

Mn-bearing pinkish epidote from Nakatatsu Mine, Fukui Prefecture

Kyoko MOHRI*, Takeo MATSUMOTO and Kuniaki KIHARA

*Department of Earth Sciences, Faculty of Science, Kanazawa University,
Marunouchi 1-1, Kanazawa 920 Japan*

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Abstract Pinkish epidote was found from Nakatatsu Mine, Fukui Prefecture, Japan, and its mineralogical data and crystal structure are described.

The average chemical composition is

$\text{Ca}_{1.85} \text{Sr}_{0.04} \text{Al}_{2.50} \text{Fe}_{0.32} \text{Mn}_{0.04} \text{Si}_{3.00} \text{O}_{12} (\text{OH})$,
and cell dimensions are $a=8.879(2)$, $b=5.6083(3)$, $c=10.1483(10)$ Å, and $\beta=115.42(4)^\circ$.
Least-squares refinement of the structure using X-ray intensity data from a single crystal converged to an R -value of 6.42%, and shows that Fe and Mn are located over $M(3)$ sites and most Sr atoms replace Ca atoms at $A(2)$ sites. Atomic distances are 1.906, 1.883 and 1.812 Å for $M(1)-O$, $M(2)-O$ and $M(3)-O$, respectively, and 2.531 and 2.585 Å for $A(1)-O$ and $A(2)-O$, respectively.

Introduction

Al-Fe³⁺ and Sr²⁺-bearing epidotes are known in several metamorphic rocks, such as metagreywacke-quartzofeldspathic schist (Grapes and Watanabe, 1984). These epidotes have been described mainly for petrological aspects. The crystal structures of epidote minerals have been studied by many authors: e. g. Ito(1950), Dollase(1968, 1969 and 1971) and Gabe et al. (1973). However, Mn and Sr locations have not been well established.

Pinkish epidote, which contains Fe, Mn and small amount of Sr, was found from Nakatatsu Mine, Fukui Prefecture, Japan. Chemical composition, mineralogical data and crystal structure of this material are reported.

Experimental

Specimen

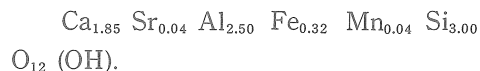
The sample was found in debris from Hitokata deposit of Nakatatsu Mine. Optical

* Present address: Department of Geology and Mineralogy, Faculty of Science, Kyoto University, Oiwake-cho Kitashirakawa Sakyo-ku, Kyoto 606

microscopic observation shows that the rock consists of 60% epidote, 20% quartz, 10% calcite and 10% opaque minerals; quartz appears idiomorphic or hypautomorphic, and calcite allotriomorphic. On the surface of the rock, lawmontite is also observed. Most of the pinkish epidote crystals are columnar or acicular elongating along b , and attain up to several mm in length. The optical microscopic photographs of the thin section are shown in plate 1. Optical axial angles measured are $2V(+)=85-95^\circ$.

Chemical composition

Chemical analyses were carried out using an electron microprobe analyzer, model HITACHI XMA-5A. In these analyses, small amount of Sr was detected. Chemical compositions and numbers of cations were calculated based on 12 oxygen atoms per formula unit, assuming perfect stoichiometry for the relative cation proportions (Table 1). The chemical formula averaged over five points in one grain is



X-ray studies

Weissenberg and precession photographs indicate that Laue group is $2/m$ and reflections $0k0$ are systematically absent if k is odd. Possible space group is thus $P2_1/m$ or $P2_1$.

A specimen, $0.07 \times 0.06 \times 0.05 \text{mm}^3$ in size, was selected for intensity measurements on a Philips PW 1100 single crystal diffractometer. Cell constants were determined using 25 reflections. Crystal data and information for the structure analysis are given in Table 2. Intensities of 2247 reflections in the range of 2θ from 6 to 70° were measured with graphite monochromatized $\text{Mo K}\alpha$ radiation ($\lambda = 0.71069 \text{ \AA}$) and the $\theta/2\theta$ scan mode. Structure factors of 1444 reflections, magnitude of which exceeds corresponding $3\sigma (F_0)$, were used in the following calculations.

Refinement was carried out using the least-squares program *ORXFLS4* (Busing et al. 1962 and Johnson, 1969). Scattering factors for neutral atoms (*International Tables for X-ray Crystallography*, vol. IV, 1974) were used throughout this study. The space group $P2_1/m$ was assumed and initial positional parameters were taken from those by Dollase (1971). R -values with isotropic temperature factors is 6.72%. The occupancy of the M sites and the A sites were also refined (Fig. 1). First of all, the multiplicity of the M sites was refined without chemical constraints, using only the Al atomic form factor. This result (Table 4) suggests that the $M(1)$ and $M(2)$ sites are occupied only by Al, but the $M(3)$ by Al and partly heavier cations, Fe and Mn in this case. In the following calculations, the

Table 1 Chemical Compositions

	(1)	(2)	(3)	(4)	(5)
SiO ₂	39.46	40.38	40.29	39.63	40.18
Al ₂ O ₃	29.31	28.27	26.48	27.85	29.54
Fe ₂ O ₃ *	5.78	5.83	5.46	5.69	5.13
MnO	0.70	0.76	0.75	0.58	0.53
CaO	22.33	23.02	23.32	23.13	23.05
SrO	1.25	1.15	1.11	1.12	0.98
Total	98.83	99.41	97.41	98.00	99.41
Numbers of ions on the basis of 12(O)					
Si	2.95	3.01	3.06	3.00	2.97
Al	2.59	2.48	2.37	2.49	2.58
Fe	0.33	0.33	0.31	0.33	0.29
Mn	0.04	0.05	0.05	0.04	0.03
Ca	1.79	1.84	1.90	1.88	1.83
Sr	0.05	0.05	0.04	0.04	0.04

* Fe total as Fe₂O₃.

Table 2 Crystal Data and information for Structure Analysis

a (Å)	8.879(2)
b (Å)	5.6083(3)
c (Å)	10.1483(10)
β (°)	115.42(4)
V_{calc}	456.42(2)
Crystal System	monoclinic
Space Group	$P2_1/m$
Z	2
D_{calc}	3.63
Radiation Used	MoK α (0.71069 Å), 40kV, 20mA
Monochromator	graphite
Crystal Size (mm ³)	0.07 × 0.06 × 0.05
μ (cm ⁻¹)	26.97
Diffractometer	Philips PW-1100
Scan Type	$\theta - 2\theta$
2θ Range (°)	6-70
No. of independent reflections measured	2247
No. of independent reflections used	
for refinement with $F_o > 3\sigma(F_o)$	1444
Final R	6.42%
Final R_w	5.40%

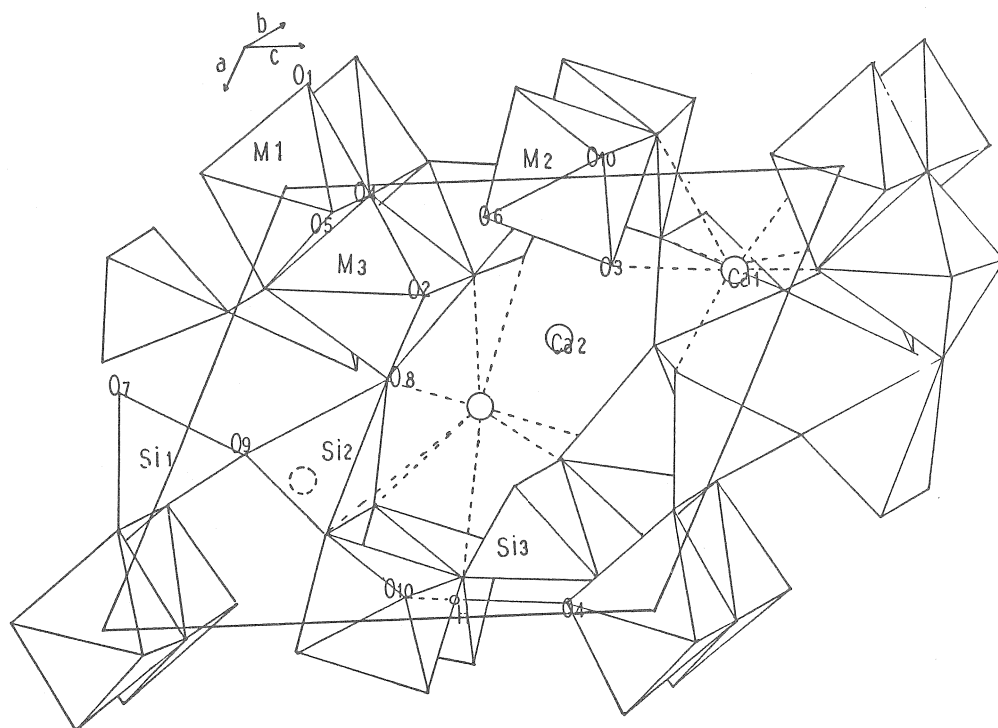


Fig. 1 Polyhedral linkage of epidote
 —: Boundary of the Unit Cell

scattering factors for the M sites are assumed as shown in the last column of (a) in Table 4. Then the site occupancy of the A-sites refined with a chemical constraint, $Sr=0.04$

Table 3 (a) Positional Parameters

	y/a	y/b	z/c
A 1	0.7592(2)	0.75	0.1536(2)
A 2	0.6061(2)	0.75	0.4239(2)
Si 1	0.3389(3)	0.75	0.0478(3)
Si 2	0.6815(3)	0.25	0.2753(3)
Si 3	0.1829(3)	0.75	0.3169(3)
M 1	0.0	0.0	0.0
M 2	0.0	0.0	0.5
M 3	0.2914(2)	0.75	0.2242(2)
O 1	0.2332(4)	0.9965(7)	0.0426(4)
O 2	0.3016(4)	0.9840(8)	0.3526(4)
O 3	0.7911(4)	0.0134(7)	0.3430(4)
O 4	0.0536(6)	0.25	0.1303(5)
O 5	0.0410(6)	0.75	0.1447(5)
O 6	0.0643(6)	0.75	0.4039(6)
O 7	0.5145(6)	0.75	0.1789(6)
O 8	0.5173(7)	0.25	0.3029(6)
O 9	0.6335(7)	0.25	0.1012(6)
O 10	0.0784(6)	0.25	0.4257(5)

The numbers in parentheses represent estimated standard deviations.

Table 3 (b) Anisotropic thermal Parameters $\times 10^{-2}$

	B_{11}	B_{22}	B_{33}	B_{12}	B_{13}	B_{23}
Ca 1	0.34(3)	0.58(5)	0.17(2)	0.0	0.17(2)	0.0
Ca 2	0.34(3)	1.05(6)	0.17(2)	0.0	0.11(2)	0.0
Si 1	0.15(3)	0.28(6)	0.09(2)	0.0	0.03(2)	0.0
Si 2	0.19(3)	0.41(6)	0.09(2)	0.0	0.06(2)	0.0
Si 3	0.13(3)	0.35(6)	0.11(2)	0.0	0.04(2)	0.0
M 1	0.16(3)	0.29(6)	0.11(2)	0.01(4)	0.04(2)	0.04(3)
M 2	0.20(3)	0.23(6)	0.13(2)	0.01(4)	0.06(2)	0.0001(9)
M 3	0.15(3)	0.39(5)	0.09(2)	0.0	0.01(2)	0.0
O 1	0.27(5)	0.19(9)	0.28(4)	0.04(6)	0.13(4)	-0.03(5)
O 2	0.23(4)	0.52(10)	0.17(4)	0.12(6)	0.08(3)	-0.04(5)
O 3	0.23(4)	0.37(10)	0.24(4)	0.03(6)	0.02(3)	-0.04(5)
O 4	0.15(6)	0.26(14)	0.18(5)	0.0	0.10(5)	0.0
O 5	0.16(6)	0.31(13)	0.05(5)	0.0	0.01(4)	0.0
O 6	0.29(7)	0.17(14)	0.22(5)	0.0	0.12(5)	0.0
O 7	0.11(6)	0.73(16)	0.21(5)	0.0	0.03(5)	0.0
O 8	0.45(8)	0.83(17)	0.39(6)	0.0	0.30(6)	0.0
O 9	0.64(9)	1.57(21)	0.16(5)	0.0	0.19(6)	0.0
O 10	0.27(7)	0.23(14)	0.16(5)	0.0	0.15(5)	0.0

The numbers in parentheses represent estimated standard deviations.

$$\text{Anisotropic temperature factors: } \exp \left[- \sum_{i=1}^3 \sum_{j=1}^3 h_i h_j B_{ij} \right]$$

atoms per formula unit. The final R -value is 6.42% and the parameter shifts are less than one quarter of the corresponding standard deviations. The positional and thermal parameters are listed in Table 3a and b. The structure factors are given in Appendix.

Discussion

Table 4 shows the refined site occupancies for the M and A sites. Sr is mostly distributed over the $A(2)$ sites. The chemical formula is thus calculated as $(\text{Ca}_{0.998} \text{Sr}_{0.002}) (\text{Ca}_{0.962} \text{Sr}_{0.038}) \text{Al}_{1.00} \text{Al}_{1.00} (\text{Al}_{0.603} \text{Fe}_{0.376} \text{Mn}_{0.021}) \text{Si}_5\text{O}_{13}\text{H}$ based on 12 O and 1 OH.

Tables 5 and 6 show the comparison of $A-O$ and $M-O$ distances with those of other epidote minerals. The chemical formula of other epidote minerals are listed in the bottom of Table 5. Mean $M-O$ distances and their ratio to clinozoisite are also shown in Table 6. The volume of the $A(2)$ sites of the present specimen and piemontite (Dollase, 1969) is larger than that of other epidotes where the $A(2)$ sites are occupied only by Ca. Thus the $A(2)$ site is considered to be enlarged by including large cations as Sr. Clinozoisite (Dollase, 1968) has chemical composition close to Al end-member of Al-Fe-Mn epidotes. The substitution of Fe and Mn might occur more easily in the $M(3)$ site, and therefore, the $M(3)-O$ distances become larger in proportion to the amount of Fe and/or Mn contents.

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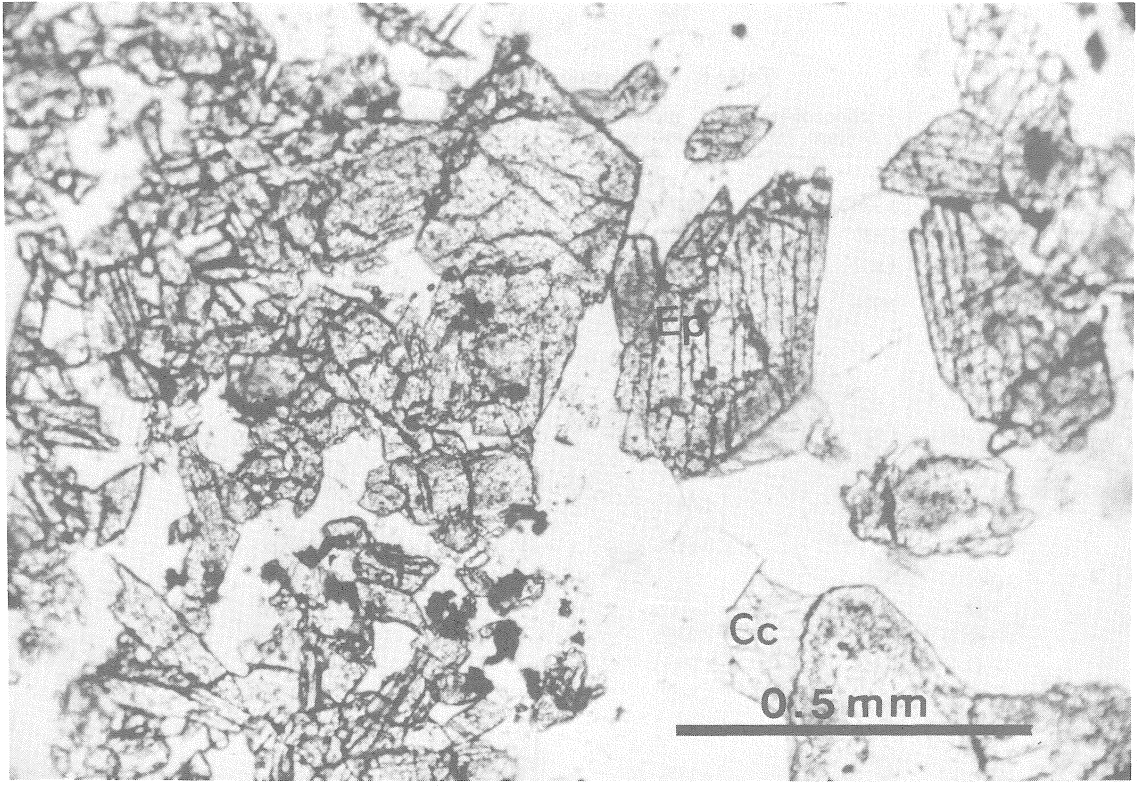
Table 4 Site Occupancy

	Multiplicity	Capable Site Occupancy
(a) calculated site occupancies without any constrain		
A(1)	0.501(5)	
A(2)	0.496(5)	
M(1)	0.489(6)**	$\text{Al}_{1.000}$
M(2)	0.492(6)**	$\text{Al}_{1.000}$
M(3)	0.719(7)**	$\text{Al}_{0.603}\text{Fe}_{0.376}\text{Mn}_{0.021}$
(b) calculated site occupancy in the A sites with chemical constraint as Sr=0.04 atoms per formula*		
A(1)	Ca 0.499(4) Sr 0.0009	$\text{Ca}_{0.998}\text{Sr}_{0.002}$
A(2)	Ca 0.481(7) Sr 0.0191	$\text{Ca}_{0.962}\text{Sr}_{0.038}$

* This value is obtained by the chemical analysis shown in Table 1.

**The multiplicities of M sites were calculated using only the Al atomic form factor.

(a)



(b)

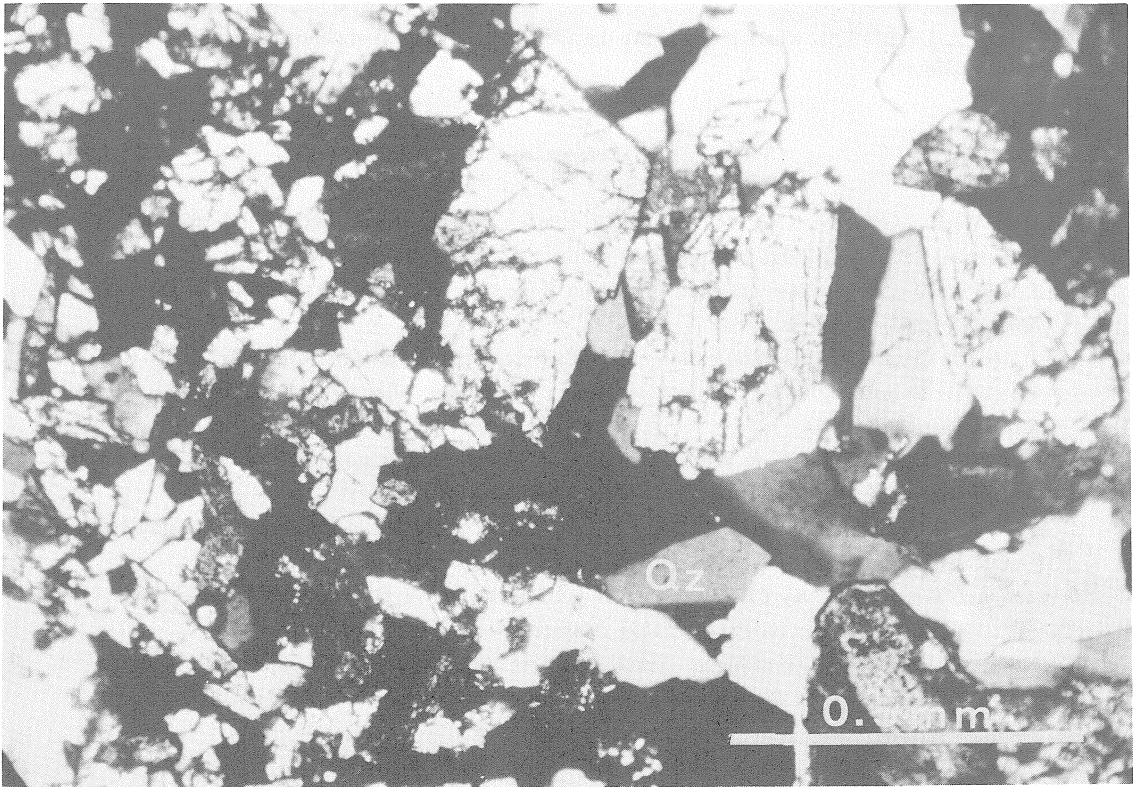


Table 6 Comparison of M-O Distances

Bond	clinozoisite Dollase, 1968	piemontite Dollase, 1969	epidote Gabe et al, 1973	This Study
M(1)				
—O(1)	1.930 Å	1.94(2) Å	1.9316(8) Å	1.925(4) Å
—O(4)	1.850	1.87(3)	1.8466(7)	1.844(4)
—O(5)	1.937	1.98(6)	1.9433(8)	1.948(4)
Average	1.906	1.93	1.9072	1.906
$\Delta L/L^*$		1.26%	0.06%	0.0%
M(2)				
—O(3)	1.859	1.85(8)	1.8582(7)	1.857(3)
—O(6)	1.923	1.93(5)	1.9262(9)	1.929(5)
—O(10)	1.852	1.88(2)	1.8642(10)	1.862(4)
Average	1.878	1.89	1.8829	1.883
$\Delta L/L^*$		0.64%	0.26%	0.27%
M(3)				
—O(1)	2.184	2.27(5)	2.2000(8)	2.206(4)
—O(2)	1.927	2.03(2)	1.9563(8)	1.957(4)
—O(4)	1.862	1.90(1)	1.9027(11)	1.907(5)
—O(8)	1.781	1.86(2)	1.8100(12)	1.812(6)
Average	1.978	2.06	2.0042	2.008
$\Delta L/L^*$		4.15%	1.32%	1.52%

* : $\Delta L/L = (L' - L)/L$, where L and L' are the average bond lengths of clinozoisite and other epidotes.

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Appendix |Fo| - |Fc| Tables

L=0				L=1				L=2							
H	K	F(obs)	F(calc)	H	K	F(obs)	F(calc)	H	K	F(obs)	F(calc)	H	K	F(obs)	F(calc)
2	0	54.1503	56.9084	5	6	28.5393	27.9080	-1	5	8.4129	9.4525	10	0	15.0565	16.9719
3	0	82.5904	85.5153	7	2	24.7920	21.4361	6	5	22.0621	22.5663	12	0	24.0227	24.4544
4	0	73.8563	75.1564	8	6	20.6972	18.1204	5	5	23.7269	23.7398	4	5	17.8681	15.0247
5	0	20.3994	20.5566	9	6	28.5642	28.5294	4	5	9.9764	11.8281	10	1	17.7192	16.8267
6	0	27.8751	30.1197	5	7	28.5393	28.8337	3	5	20.1364	20.4937	9	1	39.5083	39.8368
10	0	29.9539	30.1197	2	2	23.2534	26.6905	2	2	22.5833	22.7869	8	1	13.8233	10.5376
11	0	11.9121	8.3181	3	7	13.8201	11.8399	7	6	17.0192	17.0490	7	1	14.9894	17.7134
12	1	21.8388	18.5221	3	5	86.2851	90.5903	-1	2	9.5345	10.3707	5	1	15.8864	13.4711
11	1	15.9820	14.7620	2	3	16.0555	14.7276	-2	6	32.6069	9.9704	6	1	15.8842	14.4644
10	1	11.6143	11.8627	3	3	26.4547	26.2464	-3	2	35.8375	32.3601	4	1	67.1047	66.9239
8	1	25.2387	26.4174	4	3	22.5826	24.2761	-4	2	22.3351	22.2082	-2	6	42.0893	41.0686
7	1	60.2800	62.6795	-5	2	20.1536	21.1128	-3	6	11.5573	17.3828	2	1	10.4727	20.0911
6	1	11.9931	11.1917	-6	2	40.1836	41.7342	-4	6	11.4654	10.6917	-1	1	19.8727	11.2189
5	1	55.6408	55.8640	-7	2	21.5658	22.3307	-5	6	14.0363	13.5053	-3	1	15.7339	17.8393
4	1	12.8296	10.2819	-8	2	11.5150	11.8137	-6	6	22.0125	21.2953	-4	1	25.4869	24.0087
3	1	11.7632	13.5589	-9	0	41.9655	42.6572	-7	6	15.2850	15.3375	-5	1	44.9703	44.1921
1	1	10.8946	8.7551	8	0	11.2172	12.2761	-12	2	19.8783	21.5192	-8	6	24.1964	22.1751
0	2	109.5663	121.6660	7	0	39.5332	39.8166	-10	5	18.2365	22.0958	-9	1	9.4552	9.0953
1	2	60.9749	62.9173	6	0	19.4068	21.1796	-5	3	17.1740	18.6389	-8	7	20.3758	20.5390
3	2	14.9397	15.7440	5	0	12.5325	16.0204	-6	5	18.7170	18.5394	-7	7	20.5980	18.8352
5	2	45.4644	47.1132	4	0	17.4958	19.5886	-7	3	25.9336	25.7101	-6	7	21.0198	22.4573
2	2	45.9856	47.9927	2	0	59.7326	60.1582	-5	3	82.3342	83.5554	-5	7	13.9690	9.9448
6	2	13.0040	12.6031	-3	0	21.8140	20.4324	-4	3	8.3136	7.5752	-4	7	13.9719	13.0825
7	2	34.2224	35.6432	-4	0	98.3491	97.5878	-3	3	77.5329	77.5351	-3	7	15.9572	18.4075
8	2	29.8298	25.5317	-6	0	13.2274	12.7842	-2	3	44.4717	45.0069	-2	7	12.8955	15.2138
10	2	41.8207	43.4249	-7	0	13.5252	13.4748	-1	3	9.2815	7.7671	1	7	21.1447	19.8373
11	2	15.5602	15.8608	-8	0	51.8175	53.3041	1	3	24.8168	24.3512	2	3	23.3030	23.5181
12	3	17.2477	18.6541	-10	0	9.3808	2.6207	2	3	34.8438	31.5394	2	7	20.1958	21.1793
11	3	16.1557	16.2789	-12	0	27.35978	27.5201	7	3	44.4198	44.7812	7	3	54.7664	64.6262
7	3	51.8423	51.7910	-12	1	15.2127	13.2476	8	3	30.4999	28.8439	-5	2	27.1744	27.6204
5	3	47.9722	47.6980	-10	1	14.6419	16.7796	10	3	15.8093	16.7932	-4	2	33.6750	32.6418
3	3	18.1411	18.0841	-8	1	21.4665	19.9160	10	3	12.1354	8.8681	-3	2	29.9787	30.5469
0	4	190.9969	210.0526	-6	1	12.9544	12.320	9	4	35.9844	35.1249	-12	0	62.3398	51.4797
1	4	13.9442	11.7319	-5	1	31.7655	31.8377	8	4	9.4219	9.1511	-10	0	54.7204	54.1701
2	4	54.6714	56.0645	-2	1	94.8996	96.2323	6	4	29.4053	30.1599	-9	0	77.7759	79.3791
3	4	45.6381	46.4557	-1	1	60.7764	61.3885	3	4	9.6304	13.7247	-8	0	10.9598	9.9515
5	4	22.8055	22.4466	0	1	11.2172	12.8205	-5	4	67.3569	59.3671	2	2	54.6433	67.3194
6	4	16.8059	15.4466	0	1	11.5165	10.3770	-3	4	35.5070	35.7289	-5	0	56.2248	53.1301
5	4	22.9059	22.3942	1	1	24.7175	24.6972	-4	4	50.8745	42.9353	4	2	11.7733	12.6405
8	5	15.8828	18.8521	6	1	12.1354	11.7855	-8	4	39.2850	39.5758	-1	0	8.0932	7.8001
7	5	45.2659	46.9380	7	1	21.8140	21.677	-10	4	50.3431	51.3493	6	2	50.2789	47.7736
6	5	14.9397	7.4310	7	1	29.7305	32.3740	-8	5	13.2552	14.1492	2	0	34.9421	33.7558
5	5	34.9669	34.8917	8	1	14.5689	17.6332	-6	5	18.2404	17.7556	3	0	22.6082	22.7220
0	6	55.3415	54.1196	12	1	15.8331	15.7032	-4	5	65.3464	65.3371	10	3	15.8010	14.6366
1	6	30.8225	30.5779	12	2	27.2489	25.7072	-4	5	17.3718	17.0967	9	3	33.2545	33.0420
2	6	23.2782	23.3411	9	2	33.7509	34.0615	-3	5	50.9489	48.9910	8	3	9.9267	8.3638
4	6	25.1146	23.7225	8	2	17.6448	18.0610	-2	5	27.1090	27.8114	9	3	13.1033	10.5652

Appendix |Fo| - |Fc| Tables (continued)

H	K	F(obs)	F(calc)	H	K	F(obs)	F(calc)	H	K	F(obs)	F(calc)	H	K	F(obs)	F(calc)	H	K	F(obs)	F(calc)
L=2				L=2				L=3				L=4							
5	3	15.3616	18.2062	-1	6	27.7452	27.7322	5	1	12.1106	9.8115	-10	5	10.0508	10.8906	-2	0	10.7953	11.3648
4	3	52.5620	51.7374	0	6	39.6573	41.3533	7	1	22.5545	22.9560	-7	5	8.7603	2.8357	-1	0	46.0600	47.0305
3	3	20.6476	21.6472	2	6	34.9669	34.1651	8	1	16.4724	14.1555	-5	5	18.3148	19.0396	0	0	19.5308	15.2550
2	3	18.2404	17.2973	3	6	32.3115	30.7351	9	1	10.9690	6.3919	-3	5	58.3443	58.2080	1	0	32.5349	31.6532
-1	3	13.4011	15.1631	4	6	66.7324	67.3021	11	1	18.9104	17.0292	-2	5	18.8111	15.7269	2	0	39.6573	38.8923
-3	3	28.0926	27.4444	6	6	11.2172	5.1298	11	2	36.0092	35.2894	-1	5	76.2669	78.5557	3	0	50.3037	50.5305
-4	3	13.0040	11.8316	7	6	32.1130	31.1438	10	2	15.9820	12.3229	0	5	43.1068	45.2872	4	0	55.0437	55.2329
-5	3	42.6601	42.5950	8	6	25.1643	24.6194	8	2	10.6216	11.4603	1	5	28.7131	26.8047	6	0	20.0023	20.6496
-6	3	20.0520	20.1733	5	7	14.2697	11.8006	7	2	28.1423	29.2380	2	5	25.0402	24.6657	7	0	49.3877	50.0399
-8	3	15.0390	16.7206	4	7	25.8343	25.2129	6	2	35.4881	35.2813	3	5	11.8128	11.4406	8	0	11.7135	11.5915
-9	3	15.9572	16.4965	2	7	13.7982	10.6597	4	2	77.7759	75.8269	7	5	17.6199	17.1043	9	0	14.7660	10.9629
-10	3	20.2009	19.6387	-1	7	11.1924	9.9093	3	2	32.8327	32.3986	7	6	17.7192	18.3700	10	0	16.6273	16.5890
-11	3	12.0113	8.8019	-3	7	18.5622	19.0742	1	2	23.3030	21.6162	6	6	20.6724	22.9443	11	0	21.7892	21.3640
-12	3	13.0288	9.7697	-5	7	24.9161	23.5259	0	2	76.7584	72.6388	4	6	44.4221	45.2909	10	1	12.7558	10.7715
-12	4	14.4434	15.4805	-6	8	11.1179	6.0779	-1	2	46.5812	44.1829	3	6	17.9922	16.6094	9	1	11.3909	11.4373
-11	4	23.2534	21.6229	-5	8	15.5850	18.3259	-2	2	82.1933	79.2856	2	6	8.8844	4.3789	8	1	40.8237	41.5233
-10	4	11.1676	7.8980	-3	8	25.8095	22.8121	-3	2	24.4694	23.5456	0	6	22.3848	22.9452	6	1	31.1947	30.9015
-9	4	23.5263	23.6014	-2	8	12.3340	11.6886	-4	2	21.1687	19.5587	-1	6	16.8506	16.0691	5	1	10.2245	11.7373
-8	4	42.4368	42.0562	-1	8	11.1924	14.1119	-5	2	7.1969	5.9268	-2	6	23.8986	24.1912	4	1	15.3616	14.5873
-6	4	14.2200	12.9084	1	8	17.7640	13.3716	-6	2	45.6133	45.9003	-3	6	8.7603	12.7327	2	1	36.4559	36.4688
-5	4	42.8090	42.4022	2	8	36.4311	35.3236	-7	2	44.4965	45.4374	-5	6	12.5325	6.3642	1	1	47.7476	47.1351
-3	4	47.5490	48.7040	5	8	27.8197	25.5918	-8	2	54.0510	53.0326	-6	6	28.8868	29.5314	0	1	29.5072	27.5127
-2	4	29.3335	29.6369					-10	2	11.1179	13.3811	-7	6	28.7379	26.6353	-1	1	26.1569	25.0054
-1	4	30.3510	30.7307					-13	2	13.0785	11.1162	-8	6	33.8998	33.9972	-2	1	29.8298	27.5488
1	4	28.3656	29.1917	11	0	30.5495	27.0543	-11	3	9.6289	8.0911	-10	6	11.9399	9.0157	-5	1	18.8856	18.8904
2	4	68.0229	69.0800	7	0	36.7785	36.3787	-10	3	17.2229	16.9641	-5	7	11.9121	10.3345	-6	1	16.9251	16.0860
3	4	12.7062	13.9295	6	0	35.8603	36.1585	-6	3	9.8275	6.5109	-3	7	31.8896	31.2936	-7	1	21.8140	20.4443
4	4	10.7209	8.8741	4	0	53.1824	53.5824	-5	3	20.5980	21.8266	-1	7	40.0295	41.2480	-8	1	15.5105	15.7831
5	4	49.0629	48.7397	3	0	18.7367	18.2435	-3	3	62.1413	62.5455	0	7	30.4006	28.7336	-10	1	20.1761	19.1312
6	4	12.1354	9.5517	2	0	30.3817	75.2283	-2	3	19.3097	18.4777	2	7	11.6143	14.5219	-11	1	42.6601	44.6567
8	4	29.0853	27.5251	1	0	10.8698	10.9237	-1	3	88.2486	88.9885	3	7	10.8201	13.4510	-12	1	12.7062	15.0832
9	4	19.4544	22.1273	0	0	34.9173	34.2451	0	3	59.3618	58.5910	6	7	14.5916	2.3163	-13	1	37.7960	36.2897
9	5	31.9649	31.5226	-1	0	9.1078	9.0486	1	3	20.6476	19.7844	4	8	22.5585	22.2095	-12	2	14.1704	14.4250
7	5	19.2082	17.1252	-2	0	20.9520	19.1213	2	3	27.8941	27.7513	3	8	15.3886	8.8665	-11	2	13.7485	13.9371
4	5	37.4486	38.2302	4	0	40.2281	38.7724	3	3	21.8884	21.6594	2	8	19.3075	15.3762	-10	2	11.9121	12.1415
3	5	22.1118	20.0398	-5	0	25.0550	24.4693	7	3	17.4710	17.0261	1	8	12.1106	4.2047	-8	2	60.0815	59.2681
2	5	12.7062	14.2984	-6	0	43.6996	43.3777	8	3	12.2059	10.8552	-4	8	15.2375	7.2007	-6	2	59.2626	58.5276
-3	5	10.9939	10.4807	-7	0	27.3770	28.6280	7	4	27.5715	26.1214	-5	8	16.1061	5.9426	-5	2	96.5871	99.5987
-5	5	20.1513	20.2324	-3	0	74.0038	74.2426	6	4	26.1577	26.8693	-6	8	12.7607	18.9011	-4	2	94.9492	97.3104
-6	5	9.5793	10.9135	-9	0	23.8738	22.9270	4	4	37.9201	40.1101					-2	2	83.8312	82.4797
-7	5	11.8376	8.5182	-10	0	40.5011	40.7957	3	4	14.9397	12.8477					-1	2	52.7854	51.5115
-8	5	17.7937	16.4648	-11	0	22.1614	21.0141	2	4	35.5129	36.4522	-14	0	10.5464	12.5796	0	2	35.9099	35.2009
-9	5	16.1806	13.6848	-13	1	13.7237	5.6529	1	4	9.3559	5.0523	-13	0	34.7684	34.4133	1	2	72.7133	70.9876
-10	5	17.3718	17.0958	-11	1	11.7880	13.9390	0	4	15.2127	16.3471	-12	0	3.6611	13.3838	2	2	57.5502	57.7626
-10	6	14.6171	13.5608	-10	1	17.8433	18.0269	-4	4	18.1907	18.4727	-11	0	11.4476	10.4872	3	2	8.2144	11.1453
-9	6	11.3413	14.4924	-5	1	30.9466	30.7358	-5	4	10.6216	11.0626	-10	0	31.3188	31.5321	4	2	20.8709	21.3839
-8	6	13.0288	12.4036	-3	1	85.6428	87.4947	-6	4	32.6837	32.1283	-9	0	45.9559	47.4044	5	2	37.6471	35.7160
-7	6	12.0610	12.2048	-2	1	24.3701	24.8283	-7	4	19.2330	19.4300	-8	0	11.5895	10.8799	6	2	19.3819	19.8437
-6	6	35.8355	34.2413	-1	1	132.5963	133.7845	-8	4	54.2992	55.9284	-7	0	30.3758	31.1016	8	2	33.1304	29.7643
-5	6	16.6769	18.6301	0	1	77.8008	77.9973	-9	4	15.8331	17.6717	-6	0	85.4662	85.8455	9	2	10.2742	10.6621
-4	6	18.9849	17.9424	1	1	37.9697	36.5899	-10	4	28.9354	31.7470	-5	0	18.7615	18.7945	10	2	11.6391	12.3809
-3	6	12.1602	9.8432	2	1	36.8530	35.4785	-11	4	16.7513	16.9249	-4	0	22.4344	22.1139	10	3	17.3243	11.1186
-2	6	26.1073	26.7672	3	1	19.5556	19.8415	-11	5	11.4902	12.5631	-3	0	16.8506	20.0767	8	3	37.0267	37.3477

Appendix |Fo| - |Fc| Tables (continued)

H	K	F(obs)	F(calc)	H	K	F(obs)	F(calc)	H	K	F(obs)	F(calc)	H	K	F(obs)	F(calc)	H	K	F(obs)	F(calc)
L=4				L=4				L=5				L=5				L=6			
6	3	28.5642	26.9653	2	6	31.7159	29.5260	5	1	25.5613	26.7666	1	5	40.5755	41.3474	3	1	34.7435	34.8250
2	3	32.9319	30.9707	5	6	21.3943	20.3942	7	1	12.1176	15.5275	2	5	34.4716	35.7195	2	1	22.4096	21.3076
1	3	43.3550	43.4701	5	6	13.8478	10.9817	9	1	16.5528	12.7486	3	5	19.8698	7.0589	0	1	8.1896	6.3151
0	3	15.6842	15.6154	7	6	13.5726	7.5553	9	2	17.1491	16.6884	4	5	23.2534	22.3171	-1	1	19.5805	19.6378
-1	3	7.6932	9.5488	6	7	18.1411	16.4658	8	2	9.8523	14.2744	5	5	24.3949	21.4268	-2	1	22.0109	28.6520
-2	3	16.5032	16.1599	2	7	14.8156	15.9743	6	2	10.7209	8.4392	7	5	16.5273	14.5179	-4	1	9.9019	5.6450
-5	3	13.3763	8.4696	1	7	22.9621	23.5551	4	2	51.1203	31.4273	4	6	18.4885	18.2344	-5	1	15.7339	14.9207
-6	3	14.1656	15.2475	0	7	10.3250	3.4625	3	2	32.5137	31.2294	3	6	20.9950	19.6181	-6	1	24.0475	23.6241
-7	3	13.6741	10.6454	-6	7	15.9572	9.2603	2	2	25.8022	27.1364	2	6	12.1106	15.3565	-7	1	32.3115	32.4767
-8	3	15.3616	12.4619	-6	8	37.3245	35.9118	1	2	16.2798	16.2180	-4	6	21.3425	20.9563	-8	1	41.9222	41.5583
-10	3	18.3148	17.5002	-4	3	11.6639	9.4246	-2	2	18.4389	17.1077	-6	6	44.0499	43.5190	-9	1	46.8790	48.0323
-11	3	38.9872	38.7214	-3	3	10.5472	12.6063	-3	2	12.8551	12.0167	-9	7	15.4361	9.4452	-11	1	38.6150	37.9035
-12	3	17.7937	14.2938	-1	8	14.8901	15.4589	-4	2	45.1666	43.6654	-8	7	9.9764	5.7735	-13	2	12.7045	21.5421
-13	3	32.4852	33.1273	0	8	12.1354	4.9634	-5	2	79.9846	62.3990	-4	7	24.4446	25.9413	-10	2	37.0515	38.4246
-12	4	15.2127	10.9148	1	8	15.6098	12.0739	-11	2	15.9820	16.1106	-3	7	12.9047	8.1340	-9	2	12.1354	12.2213
-11	4	11.9865	8.2632	2	8	13.3515	9.9276	-11	3	19.7045	20.0305	-2	7	13.6216	6.1266	-8	2	9.3085	10.5418
-10	4	27.1000	26.2120	3	8	22.0125	23.1510	-10	3	12.4580	15.8198	-1	7	10.7209	13.2620	-7	2	28.4153	28.8015
-9	4	37.3741	37.7862					-9	3	14.1704	13.2645	0	7	18.9608	16.3955	-6	2	38.2675	37.5443
-7	4	24.3701	23.7936					-8	3	8.7603	12.9550	1	7	29.4327	31.4539	-5	2	34.2224	34.3736
-6	4	65.6405	66.3600	9	0	25.7847	25.0546	-4	3	49.7329	49.7586	2	7	28.6158	27.9292	-4	2	34.9917	36.1286
-5	4	14.8405	13.9455	8	0	40.9725	40.6160	-3	3	13.1777	13.8035	3	7	16.9003	14.2078	-3	2	87.0637	87.6937
-4	4	12.4829	14.0462	7	0	25.2635	23.9534	-1	3	31.4181	30.0624	4	7	19.0593	20.0332	-2	2	66.2561	65.7638
-3	4	28.4401	26.4363	6	0	27.8445	27.1807	0	3	29.9539	29.4987	1	3	17.7440	18.3947	-1	2	29.0023	19.5249
-1	4	32.1130	32.9409	5	0	27.4226	28.5921	1	3	60.7764	59.8918	-1	8	19.8201	13.3196	0	2	62.4041	60.6712
0	4	8.1647	5.7284	3	0	60.2800	60.6067	2	3	52.1898	51.4710	-3	8	16.5280	13.8301	1	2	34.1728	34.0789
1	4	18.9849	19.1848	1	0	44.6455	44.2179	3	3	16.4287	17.9582	-6	8	13.3040	14.3967	2	2	23.1541	23.6396
2	4	22.9804	23.2735	0	0	10.3982	11.4961	4	3	31.6911	32.2291					3	2	51.9912	54.7356
3	4	39.3347	39.6044	-1	0	37.9946	36.7811	5	3	18.1659	17.9360					4	2	16.1806	20.9268
4	4	40.6003	41.1126	-2	0	23.1293	23.4282	7	3	12.5821	10.0816	-14	0	18.8360	18.2079	7	2	20.4242	20.9268
5	4	8.9341	4.3975	-3	0	47.2760	46.1734	9	3	12.7558	10.3038	-13	0	13.4755	6.2110	8	3	16.6521	17.0948
6	4	12.7062	16.0952	-4	0	17.5951	17.1870	9	4	20.6228	20.3546	-11	0	14.2449	13.6357	7	3	14.0215	18.0655
7	4	39.1609	39.9928	-5	0	18.1659	19.9964	8	4	32.8078	33.5294	-10	0	23.6256	23.7386	6	3	18.2155	19.6897
8	4	12.7558	10.2094	-6	0	35.0910	35.2747	7	4	17.4462	19.2785	-9	0	35.7537	35.0849	5	3	18.7119	18.9512
9	4	10.8698	8.3565	-7	0	14.7650	15.0566	6	4	21.1936	21.2596	-8	0	13.3018	12.0003	4	3	25.7350	25.5259
8	5	32.3363	30.8848	-8	0	28.9182	30.7975	5	4	18.3644	22.0612	-5	0	38.4909	38.4836	3	3	13.1056	31.4895
6	5	22.3351	23.3764	-9	0	10.3508	10.4605	3	4	44.3228	43.7936	-4	0	12.6154	132.9214	2	3	29.7294	20.0639
5	5	12.3340	10.2242	-10	0	21.2680	21.1504	1	4	31.7159	31.5543	-3	0	70.3805	68.5025	1	3	14.2945	13.9957
4	5	9.6537	10.5834	-11	0	23.7993	23.9866	-1	4	21.1936	21.8919	-2	0	64.4741	62.7563	-1	3	9.7778	8.9112
2	5	22.7818	21.7211	-14	0	16.5776	13.4011	-3	4	25.9584	25.9989	-1	0	118.4011	119.1353	-2	3	24.4942	23.6100
1	5	21.1936	19.8582	-12	1	13.2274	6.2620	-5	4	10.7705	12.3046	0	0	35.1829	35.7462	-3	3	10.1004	9.0323
-2	5	12.6814	11.6260	-11	1	22.0125	23.1868	-6	4	25.4547	26.6255	0	0	13.5500	12.3724	-6	3	18.6871	19.7344
-5	5	17.9792	11.2790	-10	1	19.6371	19.0351	-7	4	12.0610	11.6826	2	0	55.5649	56.3299	-7	3	26.5540	26.5516
-7	5	14.7111	15.4623	-9	1	12.1602	12.4927	-8	4	21.0943	21.7797	4	0	27.0751	27.9360	-8	3	34.6939	35.9031
-10	5	13.5216	12.3323	-8	1	15.9324	16.2612	-9	4	11.8624	8.2846	5	0	38.7938	36.6775	-9	3	39.0368	38.9940
-11	5	32.6341	35.0155	-5	1	13.8974	11.8991	-10	4	15.9572	16.9243	6	0	44.1491	41.9077	-10	3	12.1106	9.5301
-8	6	35.7859	35.7205	-4	1	63.6800	63.2607	-11	4	18.3893	19.3643	8	0	19.5053	19.1240	-11	3	31.4925	29.8453
-6	6	31.7407	32.4313	-3	1	8.5618	9.9355	-11	5	20.6724	17.6041	9	0	19.3819	21.1116	-10	4	20.1761	18.5247
-5	6	53.3029	55.1248	-1	1	42.4864	41.3357	-10	5	15.8083	13.5205	9	1	17.7457	2.6968	-9	4	25.5365	27.3969
-4	6	51.3957	52.1273	0	1	37.0315	36.7234	-8	5	34.2720	35.0800	8	1	16.9003	17.2581	-5	4	30.6488	31.2623
-2	6	40.3047	39.5138	1	1	72.1475	73.8147	-4	5	10.3466	1.7327	7	1	21.0695	17.3715	-4	4	89.4398	90.8055
-1	6	24.1219	23.9606	2	1	62.4639	61.2161	-3	5	26.3803	25.4514	6	1	23.2782	22.9727	-3	4	43.3798	43.5053
0	6	16.5776	17.6820	3	1	13.5748	13.4397	-1	5	18.9618	21.6344	5	1	23.5740	23.3006	-2	4	36.1353	37.9965
1	6	40.2529	41.2771	4	1	35.7289	34.9502	0	5			4	1	29.5320	28.4058	-1	4	81.1510	83.1025

Mn-bearing pinkish epidote from Nokatatsu Mine, Fukui Prefecture

Appendix |Fo| -|Fc| Tables (continued)

H	K	F(obs)	F(calc)	H	K	F(obs)	F(calc)	H	K	F(obs)	F(calc)	H	K	F(obs)	F(calc)	H	K	F(obs)	F(calc)
L=9				L=9				L=10				L=10				L=11			
4	2	17.4710	18.2766	1	3	14.0711	14.2374	2	0	34.9173	34.4815	-1	4	40.1536	39.7629	-6	2	10.1074	0.6009
3	0	25.5676	24.5071	2	3	19.4812	19.8548	3	0	23.7993	20.7472	0	4	12.5325	10.0630	-7	2	22.0621	25.7714
2	0	27.9934	29.6339	4	3	16.9995	19.7658	4	0	20.3498	22.0197	1	4	10.5472	10.4430	-8	2	34.7435	35.4451
-1	0	9.0333	10.1091	4	4	16.5776	14.8319	6	0	28.7875	28.5625	2	4	26.2066	28.0362	-9	2	26.3803	26.0991
-2	0	39.8806	39.2369	3	4	17.0740	19.6895	5	1	30.5991	33.1079	3	4	19.7542	16.5517	-13	2	19.58015	14.8460
-3	0	16.6769	16.4044	2	4	23.5015	23.5140	4	1	32.5349	32.2390	4	4	18.3915	18.8568	-12	3	18.0666	15.3251
-6	0	7.9166	7.5933	0	4	8.8348	2.1952	2	1	10.3734	10.5101	-1	5	11.8624	11.0338	-11	3	10.1997	3.9652
-7	0	22.4592	23.2535	-1	4	11.0931	6.6919	-1	1	19.4316	20.4394	-2	5	11.7135	12.4001	-10	3	10.3734	2.5719
-9	0	28.4897	28.1595	-2	4	24.3453	27.0355	-2	1	19.9279	16.8243	-10	5	13.1033	13.5898	-9	3	12.4084	11.2323
-10	0	38.2179	35.5788	-3	4	10.3238	10.4197	-3	1	15.4112	14.1377	-9	6	32.8823	32.4361	-8	3	33.2794	32.4057
-11	0	47.7476	46.3338	-7	4	18.7367	18.6398	-4	1	12.7807	13.5133	-8	6	23.2037	21.7314	-7	3	26.7029	25.7120
-12	0	45.8615	47.0745	-9	4	23.8241	22.5309	-5	1	12.2347	11.6069	-7	6	11.3413	14.9617	-6	3	22.1366	22.4021
-14	0	12.4332	9.8286	-10	4	28.1175	29.4228	-6	1	11.0683	7.0410	-6	6	20.5972	19.0711	-5	3	20.9454	22.0527
-13	1	10.0508	7.4363	-11	4	35.9274	37.6939	-7	1	14.4682	12.7417	-5	6	12.7310	7.4772	-4	3	23.4023	22.6909
-10	1	17.2725	16.5826	-12	4	37.9449	38.3915	-10	1	16.4227	18.8774	-3	5	35.6866	35.8193	-2	3	30.2021	27.4488
-8	1	23.5760	23.8631	-10	5	14.2449	12.0831	-12	1	18.8350	18.0022	1	6	28.5642	30.2491	0	3	24.6679	27.2139
-7	1	14.9397	13.2485	-9	5	9.2764	3.5027	-13	1	10.4727	3.6595	-2	7	14.6419	10.5218	1	3	20.7965	21.4644
-6	1	21.4665	22.2917	-8	5	15.2798	16.1555	-12	2	23.2037	24.1495	-3	7	11.3165	11.7304	2	4	13.1281	10.8660
-5	1	31.1947	31.4808	-7	5	9.7530	10.4515	-9	2	48.2935	48.9290					1	4	20.1513	21.7502
-4	1	70.7776	71.4429	-6	5	14.7412	15.7211	-8	2	34.9421	33.9892					0	4	30.9714	32.1089
-3	1	17.8433	17.8039	-5	5	24.9227	24.7701	-7	2	24.2957	23.4826					-2	4	9.7034	10.5778
-2	1	35.8033	36.1638	-4	5	48.9636	49.5459	-6	2	29.9291	29.9461	5	0	17.2973	18.3886	-5	4	12.4829	11.3402
-1	1	24.4446	25.0982	-3	5	16.5528	16.2392	-5	2	11.4932	12.8022	4	0	12.9296	12.9059	-4	4	24.1219	22.5783
0	1	14.7265	14.8751	-2	5	26.7277	27.2771	-4	2	10.5472	9.5527	3	0	8.8359	6.1781	-6	4	28.5634	28.2743
2	1	21.2680	21.9489	-1	5	14.1704	14.1746	-3	2	57.1283	56.8905	2	0	11.1428	12.3318	-7	4	13.3661	12.2482
4	1	21.7454	22.2883	1	5	12.4580	9.0757	-2	2	11.1676	9.6220	1	0	25.1569	25.8391	-9	4	17.1236	17.1776
7	1	11.5624	15.5231	2	5	13.8230	13.7459	-1	2	14.3441	11.0111	0	0	38.5653	38.1111	-10	4	12.7310	13.4032
7	2	13.2025	16.0727	4	5	17.0998	17.3527	1	2	46.2732	46.5775	-2	0	12.7310	13.1146	-10	5	10.2493	1.6880
6	2	18.9849	18.3805	3	6	23.1293	21.3196	2	2	26.3058	25.1430	-4	0	29.7875	28.9374	-9	5	19.0983	13.5627
5	2	9.7530	12.0013	2	6	17.2725	15.7098	4	2	33.0312	31.5521	-6	0	33.8143	36.2123	-8	5	27.2737	27.6151
3	2	32.6341	32.1345	1	6	13.5720	11.3208	5	2	16.1557	12.8370	-7	0	17.8433	16.1054	-6	5	20.6972	20.4669
2	2	25.7599	26.5299	-3	6	12.7310	14.3879	6	2	12.6069	4.1921	-9	0	27.1373	20.6844	-5	5	9.6537	12.0340
1	2	15.1631	15.4827	-7	5	19.0345	15.5456	5	3	31.0955	30.9846	-10	0	16.5528	15.1365	-4	5	20.8461	21.6252
0	2	13.5748	9.9368	-9	6	10.9442	15.1474	4	3	27.4474	28.0842	-12	0	14.1456	13.2428	-5	5	20.2505	23.2956
-1	2	9.1574	6.7718	-7	7	11.3939	7.6415	0	3	8.9341	9.1194	-13	1	17.5472	1.4995	0	5	23.6504	17.8647
-2	2	17.5696	18.9076	-5	7	14.4930	12.0356	-1	3	21.5410	22.2855	-12	1	19.0050	17.1592	1	5	20.3055	20.3055
-3	2	27.3730	26.1230	-4	7	36.9522	36.4743	-2	3	13.4259	15.7250	-9	1	14.7660	15.9927	0	5	25.6110	24.9633
-4	2	10.1501	8.8614	-2	7	16.3295	17.1167	-3	3	14.1704	15.9737	-8	1	37.6957	37.1061	-3	5	12.9544	12.8956
-7	2	18.2155	20.1102	-1	7	14.5916	17.0226	-4	3	8.7355	11.2992	-7	1	23.6008	24.1074	-7	5	14.3666	14.9102
-8	2	13.0536	10.6458					-6	3	8.6363	7.5447	-6	1	25.1394	25.9246	-8	5	20.7220	23.7751
-9	2	21.3176	22.7221					-7	3	12.0362	9.3105	-5	1	19.1834	20.1724				
-10	2	13.4259	11.8957	-11	0	27.5715	27.1519	-10	3	17.9177	15.1483	-4	1	27.8211	27.2021				
-11	2	40.2529	39.0875	-10	0	28.3994	27.7670	-11	5	9.5297	4.0290	-2	1	31.8152	31.7388				
-12	2	19.3075	21.1071	-9	0	24.3701	24.0527	-12	5	19.0841	17.8725	0	1	28.6138	33.5514	-13	0	23.1045	23.3656
-10	3	15.3142	15.7670	-8	0	9.8523	6.9348	-11	4	24.5190	22.4494	1	1	26.1817	26.4067	-12	0	12.0610	6.3415
-8	3	21.2680	22.1344	-7	0	62.9603	63.4713	-10	4	23.8490	23.1658	2	1	12.2643	9.2713	-10	0	36.4063	34.4426
-7	3	10.4727	11.5627	-6	0	16.7565	13.4063	-9	4	22.5081	19.7523	3	1	11.3155	15.3743	-9	0	19.031	18.0815
-6	3	21.7892	23.3020	-5	0	29.4824	28.6300	-7	4	51.1475	50.4721	4	1	11.2668	13.5626	-6	0	12.6318	13.4264
-5	3	24.6183	24.3979	-4	0	27.5219	28.5287	-6	4	14.4434	11.3892	5	0	11.0683	5.7170	-7	0	14.3763	15.2191
-4	3	60.6027	61.8025	-3	0	19.6301	19.2794	-5	4	21.3746	21.5857	2	0	16.3295	19.4574	-6	0	13.7209	13.8572
-3	3	11.8128	11.3287	-2	0	67.2040	67.1886	-4	4	22.0373	22.1395	1	0	17.9177	17.2141	-5	0	59.8334	58.2310
-2	3	32.3363	30.3706	-1	0	48.4424	49.0587	-3	4	15.0142	14.9828	0	0	37.1508	36.4284	-4	0	8.8844	2.9655
-1	3	26.9263	25.7562	0	0	12.6586	11.7063	-2	4	51.4701	51.6163	-3	0	19.2404	17.4209	-3	0	10.2990	8.9869

Mn-bearing pinkish epidote from Nabatsutsu Mine, Fukui Prefecture

Appendix |Fo|-|Fc| Tables (continued)

H	K	F(obs)	F(calc)	H	K	F(obs)	F(calc)	H	K	F(obs)	F(calc)	H	K	F(obs)	F(calc)
L=12				L=13				L=14				L=16			
-2	0	32.7334	32.3054	-9	0	17.1484	16.0748	-6	0	13.7471	15.0243	-8	0	23.4519	22.2543
0	0	20.6724	20.0196	-10	0	16.7762	17.1056	-4	0	16.5576	12.3556	-6	0	36.8282	36.6869
1	0	36.5552	36.3394	-11	0	14.7164	11.0050	-3	0	32.9071	33.4927	-5	0	21.1936	21.4547
4	0	12.2843	13.3284	-12	0	10.9690	1.3549	-1	0	15.5223	8.5631	-4	0	23.9234	24.1546
2	1	27.6956	27.1294	-12	1	10.9194	2.2767	0	0	29.3543	29.4721	-4	1	24.2460	25.9006
0	1	27.4226	25.9591	-11	1	19.6549	15.2495	1	1	13.1529	11.5683				
1	1	17.8929	18.2710	-10	1	34.1231	34.7633	-1	1	35.6618	35.4863				
-2	1	11.0683	5.2225	-9	1	9.5048	6.1561	-3	1	10.1004	9.2143				
-5	1	14.4186	15.1384	-8	1	29.6561	28.9123	-4	1	11.1676	6.1142				
-7	1	11.7632	9.5379	-6	1	21.5658	19.4566	-7	1	19.7790	19.0278				
-9	1	13.6741	10.9667	-5	1	12.2099	7.7318	-10	1	26.1073	24.8365				
-10	1	31.6663	30.6281	-4	1	34.0983	35.0739	-11	1	10.2493	10.2511				
-12	1	33.7509	32.8813	-3	1	41.4441	42.8386	-10	2	16.3791	15.4421				
-13	1	21.9877	21.4650	-2	1	9.8523	15.0957	-9	2	32.9319	34.7042				
-11	2	29.5816	31.8776	-1	1	19.5398	22.6001	-8	2	21.3971	22.0962				
-8	2	13.4259	16.0128	1	1	19.5223	12.4512	-6	2	54.1007	56.0854				
-7	2	52.1401	51.9743	2	2	30.4006	30.8275	-5	2	19.4316	19.8422				
-6	2	34.1231	34.6092	-1	2	14.6916	15.1418	-2	2	19.9031	23.2645				
-5	2	26.4795	26.3620	-2	2	20.1761	20.3475	-1	3	32.7830	33.5512				
-4	2	39.1361	40.6527	-3	2	25.4124	27.0068	-2	3	12.4580	11.1708				
-3	2	36.7785	37.6046	-4	2	28.2167	28.9955	-3	3	19.5720	8.0184				
-2	2	10.3486	8.3607	-7	2	19.5720	5.8383	-4	3	11.0883	7.4754				
-1	2	41.3944	40.8192	-12	2	15.4857	13.9147	-5	3	10.2742	5.3298				
1	2	13.3515	11.2605	-11	3	17.3221	16.6078	-7	3	15.6346	14.3064				
2	2	27.0007	27.2482	-10	3	27.1744	31.5249	-10	3	21.3176	22.5923				
3	2	15.8331	15.1402	-8	3	25.6358	26.2780	-8	4	21.8636	23.9458				
2	3	23.5263	24.5905	-7	3	13.1777	4.4337	-7	4	27.3445	29.4012				
1	3	21.2184	23.4833	-6	3	18.8360	17.1619	-6	4	17.3718	12.9024				
0	3	14.0215	17.4028	-5	3	11.1676	7.4133	-4	4	15.7587	13.1685				
-10	3	28.0678	27.0117	-4	3	31.0955	31.5840	-3	4	26.7029	27.5418				
-12	3	25.9584	29.0401	-3	3	34.3217	35.7897								
-10	4	27.7234	27.3562	-1	3	15.2623	17.6547								
-9	4	10.6712	15.3726	1	3	11.7135	8.6060								
-7	4	11.2658	13.3534	0	4	10.9194	9.8629	-4	0	19.4279	19.4697				
-6	4	9.8275	10.5942	-2	4	10.2245	3.4774	-6	0	13.1288	17.4188				
-5	4	45.0674	45.6981	-3	4	10.1501	14.7144	-10	0	20.8958	22.1666				
-2	4	25.3628	25.6748	-7	4	8.9341	10.2571	-10	1	11.4654	11.7534				
0	4	17.1236	15.8417	-8	4	8.8844	7.6084	-9	1	15.4857	6.8485				
1	4	23.1423	29.7807	-9	4	12.6814	13.6470	-8	1	15.9572	18.6332				
-6	6	23.8241	23.6702	-10	4	16.1061	14.1092	-6	1	29.2094	28.2843				
-5	6	19.6797	16.6257	-8	5	16.1557	21.1278	-5	1	11.9624	13.7773				
-4	6	27.2737	25.8284	-6	5	12.3091	15.0442	-2	1	13.5252	14.4984				
-3	6	28.2167	26.2789	-4	5	20.7220	23.9388	-1	1	12.1351	11.8266				
				-3	5	33.1056	34.4176	-2	2	18.3148	17.6135				
				-2	5	12.4318	10.5385	-4	2	17.8946	5.0423				
								-5	2	11.9617	3.7212				
								-7	2	10.1253	1.3703				
								-8	2	13.4989	11.7724				
								-9	2	12.2099	8.0771				
								-8	3	16.8258	17.8275				
								-6	3	23.2730	25.3637				
								-5	3	12.5551	15.4734				
								-4	3	11.3413	2.2626				