Långban, Sweden. Color orange-red. Analyst: H. von ECKERMANN (von ECKERMANN, 1927).
5. Manganchlorit from Harstigen, Vermland, Sweden. Color red. Analyst: A. HAMBERG (HAMBERG, 1890).

X-ray powder pattern

The x-ray powder data for FeK_α are compared with those of some Mg-chlorites with a close agreement between them as shown in Table 2. The indexing of reflections and the calculation of spacings have been done on referring to the results

Table 2. X-ray powder data for Mg-chlorites

No.	Probable indices	1			2		3	
		d(Å)calc.	d(Å)obs.	I	d(kX)	I	d(kx)	I
1	001	14.18	14.1	7	13.138	6	13.678	7
2	002	7.09	7.07	9	6.970	9	7.040	8
3	003	4.727	4.72	8	4.678	9	4.680	9
4	020	4.605	4.59	1				
5	004	3.545	3.54	10	3.515	10	3.509	10
6	005	2.836	2.84	5	2.824	5	2.828	7
7	131,20$\bar{2}$	2.580	2.58	3	broad	8	2.578	7
8	13$\bar{2}$,201	2.538	2.53	6	2.523		2.542	5
9	132,20$\bar{3}$	2.435	2.43	5	2.431	5	2.430	6
10	13$\bar{3}$,202	2.378	2.37	4	2.396	1	2.370	3
11	133,20$\bar{4}$	2.254	2.25	3	2.251	3	2.247	4
12	134,20$\bar{5}$	2.063	2.06	1				
13	007	2.026	2.026	2			2.021	7
14	13$\bar{5}$,204	2.001	2.000	6	1.998	8	1.998	6
15	135,20$\bar{6}$	1.880	1.883	3	1.880	3	1.881	4
16	13$\bar{6}$,205	1.822	1.825	3	1.818	3	1.825	4
17	136,20$\bar{7}$	1.712	1.73	½B	1.688	2	1.706	3
18	13$\bar{7}$,206	1.661	1.660	1	1.655	2	1.659	2
19	137,20$\bar{8}$	1.564	1.562	4	1.563	7	1.562	10
20	060,33$\bar{1}$	1.535	1.534	7	1.531	9	1.534	10
21	062,331,33$\bar{3}$	1.500	1.500	2	1.499	3	1.502	2
22	063,332,33$\bar{4}$	1.460	1.458	1	1.455	2	1.460	2
23	0010	1.418	1.417	2	1.420	1	1.417	3
24	064,333,33$\bar{5}$	1.409	1.407	½				
25	13$\bar{9}$,208	1.393	1.392	5	1.394	8	1.390	10
26	065,334,33$\bar{6}$	1.350	1.349	½			1.350	2
27	400,139,20$\bar{1}\bar{0}$,26$\bar{2}$	1.319	1.317	2	1.315	3	1.319	4
28	401,26$\bar{3}$	1.299	1.297	½				
29	066,335,33$\bar{7}$	1.287	1.287	2	1.287	3	1.283	4
30							1.251	½
31	1310,20$\bar{1}\bar{1}$	1.219	1.220	2			1.218	7
32	13$\bar{1}\bar{1}$,2010,26$\bar{6}$,404	1.189	1.190	½			1.191	½
33	0012	1.182	1.182	1			1.181	3
34	1311,20$\bar{1}\bar{2}$	1.132	1.132	1			1.131	4
35	26$\bar{8}$,406	1.096	1.096	1			1.094	4
36	0610,339,33$\bar{1}\bar{1}$	1.042	1.042	2			1.040	5
37	13$\bar{1}\bar{3}$,2012,268,40$\bar{1}\bar{0}$	1.032	1.032	2			1.030	5
38	0014	1.013	1.013	2			1.013	3
39			1.000	1			1.001	3
40			.988	2			.987	4

1. Manganoan leuchtenbergite from Muramatsu. Filtered FeK$_{\alpha}$ radiation, λ=1.9373Å. Camera radius 57.3 mm. B: broad line.
2. Leuchtenbergite from Philipsburg, Montana. Unfiltered FeK radiation. Camera radius 57.3 mm. Lines for K$_{\beta}$ omitted. (McMurchy, 1934).
3. Sheridanite from Miles City, Montana. Unfiltered CuK radiation. Camera radius 57.3 mm. Lines for K$_{\beta}$ omitted. (McMurchy, 1934).

obtained by BRINDLEY and others (BRINDLEY and ROBINSON, 1951) that the successive layer displacements were $-a_0/3$ and b_0/a_0 was $\sqrt{3}$. The cell dimensions obtained here are:

$$a_0 = b_0/\sqrt{3}, \; b_0 = 9.21 \text{ Å}, \; c_0 \sin\beta = d_{(001)} = 14.18 \text{ Å}, \; \beta = 97.1°.$$

The details of the x-ray investigation together with those of other chlorites found in Japan will be presented in future.

Differential thermal analysis

The differential thermal analysis curve is given in Fig. 1, which shows the characteristic features of minerals of the chlorite group. Endothermic peaks are shown at about 675°C and 840°C, while exothermic peaks at about 870°C and 920°C. The material heated at about 1000°C gives an x-ray pattern of a mixture of olivine and spinel.

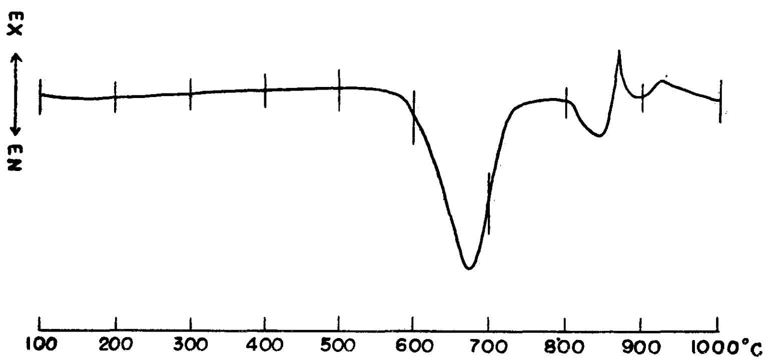

Fig. 1. Differential thermal analysis curve for manganoan leuchtenbergite from Muramatsu.

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