

Electron Microprobe Analyses of Rock-forming Minerals from the Sanbagawa Metamorphic Rocks, Shikoku Part III. Nakatsu-Nanokawa and Yamadani-Mikawa Areas

メタデータ	言語: eng 出版者: 公開日: 2017-10-03 キーワード (Ja): キーワード (En): 作成者: 板野, 昇平 メールアドレス: 所属:
URL	https://doi.org/10.24517/00011206

This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 3.0 International License.



**Electron Microprobe Analyses of Rock-forming Minerals
from the Sanbagawa Metamorphic Rocks, Shikoku
Part III. Nakatsu-Nanokawa and Yanadani-Mikawa Areas**

Kiyofumi AIBA*, Toshio HIGASHINO**,
Chihiro SAKAI*** and Shohei BANNO***

Department of Earth Sciences, Faculty of Science, Kanazawa University

(Received April 28, 1984)

Abstract Chemical compositions of rock-forming minerals from the basic rocks and the chloritoid-bearing lateritic rock in the Nakatsu-Nanokawa and Yanadani-Mikawa areas situated in the northern subbelt of the Chichibu belt are tabulated. They include 317 electron microprobe analyses of plagioclase, stilpnomelane, chlorite, amphibole, pyroxene, pumpellyite, epidote, chloritoid and diaspore, which were formed under the pumpellyite-actinolite facies of the Sanbagawa metamorphism.

Introduction

This is the third report of "*Electron microprobe analyses of rock-forming minerals from the Sanbagawa metamorphic rocks, Shikoku*". It deals with the chemical data in the Nakatsu-Nanokawa¹⁾ and Yanadani-Mikawa²⁾ areas, central Shikoku, which are situated in the northern subbelt of the Chichibu belt. The Chichibu belt is generally bounded on the north by the Sanbagawa belt, but in places the Mikabu Green Rocks, consisting mainly of basic volcanics, diabases, gabbros, ultrabasic rocks and the sediments derived therefrom, lies between them. The Mikabu Green Rocks and the northern part of the Chichibu belt suffered the Sanbagawa metamorphism of the pumpellyite-actinolite facies.

In this report, analyses of main constituent minerals from the basic and chloritoid-bearing rocks are tabulated. Table 1-9 and 10 show the analyses and the mineral assemblages of the rocks containing the analyzed minerals, respectively. Chemical analyses were made using two electronprobe microanalyzers, Hitachi XMA-5A of the Kanazawa University and Hitachi S-550 with Kevex EDS (Energy Dispersive System) of the

* Takada-cho 6-3, Nagahama, Shiga 526

** Hakusan Nature Conservation Center, Yoshinodani-mura, Ishikawa 920-23

*** Department of Geology and Mineralogy, University of Kyoto, Kyoto 606

1) 中津一名野川 2) 柳谷一美川

Reprint requests to S. Banno.

Kyoto University. Correction procedure for the latter was done by Magic V of the Kevev Co..

Outline of geology

The Nakatsu-Nanokawa area is located in Agawa-mura, Agawa-gun, Kochi Prefecture¹⁾. Fig. 1 shows the geological map of the Nakatsu area. The rocks exposed in this area can be divided into four lithological units; an alternation of mudstone, chert and sandstone, a series of basic volcanic rocks, a mudstone group and a calcareous group from the lower to the higher horizons. The first group consists mainly of the alternation of mudstone and chert with a few lenses of graywacke with a maximum thickness of 150 m. The basic volcanic rock unit, having a maximum thickness of 500 m, consists of pillow lavas, massive lavas, hyaloclastites and tuffs. Within the mudstone group, mudstone is the dominant lithology with subordinate tuffs, cherts and sandstones. The calcareous group is mainly composed of limestones with minor mudstones, tuffs and lenticular beds including lateritic rocks, and has a thickness of 100 to 200 m. The basic volcanic rock unit and the calcareous group conformably lie on the alternation unit of mudstone, chert and sandstone, and the mudstone group, respectively, but the boundary between the basic volcanic rock unit and the mudstone group is a large-scale thrust (Aiba, 1982b). The Nanokawa area, where basic rocks are widely distributed, is on the north of the Nakatsu area, but its geology has not yet been studied in detail. The specimens containing the analyzed minerals are basic rocks from the basic volcanic rock and mudstone units of the Nakatsu area, and from the Nanokawa area, and chloritoid-bearing lateritic rock from the calcareous unit of the Nakatsu area. The basic rocks examined include lavas, tuffs and hyaloclastites.

The Yanadani-Mikawa area is located in Yanadani-mura and Mikawa-mura, Kamiukena-gun, Ehime Prefecture²⁾, being to the west of the Nakatsu-Nanokawa area. Geological map of the area is shown in Fig. 2. The basic rocks are the dominant lithology in this area. They are mainly composed of tuffs with minor thin layers of pillow lava and tuff breccia, and sheeted dolerites, which, however, occur only locally. The chert lithology is interlayered by a few mudstone beds. Most of cherts are massive, but a few of their layers are laminated. The sandstone formation consists mainly of medium to coarse sandstones with intercalated thin layers of mudstone. These rocks of the Chichibu belt is in contact on the north with the Mikabu Green Rocks by the fault, which consists mainly of massive lavas. Chemical analysis was made on the main constituent minerals from the tuffs, tuff breccias, pillow lavas and dolerites in the Chichibu belt.

Petrography and rock-forming minerals in brief

The rocks in the Nakatsu-Nanokawa and Yanadani-Mikawa areas were metamor-

1) 高知県吾川郡吾川村

2) 愛媛県上浮穴郡柳谷村, 美川村

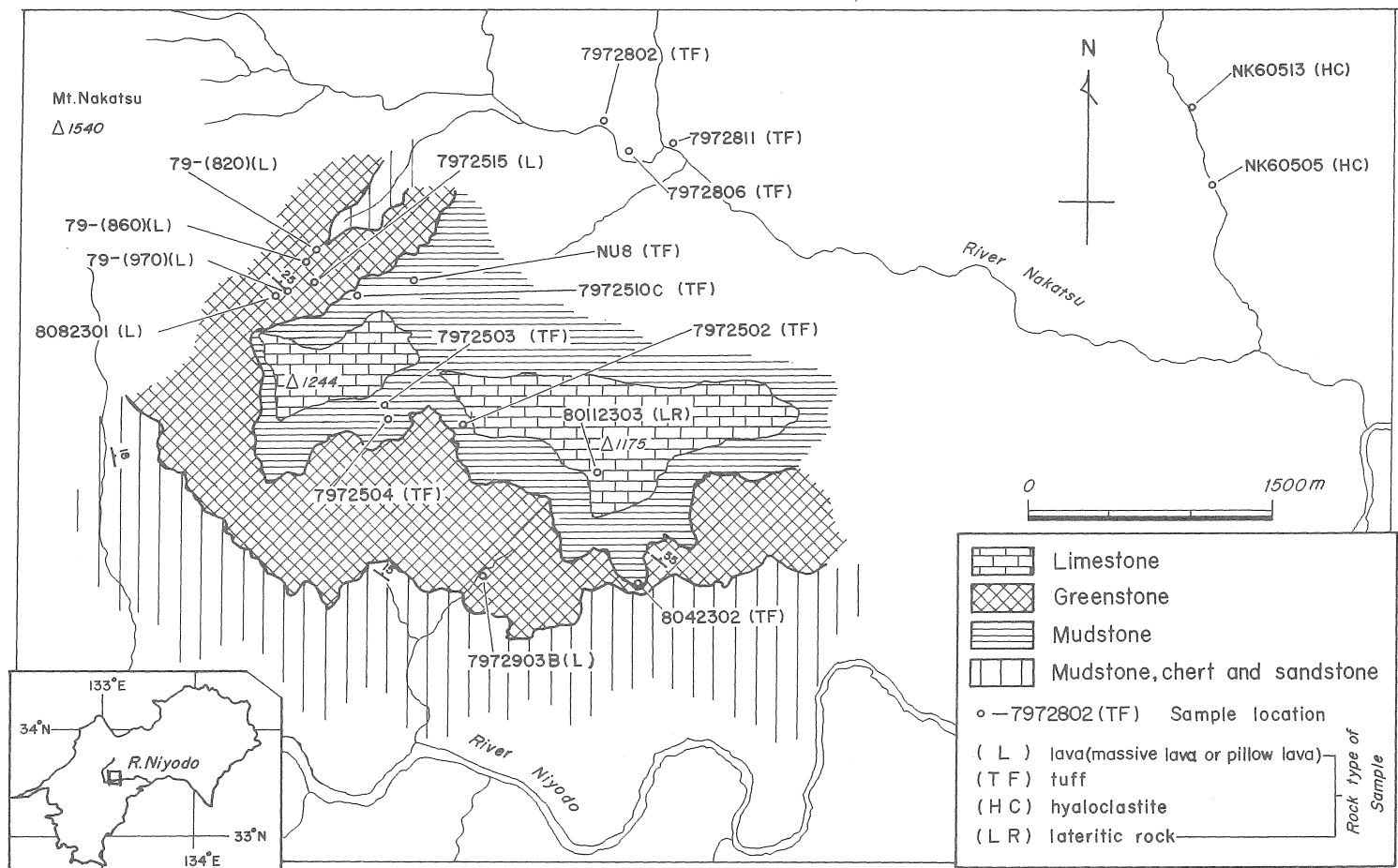


Fig. 1 Geological map of the Nakatsu area and sample localities in the Nakatsu-Nanokawa area.

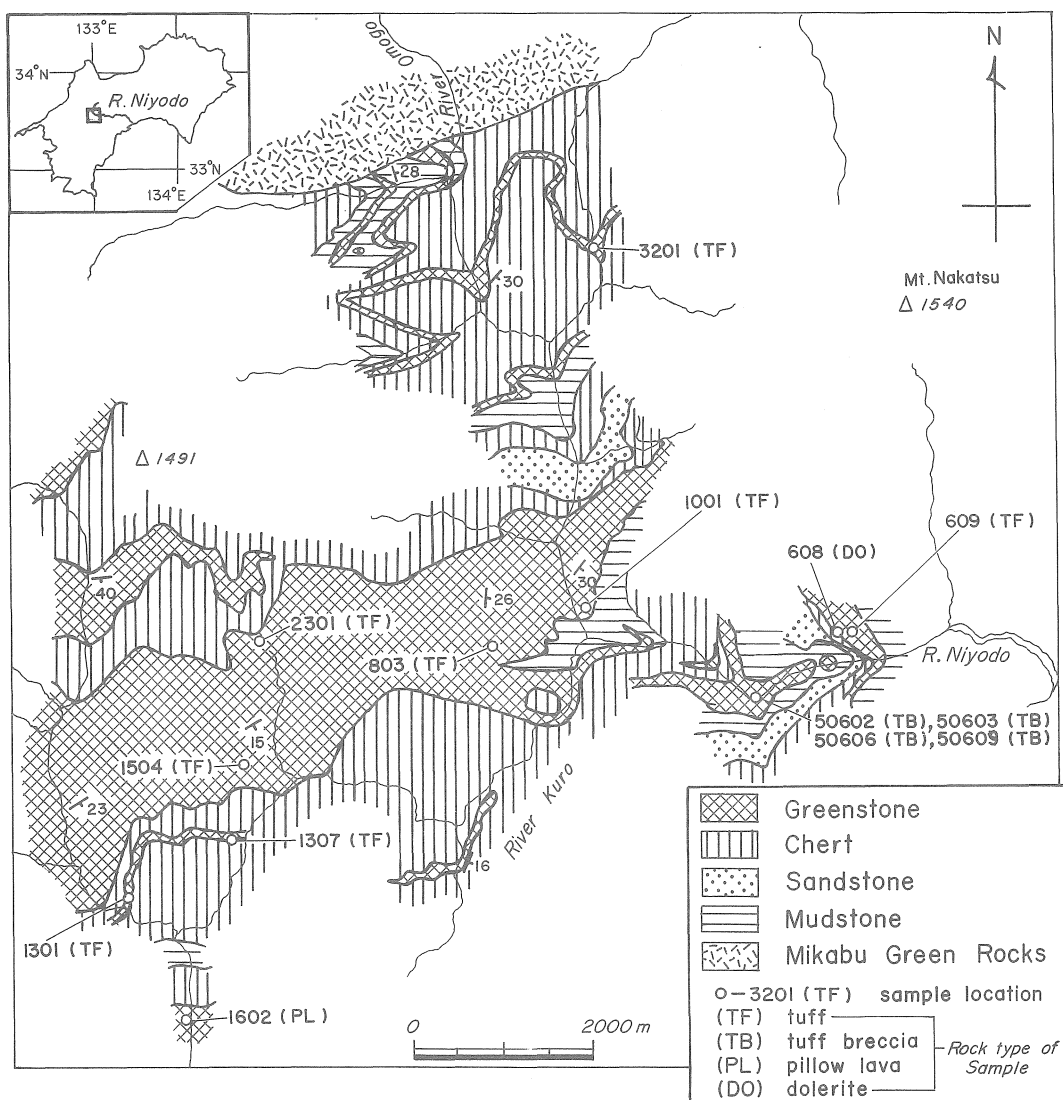


Fig. 2 Geological map and sample localities in the Yanadani-Mikawa area.

phosed under the pumpellyite-actinolite facies of the Sanbagawa metamorphism, which is characterized by the mineral assemblage of chlorite + epidote + pumpellyite + actinolite + albite + quartz in basic rocks. In addition to the above characteristic mineral assemblage, a variety of the mineral assemblage are observed in basic rocks as shown in Table 10. The basic rocks contain sphene, calcite, phengite, stilpnomelane, Na-amphibole, Na-pyroxene, hematite and the other opaque minerals other than the above minerals as stable phases, and sometimes relicts of plagioclase, pyroxene, amphibole and others, which are partly or wholly replaced by the metamorphic minerals. The mineral assemblages of the chloritoid-bearing lateritic rocks are chloritoid + chlorite + diaspore + paragonite + muscovite + apatite + hematite + calcite and the ones without hematite or

calcite.

Based on the chemistry of the minerals, the pumpellyite-actinolite facies of the present areas can be divided into two grades, the lower and higher pumpellyite-actinolite facies. The metamorphic grade of the Nanokawa and Yanadani-Mikawa areas, and the basic volcanic rock unit of the Nakatsu area belongs to the former grade, while that of the basic rocks from the mudstone unit of the Nakatsu area the latter.

In the Tables, analyses of albite, stilpnomelane, chlorite, actinolite, Na-amphibole, Na-pyroxene, pumpellyite, epidote, chloritoid and diaspore are presented. Most analyzed points are chosen arbitrarily, but for a few relatively large grains of pumpellyites, the rim and core were analyzed separately. In such a case, their POINT NO in the Table are named "RIM" and "CORE", respectively.

Albite is present in almost all the basic rocks. It commonly occurs replacing relicts of plagioclase or as fine-grained aggregates. Chemical analyses were made only on three albites from basic rocks in the Yanadani-Mikawa area. Their An contents are 0.1, 0.2 and 0.8 mole per cents.

Stilpnomelane is not uncommon in the basic rocks, and grows in the matrix, in the blastoamygdules or in the veins. It is green or brown colored, and chemical compositions tabulated are mainly of green colored stilpnomelanes.

Chlorite is ubiquitous in all the basic and lateritic rocks. It generally grows in the matrix, but in the lavas it occurs in the blastoamygdules, too. Chlorites from the basic rocks have various compositions, mainly with regard to Fe-Mg substitution, accompanied by the variation of the mineral assemblage of their host rocks. The compositions of chlorites coexisting with stilpnomelane are generally richer in FeO than those coexisting with actinolite, while those from the chloritoid-bearing lateritic rocks are much richer in Al_2O_3 and FeO than those from the basic rocks.

Actinolite is a main constituent in most of the basic rocks from the mudstone unit of the Nakatsu area, but it is rare in the basic volcanic rock unit of the Nakatsu area, and in the Nanokawa and Yanadani-Mikawa areas. It occurs as needle- or feather-like crystals in the matrix or as overgrowth on relicts of clinopyroxene. Chemical analyses were made only on actinolites from the basic rocks intercalated in the mudstone unit of the Nakatsu area, as actinolites from the other localities are too fine-grain for analysis. Most of them have 1.5-2.0 Ca ions based on the 23 oxygens, but one analysis has 1.17 Ca ions, being subcalcic actinolite (winchite).

Na-amphibole has not been found from the basic rocks of the Nakatsu-Nanokawa area, but is not uncommon in those of the Yanadani-Mikawa area. The Na-amphiboles are magnesioriebeckite. The Na-amphibole-bearing rocks are generally richer in MgO than the Na-amphibole-free ones in the same area, and stable calcic phases in the former are only calcite and sphene, probably suggesting that the stability field of Na-amphibole was spread more widely under the high f_{CO_2} condition.

Na-pyroxene is very rare in the Chichibu belt. In our study, one basic rock of the Yanadani-Mikawa area contains green colored aegirinaugite, which grows replacing

relicts of clinopyroxene.

Pumpellyite is a main constituent in most of the basic rocks. Fine-grained aggregates are common form of this mineral, which occurs in the matrix, the veins, the blastoamygdules or replacing relicts of plagioclase, and independent grains in the matrix are rare form. Chemical heterogeneity was examined in four grains of pumpellyites from the four specimens 803, 1001, 1301 (Yanadani-Mikawa area) and 7972811 (Nakatsu-Nanokawa area), all of which show a decrease of Al_2O_3 and an increase of Fe_2O_3 (Fe total as Fe_2O_3) from the core to the rim. The compositions of pumpellyites from the basic rocks intercalated in the mudstone unit of the Nakatsu area are more aluminous than those from the other basic rocks, being similar to those of the southern marginal belt of the Sanbagawa belt described by Nakajima *et al.* (1977).

Most of the basic rocks contain *epidote* as main constituent, which occurs as independent grain or aggregates in the matrix, and sometimes in the blastoamygdules, the veins or replacing plagioclase. Chemical heterogeneity of epidote is observed in one grain, but the compositional range in the grain is not so large as that described by Nakajima *et al.* (1977). Epidote is rich in pistacite mole, ranging from 24 to 41 mole per cents, and its pistacite mole from the basic rocks intercalated in the mudstone unit of the Nakatsu area is generally lower than that from the other basic rocks.

Chloritoid and *diaspore* occur in the lateritic rocks. Chloritoid grows commonly as sheaf-like aggregates, and sometimes as independent laths. Diaspore commonly forms fine-grained aggregates, and occasionally grows in chlorite pool as independent laths.

Mineral parageneses of the basic rocks and the chloritoid-bearing rocks of the Nakatsu-Nanokawa area, and the basic rocks of the Yanadani-Mikawa area have been described in Aiba (1982b), Aiba (1982a) and Aiba (1979) in detail, respectively.

Acknowledgements We thank Mr. K. Nakamura for drafting figures. Tables 1-9 were drafted by the FACOM M-382 Computer of the Kyoto University using the program written by H. Yoshizawa, to whom we are also thankful.

References

- AIBA, K., 1979, Geological and petrological studies on the greenstones of the northern part of the Chichibu belt in western Shikoku. *Grad. Thesis, Kanazawa Univ.* (in Japanese with English abstract).
- AIBA, K., 1982a, Notes on petrography and rock-forming mineralogy (12) Chloritoid-bearing rocks from the pumpellyite-actinolite facies region of the Sanbagawa metamorphic belt in western central Shikoku. *Jour. Japan. Assoc. Mineral. Petrol. Econ. Geol.*, **77**, 18-22.
- AIBA, K., 1982b, Sanbagawa metamorphism of the Nakatsu-Nanokawa district, the northern subbelt of the Chichibu belt in western central Shikoku. *Jour. Geol. Soc. Japan*, **88**, 875-885 (in Japanese with English abstract).
- NAKAJIMA, T., BANNO, S. and SUZUKI, T., 1977, Reactions leading to the disappearance of pumpellyite in low-grade metamorphic rocks of the Sanbagawa metamorphic belt in central Shikoku, Japan. *Jour. Petrol.*, **18**, 263-284.

Abbreviations used in Table 1-9 are as follows.

(ROCK TYPE) L=lava (massive lava or pillow lava), PL=pillow lava, HC=hyaloclastite,

TF=tuff, TB=tuff breccia, DO=dolerite, LR=lateritic rock

(ZONE) P-A=pumpellyite-actinolite facies

(ANALYST) KA=Kiyofumi Aiba

(INSTRUMENT) KU=Hitachi XMA-5A of the Kanazawa University,

HS=Hitachi S-550 with Kevex EDS of the Kyoto University

TABLE 1. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF PLAGIOCLASES

SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	803	50609	1602
	TF	TB	PL
	P-A	P-A	P-A
	1	1	1
SiO ₂	68.09	68.21	68.92
Al ₂ O ₃	20.03	19.65	19.53
CaO	0.17	0.04	0.03
Na ₂ O	11.79	11.63	11.42
K ₂ O	0.24	0.16	0.06
TOTAL	100.32	99.69	99.96
ATOMIC RATIOS (O = 8.0)			
SI	2.971	2.989	3.005
AL	1.030	1.015	1.003
CA	0.008	0.002	0.001
NA	0.997	0.988	0.965
K	0.013	0.009	0.003
ANALYST	KA	KA	KA
INSTRUMENT	KU	KU	KU

SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	50602			50606		
	TB			TB		
	P-A			P-A		
	1	2	3	1	2	3
SiO ₂	47.30	49.08	47.88	46.25	50.82	45.64
TiO ₂	0.02	0.01	0.04	0.01	0.36	0.03
Al ₂ O ₃	6.11	5.79	5.88	5.81	5.83	6.84
FeO	23.95	23.37	23.87	24.76	22.33	24.28
MnO	0.17	0.19	0.20	0.18	0.18	0.21
MgO	9.80	9.41	9.06	10.16	9.91	10.32
CaO	0.59	1.13	1.53	0.29	0.39	0.36
Na ₂ O	0.13	0.16	0.08	0.02	0.09	0.12
K ₂ O	2.05	3.36	1.82	0.63	0.72	1.84
TOTAL	90.12	92.50	90.36	88.11	90.63	89.64
ATOMIC RATIOS (SI = 8.0)						
SI	8.000	8.000	8.000	8.000	8.000	8.000
TI	0.003	0.001	0.005	0.001	0.043	0.004
AL	1.218	1.112	1.158	1.184	1.082	1.413
FE	3.388	3.186	3.335	3.582	2.940	3.559
MN	0.024	0.026	0.028	0.026	0.024	0.031
MG	2.471	2.287	2.257	2.620	2.326	2.697
CA	0.107	0.197	0.274	0.054	0.066	0.068
NA	0.043	0.051	0.026	0.007	0.027	0.041
K	0.442	0.699	0.388	0.139	0.145	0.411
ANALYST	KA	KA	KA	KA	KA	KA
INSTRUMENT	KU	KU	KU	KU	KU	KU

TABLE 2. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF STILPNOSELANES

SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	7972515				79-(970)	
	L				L	
	P-A				P-A	
	1	2	3	4	1	2
SiO ₂	45.58	46.15	44.30	45.98	46.39	45.01
TiO ₂	0.0	0.0	0.0	0.0	N.D.	N.D.
Al ₂ O ₃	6.82	6.54	8.19	7.19	6.23	5.94
FeO	28.96	29.03	28.45	28.01	26.02	26.63
MnO	0.86	0.90	0.77	0.78	N.D.	N.D.
MgO	7.24	7.32	7.11	6.77	7.99	6.58
CaO	0.68	0.60	0.72	0.74	0.55	0.35
Na ₂ O	0.04	0.01	0.09	0.08	N.D.	N.D.
K ₂ O	1.27	0.56	1.44	1.59	2.16	2.22
TOTAL	91.45	91.11	91.07	91.14	89.34	86.73
ATOMIC RATIOS (SI = 8.0)						
SI	8.000	8.000	8.000	8.000	8.000	8.000
TI	0.0	0.0	0.0	0.0	0.0	0.0
AL	1.411	1.336	1.743	1.474	1.266	1.244
FE	4.251	4.208	4.297	4.076	3.753	3.958
MN	0.128	0.132	0.118	0.115		
MG	1.894	1.892	1.914	1.756	2.054	1.743
CA	0.128	0.111	0.139	0.138	0.102	0.067
NA	0.014	0.003	0.032	0.027		
K	0.284	0.124	0.332	0.353	0.475	0.503
ANALYST	KA	KA	KA	KA	KA	KA
INSTRUMENT	KU	KU	KU	KU	KU	KU

TABLE 3. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF CHLORITES

SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	NK60513			NK60505			7972811			7972806		
	HC			HC			TF			TF		
	P-A			P-A			P-A			P-A		
	1	2	3	1	1	2	1	2	3	1	1	
	1	1	1	1	2	1	1	1	1	1	2	
SI02	27.69	27.05	26.69	28.58	27.97	28.85	27.53	27.85	28.89	26.55	26.62	
AL203	17.89	17.71	18.17	18.58	17.83	17.13	18.53	18.23	18.48	18.75	18.43	
FEO	24.25	25.24	25.00	21.96	23.07	23.12	21.29	22.54	21.37	26.64	27.75	
MNO	0.45	0.45	0.50	N.D.	N.D.	0.23	N.D.	N.D.	N.D.	0.53	0.49	
MGO	16.03	16.16	16.02	18.03	17.82	18.07	18.88	18.30	18.73	15.65	14.52	
TOTAL	86.31	86.61	86.38	87.15	86.69	87.40	86.23	86.92	87.47	88.12	87.81	
ATOMIC RATIOS (O = 28.0)												
SI	5.893	5.782	5.717	5.917	5.874	6.008	5.762	5.817	5.937	5.619	5.686	
AL	4.487	4.462	4.587	4.533	4.413	4.204	4.571	4.487	4.476	4.677	4.639	
FE	4.316	4.512	4.478	3.802	4.052	4.027	3.727	3.937	3.673	4.715	4.957	
MN	0.081	0.081	0.091			0.041				0.095	0.089	
MG	5.086	5.150	5.116	5.565	5.579	5.610	5.891	5.698	5.738	4.937	4.623	
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	
SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	7972806			7972802			80112303			NU8		
	TF			TF			LR			TF		
	P-A			P-A			P-A			P-A		
	2	3	1	2	3	4	5	1	2	1	1	
	1	1	1	1	1	1	1	1	1	1	2	
SI02	27.20	26.66	26.71	26.90	26.60	28.33	28.03	21.61	22.26	26.78	26.85	
AL203	17.46	18.43	18.14	17.81	17.68	17.05	18.13	26.00	26.39	19.02	18.61	
FEO	25.17	24.78	34.05	33.17	33.28	29.52	31.29	39.86	39.21	25.95	25.14	
MNO	0.46	0.49	N.D.	N.D.	N.D.	N.D.	N.D.	0.03	0.06	0.83	0.78	
MGO	15.94	16.80	9.67	10.07	9.21	12.43	10.92	2.46	1.80	15.34	16.16	
TOTAL	86.23	87.16	88.57	87.95	86.77	87.33	88.37	89.96	89.72	87.92	87.54	
ATOMIC RATIOS (O = 28.0)												
SI	5.837	5.652	5.826	5.883	5.910	6.101	6.011	4.794	4.919	5.661	5.679	
AL	4.416	4.605	4.663	4.590	4.630	4.327	4.583	6.798	6.874	4.739	4.639	
FE	4.517	4.393	6.211	6.066	6.184	5.316	5.612	7.395	7.247	4.587	4.447	
MN	0.084	0.088						0.006	0.011	0.149	0.140	
MG	5.100	5.309	3.144	3.283	3.051	3.991	3.491	0.814	0.593	4.834	5.096	
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	

TABLE 3. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF CHLORITES (CONTINUED)

SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	7972510C			7972502				7972503			
	TF			TF				TF			
	P-A			P-A				P-A			
	1	2	2	1	2	3	4	1	2	3	4
SI02	26.89	27.39	27.90	25.35	24.96	25.86	25.08	28.00	27.24	27.85	27.12
AL203	19.71	19.12	18.39	19.07	19.28	18.93	19.41	17.60	19.21	17.84	18.33
FEO	23.01	22.61	23.61	30.28	29.95	30.00	29.99	23.83	23.60	22.76	23.56
MNO	0.30	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.34	0.29	0.29	0.28
MGO	17.04	17.29	17.30	10.69	11.26	11.02	10.88	16.97	16.95	17.96	16.92
TOTAL	86.95	86.41	87.20	85.39	85.45	85.81	85.36	86.74	87.29	86.70	86.21
ATOMIC RATIOS (O = 28.0)											
SI	5.639	5.755	5.837	5.648	5.554	5.715	5.583	5.911	5.705	5.850	5.761
AL	4.871	4.735	4.534	5.008	5.056	4.930	5.093	4.379	4.742	4.417	4.589
FE	4.035	3.973	4.131	5.642	5.573	5.544	5.583	4.207	4.134	3.998	4.185
MN	0.053							0.061	0.051	0.052	0.050
MG	5.327	5.416	5.395	3.551	3.735	3.630	3.611	5.341	5.292	5.624	5.358
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU
SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	7972504			8042302		79-(820)		79-(860)			
	TF			TF		L		L			
	P-A			P-A		P-A		P-A			
	1	1	2	1	2	1	2	3	3	1	2
	1	2	1	1	1	1	1	1	2	1	1
SI02	27.38	27.88	27.02	26.56	27.21	26.40	26.17	26.03	26.07	27.40	27.11
AL203	19.64	18.91	19.10	18.81	18.42	18.00	18.73	18.37	18.19	17.85	17.60
FEO	23.33	23.21	22.93	20.16	20.96	28.87	28.02	28.59	28.31	24.05	23.88
MNO	0.40	0.36	0.33	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
MGO	17.32	17.79	17.63	20.54	19.39	13.02	12.89	13.16	12.76	17.17	17.73
TOTAL	88.07	88.15	87.01	86.07	85.98	86.29	85.81	86.15	85.33	86.47	86.32
ATOMIC RATIOS (O = 28.0)											
SI	5.673	5.764	5.665	5.556	5.710	5.767	5.720	5.691	5.748	5.809	5.762
AL	4.796	4.608	4.720	4.637	4.556	4.634	4.825	4.734	4.727	4.460	4.409
FE	4.042	4.013	4.021	3.527	3.679	5.274	5.122	5.228	5.220	4.264	4.245
MN	0.070	0.063	0.059								
MG	5.349	5.483	5.511	6.405	6.066	4.240	4.200	4.289	4.194	5.427	5.618
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

TABLE 3. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF CHLORITES (CONTINUED)

SAMPLE NO ROCK TYPE ZONE	7972515					79-(970)					8082301				
	L	L	L	L	L	P-A	P-A	P-A	P-A	P-A	L	L	L	L	L
GRAIN NO	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
POINT NO	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3
SI02	27.04	27.07	26.11	26.97	27.06	26.77	26.77	28.20	28.52	28.23	28.52	28.23	28.74	28.12	28.12
AL203	17.37	17.31	18.39	18.15	17.38	18.29	18.29	16.28	16.78	16.87	16.78	16.87	16.84	17.70	17.70
FE0	31.07	27.87	28.52	28.29	27.81	28.08	28.08	25.27	24.99	25.79	24.99	25.79	24.03	23.97	23.97
MNO	0.29	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
MGO	12.25	13.99	14.23	13.88	14.14	14.32	14.32	16.23	16.79	15.42	16.79	15.42	16.50	16.61	16.61
TOTAL	88.02	86.24	87.25	87.29	86.39	87.46	85.98	87.08	86.31	86.31	86.11	86.11	86.40	86.40	86.40
ATOMIC RATIOS (0 = 28.0)															
SI	5.857	5.880	5.633	5.792	5.865	5.735	6.050	6.021	6.041	6.099	6.099	6.099	6.099	5.950	5.950
AL	4.434	4.431	4.676	4.594	4.440	4.618	4.116	4.175	4.255	4.212	4.212	4.212	4.414	4.414	4.414
FE	5.628	5.063	5.145	5.081	5.041	5.031	4.534	4.412	4.616	4.265	4.265	4.265	4.265	4.261	4.261
MN	0.053														
MG	3.955	4.530	4.576	4.444	4.569	4.573	5.191	5.284	4.919	5.220	5.220	5.220	5.239	5.239	5.239
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU
SAMPLE NO	8082301					7972903B					3201				
ROCK TYPE	L					L					TF				
ZONE	P-A					P-A					P-A				
GRAIN NO	6	1	1	2	1	1	1	1	1	1	1	1	1	1	1
POINT NO	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SI02	29.05	27.73	28.42	27.70	28.20	29.16	29.17	28.75	27.89	27.92	27.92	27.92	27.92	27.98	27.98
AL203	16.90	18.40	18.04	17.57	17.58	17.49	17.16	16.74	17.77	17.77	17.77	17.77	17.77	19.00	19.00
FE0	25.03	19.26	19.26	19.46	20.42	20.24	20.42	20.68	24.87	26.25	26.25	26.25	24.12	24.12	24.12
MNO	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.36	0.31	0.33	0.39	0.39	0.39	0.31	0.31	0.31
MGO	16.04	21.54	21.42	21.20	21.19	20.20	20.68	20.49	16.45	16.09	16.09	16.09	16.73	16.73	16.73
TOTAL	87.02	87.14	87.14	85.93	87.24	87.09	87.79	86.97	87.31	88.30	88.30	88.30	88.14	88.14	88.14
ATOMIC RATIOS (0 = 28.0)															
SI	6.124	5.693	5.818	5.773	5.805	5.991	5.967	5.954	5.881	5.864	5.864	5.864	5.807	5.807	5.807
AL	4.199	4.452	4.353	4.316	4.265	4.235	4.137	4.086	4.416	4.369	4.369	4.369	4.647	4.647	4.647
FE	4.413	3.343	3.297	3.392	3.490	3.478	3.493	3.582	4.385	4.611	4.611	4.611	4.186	4.186	4.186
MN							0.062	0.054	0.059	0.054	0.059	0.054	0.054	0.054	0.054
MG	5.041	6.593	6.537	6.587	6.503	6.187	6.306	6.326	5.171	5.038	5.038	5.038	5.176	5.176	5.176
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

TABLE 3. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF CHLORITES (CONTINUED)

SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	2301			1504			1307			1301	
	TF			TF			TF			TF	
	P-A			P-A			P-A			P-A	
	1	2	3	1	2	3	1	2	3	1	2
SI02	28.22	28.46	28.50	28.77	27.31	27.37	26.68	27.66	27.56	27.65	26.73
AL203	17.11	17.34	17.69	17.41	17.22	17.65	17.80	17.99	17.71	16.95	17.88
FE0	21.97	21.65	22.46	25.27	25.86	26.12	23.50	23.01	23.64	28.57	28.59
MNO	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.43	0.43
MGO	19.25	19.96	19.43	16.83	14.98	16.14	18.16	17.38	17.27	12.96	13.11
TOTAL	86.55	87.41	88.08	88.28	85.37	87.28	86.14	86.04	86.18	86.56	86.74
ATOMIC RATIOS (O = 28.0)											
SI	5.907	5.884	5.867	5.987	5.927	5.812	5.679	5.855	5.849	6.009	5.807
AL	4.221	4.225	4.292	4.270	4.404	4.418	4.465	4.488	4.429	4.341	4.578
FE	3.846	3.743	3.866	4.398	4.693	4.639	4.183	4.073	4.195	5.192	5.194
MN										0.079	0.079
MG	6.007	6.152	5.963	5.222	4.846	5.110	5.762	5.484	5.464	4.199	4.246
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU
SAMPLE NO	1301										
ROCK TYPE	TF										
ZONE	P-A										
GRAIN NO	3	4	5								
POINT NO	1	1	1								
SI02	26.80	27.63	26.90								
AL203	17.32	16.36	16.79								
FE0	29.08	27.44	27.40								
MNO	0.42	0.38	0.40								
MGO	12.62	14.48	14.22								
TOTAL	86.24	86.29	85.71								
ATOMIC RATIOS (O = 28.0)											
SI	5.876	5.995	5.887								
AL	4.476	4.184	4.331								
FE	5.332	4.979	5.015								
MN	0.078	0.070	0.074								
MG	4.125	4.684	4.640								
ANALYST	KA	KA	KA								
INSTRUMENT	KU	KU	KU								

TABLE 4. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF AMPHIBOLES

SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	7972510C			7972503			7972504					
	TF			TF			TF					
	P-A			P-A			P-A					
	1	2	3	1	2	3	1	2	3	4	1	
SI02	52.98	54.85	54.13	54.81	54.80	54.44	53.58	52.84	54.26	52.17	53.86	
TI02	0.01	0.01	0.0	0.0	0.02	0.01	0.02	0.0	0.01	0.02	0.0	
AL203	2.58	0.89	0.94	0.78	0.71	0.47	1.30	1.44	0.84	1.67	0.82	
FE0	16.03	15.09	15.57	13.23	12.50	11.14	15.44	16.79	12.73	12.94	14.83	
MNO	0.89	1.11	0.56	0.27	0.25	0.27	0.41	0.48	0.26	0.18	0.15	
MGO	13.29	13.81	13.62	16.52	16.50	16.86	14.39	12.82	15.98	16.05	14.81	
CA0	7.34	10.55	12.10	11.82	12.59	12.91	12.60	12.50	13.06	12.37	12.84	
NA20	2.81	1.56	0.06	0.08	0.04	0.02	0.22	0.18	0.16	0.19	0.31	
K20	0.06	0.06	0.04	0.03	0.01	0.02	0.08	0.10	0.06	0.05	0.02	
TOTAL	95.99	97.93	97.02	97.54	97.42	96.14	98.04	97.15	97.36	95.64	97.64	
ATOMIC RATIOS (O = 23.0)												
SI	7.855	7.970	7.942	7.895	7.893	7.911	7.801	7.820	7.854	7.707	7.848	
TI	0.001	0.001	0.0	0.0	0.002	0.001	0.002	0.0	0.001	0.002	0.0	
AL	0.451	0.152	0.163	0.132	0.121	0.080	0.223	0.251	0.143	0.291	0.141	
FE	1.988	1.834	1.910	1.594	1.506	1.354	1.880	2.078	1.541	1.599	1.807	
MN	0.112	0.137	0.070	0.033	0.030	0.033	0.051	0.060	0.032	0.023	0.019	
MG	2.937	2.991	2.979	3.547	3.543	3.653	3.123	2.828	3.448	3.535	3.217	
CA	1.166	1.642	1.902	1.824	1.943	2.010	1.966	1.982	2.025	1.958	2.005	
NA	0.808	0.439	0.017	0.022	0.011	0.006	0.062	0.052	0.045	0.054	0.088	
K	0.011	0.011	0.007	0.006	0.002	0.004	0.015	0.019	0.011	0.009	0.004	
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	
SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	7972504			3201			1001			50603		
	TF			TF			TF			TF		
	P-A			P-A			P-A			P-A		
	2	3	4	5	6	1	2	1	2	3	1	
SI02	54.62	55.44	54.98	53.39	53.86	55.14	53.81	53.31	53.97	53.93	55.28	
TI02	0.0	0.0	0.0	0.0	0.0	0.04	0.46	0.04	0.02	0.03	0.29	
AL203	1.56	0.90	0.88	2.72	1.41	2.26	2.58	1.41	1.71	1.37	1.01	
FE0	13.29	16.09	12.78	11.79	13.49	22.87	22.07	22.40	22.46	20.34	21.44	
MNO	0.23	0.29	0.26	0.28	0.31	0.10	0.21	0.17	0.18	0.17	0.02	
MGO	15.73	12.76	16.08	16.31	15.27	9.45	9.38	8.87	8.88	10.38	10.70	
CA0	12.62	10.18	12.76	12.88	12.88	0.90	0.94	2.58	1.99	4.67	0.36	
NA20	0.22	2.04	0.16	0.14	0.13	6.86	6.98	5.99	5.97	6.01	6.83	
K20	0.02	0.03	0.02	0.04	0.03	0.04	0.09	0.05	0.04	0.05	0.04	
TOTAL	98.29	97.73	97.92	97.55	97.38	97.66	96.52	94.82	95.22	96.95	95.97	
ATOMIC RATIOS (O = 23.0)												
SI	7.827	8.065	7.892	7.677	7.817	8.168	8.072	8.181	8.215	8.064	8.272	
TI	0.0	0.0	0.0	0.0	0.0	0.004	0.052	0.005	0.002	0.003	0.033	
AL	0.263	0.154	0.149	0.461	0.241	0.395	0.456	0.255	0.307	0.241	0.178	
FE	1.593	1.958	1.534	1.418	1.637	2.833	2.769	2.875	2.859	2.543	2.683	
MN	0.028	0.036	0.032	0.034	0.038	0.013	0.027	0.022	0.023	0.022	0.003	
MG	3.360	2.767	3.441	3.496	3.304	2.087	2.098	2.029	2.015	2.314	2.387	
CA	1.938	1.587	1.962	1.984	2.003	0.143	0.151	0.424	0.325	0.748	0.058	
NA	0.061	0.575	0.045	0.039	0.037	1.970	2.030	1.782	1.762	1.742	1.981	
K	0.004	0.006	0.004	0.007	0.006	0.008	0.017	0.010	0.008	0.010	0.008	
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	

TABLE 4. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF AMPHIBOLES (CONTINUED)

SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	50603		50609				1307	
	TB		TB		TB		TF	
	P-A		P-A		P-A		P-A	
	1	2	1	1	2	2	1	2
SI02	54.61	54.86	55.03	55.02	54.86	54.89	54.61	54.20
TI02	0.52	0.36	0.38	0.43	0.28	0.30	0.25	0.26
AL203	1.04	0.97	1.20	1.24	0.84	0.89	1.79	1.73
FE0	21.71	22.03	20.19	19.69	20.52	19.92	23.99	24.38
MNO	0.02	0.0	0.02	0.01	0.01	0.02	N.D.	N.D.
MGO	10.31	10.22	10.94	11.24	11.14	11.27	7.84	7.78
CA0	0.22	0.23	0.57	0.38	0.20	0.35	0.07	0.06
NA20	6.88	6.81	7.21	7.47	6.73	6.78	7.41	7.46
K20	0.05	0.06	0.08	0.09	0.04	0.06	0.03	0.02
TOTAL	95.36	95.54	95.62	95.57	94.62	94.48	95.99	95.89
ATOMIC RATIOS (O = 23.0)								
SI	8.246	8.273	8.239	8.227	8.292	8.291	8.275	8.248
TI	0.059	0.041	0.043	0.048	0.032	0.034	0.028	0.030
AL	0.185	0.172	0.212	0.219	0.150	0.158	0.320	0.310
FE	2.741	2.778	2.528	2.462	2.594	2.516	3.040	3.103
MN	0.003	0.0	0.003	0.001	0.001	0.003		
MG	2.321	2.298	2.442	2.506	2.510	2.538	1.771	1.765
CA	0.036	0.037	0.091	0.061	0.032	0.057	0.011	0.010
NA	2.014	1.991	2.093	2.166	1.972	1.986	2.177	2.201
K	0.010	0.012	0.015	0.017	0.008	0.012	0.006	0.004
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU

TABLE 5. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF PYROXENE

SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	1001	
	TF	
	P-A	
	1	2
SI02	52.96	50.83
TI02	0.07	0.05
AL203	1.62	2.38
FE0	19.14	20.14
MNO	0.27	0.24
MGO	4.76	4.95
CA0	9.49	9.64
NA20	8.58	8.66
TOTAL	96.89	96.89
ATOMIC RATIOS (O = 6.0)		
SI	2.108	2.046
TI	0.002	0.002
AL	0.076	0.113
FE	0.637	0.678
MN	0.009	0.008
MG	0.283	0.297
CA	0.405	0.416
NA	0.662	0.676
ANALYST	KA	KA
INSTRUMENT	KU	KU

TABLE 6. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF PUMPELLYTES

SAMPLE NO ROCK TYPE ZONE	NK60513						NK60505				7972811	
	HC		P-A		P-A		HC		P-A		TF	
	GRAIN NO	POINT NO	1	2	3	4	5	6	1	2	3	1
SI02	37.05	35.87	36.60	36.75	36.64	36.23	36.14	37.40	36.42	35.97	37.52	
TI02	0.08	0.06	0.06	0.07	0.10	0.08	0.03	0.04	0.01	0.09	N.D.	
AL203	20.84	20.62	20.52	20.75	20.72	20.68	20.35	21.22	22.09	20.14	21.95	
FE203	10.65	10.45	10.54	10.37	10.71	10.36	11.08	8.86	7.99	9.48	8.54	
MNO	0.24	0.28	0.26	0.23	0.20	0.26	0.24	0.18	0.13	0.14	N.D.	
MGO	2.33	2.46	2.42	2.37	2.35	2.44	2.50	3.30	2.35	3.62	2.88	
CAO	22.12	21.96	22.18	21.97	22.00	21.92	21.58	22.23	22.20	21.80	22.14	
NA20	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.05	0.03	0.02	N.D.	
K20	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.0	0.02	0.02	0.0	
TOTAL	93.31	91.70	92.58	92.51	92.72	91.97	91.92	93.28	91.24	91.28	93.03	
ATOMIC RATIOS (O = 24.5)												
SI	6.033	5.958	6.016	6.032	6.009	5.990	5.988	6.056	6.014	5.983	6.068	
TI	0.010	0.007	0.007	0.009	0.012	0.010	0.004	0.005	0.001	0.011	0.011	
AL	3.999	4.036	3.975	4.014	4.005	4.030	3.974	4.049	4.299	3.948	4.184	
FE	1.305	1.306	1.304	1.281	1.322	1.289	1.382	1.080	0.993	1.187	1.039	
MN	0.033	0.039	0.036	0.032	0.028	0.036	0.034	0.025	0.018	0.020		
MG	0.566	0.609	0.593	0.580	0.575	0.601	0.618	0.797	0.579	0.898	0.694	
CA	3.859	3.908	3.906	3.864	3.866	3.883	3.831	3.856	3.928	3.885	3.836	
NA								0.016	0.010	0.006		
K								0.0	0.004	0.004	0.0	
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU
SAMPLE NO ROCK TYPE ZONE	7972811		7972806				7972510C			7972503		
	TF		P-A		P-A		P-A		P-A		TF	
	GRAIN NO	POINT NO	1	3	4	4	1	2	1	2	3	1
SI02	36.71	37.18	36.95	37.27	36.72	36.57	36.86	37.41	37.00	36.80	36.73	
TI02	N.D.	N.D.	N.D.	N.D.	0.04	0.04	0.07	0.07	0.07	0.08	0.06	
AL203	21.54	21.38	21.19	22.19	20.71	20.11	23.94	24.42	23.59	24.22	23.72	
FE203	9.15	9.55	9.40	8.34	10.87	12.18	5.91	5.52	6.75	5.48	5.82	
MNO	N.D.	N.D.	N.D.	N.D.	0.24	0.21	0.26	0.21	0.22	0.33	0.32	
MGO	2.82	2.71	2.59	3.05	2.75	1.80	3.60	2.61	3.49	3.62	3.47	
CAO	22.26	22.09	21.96	22.03	21.83	22.19	21.66	22.55	21.65	22.09	22.29	
NA20	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.06	0.10	0.02	0.13	0.15	
K20	0.01	0.02	0.0	0.01	N.D.	N.D.	0.02	0.01	0.13	0.02	0.02	
TOTAL	92.49	92.93	92.09	92.89	93.16	93.10	92.38	92.90	92.92	92.77	92.58	
ATOMIC RATIOS (O = 24.5)												
SI	6.000	6.046	6.061	6.034	5.995	6.008	5.954	6.004	5.959	5.924	5.938	
TI					0.005	0.005	0.009	0.008	0.008	0.010	0.007	
AL	4.150	4.098	4.097	4.234	3.985	3.894	4.557	4.619	4.478	4.595	4.520	
FE	1.125	1.169	1.160	1.016	1.335	1.506	0.718	0.667	0.818	0.664	0.708	
MN					0.033	0.029	0.036	0.029	0.030	0.045	0.044	
MG	0.687	0.657	0.633	0.736	0.669	0.441	0.867	0.624	0.838	0.869	0.836	
CA	3.898	3.849	3.859	3.821	3.818	3.906	3.748	3.877	3.736	3.810	3.861	
NA							0.019	0.031	0.006	0.041	0.047	
K	0.002	0.004	0.0	0.002			0.004	0.002	0.027	0.004	0.004	
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

TABLE 6. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF PUMPELLYITES (CONTINUED)

SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	7972503		7972504		8042302						
	TF	TF			TF						
	P-A	P-A			P-A	2	3	4	5	6	7
	3	1	2	3	1	1	1	1	1	1	1
SI02	37.29	37.17	37.49	36.91	37.95	37.79	37.52	37.42	37.71	37.70	37.45
TI02	0.09	0.05	0.06	0.04	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
AL203	23.54	23.19	22.63	23.78	24.48	26.04	25.52	25.21	25.90	26.45	25.30
FE203	6.48	6.79	7.75	6.99	8.87	5.23	5.27	7.08	5.77	4.31	5.23
MNO	0.23	0.24	0.27	0.32	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
MGO	3.05	2.59	2.54	2.59	2.30	3.25	3.02	2.69	2.88	3.13	2.91
CAO	22.55	22.44	22.50	22.14	23.20	23.24	23.48	23.58	23.55	23.35	23.20
NA2O	0.15	0.11	0.14	0.10	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
K2O	0.02	0.02	0.0	0.03	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
TOTAL	93.40	92.60	93.38	92.90	96.80	95.55	94.81	95.98	95.81	94.94	94.09
ATOMIC RATIOS (O = 24.5)											
SI	5.983	6.019	6.040	5.958	5.904	5.887	5.902	5.852	5.875	5.894	5.930
TI	0.011	0.006	0.007	0.005							
AL	4.451	4.426	4.297	4.524	4.489	4.781	4.731	4.646	4.756	4.874	4.722
FE	0.782	0.827	0.939	0.849	1.038	0.613	0.624	0.833	0.677	0.507	0.623
MN	0.031	0.033	0.037	0.044							
MG	0.729	0.625	0.610	0.623	0.533	0.755	0.708	0.627	0.669	0.730	0.687
CA	3.876	3.893	3.884	3.829	3.867	3.879	3.957	3.951	3.931	3.911	3.936
NA	0.047	0.035	0.044	0.031							
K	0.004	0.004	0.0	0.006							
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA
INSTRUMENT	KU	KU	KU	KU	HS	HS	HS	HS	HS	HS	HS
SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	8042302		79-(820)		79-(860)						
	TF	L			L				P-A		
	P-A	P-A			2	2	3	4	1	1	2
	8	1	1	2	1	2	1	1	1	2	1
SI02	37.29	35.96	35.95	36.33	36.04	36.41	36.42	36.03	36.49	36.52	36.03
TI02	N.D.	0.08	0.07	0.06	0.03	0.11	0.14	0.01	N.D.	N.D.	N.D.
AL203	25.41	20.09	20.05	20.27	19.90	20.61	21.55	21.18	20.10	20.74	20.72
FE203	7.04	11.93	11.47	11.78	11.78	11.61	11.14	11.84	11.51	11.35	10.64
MNO	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
MGO	2.54	1.87	1.90	1.80	1.88	1.81	1.48	1.54	2.22	2.26	2.25
CAO	22.63	21.98	21.88	21.95	22.38	21.99	22.13	21.88	22.78	22.33	22.32
NA2O	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
K2O	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
TOTAL	94.91	91.91	91.32	92.19	92.01	92.54	92.86	92.48	93.10	93.20	91.96
ATOMIC RATIOS (O = 24.5)											
SI	5.876	5.979	6.005	6.011	5.991	5.996	5.963	5.940	5.991	5.972	5.966
TI		0.010	0.009	0.007	0.004	0.014	0.017	0.001			
AL	4.719	3.937	3.947	3.953	3.899	4.000	4.158	4.115	3.889	3.997	4.043
FE	0.835	1.493	1.442	1.467	1.474	1.439	1.373	1.469	1.422	1.397	1.326
MN											
MG	0.597	0.463	0.473	0.444	0.466	0.444	0.361	0.378	0.543	0.551	0.555
CA	3.821	3.915	3.916	3.891	3.986	3.880	3.882	3.864	4.007	3.913	3.960
NA											
K											
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA
INSTRUMENT	HS	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

Analyses of rock-forming minerals, Sanbagawa metamorphic rocks, Part III

TABLE 6. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF PUMPELLYITES (CONTINUED)

SAMPLE NO	608			609		1301					
	DO			TF		TF					
	P-A			P-A		P-A					
GRAIN NO	1	2	2	1	1	1	2	3	3	4	4
POINT NO	2	1	2	1	2	1	1	1	2	CORE	RIM
SI02	37.35	36.73	36.83	36.51	37.57	36.61	36.08	36.26	36.61	37.07	35.34
TI02	0.03	0.02	0.0	1.03	0.90	0.07	0.05	0.05	0.03	0.03	0.08
AL203	23.25	22.97	23.01	19.85	20.55	21.16	21.20	20.95	20.91	22.39	20.78
FE203	8.61	8.60	8.71	10.88	9.84	11.50	10.06	11.91	11.55	9.44	11.68
MNO	0.15	0.11	0.15	0.41	0.41	0.20	0.20	0.11	0.14	0.19	0.18
MGO	2.11	2.14	2.13	2.01	2.20	1.49	2.27	1.68	1.72	1.71	1.41
CAO	22.23	22.79	22.52	21.48	21.32	22.08	22.15	21.90	22.12	21.97	22.23
NA2O	0.06	0.05	0.02	0.06	0.11	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
K2O	0.03	0.0	0.02	0.03	0.02	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
TOTAL	93.82	93.41	93.39	92.26	92.92	93.11	92.01	92.86	93.08	92.80	91.70
ATOMIC RATIOS (O = 24.5)											
SI	5.991	5.938	5.951	6.029	6.115	5.989	5.958	5.957	5.994	6.028	5.898
TI	0.004	0.002	0.0	0.128	0.110	0.009	0.006	0.006	0.004	0.004	0.010
AL	4.396	4.376	4.382	3.863	3.942	4.080	4.126	4.056	4.035	4.291	4.088
FE	1.039	1.046	1.059	1.352	1.205	1.416	1.250	1.472	1.423	1.155	1.467
MN	0.020	0.015	0.021	0.057	0.057	0.028	0.028	0.015	0.019	0.026	0.025
MG	0.505	0.516	0.513	0.495	0.534	0.363	0.559	0.411	0.420	0.415	0.351
CA	3.821	3.947	3.899	3.800	3.718	3.870	3.919	3.855	3.880	3.828	3.975
NA	0.019	0.016	0.006	0.019	0.035						
K	0.006	0.0	0.004	0.006	0.004						
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU
SAMPLE NO	1301	1602									
ROCK TYPE	TF	PL									
ZONE	P-A	P-A									
GRAIN NO	5	1	2	2	3	3					
POINT NO	1	1	1	2	1	2					
SI02	36.33	36.92	36.38	36.86	37.04	37.09					
TI02	0.01	0.10	0.18	0.17	0.09	0.10					
AL203	21.81	21.05	22.55	22.51	21.25	21.82					
FE203	10.33	10.63	9.08	8.96	9.61	9.38					
MNO	0.19	0.22	0.43	0.45	0.26	0.38					
MGO	1.55	2.20	2.21	2.19	2.42	2.10					
CAO	22.14	22.18	22.36	22.25	22.31	22.65					
NA2O	N.D.	0.01	0.11	0.08	0.04	0.07					
K2O	N.D.	0.01	0.01	0.01	0.01	0.03					
TOTAL	92.36	93.32	93.31	93.48	93.03	93.62					
ATOMIC RATIOS (O = 24.5)											
SI	5.970	6.012	5.908	5.963	6.034	6.006					
TI	0.001	0.012	0.022	0.021	0.011	0.012					
AL	4.224	4.040	4.316	4.292	4.080	4.164					
FE	1.277	1.303	1.110	1.091	1.178	1.143					
MN	0.026	0.030	0.059	0.062	0.036	0.052					
MG	0.380	0.534	0.535	0.528	0.588	0.507					
CA	3.898	3.870	3.890	3.856	3.894	3.930					
NA		0.003	0.035	0.025	0.013	0.022					
K		0.002	0.002	0.002	0.002	0.006					
ANALYST	KA	KA	KA	KA	KA	KA					
INSTRUMENT	KU	KU	KU	KU	KU	KU					

TABLE 7. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF EPIDOTES

SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	NK60513							NK60505		7972811		
	HC							HC	TF	P-A		
	P-A							P-A	P-A	P-A		
	1	2	3	4	5	6	7	1	1	2	3	
SI02	37.24	37.18	36.84	37.35	37.34	36.80	37.35	38.18	37.55	37.20	38.01	
AL203	21.73	21.12	20.64	20.81	20.96	21.05	21.09	20.59	21.25	21.30	21.46	
FE203	15.56	15.65	14.99	15.87	15.97	15.69	15.59	16.07	15.91	15.65	15.72	
MNO	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	
CAO	22.38	22.55	22.67	22.58	22.69	22.65	22.55	22.72	23.06	22.97	22.80	
TOTAL	96.91	96.50	95.14	96.61	96.96	96.19	96.58	97.56	97.77	97.12	97.99	
ATOMIC RATIOS (O = 12.5)												
SI	3.014	3.027	3.042	3.040	3.029	3.011	3.037	3.074	3.022	3.013	3.043	
AL	2.073	2.027	2.009	1.996	2.004	2.030	2.021	1.954	2.015	2.033	2.025	
FE	0.948	0.959	0.931	0.972	0.975	0.966	0.954	0.974	0.963	0.954	0.947	
MN												
CA	1.941	1.967	2.006	1.969	1.972	1.985	1.964	1.960	1.988	1.993	1.956	
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	
SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	7972811					7972806						
	TF					TF						
	P-A					P-A						
	4	5	6	7	1	2	3	4	5	6	7	
1	1	1	1	1	1	1	1	1	1	1		
SI02	38.01	37.31	37.74	38.32	37.35	37.82	37.27	36.82	37.48	37.67	37.58	
AL203	21.72	21.46	21.46	21.83	21.26	21.38	21.79	21.85	21.75	21.29	21.37	
FE203	15.72	15.70	15.55	15.21	16.35	16.38	16.26	15.95	15.87	16.29	16.29	
MNO	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	
CAO	22.93	22.70	22.69	22.76	23.30	23.13	23.10	23.36	23.23	23.28	22.20	
TOTAL	98.38	97.17	97.44	98.12	98.26	98.71	98.42	97.98	98.33	98.53	97.44	
ATOMIC RATIOS (O = 12.5)												
SI	3.032	3.017	3.038	3.055	2.998	3.017	2.983	2.964	2.999	3.012	3.028	
AL	2.042	2.045	2.036	2.051	2.012	2.010	2.056	2.073	2.051	2.007	2.030	
FE	0.943	0.955	0.942	0.913	0.988	0.983	0.979	0.966	0.956	0.980	0.988	
MN												
CA	1.959	1.966	1.957	1.944	2.004	1.977	1.981	2.015	1.992	1.995	1.917	
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	

TABLE 7. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF EPIDOTES (CONTINUED)

SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	7972806		7972503										
	TF		TF										
	P-A		P-A		1	2	3	4	5	6	7	8	9
	8	9	1	2	3	4	5	6	7	8	9		
	1	1	1	1	1	1	1	1	1	1	1	1	1
SI02	37.48	37.04	37.70	37.64	37.38	37.51	37.50	37.25	37.18	37.25	37.75		
AL203	21.29	21.27	23.70	23.11	22.87	22.86	22.51	22.42	22.26	21.88	22.83		
FE203	15.85	16.36	13.07	13.84	14.42	14.14	14.29	14.64	15.05	14.98	13.99		
MNO	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.		
CAO	23.26	22.98	23.60	23.09	23.34	23.40	23.27	23.13	23.08	23.22	23.39		
TOTAL	97.88	97.65	98.07	97.68	98.01	97.91	97.57	97.44	97.57	97.33	97.96		
ATOMIC RATIOS (O = 12.5)													
SI	3.015	2.992	2.995	3.006	2.986	2.997	3.008	2.995	2.990	3.005	3.011		
AL	2.018	2.025	2.219	2.176	2.153	2.152	2.128	2.125	2.110	2.080	2.146		
FE	0.959	0.994	0.781	0.832	0.867	0.850	0.862	0.886	0.911	0.909	0.840		
MN													
CA	2.004	1.989	2.009	1.976	1.998	2.003	2.000	1.993	1.989	2.007	1.999		
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA		
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU		
SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	7972503		7972504			8042302							
	TF		TF			TF							
	P-A		P-A	1	2	3	4	1	1	2	3	3	4
	10	1	1	2	3	4	1	1	2	3	3	4	
	1	1	1	1	1	1	CORE	RIM	1	CORE	RIM	1	1
SI02	37.52	37.70	37.94	38.04	38.12	36.33	35.97	35.97	35.97	36.63	37.04	37.15	
AL203	23.95	22.47	22.04	21.91	22.70	20.99	23.56	21.73	21.64	24.02	23.50		
FE203	12.53	14.29	15.28	14.90	14.05	14.97	12.09	14.61	14.52	12.21	13.68		
MNO	N.D.	0.06	0.08	0.05	0.07	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.		
CAO	23.59	23.02	23.04	22.90	23.24	22.81	23.07	22.89	23.25	22.98	23.36		
TOTAL	97.59	97.54	98.38	97.80	98.18	95.10	94.69	95.20	96.04	96.25	97.69		
ATOMIC RATIOS (O = 12.5)													
SI	2.991	3.021	3.024	3.044	3.031	3.005	2.959	2.970	2.996	2.988	2.971		
AL	2.250	2.122	2.070	2.066	2.128	2.046	2.284	2.115	2.086	2.284	2.215		
FE	0.752	0.862	0.916	0.897	0.841	0.932	0.748	0.908	0.894	0.741	0.823		
MN		0.004	0.005	0.003	0.005								
CA	2.015	1.977	1.967	1.963	1.980	2.022	2.033	2.025	2.038	1.986	2.001		
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA		
INSTRUMENT	KU	KU	KU	KU	KU	HS	HS	HS	HS	HS	HS		

TABLE 7. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF EPIDOTES (CONTINUED)

SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	8042302				79-(860)						
	TF				L						
	P-A				P-A						
	5	6	7	8	1	2	3	4	5	6	7
	1	1	1	1	1	1	1	1	1	1	1
SI02	36.60	36.40	36.80	36.67	37.33	37.55	37.05	37.44	37.58	36.97	37.30
AL203	22.77	23.45	23.48	23.91	22.26	22.45	21.91	22.32	22.22	21.39	22.22
FE203	14.69	12.54	13.00	12.81	14.45	14.83	14.67	14.06	14.16	15.47	14.69
MNO	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
CAO	23.46	23.25	23.62	23.48	22.85	23.38	22.69	22.93	22.86	23.06	23.42
TOTAL	97.52	95.64	96.90	96.87	96.89	98.21	96.32	96.75	96.82	96.89	97.63
ATOMIC RATIOS (O = 12.5)											
SI	2.948	2.968	2.966	2.953	3.014	2.998	3.013	3.024	3.032	3.002	2.997
AL	2.162	2.253	2.230	2.269	2.118	2.112	2.100	2.124	2.113	2.047	2.104
FE	0.890	0.769	0.788	0.776	0.878	0.891	0.898	0.854	0.860	0.945	0.888
MN											
CA	2.025	2.031	2.040	2.026	1.977	2.000	1.977	1.984	1.976	2.006	2.016
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA
INSTRUMENT	HS	HS	HS	HS	KU	KU	KU	KU	KU	KU	KU
SAMPLE NO ROCK TYPE ZONE GRAIN NO POINT NO	7972515			79-(970)			7972903B				
	L			L			L				
	P-A			P-A			P-A				
	1	2	3	1	2	3	4	1	2	3	4
	1	1	1	1	1	1	1	1	1	1	1
SI02	37.15	36.67	36.78	37.89	36.88	37.10	37.13	36.95	37.32	37.29	37.06
AL203	21.50	20.00	19.10	22.79	22.14	22.23	22.26	19.96	21.08	21.89	21.77
FE203	13.91	17.96	19.25	13.56	14.47	13.64	14.17	18.14	16.93	15.72	15.68
MNO	0.11	0.06	0.10	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
CAO	22.46	23.25	22.21	23.01	22.84	22.80	22.76	23.27	22.76	22.23	23.11
TOTAL	95.13	97.94	97.44	97.25	96.33	95.77	96.32	98.32	98.09	97.13	97.62
ATOMIC RATIOS (O = 12.5)											
SI	3.052	2.978	3.006	3.036	2.999	3.025	3.014	2.988	3.002	3.010	2.987
AL	2.082	1.914	1.840	2.152	2.122	2.136	2.130	1.902	1.998	2.083	2.068
FE	0.860	1.097	1.184	0.817	0.886	0.837	0.866	1.104	1.025	0.955	0.951
MN	0.008	0.004	0.007								
CA	1.977	2.023	1.945	1.975	1.990	1.992	1.979	2.016	1.961	1.923	1.996
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	HS	HS	HS	HS

TABLE 7. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF EPIDOTES (CONTINUED)

SAMPLE NO	7972903B						1301					
ROCK TYPE	ML						TF					
ZONE	P-A						P-A					
GRAIN NO	5	5	6	7	8	8	9	1	2	3	4	
POINT NO	CORE	RIM	1	1	CORE	RIM	1	1	1	1	1	
SI02	36.79	35.68	37.06	37.25	37.07	36.64	37.03	37.67	36.84	36.92	36.77	
AL203	21.12	18.77	21.77	22.58	20.52	20.69	21.14	21.84	18.37	18.47	18.75	
FE203	16.19	19.11	14.74	12.82	17.98	17.32	16.78	15.21	18.82	18.42	19.00	
MNO	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	
CAO	23.24	22.71	22.21	22.39	22.28	22.97	22.73	21.80	22.26	22.11	22.42	
TOTAL	97.34	96.27	95.78	95.04	97.85	97.62	97.68	96.52	96.29	95.92	96.94	
ATOMIC RATIOS (O = 12.5)												
SI	2.984	2.965	3.027	3.046	2.998	2.974	2.992	3.048	3.045	3.057	3.021	
AL	2.019	1.838	2.096	2.176	1.956	1.979	2.013	2.083	1.789	1.802	1.815	
FE	0.988	1.195	0.906	0.789	1.094	1.058	1.020	0.926	1.170	1.148	1.175	
MN												
CA	2.020	2.022	1.944	1.961	1.930	1.997	1.967	1.890	1.971	1.961	1.973	
ANALYST	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	KA	
INSTRUMENT	HS	HS	HS	HS	HS	HS	HS	KU	KU	KU	KU	
SAMPLE NO	1301											
ROCK TYPE	TF											
ZONE	P-A											
GRAIN NO	5	6	7	8	9	10						
POINT NO	1	1	1	1	1	1						
SI02	36.87	37.04	37.38	36.47	37.18	37.02						
AL203	18.75	18.59	21.32	19.48	19.17	18.89						
FE203	18.86	18.72	16.92	18.40	17.17	18.59						
MNO	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.						
CAO	22.30	22.66	21.81	22.58	21.94	22.45						
TOTAL	96.78	97.01	97.43	96.93	95.46	96.95						
ATOMIC RATIOS (O = 12.5)												
SI	3.031	3.039	3.016	2.992	3.075	3.035						
AL	1.816	1.798	2.027	1.884	1.869	1.825						
FE	1.167	1.156	1.027	1.136	1.069	1.147						
MN												
CA	1.964	1.992	1.885	1.985	1.944	1.972						
ANALYST	KA	KA	KA	KA	KA	KA						
INSTRUMENT	KU	KU	KU	KU	KU	KU						

Analyses of rock-forming minerals, Sambagawa metamorphic rocks, Part III

TABLE 8. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF CHLORITOIDS

SAMPLE NO	80112303		
	LR		
ROCK TYPE	P-A		
ZONE			
GRAIN NO	1	2	3
POINT NO	1	1	1
SI02	24.15	24.37	24.10
TI02	0.0	0.01	0.0
AL2O3	39.64	40.08	40.00
FE0	27.04	26.70	25.76
MNO	0.13	0.09	0.10
MGO	1.13	1.33	1.37
CA0	0.0	0.0	0.0
NA2O	0.0	0.0	0.0
K2O	0.0	0.0	0.01
TOTAL	92.09	92.58	91.34
ATOMIC RATIOS (O = 12.0)			
SI	2.030	2.031	2.028
TI	0.0	0.001	0.0
AL	3.926	3.936	3.967
FE	1.900	1.861	1.813
MN	0.009	0.006	0.007
MG	0.142	0.165	0.172
CA	0.0	0.0	0.0
NA	0.0	0.0	0.0
K	0.0	0.0	0.001
ANALYST	KA	KA	KA
INSTRUMENT	KU	KU	KU

TABLE 9. CHEMICAL COMPOSITION AND ATOMIC RATIO OF DIASPORE

SAMPLE NO	80112303	
	LR	
ROCK TYPE	P-A	
ZONE		
GRAIN NO	1	
POINT NO	1	
SI02	0.22	
TI02	0.17	
AL2O3	80.00	
FE2O3	1.15	
MNO	0.01	
MGO	0.02	
CA0	0.01	
NA2O	0.0	
K2O	0.01	
TOTAL	81.59	
ATOMIC RATIOS (O = 3.0)		
SI	0.005	
TI	0.003	
AL	1.971	
FE	0.018	
MN	0.000	
MG	0.001	
CA	0.000	
NA	0.0	
K	0.000	
ANALYST	KA	
INSTRUMENT	KU	

Table 10. Mineral assemblages of the rocks containing the analyzed minerals. Chemical compositions of the minerals marked with ● are listed in this paper. Abbreviations are as follows. (Rock type) L=lava (massive lava or pillow lava), PL=pillow lava, HC=hyaloclastite, TF=tuff, TB=tuff breccia, DO=dolerite, LR=lateritic rock (Mineral zone) P-A=pumpellyite-actinolite facies (Mineral) Qz=quartz, Ab=albite, St=stilpnomelane, Ch=chlorite, Ac=actinolite, wi=winchite, Mr=magnesioriebeckite, Pu=pumpellyite, Ep=epidote, Cc=calcite, Op=opaque minerals, ht=hematite, Ph=phengite, Sp=sphene, Ct=chloritoid, Di=diaspore, Pa=paragonite, Ap=apatite, Ae=aegirinaugite, cpx=clinopyroxene, hb=hornblende, ○, ● = present

Sample No.	Rock type	Mineral zone	Qz	Ab	St	Ch	Ac	Mr	Pu	Ep	Cc	Op	Ph	Sp	others	relicts
Nakatsu-Nanokawa area																
NU8	TF	P-A	o	o		•	wi			o	o	o	o	o		
7972510C	TF	P-A	o	o		•	•		•		o	o		o		
7972503	TF	P-A	o	o		•	•		•	•	o	o	o	o		
7972504	TF	P-A	o	o		•	•		•	•		o	o	o		
7972502	TF	P-A	o	o	o	•				o	o		o			
8042302	TF	P-A	o	o		•	o		•	•		o		o		
80112303	LR	P-A				•					o	ht	o		•Ct,•Di, Pa,Ap	
79-(820)	L	P-A	o	o		•			•	o	o	o	o	o		
79-(860)	L	P-A	o	o		•	o		•	•	o	o	o	o		
7972515	L	P-A	o	o	•	•			•	•	o	o	o	o		
79-(970)	L	P-A	o	o	•	•			•	•	o	o	o	o		
8082301	L	P-A	o	o	o	•	o		o	o	o	o	o	o		
7972903B	L	P-A	o	o		•	o		•	•	o	o	o	o		
7972802	TF	P-A	o	o	o	•			o	o	o	o	o	o		
7972806	TF	P-A	o			•			•	•	o	o				cpx
7972811	TF	P-A	o			•	o		•	•	o	o	o	o		
NK60513	HC	P-A	o	o		•			•	•	o	ht	o	o		
NK60505	HC	P-A	o	o		•	o		•	•	o	o	o	o		
Yanadani-Mikawa area																
3201	TF	P-A	o	o		•		•			o			o		
1001	TF	P-A	o	o		•		•	•	o	o	ht	o	o	•Ae	cpx
803	TF	P-A	o	•	o	•			•	o		o	o	o		
2301	TF	P-A	o		o	•					o		o	o		
1504	TF	P-A	o		o	•					o	o	o			
1307	TF	P-A	o	o		•		•			o	o	o	o		
1301	TF	P-A	o	o		•			•	•	o	o				cpx
1602	PL	P-A	o	•		o			•		o					
50602	TB	P-A	o	o	•	•					o	o	o	o		
50603	TB	P-A	o	o		•		•			o	o	o	o		
50606	TB	P-A	o	o	•	o					o	o	o	o		
50609	TB	P-A	o	•		•		•			o	ht	o	o		
608	DO	P-A	o	o		•			•			o	o			hb
609	TF	P-A	o			•			•		o	o	o	o		cpx