Electron Microprobe Analyses of Rock-Forming Minerals from the Sanbagawa Metamorphic Rocks, Shikoku part I. Asemi River area

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Electron microprobe analyses of rock-forming minerals from the Sanbagawa metamorphic rocks, Shikoku Part I. Asemi River area

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Abstract Chemical compositions of rock-forming minerals from the Sanbagawa metamorphic rocks in the Asemi River area, central Shikoku, are tabulated along with their brief descriptions. They include 867 electron microprobe analyses of silicate, oxide and sulfide minerals, and 10 analyses of carbonaceous matter.

Introduction

The Sanbagawa metamorphic belt is of an intermediate high-pressure type terrain, Miyashiro (1961). It extends longitudinally for about 800 km through the central and southwestern portion of the Japanese island arc on the Pacific Ocean side. Through the studies of Miyashiro and Banno (1958), Seki (1958), Iwasaki (1963), Banno (1964), Ernst et al. (1970) and others, the basic petrology of this belt has been established and is best summarized in the textbooks of Miyashiro (1965, 1973). The early petrological studies were mainly based upon conventional wet chemical analyses, and optical and X-ray properties of rock-forming minerals, but Ernst et al. (1970) have used electronprobe analyses. We have been engaged in the petrology of the Sanbagawa metamorphic rocks in the Shikoku region for the last ten years. This research has involved extensive use of the electronprobe microanalyser. Electronprobe microanlaysis has revealed that most of the rock-forming minerals with solid solution show chemical heterogeneity, often exhibiting more or less regular zonal structure. This offers us an opportunity to elucidate the metamorphic history more deeply. Some of our works have been published, and others are in progress. Our present view on the phase petrology and its implication to the tectonics of the south western Japan was recently summarized by Banno et al. (1978).

In the literature, full details of the electronprobe microanalysis have not always been

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published, only representative or average compositions were generally reported, or chemical data were summarized in figures. This method of data presentation is neither convenient nor fair, but was necessitated by editorial requirements. Therefore, we have decided to publish a full compilation of chemical data for the Sanbagawa metamorphic rocks collected by us in Shikoku, so that interested persons can examine their own ideas on the Sanbagawa metamorphism, not necessarily following the logic and prejudices of the authors.

This is the first report in a series of papers presently in preparation. It deals with the chemical data in the Asemi River* area in central Shikoku.

Outline of geology and petrography

The Asemi River area is located in Motoyama-cho, Nagaoka-gun, Kochi Prefecture** in central Shikoku, and a part of the Shiragayama*** area of Higashino (1975). It is underlain by the upper two formations of stratigraphy in central Shikoku established by Kojima and his collaborators (Kojima et al., 1956 and others), that is, the Ojoin formation mainly composed of alternating pelitic and psammitic schists with minor intercalated quartz and basic schists, and the Minawa formation composed of basic, pelitic and psammitic schists with a very thin intercalated calcareous bed. The latter formation is further divided into three members, the lower, main and upper members. The localities of the samples containing analyzed minerals, and the traverse map along the Asemi River section are shown in Fig. 1. Intercalated thin beds are not shown. Also, psammitic schists are not distinguished from pelitic schists because of their similar appearance in the intensely recrystallized area and their tendency to alternate in beds varying from a few to several tens of centimeters in thickness. In our definitions of rock-types, the term "siliceous schist" is applied to a rock, which is more siliceous than ordinary pelitic and basic schists, this includes psammitic and quartzitic schists, and so on.

The apparent geologic structure is that of a simple monocline trending approximately E-W and dipping north, minor folding is common. Kawachi (1968) and Hara et al. (1977), who made a detailed structural analysis of the geology of this area, have proposed a large scale recumbent fold or nappe. However, the location and significance of folds, their axial planes and the thrust zone are still in dispute. We have also proposed a large recumbent fold based upon the thermal structure (Banno et al., 1978), but the location of the axial plane differs from that postulated in the earlier works.

On the basis of the mineral assemblage in pelitic schists, this area is divided into three mineral zones, the chlorite, garnet and biotite zones in order of ascending metamorphic grade. The garnet zone is not comparable to the almandine zone of Barrovian-type metamorphism, as the garnet in the garnet zone contains 2-6 wt. % of MnO and 8-11 wt. % of CaO at the rim, and biotite is absent. In basic schists, two isograds are defined in the

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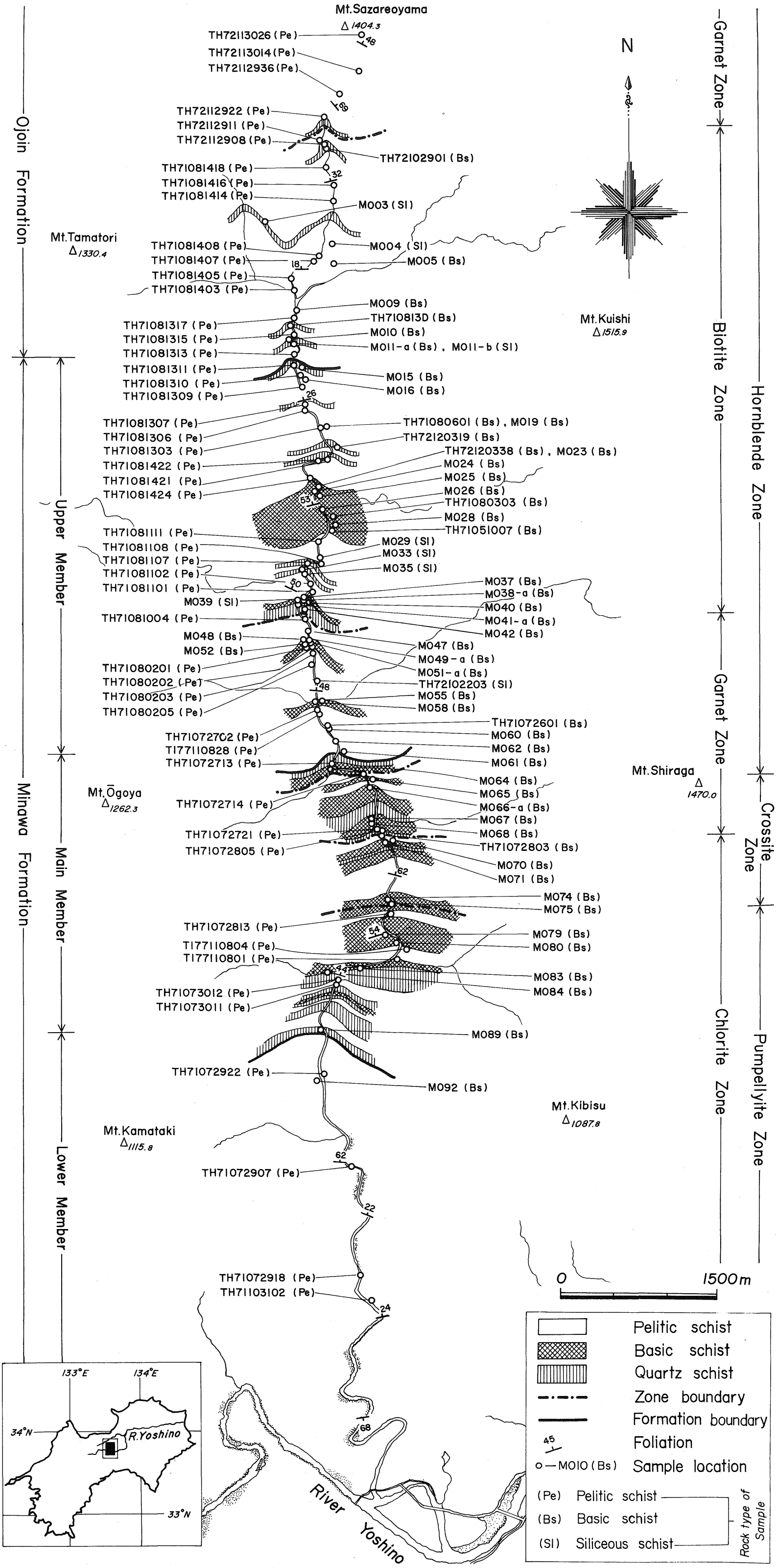

Fig. 1. Traverse map and sample localities along the Asemi River section.

study area. One of these is the transition from crossite-bearing to barroisite (subcalcic hornblende)-bearing assemblages in hematite-bearing basic schists, and the other is that from pumpellyite-bearing to pumpellyite-free assemblages in Fe_2O_3-poor basic schists. The crossite to barroisite isograd is located in the garnet zone, and pumpellyite disappearance isograd in the chorite zone. In the Asemi River section, not only the metamorphic grade is defined in terms of mineral zones, but it is also confirmed by the sliding equilibrium among silicate minerals that metamorphic temperature in each zone increases from the lower-grade to higher-grade parts. The schematic stability field of diagnostic minerals and the distribution of mineral zones are shown in Fig. 2 and Fig. 1, respectively. The mineral assemblages of the samples containing analyzed minerals are shown in Table 18.

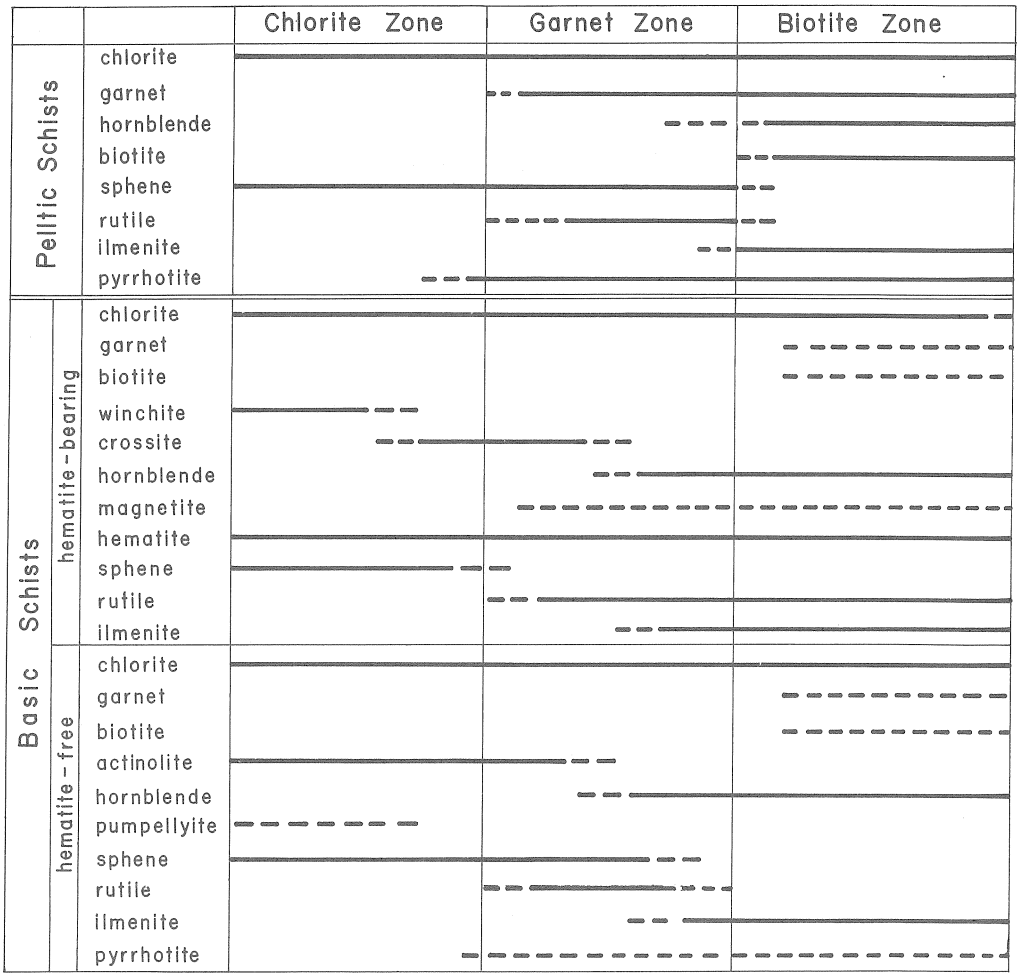

Fig. 2. Schematic stability field of diagnostic minerals. Quartz, albite, muscovite, epidote, calcite, tourmaline, apatite, pyrite, chalcopyrite and carbonaceous matter, which appear throughout the three zones, are not shown in this figure. Among them, quartz, albite, muscovite and epidote always occur in the pelitic and basic schists.

The detailed discussions on the mineral assemblages of the Sanbagawa schists of the Asemi River area have been given in the following papers : Higashino (1975) on silicate minerals in pelitic schists ; Nakajima et al. (1977), Otsuki (1980a), Nakajima (in press) and Otsuki and Banno (in prep.) on silicate minerals in basic schists ; Itaya (1975) on pyrrhotite in pelitic schists ; Itaya and Banno (1980) on titanium-bearing accessories in pelitic schists and Itaya and Otsuki (1978) on those in basic schists ; Itaya (1981) on carbonaceous matter in pelitic schists.

Analytical Procedure

We used two electronprobe microanalysers, Hitachi XMA-5A of the Kanazawa University and J.E.O.L JXA-5A of the University of Tokyo in the determination of chemical analyses of silicate, oxide and sulfide minerals. Correction procedures follow the methods of Bence and Albee (1968) for silicate minerals, Yui and Shoji (1976) for oxide minerals and Itaya (1975) for pyrrhotites. Chemical analyses of carbonaceous matter were determined using Shimazu Organic Microanalyser of Universal type of the Tohoku University by the Pregle method for carbon and hydrogen, and the Unterzaucher method for oxygen.

Iron content is represented as FeO for silicate and oxide minerals, except epidote, pumpellyite, magnetite and hematite. For epidote and pumpellyite, it is represented as Fe_2O_3, and the amounts of ferrous and ferric iron in magnetite and hematite were estimated by the method of Carmichael (1967) or Rumble (1973).

Brief description of individual minerals

In this chapter, we briefly describe the mode of occurence and the chemical characteristics of individual minerals listed in Tables 1-17. Analyses were determined on arbitrarily selected points unless otherwise stated. More detailed descriptions were given in the papers referred.

Albite (OTSUKI, 1980b)

Albite occurs as a stable phase in most schists of all the mineral zones in the Asemi River area. It is almost pure albite and not zoned in the chlorite zone. However, it generally forms porphyroblastic aggregates zoned optically and chemically in the garnet and bitote zones. Its An content ranges from nearly 0 to 6 in a conspicuously zoned albite. A preliminary study of the zonal structure of albite porphyoblasts was reported by Otsuki (1980b). The chemical compositions of albities from basic and siliceous schists are listed in Table 1.

Muscovite (HIGASHINO, 1974 ; OTSUKI, 1980 a ; OTSUKI and BANNO, in Pre.)

This phase is phengitic, and its FeO for total Fe and MgO contents are about 1.7-8.3

and 1.6-4.0 wt. %, respectively. Chemical heterogeneity is observed within individual grains. For example, a muscovite grain of specimen TH71080201 shows a variation of 1.7-3.2 wt. % in FeO and 1.6-2.4 wt. % in MgO, but the details of this zonation have not, as yet, been worked out. The chemical compositions of muscovites are listed in Table 2.

Paragonite (OTSUKI, 1980a)

Electron microprobe analysis enabled the recognition of paragonite in one basic schist (MO10). Two analyses from this specimen are listed in Table 3.

Biotite (HIGASHINO, 1975; OTSUKI, 1980a)

In the pelitic schists of the biotite zone, biotite is common and is usually brown colored with $TiO_2 = 0.8$-2.7 wt. %. The brown biotite is almost homogeneous within individual grains, except for a few grains with pale green colored margins, which always make contact with quartz, albite or garnet. The pale green colored margin is very poor in TiO_2. Occasionally, minute grains of brown biotite occur growing in cracks of garnet and hornblende, or replacing them along with chlorite. Their chemical compositions are similar to those of the brown biotites in the matrix. In the basic schists of the biotite zone, brown biotite occurs but sporadically.

Table 4 includes analyses of the brown biotites in the matrix and, in addition, analyses of two points of the pale green margin and one point of the brown biotite replacing garnet.

Chlorite (HIGAHINO, 1975 ; OTSUKI, 1980a ; OTSUKI and BANNO, in prep.)

Chlorite generally occurs forming the schistosity plane along with muscovite, but some chlorites occur in pressure shadow of garnet or replacing ferromagnesian minerals such as garnet, hornblende and biotite. Chemical heterogeneity, mainly in regard to Fe-Mg substitution, is often distinct among the chlorites with different mode of occurence and also sometimes within individual grains.

Analyzed points for pelitic schists listed in Table 5 are Mg-rich parts of the schistosity-forming chlorites. which were assumed to represent the composition stable during the prograde metamorphism. On the other hand, analyzed points for the schistosity-forming chlorites in basic and siliceous schists in the table were chosen arbitrarily, as they are rather homogeneous within a grain. Some analyses of chlorite replacing hornblende or garnet in basic schists are also listed.

Stilpnomelane (OTSUKI, 1980a)

Basic schists rarely contain stilpnomelane, but pelitic schists do not. The basic schists, which contain stilpmomelane, are rich in iron as judged from the chemistry of coexisting chlorite. Analyses of stilpnomelanes from three specimens are listed in Table 6.

Amphibole (HIGASHINO, 1974 ; OTSUKI, 1980a ; OTSUKI and BANNO, in prep.)

With advancing metamorphic grade, the species of amphibole changes in the following order ; winchite, crossite and subcalcic hornblende in hematite-bearing basic schists, and actinolite, subcalcic hornblende and calcic hornblende in hematite-free schists. With a few exceptions (e.g. some actinolites), they are chemically zoned, and most of the zoned amphiboles have Al_2O_3-poor compositions at the marginal part. The composition of the Al_2O_3-rich core is usually the same from grain to grain, whereas that at the margin is heterogeneous even in the same grain. The aluminous core represents the chemistry during the prograde metamorphism, while the less aluminous margin that during the retrograde metamorphism. The same zonal structure is also observed in amphiboles in siliceous schists. In the pelitic schists, hornblende commonly occurs in the uppermost garnet zone and biotite zone, but its heterogeneity has not been examined in detail. Acicular actinolite occurs in a quartz vein of one pelitic schist of the biotite zone (TH71081303), but this occurence is exceptional.

The chemical compositions of amphiboles are listed in Table 7. For the amphiboles in the basic and siliceous schists, the analyzed points of the aluminous core are distinguished from those of the less aluminous margin by naming POINT NO of the former "CORE".

Pyroxene (OTSUKI, 1980a)

Metamorphic pyroxene has been found from only one specimen of the lower chlorite zone (MO83) in our study. It is green colored aegirine-augite, grown replacing the rim of relic augite. Analyses of three grains are listed in Table 8.

Pumpellyite (OTSUKI, 1980a ; NAKAJIMA, in press)

In the present area, pumpellyite is stable in the lower-grade part of the chlorite zone, but is sporadic. Pumpellyite was analyzed from only one specimen (MO80), and its composition is listed in Table 9. It occurs as aggregates and is more aluminous than those of the Omoiji -Nagasawa area studied by Nakajima et al. (1977).

Garnet (HIGASHINO, 1975 ; ITAYA, 1978b ; OTSUKI, 1980a)

Garnet usually shows chemical zoning with regard to Mn, Ca, Fe and Mg. Homogeneous garnet occurs in the basic schist (TH71120338), but this occurence is exceptional. Based upon the Mn distribution, the zonal structure is classified into three types ; normal zoning with a decrease in Mn outwards from the core, reverse zoning with Mn-rich rim around normal zoning and oscillatory zoning with an oscillatory distribution of Mn. Most garnets in the pelitic schists show the normal zoning, although a few garnets show the reverse type. Garnets in the basic schists show all three types of zoning.

Chemical compositions of garnet are listed in Table 10. The analyses for the normally zoned garnets were determined on the rim and rarely on the core, while those for the reversely and oscillatorily zoned garnets on the Mn-poor part, and rarely on the core and the rim. Partial analysis was done on the rim and the Mn-poor part for the reversely

zoned garnets in pelitic schists (Itaya, 1978b), but not listed in Table 10.

Epidote (OTSUKI, 1980a; OTSUKI and BANNO, in prep.)

Epidote is a major constituent of the basic schists, and is also a common but minor constituent of the pelitic schists. Analyses were determined on epidotes from basic and siliceous schists, and are listed in Table 11. Zoning is common, but it has not been studied in detail at the time this compilation is completed.

Ilmenite (ITAYA and OTSUKI, 1978; ITAYA and BANNO, 1980)

Ilmenite occurs as discrete grain, intergrowth with hematite, fine lamellae in hematite, and in composite aggregates. The composite aggregates are made up of ilmenite, and sphene or rutile, or both. Ilmenite is manganoan, and its MnO content is 1-9 wt. % in pelitic and basic schists. The maximum MnO content is 24 wt. %, as observed in a discrete grain in the siliceous schist of the garnet zone (MO52). Ilmenite is homogeneous, when occuring as discrete grains and in hematite-ilmenite intergrowths, but ilmenite in composite aggregates is distinctly heterogeneous even within the same aggregate. Table 12 shows the chemical compositions of ilmenites of various modes of occurence described above.

Rutile (ITAYA and OTSUKI, 1978; ITAYA and BANNO, 1980)

Rutile is widespread in the garnet and biotite zones, and very often armoured by sphene of retrograde origin. The chemical compositions of this mineral are listed in Table 13. SiO_2, Al_2O_3, MnO and FeO are minor components.

Magnetite (ITAYA and OTSUKI, 1978)

Magnetite is rare in the present area, and usually coexists with hematite. It is euhedral, and is homegeneous. Analyses of magnetite are listed in Table 14. TiO_2, Al_2O_3, MnO and SiO_2 are detected as minor components. Among them, SiO_2 is sometimes as high as 4.62 wt. %, as observed in magnetite of specimen MO38b.

Hematite (ITAYA and OTSUKI, 1978)

Hematite occurs in various forms; as intergrowths with ilmenite or rutile, discrete grains, or as lamellae in ilmenite. Coarse-grained discrete hematite grains are usually zoned with TiO_2 decreasing towards the rim. The composition of the core is constant throughout a single thin section, but that of the rim differs from grain to grain. On the other hand, hematite intergrown with ilmenite is homogeneous, and does not differ from grain to grain. The compositions of the core and rim of the zoned hematite, the core of hematite in hematite-ilmenite intergrowths and hematite lamellae are listed in Table 15.

Pyrrhotite (ITAYA, 1975)

Pyrrhotite is rare in the basic schists, but common in pelitic schists of the higher chlorite zone to the biotite zone. Chemical analyses were determined on pyrrhotites from the pelitic schists. These analyses are homogeneous within one grain. The totals of analyses are generally less than 100 %, suggesting oxidation of them at the earth's surface. The Fe/S ratios of pyrrhotites range from 0.87 to 0.90, though most of them are close to 0.875, the value of Fe_7S_8. The pyrrhotites with Fe/S ratio of nearly 0.875 are monoclinic, while the pyrrhotites with the higher value of it exhibit the X-ray powder pattern intermediate between monoclinic and hexagonal pyrrhotites. Table 16 shows analyses of pyrrhotites.

Carbonaceous matter (ITAYA, 1981)

Pelitic schists of the Sanbagawa terrain are black colored by the ubiquitous presence of carbonaceous matter, and in the field the name of "black schist" is often used instead of pelitic schist. Carbonaceous matter is amorphous carbon in the lower-grade area of the chorite zone. The degree of graphitization advances with the grade of metamorphism until the higher-grade part of the biotite zone is reached, where carbonaceous matter close to the well-ordered graphite occurs. Table 17 shows analyses of carbonaceous matter with regard to C, H, O and ash. Atomic ratios of C, H and O are recalculated to 100.0 %.

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Abbreviations used in Tables 1-17 are as follows.

(Tables 1-17) PE=pelitic schist, BS=basic schist, SL=siliceous schist, CHL=chlorite zone, GAR=garnet zone, BIO=biotite zone, TH=Toshio Higashino, MO=Masayuki Otsuki, TI=Tetsumaru Itaya, Ku=Hitach XMA-5A of the Kanazawa University, TU=J.E.O.L JXA-5A of the University of Tokyo, SM=Shimazu Organic Microanalyser of Universal type of the Tohoku University.

(Table 4) (G)=pale green colored margin, (RG)=replacing garnet.

(Table 5) (RH)=replacing hornblende, (RG)=replacing garnet.

(Table 7) (V)=occuring in quartz vein, CORE=aluminous core.

(Table 10) (N)=normally zoned, (R)=reversely zoned, (O)=oscillatorily zoned, (NZ)=not zoned, POOR=Mn-poor part.

(Table 12) (D)=discrete grain, (R)=forming composite aggregate with rutile, (S)=forming composite aggregate with sphene, (RS)=forming composite aggregate with rutile and sphene, (L)=lamellae in hematite.

(Table 15) (D)=discrete grain, (I)=intergrown with ilmenite, (L)=lamellae in ilmenite.

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TABLE 1. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF PLAGIOCLASES

SAMPLE NO	TH710813D		TH71080601	MO26		TH71080303		MO68	MO84
ROCK TYPE	BS		BS	BS		BS		SL	BS
ZONE	BIO		BIO	BIO		BIO		GAR	CHL
GRAIN NO	A1	A1	A1	A1	A1	A2	A1	A1	A1
POINT NO	1	3	3	2	1	1	1	3	1
SIO2	67.98	68.17	66.88	67.33	67.66	69.24	67.86	68.62	67.64
AL2O3	19.70	19.58	19.89	20.13	19.89	18.71	18.18	18.75	18.53
CAO	0.09	0.20	0.97	0.11	0.22	0.17	0.50	0.06	0.05
NA2O	11.71	11.60	10.21	11.66	11.76	11.81	11.37	12.06	11.61
K2O	0.03	0.06	0.06	0.05	0.07	0.03	0.04	0.01	0.04
TOTAL	99.51	99.61	98.01	99.28	99.60	99.96	97.95	99.50	97.87
ATOMIC RATIOS (O = 8.0)									
SI	2.984	2.989	2.974	2.964	2.971	3.023	3.025	3.014	3.017
AL	1.019	1.012	1.042	1.045	1.029	0.963	0.955	0.971	0.974
CA	0.004	0.009	0.046	0.005	0.010	0.008	0.024	0.003	0.002
NA	0.997	0.986	0.880	0.995	1.001	1.000	0.983	1.027	1.004
K	0.002	0.003	0.003	0.003	0.004	0.002	0.002	0.001	0.002
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	TU	TU	KU	TU	TU	TU	TU	TU	TU

TABLE 2. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF MUSCOVITES

SAMPLE NO	TH71081416			TH71081315				TH71081311			
ROCK TYPE	PE			PE				PE			
ZONE	BIO			BIO				BIO			
GRAIN NO	1	1	1	1	1	2	2	1	1	2	3
POINT NO	1	2	3	1	2	1	2	1	2	1	1
SIO2	49.05	49.02	49.16	50.88	49.35	49.59	49.97	49.13	49.23	49.24	50.27
TIO2	0.32	0.40	0.56	0.37	0.44	0.19	0.29	0.55	0.59	0.53	0.45
AL2O3	28.98	28.47	30.00	28.80	28.81	27.78	27.63	31.39	31.19	30.98	30.07
FEO	4.05	2.61	2.80	2.94	2.65	2.46	2.50	2.24	2.30	2.32	2.46
MNO	0.02	0.0	0.0	0.0	0.01	0.02	0.03	0.0	0.0	0.0	0.0
MGO	2.56	2.45	2.54	2.78	2.60	3.11	2.49	2.21	2.12	2.41	2.19
CAO	0.01	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NA2O	0.17	0.51	0.58	0.36	0.56	0.55	0.39	0.81	0.80	0.75	0.45
K2O	9.71	9.56	9.49	9.40	9.22	9.32	9.59	8.69	9.11	8.88	9.20
TOTAL	94.87	93.03	95.13	95.53	93.64	93.02	92.89	95.02	95.34	95.11	95.09
ATOMIC RATIOS (O = 22.0)											
SI	6.604	6.681	6.557	6.736	6.668	6.744	6.805	6.508	6.518	6.527	6.662
TI	0.032	0.041	0.056	0.037	0.045	0.019	0.030	0.055	0.059	0.053	0.045
AL	4.598	4.573	4.716	4.494	4.588	4.453	4.435	4.901	4.867	4.840	4.697
FE	0.456	0.298	0.312	0.326	0.299	0.280	0.285	0.248	0.255	0.257	0.273
MN	0.002	0.0	0.0	0.0	0.001	0.002	0.003	0.0	0.0	0.0	0.0
MG	0.514	0.498	0.505	0.549	0.524	0.631	0.506	0.436	0.418	0.476	0.433
CA	0.001	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NA	0.044	0.135	0.150	0.092	0.147	0.145	0.103	0.208	0.205	0.193	0.116
K	1.668	1.662	1.615	1.588	1.589	1.617	1.666	1.469	1.539	1.502	1.555
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

TABLE 2. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF MUSCOVITES (CONTINUED)

SAMPLE NO	TH71081303			TH71081111						TH71081107	
ROCK TYPE	PE			PE						PE	
ZONE	BIO			BIO						BIO	
GRAIN NO	1	2	2	1	2	2	3	3	3	1	2
POINT NO	1	1	2	1	1	2	1	2	3	1	1
SIO2	46.88	48.47	49.54	50.57	49.14	48.93	49.08	51.57	50.62	48.08	49.57
TIO2	0.46	0.53	0.47	0.12	0.43	0.41	0.12	0.30	0.12	0.40	0.26
AL2O3	29.98	29.64	30.19	28.41	31.02	29.89	29.29	28.88	27.81	29.58	27.93
FEO	3.75	2.32	2.28	3.00	2.58	2.68	3.69	2.94	3.00	4.18	3.35
MNO	0.04	0.11	0.03	0.06	0.0	0.02	0.0	0.0	0.01	0.06	0.0
MGO	2.57	2.49	2.52	2.57	1.88	2.04	2.67	2.61	2.86	2.50	2.51
CAO	0.04	0.0	0.02	0.0	0.0	0.0	0.0	0.0	0.0	0.01	0.0
NA2O	0.45	0.77	0.46	0.08	0.72	0.58	0.15	0.41	0.35	0.10	0.24
K2O	8.96	9.23	8.41	10.29	9.69	9.49	9.97	9.51	9.42	9.40	10.07
TOTAL	93.13	93.56	93.92	95.10	95.46	94.04	94.97	96.22	94.19	94.31	93.93
ATOMIC RATIOS (O = 22.0)											
SI	6.420	6.561	6.618	6.760	6.528	6.595	6.596	6.775	6.802	6.512	6.727
TI	0.047	0.054	0.047	0.012	0.043	0.042	0.012	0.030	0.012	0.041	0.027
AL	4.839	4.729	4.753	4.476	4.857	4.748	4.639	4.472	4.404	4.722	4.467
FE	0.429	0.263	0.255	0.335	0.287	0.302	0.415	0.323	0.337	0.473	0.380
MN	0.005	0.013	0.003	0.007	0.0	0.002	0.0	0.0	0.001	0.007	0.0
MG	0.525	0.503	0.502	0.512	0.372	0.410	0.535	0.511	0.573	0.505	0.508
CA	0.006	0.0	0.003	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.0
NA	0.119	0.202	0.119	0.021	0.185	0.152	0.039	0.104	0.091	0.026	0.063
K	1.565	1.594	1.433	1.755	1.642	1.632	1.709	1.594	1.615	1.624	1.743
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	TH71081107								TH71080201		
ROCK TYPE	PE								PE		
ZONE	BIO								GAR		
GRAIN NO	2	2	2	2	3	3	3	3	4	1	1
POINT NO	2	3	4	5	1	2	3	4	1	1	2
SIO2	48.48	49.02	49.89	49.06	49.51	48.92	49.14	48.46	48.78	49.05	48.70
TIO2	0.30	0.38	0.28	0.35	0.29	0.33	0.37	0.24	0.23	0.33	0.31
AL2O3	29.24	29.19	29.71	30.44	28.23	29.24	29.16	28.81	28.47	31.30	30.00
FEO	3.11	3.17	3.36	3.24	3.36	3.12	3.02	3.25	3.92	2.60	3.07
MNO	0.01	0.0	0.01	0.01	0.01	0.01	0.0	0.01	0.02	0.0	0.0
MGO	2.34	2.39	2.32	2.32	2.46	2.26	2.35	2.27	2.48	1.70	2.07
CAO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NA2O	0.32	0.29	0.19	0.31	0.25	0.33	0.26	0.24	0.24	0.53	0.49
K2O	10.04	9.99	9.90	9.83	10.07	9.94	9.74	9.82	9.81	9.32	9.61
TOTAL	93.84	94.43	95.66	95.56	94.18	94.15	94.04	93.10	93.95	94.83	94.25
ATOMIC RATIOS (O = 22.0)											
SI	6.587	6.613	6.632	6.533	6.702	6.616	6.637	6.629	6.636	6.536	6.567
TI	0.031	0.039	0.028	0.035	0.030	0.034	0.038	0.025	0.024	0.033	0.031
AL	4.682	4.641	4.655	4.777	4.504	4.661	4.642	4.645	4.565	4.916	4.767
FE	0.353	0.358	0.374	0.361	0.380	0.353	0.341	0.372	0.446	0.290	0.346
MN	0.001	0.0	0.001	0.001	0.001	0.001	0.0	0.001	0.002	0.0	0.0
MG	0.474	0.481	0.460	0.461	0.496	0.456	0.473	0.463	0.503	0.338	0.416
CA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NA	0.084	0.076	0.049	0.080	0.066	0.087	0.068	0.064	0.063	0.137	0.128
K	1.740	1.719	1.679	1.670	1.739	1.715	1.678	1.714	1.703	1.584	1.653
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

TABLE 2. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF MUSCOVITES (CONTINUED)

SAMPLE NO	TH71080201										
ROCK TYPE	PE										
ZONE	GAR										
GRAIN NO	2	2	2	2	2	2	3	3	3	3	3
POINT NO	1	2	3	4	5	6	1	2	3	4	5
SIO2	48.85	51.67	49.14	52.39	49.20	51.39	52.19	52.28	48.82	48.68	48.45
TIO2	0.19	0.27	0.16	0.25	0.27	0.25	0.13	0.24	0.21	0.31	0.29
AL2O3	31.77	29.47	33.28	28.88	31.51	30.44	27.25	28.44	31.69	29.87	30.79
FEO	1.71	2.82	1.84	3.17	2.34	2.18	2.79	3.04	2.05	2.63	2.11
MNO	0.02	0.01	0.01	0.0	0.0	0.02	0.0	0.02	0.02	0.0	0.0
MGO	1.57	2.17	1.66	2.36	1.85	1.72	2.50	2.47	1.72	2.22	1.72
CAO	0.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NA2O	0.12	0.14	0.23	0.16	0.51	0.19	0.09	0.07	0.25	0.35	0.53
K2O	9.21	9.73	9.42	9.52	9.49	9.47	9.34	9.44	9.20	9.28	9.25
TOTAL	93.46	96.28	95.74	96.73	95.17	95.66	94.29	96.00	93.96	93.34	93.14
ATOMIC RATIOS (O = 22.0)											
SI	6.555	6.775	6.450	6.836	6.529	6.746	6.965	6.865	6.534	6.595	6.559
TI	0.019	0.027	0.016	0.025	0.027	0.025	0.013	0.024	0.021	0.032	0.030
AL	5.024	4.554	5.148	4.441	4.928	4.709	4.286	4.402	4.998	4.769	4.913
FE	0.192	0.309	0.202	0.346	0.260	0.239	0.311	0.334	0.229	0.298	0.239
MN	0.002	0.001	0.001	0.0	0.0	0.002	0.0	0.002	0.002	0.0	0.0
MG	0.314	0.424	0.325	0.459	0.366	0.337	0.497	0.484	0.343	0.448	0.347
CA	0.003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NA	0.031	0.036	0.059	0.040	0.131	0.048	0.023	0.018	0.065	0.092	0.139
K	1.577	1.628	1.577	1.585	1.607	1.586	1.590	1.581	1.571	1.604	1.597
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	TH71080201	TH71073012			TH71072922					TH72102901	
ROCK TYPE	PE	PE			PE					BS	
ZONE	GAR	CHL			CHL					BIO	
GRAIN NO	3	1	2	3	1	2	3	4	5	M1	M1
POINT NO	6	1	1	1	1	1	1	1	1	3	1
SIO2	48.86	52.43	52.08	51.39	50.33	52.23	52.74	52.39	52.00	47.97	48.97
TIO2	0.22	0.13	0.05	0.12	0.09	0.05	0.07	0.06	0.05	0.43	0.34
AL2O3	30.85	29.66	29.25	29.67	28.25	28.39	27.70	27.80	28.65	28.48	26.32
FEO	2.36	2.30	2.76	2.71	3.00	2.76	2.46	3.19	2.97	4.47	5.17
MNO	0.01	0.02	0.04	0.03	0.02	0.0	0.0	0.0	0.07	0.0	0.0
MGO	1.80	2.34	2.55	2.53	2.73	2.77	2.64	2.82	2.68	2.38	2.61
CAO	0.0	0.0	0.02	0.0	0.0	0.0	0.0	0.02	0.0	0.14	0.13
NA2O	0.36	0.25	0.15	0.21	0.16	0.20	0.12	0.26	0.20	0.67	0.56
K2O	9.29	9.83	9.75	10.33	10.34	10.05	10.58	9.48	10.06	9.75	9.82
TOTAL	93.75	96.96	96.65	96.99	94.92	96.45	96.31	96.02	96.68	94.29	93.92
ATOMIC RATIOS (O = 22.0)											
SI	6.573	6.808	6.801	6.719	6.748	6.849	6.931	6.893	6.815	6.545	6.727
TI	0.022	0.013	0.005	0.012	0.009	0.005	0.007	0.006	0.005	0.044	0.035
AL	4.891	4.539	4.502	4.572	4.464	4.388	4.290	4.311	4.425	4.580	4.261
FE	0.266	0.250	0.301	0.296	0.336	0.303	0.270	0.351	0.326	0.510	0.594
MN	0.001	0.002	0.004	0.003	0.002	0.0	0.0	0.0	0.008	0.0	0.0
MG	0.361	0.453	0.496	0.493	0.546	0.542	0.517	0.553	0.524	0.484	0.535
CA	0.0	0.0	0.003	0.0	0.0	0.0	0.0	0.003	0.0	0.020	0.019
NA	0.094	0.063	0.038	0.053	0.042	0.051	0.031	0.066	0.051	0.177	0.149
K	1.594	1.628	1.624	1.723	1.769	1.681	1.774	1.591	1.682	1.697	1.721
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	MO	MO
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

TABLE 2. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF MUSCOVITES (CONTINUED)

SAMPLE NO	M004	M005	TH710813D	M011-A	M019	TH71080601	M023	M024	M026	TH71080303	M028
ROCK TYPE	SL	BS	BS	BS	BS	BS	BS	BS	BS	BS	BS
ZONE	BIO	BIO	BIO	BIO	BIO	BIO	BIO	BIO	BIO	BIO	BIO
GRAIN NO	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
POINT NO	3	1	1	3	3	3	3	2	4	2	3
SIO2	50.18	49.00	47.07	47.25	47.23	47.85	47.03	45.11	47.48	47.09	46.61
TIO2	0.29	0.12	0.72	0.57	0.46	N.D.	0.61	0.41	0.68	0.83	0.54
AL2O3	29.59	30.32	25.57	26.66	31.79	29.70	32.03	29.26	28.40	27.53	27.30
FEO	2.29	1.81	6.44	4.63	2.09	2.39	3.54	5.76	5.39	5.23	4.96
MNO	0.0	0.0	0.05	0.03	0.0	N.D.	0.0	0.02	0.03	0.03	0.02
MGO	2.63	2.66	3.16	2.96	2.33	2.42	1.63	1.85	2.83	2.62	2.67
CAO	0.0	0.02	0.0	0.06	0.01	0.03	0.0	0.08	0.0	0.11	0.09
NA2O	0.66	0.55	0.33	0.45	0.81	0.69	1.59	1.12	0.91	0.55	0.43
K2O	9.48	10.46	9.76	10.05	9.10	9.78	8.02	9.23	9.47	9.36	9.57
TOTAL	95.12	94.94	93.10	92.66	93.82	92.86	94.45	92.84	95.19	93.35	92.19
ATOMIC RATIOS (O = 22.0)											
SI	6.665	6.554	6.591	6.591	6.368	6.549	6.322	6.313	6.453	6.515	6.529
TI	0.029	0.012	0.076	0.060	0.047	N.D.	0.062	0.043	0.070	0.086	0.057
AL	4.632	4.779	4.220	4.383	5.051	4.790	5.075	4.826	4.549	4.489	4.507
FE	0.254	0.202	0.754	0.540	0.236	0.274	0.398	0.674	0.613	0.605	0.581
MN	0.0	0.0	0.006	0.004	0.0	N.D.	0.0	0.002	0.003	0.004	0.002
MG	0.521	0.530	0.660	0.616	0.468	0.494	0.327	0.386	0.573	0.540	0.558
CA	0.0	0.003	0.0	0.009	0.001	0.004	0.0	0.012	0.0	0.016	0.014
NA	0.170	0.143	0.090	0.122	0.212	0.183	0.414	0.304	0.240	0.148	0.117
K	1.606	1.785	1.744	1.788	1.565	1.708	1.375	1.648	1.642	1.652	1.710
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	KU	TU	TU	KU	TU	KU	TU	TU	TU	TU	TU

SAMPLE NO	M028	M029	M035		M037		M038-A		M042	M048	M051-A
ROCK TYPE	BS	SL	SL		BS		BS		BS	BS	BS
ZONE	BIO	BIO	BIO		BIO		BIO		BIO	GAR	GAR
GRAIN NO	M1	M1	M1	M1	M2	M1	M1	M1	M2	M2	M2
POINT NO	1	1	3	1	2	2	3	4	1	1	3
SIO2	47.02	47.12	47.80	48.52	50.97	51.37	51.40	50.93	48.37	48.34	47.85
TIO2	0.35	0.18	0.37	0.24	0.41	0.34	0.37	0.34	0.30	0.33	0.24
AL2O3	25.80	32.50	27.98	26.31	28.70	26.14	28.09	25.72	27.10	26.77	26.49
FEO	6.05	2.27	3.28	3.99	4.77	5.70	4.27	5.97	5.49	4.77	5.16
MNO	0.01	0.03	0.0	0.04	0.05	0.04	0.01	0.04	0.03	0.0	0.0
MGO	2.84	3.36	3.15	3.48	2.47	3.03	2.67	3.22	3.01	2.89	2.69
CAO	0.06	0.0	0.07	0.05	0.06	0.05	0.03	0.04	0.10	0.03	0.05
NA2O	0.38	0.13	0.28	0.10	1.06	0.29	0.99	0.30	0.23	0.35	0.24
K2O	9.65	8.83	9.50	9.75	9.64	10.74	10.11	10.81	10.65	10.71	10.68
TOTAL	92.16	94.42	92.43	92.48	98.13	97.70	97.94	97.37	95.28	94.19	93.40
ATOMIC RATIOS (O = 22.0)											
SI	6.628	6.296	6.595	6.720	6.665	6.809	6.730	6.795	6.596	6.647	6.649
TI	0.037	0.018	0.038	0.025	0.040	0.034	0.036	0.034	0.031	0.034	0.025
AL	4.286	5.118	4.549	4.295	4.423	4.084	4.335	4.044	4.356	4.338	4.338
FE	0.713	0.254	0.378	0.462	0.522	0.632	0.468	0.666	0.626	0.548	0.600
MN	0.001	0.003	0.0	0.005	0.006	0.004	0.001	0.005	0.003	0.0	0.0
MG	0.597	0.669	0.648	0.719	0.481	0.599	0.521	0.640	0.612	0.592	0.557
CA	0.009	0.0	0.010	0.007	0.008	0.007	0.004	0.006	0.015	0.004	0.007
NA	0.104	0.034	0.075	0.027	0.269	0.075	0.251	0.078	0.061	0.093	0.065
K	1.735	1.505	1.672	1.723	1.608	1.816	1.689	1.840	1.853	1.879	1.893
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	TU	TU	TU	TU	TU	TU	TU	TU	TU	KU	KU

TABLE 2. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF MUSCOVITES (CONTINUED)

SAMPLE NO	MO51-A	MO55	MO58		MO65		MO67	TH71072803	MO74		MO79
ROCK TYPE	BS	BS	BS		BS		BS	BS	BS		BS
ZONE	GAR	GAR	GAR		GAR		GAR	CHL	CHL		CHL
GRAIN NO	M2	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1
POINT NO	1	2	2	1	2	3	3	3	1	3	3
SIO2	48.35	47.31	47.49	47.25	50.83	49.51	49.34	48.44	52.39	52.06	50.39
TIO2	0.23	0.32	0.50	0.32	0.20	0.17	0.24	0.19	0.06	0.12	0.13
AL2O3	25.05	25.95	26.39	25.19	26.84	24.15	26.40	26.83	23.94	21.82	23.00
FEO	7.64	6.58	5.38	6.30	4.60	7.24	4.79	4.68	5.06	8.31	6.41
MNO	0.03	0.02	0.01	0.01	0.03	0.04	0.0	0.04	0.06	0.02	0.0
MGO	3.31	2.92	2.81	2.97	2.76	2.96	2.81	2.81	3.66	3.56	4.04
CAO	0.06	0.08	0.02	0.07	0.0	0.0	0.03	0.07	0.03	0.03	0.24
NA2O	0.33	0.24	0.57	0.24	0.31	0.16	0.50	0.60	0.09	0.07	0.08
K2O	9.34	9.38	9.43	9.67	10.59	10.42	9.43	9.75	9.89	9.54	11.24
TOTAL	94.34	92.80	92.60	92.02	96.16	94.65	93.54	93.41	95.18	95.53	95.53
ATOMIC RATIOS (O = 22.0)											
SI	6.689	6.623	6.626	6.677	6.800	6.839	6.766	6.677	7.056	7.099	6.906
TI	0.024	0.034	0.052	0.034	0.020	0.018	0.025	0.020	0.006	0.012	0.013
AL	4.084	4.282	4.340	4.195	4.232	3.931	4.267	4.359	3.800	3.507	3.715
FE	0.884	0.770	0.628	0.744	0.515	0.836	0.549	0.539	0.570	0.948	0.735
MN	0.004	0.002	0.001	0.001	0.003	0.005	0.0	0.005	0.007	0.002	0.0
MG	0.683	0.609	0.585	0.626	0.550	0.610	0.574	0.577	0.735	0.724	0.825
CA	0.009	0.012	0.003	0.011	0.0	0.0	0.004	0.010	0.004	0.004	0.035
NA	0.089	0.065	0.154	0.066	0.080	0.043	0.133	0.160	0.023	0.019	0.021
K	1.648	1.675	1.679	1.743	1.807	1.836	1.650	1.714	1.699	1.660	1.965
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	KU	KU	TU	TU	KU	KU	TU	TU	TU	TU	KU

TABLE 3. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF PARAGONITES

SAMPLE NO	MO84
ROCK TYPE	BS
ZONE	CHL
GRAIN NO	M2
POINT NO	2
SIO2	49.41
TIO2	0.07
AL2O3	23.68
FEO	5.15
MNO	0.03
MGO	3.80
CAO	0.05
NA2O	0.18
K2O	9.89
TOTAL	92.26
ATOMIC RATIOS (O = 22.0)	
SI	6.910
TI	0.007
AL	3.903
FE	0.602
MN	0.004
MG	0.792
CA	0.007
NA	0.049
K	1.764
ANALYST	MO
INSTRUMENT	TU

SAMPLE NO	MO10	
ROCK TYPE	BS	
ZONE	BIO	
GRAIN NO	P1	P1
POINT NO	2	3
SIO2	44.77	44.85
TIO2	0.08	0.03
AL2O3	39.01	39.69
FEO	0.43	0.32
MNO	0.0	0.0
MGO	0.23	0.12
CAO	0.17	0.23
NA2O	7.00	7.36
K2O	0.86	0.51
TOTAL	92.55	93.11
ATOMIC RATIOS (O = 22.0)		
SI	5.903	5.871
TI	0.008	0.003
AL	6.062	6.123
FE	0.047	0.035
MN	0.0	0.0
MG	0.045	0.023
CA	0.024	0.032
NA	1.790	1.868
K	0.145	0.085
ANALYST	MO	MO
INSTRUMENT	TU	TU

TABLE 4. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF BIOTITES

SAMPLE NO	TH71081416	TH71081408		
ROCK TYPE	PE	PE		
ZONE	BIO	BIO		
GRAIN NO	1	1	2	3
POINT NO	1	1	1	1
SIO2	37.23	38.21	39.28	38.75
TIO2	1.94	2.66	2.13	2.04
AL2O3	16.04	15.62	16.15	16.34
FEO	19.56	22.53	21.39	21.81
MNO	0.11	0.12	0.16	0.14
MGO	9.41	8.19	8.40	8.78
CAO	0.0	0.0	0.0	0.0
NA2O	0.14	0.11	0.11	0.09
K2O	7.80	7.69	8.25	8.32
TOTAL	92.23	95.13	95.87	96.27
ATOMIC RATIOS (O = 22.0)				
SI	5.796	5.830	5.910	5.827
TI	0.227	0.305	0.241	0.231
AL	2.943	2.809	2.864	2.896
FE	2.546	2.875	2.691	2.743
MN	0.015	0.016	0.020	0.018
MG	2.184	1.863	1.884	1.968
CA	0.0	0.0	0.0	0.0
NA	0.042	0.033	0.032	0.026
K	1.549	1.497	1.583	1.596
ANALYST	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU

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

SAMPLE NO	TH71081408		TH71081315								
ROCK TYPE	PE		PE								
ZONE	BIO		BIO								
GRAIN NO	4	5	1M	2Q	3M	4C	5M	6M	7Q	8Q	9C
POINT NO	1	1	1	1	1	1	1	1	1	1	1
SIO2	39.24	39.66	37.31	37.56	37.16	37.37	36.74	36.97	37.02	37.69	36.69
TIO2	1.58	1.90	1.66	2.23	1.40	1.63	1.63	1.50	1.37	1.73	1.58
AL2O3	16.30	15.57	16.36	15.89	17.02	16.38	16.93	16.01	16.05	15.99	15.75
FEO	20.45	20.95	20.82	20.76	20.98	21.21	20.96	21.59	21.41	20.57	20.98
MNO	0.11	0.12	0.11	0.08	0.12	0.10	0.14	0.13	0.11	0.10	0.11
MGO	9.20	9.61	9.88	9.98	10.15	10.05	9.75	9.95	10.23	10.61	10.10
CAO	0.0	0.01	0.0	0.0	0.0	0.01	0.0	0.05	0.0	0.01	N.D.
NA2O	0.06	0.09	0.03	0.06	0.06	0.08	0.04	0.07	0.05	0.06	0.03
K2O	7.92	8.28	8.18	8.45	7.82	8.38	8.05	7.78	8.40	8.32	8.50
TOTAL	94.86	96.19	94.35	95.01	94.71	95.21	94.24	94.05	94.64	95.08	93.74
ATOMIC RATIOS (O = 22.0)											
SI	5.925	5.934	5.719	5.726	5.664	5.694	5.644	5.704	5.690	5.729	5.695
TI	0.179	0.214	0.191	0.256	0.160	0.187	0.188	0.174	0.158	0.198	0.184
AL	2.901	2.746	2.956	2.855	3.057	2.941	3.065	2.911	2.908	2.865	2.881
FE	2.582	2.622	2.669	2.647	2.674	2.703	2.693	2.786	2.752	2.615	2.723
MN	0.014	0.015	0.014	0.010	0.015	0.013	0.018	0.017	0.014	0.013	0.014
MG	2.071	2.144	2.258	2.268	2.306	2.283	2.233	2.289	2.344	2.404	2.337
CA	0.0	0.002	0.0	0.0	0.0	0.002	0.0	0.008	0.0	0.002	N.D.
NA	0.018	0.026	0.009	0.018	0.018	0.024	0.012	0.021	0.015	0.018	0.009
K	1.526	1.581	1.600	1.643	1.521	1.629	1.578	1.531	1.647	1.613	1.683
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	TH71081315										
ROCK TYPE	PE										
ZONE	BIO										
GRAIN NO	10M	11Q	12M	13M	14C	15Q	15Q	15Q	16Q	17Q	18Q
POINT NO	1	1	1	1	1	1	1(G)	2(G)	1	1	1
SIO2	37.22	37.11	37.19	37.72	37.36	36.46	37.63	37.17	37.23	37.21	37.06
TIO2	2.16	1.40	1.41	1.45	1.64	1.51	0.09	0.14	1.41	1.65	1.51
AL2O3	16.00	16.15	16.16	16.24	16.31	15.35	13.31	13.61	15.94	15.79	16.12
FEO	20.71	21.86	21.28	21.18	21.21	23.22	23.46	23.60	21.27	21.81	21.42
MNO	0.13	0.11	0.12	0.10	0.13	0.17	0.12	0.15	0.10	0.11	0.15
MGO	9.88	10.02	10.18	10.28	10.03	10.30	12.29	12.34	10.16	9.82	10.03
CAO	0.0	0.0	0.0	0.01	0.0	0.02	0.0	0.01	0.0	0.0	0.0
NA2O	0.05	0.05	0.06	0.07	0.05	0.08	0.02	0.04	0.05	0.08	0.04
K2O	8.28	8.36	9.28	8.57	8.28	7.86	7.33	6.87	8.30	8.24	8.40
TOTAL	94.43	95.06	95.68	95.62	95.01	94.97	94.25	93.93	94.46	94.71	94.73
ATOMIC RATIOS (O = 22.0)											
SI	5.708	5.687	5.677	5.723	5.702	5.635	5.844	5.787	5.723	5.720	5.690
TI	0.249	0.161	0.162	0.165	0.188	0.175	0.011	0.016	0.163	0.191	0.174
AL	2.892	2.917	2.907	2.904	2.934	2.796	2.436	2.497	2.888	2.861	2.917
FE	2.656	2.801	2.717	2.687	2.707	3.001	3.047	3.073	2.734	2.804	2.751
MN	0.017	0.014	0.016	0.013	0.017	0.022	0.016	0.020	0.013	0.014	0.020
MG	2.259	2.289	2.317	2.325	2.282	2.373	2.845	2.864	2.328	2.250	2.296
CA	0.0	0.0	0.0	0.002	0.0	0.003	0.0	0.002	0.0	0.0	0.0
NA	0.015	0.015	0.018	0.021	0.015	0.024	0.006	0.012	0.015	0.024	0.012
K	1.620	1.634	1.807	1.659	1.612	1.550	1.452	1.365	1.628	1.616	1.645
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

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

SAMPLE NO	TH71081315								TH71081311		
ROCK TYPE	PE								PE		
ZONE	BIO								BIO		
GRAIN NO	19	19	20	20	21	21	22	22	1M	2Q	3M
POINT NO	1	2	1	2	1	2	1	2	1	1	1
SIO2	35.98	36.52	37.17	36.48	36.09	36.83	36.71	36.68	36.76	36.93	37.66
TIO2	0.90	1.47	1.20	1.26	1.24	1.42	0.81	1.75	2.00	1.95	1.60
AL2O3	16.45	16.02	15.86	16.33	16.07	16.49	17.29	15.79	16.23	16.25	16.37
FEO	21.96	21.70	21.15	21.80	21.45	21.15	20.27	20.75	21.32	20.74	20.42
MNO	0.15	0.10	0.13	0.10	0.10	0.09	0.09	0.09	0.09	0.11	0.08
MGO	9.23	9.92	9.75	10.67	8.84	9.23	9.33	9.99	9.57	9.83	10.35
CAO	0.05	0.04	0.0	0.0	0.03	0.02	0.02	0.0	0.0	0.0	0.0
NA2O	0.04	0.10	0.06	0.03	0.03	0.06	0.06	0.07	0.07	0.05	0.08
K2O	7.96	8.19	8.42	7.61	8.08	8.69	8.18	8.52	8.17	8.08	8.00
TOTAL	92.72	94.06	93.74	94.28	91.93	93.98	92.76	93.64	94.21	93.94	94.56
ATOMIC RATIOS (O = 22.0)											
SI	5.661	5.660	5.761	5.619	5.717	5.702	5.710	5.694	5.668	5.689	5.737
TI	0.106	0.171	0.140	0.146	0.148	0.165	0.095	0.204	0.232	0.226	0.183
AL	3.051	2.926	2.897	2.964	3.000	3.009	3.170	2.889	2.950	2.950	2.939
FE	2.890	2.812	2.741	2.808	2.842	2.739	2.637	2.694	2.749	2.672	2.601
MN	0.020	0.013	0.017	0.013	0.013	0.012	0.012	0.012	0.012	0.014	0.010
MG	2.165	2.292	2.253	2.450	2.088	2.130	2.163	2.312	2.200	2.257	2.350
CA	0.008	0.007	0.0	0.0	0.005	0.003	0.003	0.0	0.0	0.0	0.0
NA	0.012	0.030	0.018	0.009	0.009	0.018	0.018	0.021	0.021	0.015	0.024
K	1.598	1.619	1.665	1.495	1.633	1.716	1.623	1.687	1.607	1.588	1.555
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	TH71081311										
ROCK TYPE	PE										
ZONE	BIO										
GRAIN NO	4Q	5G	6CAL	7CAL	8CAL	8CAL	9G	10M	10M	10M	11(RG)
POINT NO	1	1	1	1	1	2	1	1	2	3	1
SIO2	37.41	38.92	39.75	39.04	38.79	38.28	37.48	37.27	37.71	37.77	40.18
TIO2	1.77	1.62	0.96	1.57	0.99	0.88	2.06	1.99	2.08	1.92	1.62
AL2O3	16.36	15.82	15.79	16.73	16.46	16.35	15.86	16.34	16.63	16.55	16.23
FEO	21.27	21.87	17.53	19.51	18.97	19.40	21.39	20.95	21.39	21.87	20.62
MNO	0.10	0.06	0.08	0.31	0.05	0.05	0.11	0.05	0.08	0.06	0.22
MGO	9.95	9.78	12.94	9.49	11.76	11.56	9.34	9.27	9.04	9.51	9.36
CAO	0.0	0.05	0.06	0.23	0.18	0.15	0.03	0.0	0.0	0.02	0.14
NA2O	0.08	0.13	0.20	0.11	0.06	0.04	0.06	0.06	0.07	0.07	0.11
K2O	8.16	7.27	8.09	7.31	8.36	8.29	8.24	8.44	8.27	8.46	7.77
TOTAL	95.10	95.52	95.40	94.30	95.62	95.00	94.57	94.37	95.27	96.23	96.25
ATOMIC RATIOS (O = 22.0)											
SI	5.700	5.865	5.897	5.892	5.798	5.777	5.752	5.724	5.732	5.704	5.969
TI	0.203	0.184	0.107	0.178	0.111	0.100	0.238	0.230	0.238	0.218	0.181
AL	2.938	2.810	2.761	2.976	2.900	2.908	2.869	2.958	2.979	2.945	2.842
FE	2.710	2.756	2.175	2.463	2.371	2.448	2.745	2.691	2.719	2.762	2.562
MN	0.013	0.008	0.010	0.040	0.006	0.006	0.014	0.007	0.010	0.008	0.028
MG	2.260	2.197	2.862	2.135	2.620	2.601	2.137	2.122	2.049	2.141	2.073
CA	0.0	0.008	0.010	0.037	0.029	0.024	0.005	0.0	0.0	0.003	0.022
NA	0.024	0.038	0.058	0.032	0.017	0.012	0.018	0.018	0.021	0.020	0.032
K	1.586	1.398	1.531	1.408	1.594	1.596	1.613	1.654	1.604	1.630	1.473
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

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

SAMPLE NO	TH71081303		TH71081422					TH71081107			
ROCK TYPE	PE		PE					PE			
ZONE	BIO		BIO					BIO			
GRAIN NO	1	2	1	2	3	4	5	1	2	3	4
POINT NO	1	1	1	1	1	1	1	1	1	1	1
SIO2	38.07	38.60	37.91	37.87	38.39	38.69	37.55	36.26	36.22	35.89	36.31
TIO2	1.54	1.20	1.53	1.90	1.63	1.23	1.36	1.42	1.24	1.39	1.47
AL2O3	15.50	16.87	15.62	16.29	15.99	15.90	15.78	16.16	16.43	15.59	15.80
FEO	19.51	17.34	18.19	18.47	18.63	18.26	19.23	23.18	22.70	23.94	23.98
MNO	0.13	0.20	0.23	0.20	0.24	0.20	0.22	0.21	0.20	0.21	0.26
MGO	11.01	10.70	11.39	11.02	11.37	11.87	10.92	8.23	8.27	8.05	8.10
CAO	0.02	0.12	0.0	0.0	0.0	0.0	0.03	0.01	0.0	0.02	0.01
NA2O	0.08	0.19	0.04	0.05	0.09	0.07	0.08	0.05	0.04	0.06	0.06
K2O	8.32	7.73	8.31	8.26	8.79	8.39	8.12	8.26	8.34	8.39	8.30
TOTAL	94.18	92.95	93.22	94.06	95.13	94.61	93.29	93.78	93.44	93.54	94.29
ATOMIC RATIOS (O = 22.0)											
SI	5.812	5.869	5.814	5.755	5.788	5.834	5.782	5.682	5.684	5.678	5.687
TI	0.177	0.137	0.176	0.217	0.185	0.139	0.157	0.167	0.146	0.165	0.173
AL	2.789	3.023	2.823	2.918	2.841	2.826	2.864	2.985	3.039	2.907	2.916
FE	2.491	2.205	2.333	2.348	2.349	2.303	2.476	3.038	2.979	3.167	3.141
MN	0.017	0.026	0.030	0.026	0.031	0.026	0.029	0.028	0.027	0.028	0.034
MG	2.506	2.425	2.604	2.497	2.555	2.668	2.507	1.923	1.935	1.899	1.891
CA	0.003	0.020	0.0	0.0	0.0	0.0	0.005	0.002	0.0	0.003	0.002
NA	0.024	0.056	0.012	0.015	0.026	0.020	0.024	0.015	0.012	0.018	0.018
K	1.620	1.499	1.626	1.601	1.691	1.614	1.595	1.651	1.670	1.693	1.658
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	TH71081107				MO19	TH71080601	MO33	MO35
ROCK TYPE	PE				BS	BS	SL	SL
ZONE	BIO				BIO	BIO	BIO	BIO
GRAIN NO	5	6	7	8	B1	B1	B1	B1
POINT NO	1	1	1	1	1	1	1	1
SIO2	36.37	37.01	34.48	36.28	37.18	37.09	35.72	36.26
TIO2	1.32	1.07	1.19	1.14	1.80	1.64	1.25	1.33
AL2O3	15.42	16.37	16.72	15.21	16.87	17.36	15.49	14.94
FEO	23.50	23.16	24.44	23.92	17.37	18.80	20.53	19.12
MNO	0.24	0.25	0.22	0.21	0.12	0.28	0.21	0.13
MGO	8.58	8.09	9.51	7.69	11.39	11.58	11.02	11.99
CAO	0.0	0.0	0.0	0.0	0.31	0.05	0.06	0.20
NA2O	0.12	0.01	0.0	0.08	0.09	0.12	0.04	0.07
K2O	8.23	8.44	8.77	8.33	7.30	9.35	8.18	8.06
TOTAL	93.78	94.40	95.33	92.86	92.43	96.27	92.50	92.10
ATOMIC RATIOS (O = 22.0)								
SI	5.715	5.750	5.391	5.775	5.697	5.563	5.621	5.685
TI	0.156	0.125	0.140	0.136	0.207	0.185	0.148	0.157
AL	2.856	2.997	3.081	2.854	3.047	3.068	2.873	2.760
FE	3.088	3.009	3.196	3.184	2.226	2.358	2.702	2.507
MN	0.032	0.033	0.029	0.028	0.016	0.036	0.028	0.017
MG	2.010	1.874	2.217	1.825	2.602	2.589	2.585	2.802
CA	0.0	0.0	0.0	0.0	0.051	0.008	0.010	0.034
NA	0.037	0.003	0.0	0.025	0.027	0.035	0.012	0.021
K	1.650	1.673	1.749	1.692	1.427	1.789	1.642	1.612
ANALYST	TH	TH	TH	TH	MO	MO	MO	MO
INSTRUMENT	KU	KU	KU	KU	TU	KU	TU	TU

Toshio HIGASHINO*, Chihiro SAKAI, Masayuki OTSUKI**,
Tetsumaru ITAYA*** and Shohei BANNO****

TABLE 5. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF CHLORITES

SAMPLE NO	TH72113014					TH72112936				TH71081416	
ROCK TYPE	PE					PE				PE	
ZONE	GAR					GAR				BIO	
GRAIN NO	1	2	3	4	5	1	2	3	4	1	2
POINT NO	1	1	1	1	1	1	1	1	1	1	1
SIO2	25.24	24.89	25.36	25.42	25.01	24.85	24.93	25.03	24.67	25.84	25.43
AL203	20.09	20.93	20.71	21.03	20.96	20.26	20.62	19.96	20.06	20.61	20.47
FEO	29.63	29.65	29.44	29.76	29.84	32.30	32.45	32.32	32.63	24.71	25.79
MNO	0.28	0.48	0.50	0.54	0.62	0.40	0.45	0.63	0.68	0.13	0.14
MGO	11.92	11.67	11.64	11.70	11.17	9.53	9.68	9.39	9.63	16.04	15.00
TOTAL	87.16	87.62	87.65	88.45	87.60	87.34	88.13	87.33	87.67	87.33	86.83
ATOMIC RATIOS (O = 28.0)											
SI	5.488	5.387	5.474	5.441	5.420	5.476	5.442	5.522	5.438	5.448	5.431
AL	5.148	5.338	5.268	5.306	5.353	5.261	5.305	5.190	5.211	5.121	5.153
FE	5.388	5.366	5.314	5.327	5.408	5.952	5.924	5.963	6.015	4.357	4.607
MN	0.052	0.088	0.091	0.098	0.114	0.075	0.083	0.118	0.127	0.023	0.025
MG	3.864	3.765	3.745	3.734	3.609	3.130	3.150	3.089	3.165	5.042	4.776
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	TH71081416		TH71081408					TH71081405			
ROCK TYPE	PE		PE					PE			
ZONE	BIO		BIO					BIO			
GRAIN NO	3	4	1	2	3	4	5	1	2	3	4
POINT NO	1	1	1	1	1	1	1	1	1	1	1
SIO2	25.42	26.20	25.77	26.65	25.55	25.32	26.23	26.01	25.72	25.31	26.27
AL203	20.71	21.05	20.46	20.19	20.84	20.65	20.60	21.45	21.35	21.44	21.51
FEO	24.98	25.22	24.62	24.65	24.32	25.12	23.89	23.55	23.64	23.33	23.95
MNO	0.14	0.11	0.28	0.07	0.13	0.10	0.09	0.15	0.12	0.17	0.20
MGO	15.86	15.86	16.38	16.42	16.75	15.95	16.53	16.70	16.46	16.82	17.22
TOTAL	87.11	88.44	87.51	87.98	87.59	87.14	87.34	87.86	87.29	87.37	89.15
ATOMIC RATIOS (O = 28.0)											
SI	5.388	5.457	5.427	5.563	5.364	5.370	5.498	5.408	5.391	5.357	5.391
AL	5.173	5.167	5.078	4.967	5.157	5.162	5.089	5.257	5.274	5.286	5.203
FE	4.428	4.393	4.336	4.303	4.270	4.456	4.188	4.095	4.144	4.081	4.110
MN	0.025	0.019	0.050	0.012	0.023	0.018	0.016	0.026	0.021	0.030	0.035
MG	5.011	4.924	5.143	5.109	5.243	5.043	5.166	5.177	5.143	5.245	5.268
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	TH71081405	TH71081315							TH71081311		
ROCK TYPE	PE	PE							PE		
ZONE	BIO	BIO							BIO		
GRAIN NO	5	1	2	3	4	5	6	7	1	2	3
POINT NO	1	1	1	1	1	1	1	1	1	1	1
SIO2	25.82	26.27	26.09	26.09	26.62	25.77	25.87	26.05	26.20	25.59	26.30
AL203	21.59	20.81	21.02	20.86	20.87	21.75	20.82	20.82	21.07	21.06	21.19
FEO	23.48	23.88	25.41	25.30	25.03	24.45	24.84	25.08	24.85	23.52	24.49
MNO	0.10	0.15	0.08	0.13	0.12	0.06	0.16	0.10	0.08	0.13	0.18
MGO	16.52	15.79	15.75	15.87	15.70	16.77	15.90	15.89	15.97	16.34	15.94
TOTAL	87.51	86.90	88.35	88.25	88.34	88.80	87.59	87.94	88.17	86.64	88.10
ATOMIC RATIOS (O = 28.0)											
SI	5.389	5.532	5.446	5.452	5.539	5.326	5.440	5.457	5.462	5.406	5.477
AL	5.311	5.165	5.171	5.138	5.118	5.297	5.160	5.141	5.177	5.243	5.201
FE	4.098	4.205	4.436	4.422	4.355	4.226	4.368	4.394	4.333	4.155	4.265
MN	0.018	0.027	0.014	0.023	0.021	0.011	0.028	0.018	0.014	0.023	0.032
MG	5.140	4.957	4.901	4.944	4.870	5.167	4.984	4.963	4.963	5.146	4.949
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

TABLE 5. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF CHLORITES (CONTINUED)

SAMPLE NO	TH71081311					TH71081303					
ROCK TYPE	PE					PE					
ZONE	BIO					BIO					
GRAIN NO	4	5	6	6	6	1	2	3	4	5	6
POINT NO	1	1	1	2	3	1	1	1	1	1	1
SIO2	25.64	26.40	26.08	26.10	25.66	26.40	26.49	26.64	26.76	26.47	26.40
AL2O3	20.78	20.71	20.72	20.60	21.07	21.55	21.72	21.65	21.92	21.50	21.20
FEO	24.04	24.79	25.33	26.62	24.75	21.60	21.30	22.03	21.22	21.52	21.78
MNO	0.08	0.07	0.08	0.10	0.05	0.12	0.13	0.17	0.08	0.20	0.16
MGO	16.18	16.21	15.38	15.42	15.94	17.95	18.05	17.96	18.07	17.71	17.57
TOTAL	86.72	88.18	87.59	88.84	87.47	87.62	87.69	88.45	88.05	87.40	87.11
ATOMIC RATIOS (O = 28.0)											
SI	5.426	5.501	5.492	5.456	5.399	5.442	5.445	5.449	5.468	5.469	5.483
AL	5.183	5.086	5.142	5.075	5.225	5.236	5.262	5.219	5.279	5.236	5.189
FE	4.255	4.320	4.461	4.653	4.355	3.724	3.662	3.768	3.626	3.718	3.783
MN	0.014	0.012	0.014	0.018	0.009	0.021	0.023	0.029	0.014	0.035	0.028
MG	5.105	5.036	4.828	4.805	5.000	5.516	5.531	5.476	5.505	5.455	5.440
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	TH71081422				TH71081111					TH71081107	
ROCK TYPE	PE				PE					PE	
ZONE	BIO				BIO					BIO	
GRAIN NO	1	2	3	4	1	2	3	4	5	1	2
POINT NO	1	1	1	1	1	1	1	1	1	1	1
SIO2	26.74	26.22	26.33	26.31	26.34	26.54	26.23	27.12	25.82	25.07	25.49
AL2O3	21.76	21.54	21.33	20.99	21.67	20.82	21.22	20.98	21.32	20.16	19.49
FEO	22.43	22.67	21.62	21.71	25.45	25.22	26.49	25.07	26.72	30.30	32.65
MNO	0.29	0.26	0.20	0.19	0.17	0.13	0.14	0.12	0.16	0.34	0.36
MGO	18.20	17.97	18.30	17.63	14.93	15.43	14.62	15.33	14.49	11.70	10.93
TOTAL	89.42	88.66	87.78	86.83	88.56	88.14	88.70	88.62	88.51	87.57	88.92
ATOMIC RATIOS (O = 28.0)											
SI	5.422	5.379	5.425	5.484	5.476	5.542	5.479	5.614	5.419	5.448	5.518
AL	5.200	5.208	5.179	5.157	5.310	5.124	5.224	5.119	5.274	5.163	4.973
FE	3.804	3.889	3.725	3.785	4.425	4.404	4.628	4.340	4.690	5.506	5.911
MN	0.050	0.045	0.035	0.034	0.030	0.023	0.025	0.021	0.028	0.063	0.066
MG	5.502	5.496	5.621	5.478	4.627	4.803	4.553	4.731	4.534	3.790	3.527
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	TH71081107		TH71080201				TH71072702				
ROCK TYPE	PE		PE				PE				
ZONE	BIO		GAR				GAR				
GRAIN NO	3	4	1	2	3	4	1	2	3	4	5
POINT NO	1	1	1	1	1	1	1	1	1	1	1
SIO2	25.27	25.44	24.81	25.24	25.88	25.19	24.93	25.40	25.18	26.20	25.01
AL2O3	19.54	20.61	21.05	20.92	21.66	21.34	20.61	20.79	20.60	20.69	20.85
FEO	30.72	30.77	28.93	28.82	29.64	28.83	29.88	30.14	29.66	28.90	28.91
MNO	0.35	0.29	0.39	0.63	0.46	0.41	0.39	0.61	0.64	0.32	0.27
MGO	11.03	12.02	12.40	12.50	12.38	11.95	11.98	11.53	11.08	12.65	12.36
TOTAL	86.91	89.13	87.58	88.11	90.02	87.72	87.79	88.47	87.16	88.76	87.40
ATOMIC RATIOS (O = 28.0)											
SI	5.549	5.429	5.350	5.406	5.421	5.410	5.391	5.451	5.481	5.546	5.399
AL	5.057	5.183	5.350	5.281	5.347	5.401	5.253	5.259	5.284	5.162	5.304
FE	5.641	5.491	5.217	5.162	5.192	5.178	5.404	5.410	5.399	5.116	5.219
MN	0.065	0.052	0.071	0.114	0.082	0.075	0.071	0.111	0.118	0.057	0.049
MG	3.611	3.824	3.986	3.991	3.866	3.826	3.862	3.689	3.595	3.992	3.977
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

TABLE 5. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF CHLORITES (CONTINUED)

SAMPLE NO	TH71072714					TH71072721					
ROCK TYPE	PE					PE					
ZONE	GAR					GAR					
GRAIN NO	1	2	3	4	5	1	2	3	4	5	6
POINT NO	1	1	1	1	1	1	1	1	1	1	1
SIO2	25.30	25.33	24.98	25.35	25.23	26.84	26.66	26.60	27.11	25.93	26.56
AL2O3	20.96	20.84	21.26	21.23	20.51	21.02	21.46	21.11	21.11	21.14	21.07
FEO	30.32	29.61	29.35	29.88	29.52	28.13	27.98	28.24	28.76	28.62	29.19
MNO	0.82	0.70	0.77	0.79	0.29	0.45	0.49	0.60	0.42	0.54	0.51
MGO	11.56	11.38	11.81	11.44	11.86	12.17	12.22	11.86	12.44	12.23	12.24
TOTAL	88.96	87.86	88.17	88.69	87.41	88.61	88.81	88.41	89.84	88.46	89.57
ATOMIC RATIOS (O = 28.0)											
SI	5.410	5.463	5.366	5.421	5.462	5.655	5.600	5.629	5.644	5.506	5.572
AL	5.282	5.297	5.382	5.350	5.233	5.220	5.313	5.265	5.180	5.291	5.210
FE	5.422	5.341	5.273	5.343	5.345	4.957	4.915	4.997	5.007	5.083	5.122
MN	0.149	0.128	0.140	0.143	0.053	0.080	0.087	0.108	0.074	0.097	0.091
MG	3.685	3.659	3.782	3.647	3.828	3.823	3.827	3.741	3.861	3.872	3.828
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	TH71072721		TH71072813								TH71073012
ROCK TYPE	PE		PE								PE
ZONE	GAR		CHL								CHL
GRAIN NO	7	8	1	2	3	4	5	6	7	8	1
POINT NO	1	1	1	1	1	1	1	1	1	1	1
SIO2	26.00	26.43	27.40	26.20	25.97	26.03	26.94	26.71	26.60	26.97	27.16
AL2O3	21.12	21.04	21.51	21.25	20.79	20.96	20.77	20.97	21.26	20.92	21.41
FEO	28.62	28.56	29.27	28.87	29.05	28.60	27.69	27.88	27.93	28.30	29.69
MNO	0.55	0.53	1.08	1.11	1.14	1.10	0.99	1.08	1.18	1.02	1.25
MGO	11.63	11.96	11.14	11.11	11.04	11.14	12.15	11.71	11.50	11.65	10.66
TOTAL	87.92	88.52	90.40	88.54	87.99	87.83	88.54	88.35	88.47	88.86	90.17
ATOMIC RATIOS (O = 28.0)											
SI	5.554	5.597	5.690	5.574	5.576	5.582	5.684	5.658	5.630	5.686	5.677
AL	5.317	5.251	5.265	5.328	5.261	5.297	5.165	5.235	5.304	5.198	5.275
FE	5.113	5.058	5.083	5.136	5.216	5.129	4.886	4.939	4.944	4.989	5.190
MN	0.100	0.095	0.190	0.200	0.207	0.200	0.177	0.194	0.212	0.182	0.221
MG	3.704	3.776	3.449	3.524	3.534	3.561	3.822	3.698	3.629	3.661	3.322
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	TH71073012		TH71072922						TH71072918		
ROCK TYPE	PE		PE						PE		
ZONE	CHL		CHL						CHL		
GRAIN NO	2	3	1	2	3	4	5	6	1	2	3
POINT NO	1	1	1	1	1	1	1	1	1	1	1
SIO2	28.01	27.70	25.61	25.12	26.38	25.68	26.31	25.67	25.41	25.77	27.26
AL2O3	19.35	21.10	21.11	20.55	20.35	20.96	20.52	20.87	20.49	20.25	20.25
FEO	28.12	28.84	29.53	30.52	30.69	30.70	29.56	29.85	29.41	29.55	28.94
MNO	1.19	1.03	0.64	0.63	0.65	0.71	0.70	0.54	0.49	0.47	0.56
MGO	10.41	9.58	10.84	11.02	10.76	10.90	11.38	10.79	11.08	10.76	10.25
TOTAL	87.08	88.25	87.73	87.84	88.83	88.95	88.47	87.72	86.88	86.80	87.26
ATOMIC RATIOS (O = 28.0)											
SI	6.020	5.877	5.519	5.450	5.639	5.491	5.616	5.540	5.534	5.616	5.859
AL	4.902	5.276	5.361	5.255	5.127	5.282	5.162	5.308	5.259	5.201	5.129
FE	5.055	5.117	5.322	5.538	5.486	5.490	5.277	5.387	5.356	5.385	5.202
MN	0.217	0.185	0.117	0.116	0.118	0.129	0.127	0.099	0.090	0.087	0.102
MG	3.336	3.030	3.482	3.564	3.429	3.475	3.621	3.471	3.597	3.496	3.284
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

TABLE 5. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF CHLORITES (CONTINUED)

SAMPLE NO	TH72102901	M003		M004	M005		TH710813D	M010	M011-A	M015	M016
ROCK TYPE	BS	SL		SL	BS		BS	BS	BS	BS	BS
ZONE	BIO	BIO		BIO	BIO		BIO	BIO	BIO	BIO	BIO
GRAIN NO	C1	C1	C1	C1	C2	C2	C1	C1	C1	C2	C2
POINT NO	1	2	1	2	2	1	3	2	4	1	3
SIO2	26.30	25.41	25.35	26.89	26.12	26.02	25.86	25.63	27.33	27.08	26.02
AL2O3	20.00	21.99	20.13	20.86	21.14	21.04	19.75	21.16	19.92	20.29	20.02
FEO	26.36	23.76	26.07	19.63	20.42	20.82	21.49	20.00	18.73	23.13	20.59
MNO	0.22	0.37	0.57	0.15	0.14	0.20	0.49	0.33	0.27	0.26	0.23
MGO	15.71	16.72	14.91	18.97	19.92	18.35	19.33	20.35	20.70	17.63	19.31
TOTAL	88.59	88.25	87.03	86.50	87.74	86.43	86.92	87.47	86.95	88.39	86.17
ATOMIC RATIOS (O = 28.0)											
SI	5.512	5.278	5.427	5.557	5.358	5.430	5.410	5.276	5.601	5.580	5.452
AL	4.940	5.383	5.079	5.081	5.111	5.175	4.870	5.134	4.811	4.928	4.944
FE	4.620	4.127	4.667	3.393	3.503	3.634	3.760	3.443	3.210	3.986	3.608
MN	0.039	0.065	0.103	0.026	0.024	0.035	0.087	0.058	0.047	0.045	0.041
MG	4.908	5.177	4.758	5.845	6.091	5.709	6.029	6.245	6.324	5.416	6.032
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	KU	KU	KU	KU	TU	TU	TU	TU	KU	KU	KU

SAMPLE NO	M016		M019		TH71080601	TH72120319			TH72120338	M023	
ROCK TYPE	BS		BS		BS	BS			BS	BS	
ZONE	BIO		BIO		BIO	BIO			BIO	BIO	
GRAIN NO	C2	C1(RH)	C1	C1	C2	C6	C2(RG)	C1(RG)	C2	C2	C1
POINT NO	1	1	3	1	2	2	1	2	1	3	1
SIO2	26.27	26.26	25.55	25.84	26.17	26.43	23.15	23.63	25.65	25.45	25.78
AL2O3	19.16	19.93	21.37	21.29	21.20	19.97	19.62	20.16	19.77	21.25	20.69
FEO	20.53	20.32	21.01	22.12	24.28	26.97	39.41	37.96	26.39	21.12	23.97
MNO	0.24	0.22	0.13	0.17	0.34	0.55	2.53	2.29	N.D.	0.07	0.08
MGO	19.05	19.12	18.50	17.87	17.39	14.79	4.28	6.14	15.60	19.25	17.12
TOTAL	85.25	85.85	86.56	87.29	89.38	88.71	88.99	90.18	87.41	87.14	87.64
ATOMIC RATIOS (O = 28.0)											
SI	5.565	5.510	5.333	5.375	5.375	5.554	5.293	5.262	5.458	5.283	5.396
AL	4.783	4.929	5.257	5.220	5.131	4.946	5.287	5.291	4.958	5.199	5.104
FE	3.637	3.566	3.668	3.848	4.170	4.740	7.535	7.069	4.697	3.666	4.196
MN	0.043	0.039	0.023	0.030	0.059	0.098	0.490	0.432	N.D.	0.012	0.014
MG	6.016	5.981	5.757	5.542	5.324	4.634	1.459	2.038	4.949	5.957	5.342
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	KU	KU	TU	TU	KU	KU	TU	TU	KU	TU	TU

SAMPLE NO	M024		M026	TH71080303	M028	TH71051007	M029	M033		M035	M037
ROCK TYPE	BS		BS	BS	BS	BS	SL	SL		SL	BS
ZONE	BIO		BIO	BIO	BIO	BIO	BIO	BIO		BIO	BIO
GRAIN NO	C2	C2	C1	C1	C1	C1	C2	C1	C1	C2	C1
POINT NO	3	1	4	3	2	3	3	1	3	1	2
SIO2	24.37	23.85	26.27	25.66	25.66	26.97	24.03	25.34	25.49	25.46	25.97
AL2O3	20.00	20.36	20.67	19.54	19.20	20.80	21.66	20.48	18.94	19.45	20.33
FEO	26.24	27.31	17.30	19.76	24.10	21.98	29.43	26.17	26.86	24.79	18.98
MNO	0.21	0.25	0.23	0.43	0.31	N.D.	0.37	0.35	0.31	0.27	0.21
MGO	14.89	14.67	21.58	20.30	16.64	17.26	11.71	15.00	13.80	16.39	20.67
TOTAL	85.71	86.44	86.05	85.69	85.91	87.01	87.20	87.34	85.40	86.36	86.16
ATOMIC RATIOS (O = 28.0)											
SI	5.314	5.192	5.412	5.401	5.506	5.601	5.227	5.398	5.586	5.454	5.397
AL	5.140	5.224	5.019	4.848	4.856	5.091	5.552	5.142	4.892	4.911	4.979
FE	4.785	4.972	2.981	3.479	4.325	3.817	5.353	4.663	4.923	4.441	3.298
MN	0.039	0.046	0.040	0.077	0.056	N.D.	0.068	0.063	0.058	0.049	0.037
MG	4.840	4.761	6.628	6.370	5.323	5.344	3.797	4.764	4.509	5.235	6.403
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	TU	TU	TU	TU	TU	KU	TU	TU	TU	TU	TU

TABLE 5. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF CHLORITES (CONTINUED)

SAMPLE NO	MO38-A	MO40	MO41-A		MO42	MO47	MO48	MO49-A	MO51-A	MO55	MO58
ROCK TYPE	BS	BS	BS		BS	BS	BS	BS	BS	BS	BS
ZONE	BIO	BIO	BIO		BIO	GAR	GAR	GAR	GAR	GAR	GAR
GRAIN NO	C1	C5	C1	C1	C1	C1	C1	C1	C1	C2	C1
POINT NO	2	2	2	4	1	1	1	2	1	2	2
SIO2	26.47	26.32	25.33	25.39	26.21	25.19	26.40	24.99	24.52	26.07	25.17
AL2O3	20.36	19.14	19.74	18.91	19.77	19.19	19.27	19.62	18.37	19.00	18.77
FEO	18.19	22.66	24.32	26.53	18.67	23.34	25.97	32.05	30.63	25.37	25.58
MNO	0.31	0.49	0.18	0.24	0.34	0.46	0.35	0.41	0.31	N.D.	0.29
MGO	20.76	18.07	16.77	14.96	24.14	17.69	16.68	11.52	11.04	16.34	16.65
TOTAL	86.09	86.68	86.34	86.03	89.13	85.87	88.67	88.59	84.87	86.78	86.46
ATOMIC RATIOS (O = 28.0)											
SI	5.476	5.550	5.412	5.515	5.270	5.401	5.527	5.425	5.543	5.559	5.422
AL	4.964	4.757	4.971	4.841	4.685	4.849	4.755	5.019	4.895	4.775	4.765
FE	3.147	3.996	4.346	4.819	3.139	4.185	4.547	5.818	5.791	4.524	4.608
MN	0.054	0.088	0.033	0.044	0.058	0.084	0.062	0.075	0.059	N.D.	0.053
MG	6.402	5.681	5.342	4.844	7.236	5.655	5.206	3.728	3.721	5.194	5.347
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	TU	KU	TU	TU	TU	TU	KU	KU	KU	KU	TU

SAMPLE NO	MO60-A	TH71072601		MO62	MO61	MO64	MO65	MO66-A	MO67	TH71072803	MO70
ROCK TYPE	BS	BS		BS	BS	BS	BS	BS	BS	BS	BS
ZONE	GAR	GAR		GAR	GAR	GAR	GAR	GAR	GAR	CHL	CHL
GRAIN NO	C1	C1	C1	C1	C1	C1	C1	C1	C2	C1	C2
POINT NO	1	3	2	1	3	1	2	1	1	3	1
SIO2	26.90	26.50	24.74	26.36	25.58	25.45	27.56	27.06	26.31	27.63	26.30
AL2O3	19.79	19.99	19.76	19.84	19.85	20.15	18.66	19.06	19.11	18.76	19.16
FEO	21.70	27.55	28.67	21.73	24.42	26.47	26.17	19.53	19.73	16.15	24.22
MNO	0.56	0.41	0.37	N.D.	0.32	0.32	0.43	0.06	0.16	0.53	0.34
MGO	17.85	14.85	13.14	17.81	15.92	14.74	14.55	20.47	19.64	22.37	16.71
TOTAL	86.80	89.30	86.68	85.74	86.09	87.13	87.37	86.18	84.95	85.44	86.73
ATOMIC RATIOS (O = 28.0)											
SI	5.620	5.543	5.400	5.570	5.481	5.444	5.844	5.624	5.568	5.700	5.582
AL	4.873	4.928	5.083	4.941	5.013	5.080	4.663	4.669	4.766	4.561	4.793
FE	3.792	4.819	5.233	3.840	4.376	4.735	4.641	3.395	3.492	2.786	4.299
MN	0.099	0.073	0.068	N.D.	0.058	0.058	0.077	0.011	0.029	0.093	0.061
MG	5.560	4.631	4.275	5.610	5.085	4.700	4.599	6.343	6.196	6.880	5.287
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	KU	TU	TU	KU	TU	TU	KU	KU	TU	TU	TU

SAMPLE NO	MO71	MO74	MO75	MO79	MO80	MO83	MO84		MO89	MO92
ROCK TYPE	BS	BS	BS	BS	BS	BS	BS		BS	BS
ZONE	CHL	CHL	CHL	CHL	CHL	CHL	CHL		CHL	CHL
GRAIN NO	C1	C1	C2	C1	C2	C1	C3	C3	C3	C3
POINT NO	2	2	1	1	2	2	2	3	1	3
SIO2	25.22	27.09	25.82	27.38	27.58	25.59	26.63	26.40	27.16	26.41
AL2O3	18.78	17.67	18.86	18.64	20.27	18.14	18.49	17.80	18.47	19.60
FEO	26.76	24.31	28.54	19.51	15.85	28.58	19.57	20.93	22.22	26.87
MNO	0.37	0.75	0.41	0.26	0.33	0.34	0.38	0.31	0.80	0.73
MGO	14.20	15.77	13.43	21.05	23.04	14.07	20.53	20.03	18.69	14.18
TOTAL	85.33	85.59	87.06	86.84	87.07	86.72	85.60	85.47	87.34	87.79
ATOMIC RATIOS (O = 28.0)										
SI	5.538	5.840	5.595	5.652	5.561	5.580	5.596	5.605	5.671	5.615
AL	4.861	4.489	4.817	4.535	4.817	4.662	4.579	4.454	4.545	4.911
FE	4.915	4.382	5.172	3.368	2.672	5.212	3.439	3.716	3.880	4.778
MN	0.069	0.137	0.075	0.045	0.056	0.063	0.068	0.056	0.141	0.131
MG	4.649	5.068	4.338	6.478	6.925	4.574	6.432	6.339	5.818	4.494
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	KU	TU	TU	KU	KU	KU	TU	TU	KU	KU

TABLE 6. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF STILPNOMELANES

SAMPLE NO	MO49-A	MO51-A	MO83
ROCK TYPE	BS	BS	BS
ZONE	GAR	GAR	CHL
GRAIN NO	S1	S1	S1
POINT NO	2	1	1
SIO2	45.06	44.93	46.49
TIO2	0.03	0.02	0.02
AL2O3	7.42	5.90	6.20
FEO	29.18	28.69	27.24
MNO	0.87	0.80	1.01
MGO	5.47	4.87	8.68
CAO	0.50	0.31	0.18
NA2O	0.13	0.21	0.15
K2O	1.04	1.06	2.60
TOTAL	89.70	86.79	92.57
ATOMIC RATIOS (SI = 8.0)			
SI	8.000	8.000	8.000
TI	0.004	0.003	0.003
AL	1.553	1.238	1.257
FE	4.333	4.272	3.920
MN	0.131	0.121	0.147
MG	1.448	1.293	2.227
CA	0.095	0.059	0.033
NA	0.045	0.072	0.050
K	0.236	0.241	0.571
ANALYST	MO	MO	MO
INSTRUMENT	KU	KU	KU

TABLE 7. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF AMPHIBOLES

SAMPLE NO	TH71081315			TH71081303		
ROCK TYPE	PE			PE		
ZONE	BIO			BIO		
GRAIN NO	1	2	3	1	2	3
POINT NO	1	1	1	1	1	1
SIO2	44.76	46.20	44.59	43.98	44.31	44.33
TIO2	0.63	0.58	0.45	0.45	0.38	0.50
AL2O3	15.16	13.83	14.66	15.78	15.54	15.73
FEO	15.79	15.01	15.87	13.92	13.96	14.33
MNO	0.05	0.06	0.03	0.05	0.08	0.11
MGO	9.04	9.02	8.89	9.57	9.94	9.47
CAO	9.07	8.23	9.00	10.43	10.40	10.00
NA2O	3.41	3.61	3.46	2.74	2.68	2.86
K2O	0.45	0.33	0.46	0.48	0.46	0.51
TOTAL	98.36	96.87	97.41	97.40	97.75	97.84
ATOMIC RATIOS (O = 23.0)						
SI	6.545	6.798	6.590	6.459	6.481	6.485
TI	0.069	0.064	0.050	0.050	0.042	0.055
AL	2.612	2.399	2.554	2.731	2.679	2.712
FE	1.931	1.847	1.962	1.710	1.707	1.753
MN	0.006	0.007	0.004	0.006	0.010	0.014
MG	1.970	1.979	1.959	2.095	2.167	2.065
CA	1.421	1.298	1.425	1.641	1.630	1.567
NA	0.967	1.030	0.992	0.780	0.760	0.811
K	0.084	0.062	0.087	0.090	0.086	0.095
ANALYST	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU

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

SAMPLE NO	TH71081303					TH72102901			MO03		
ROCK TYPE	PE					BS			SL		
ZONE	BIO					BIO			BIO		
GRAIN NO	4	5	6	7	8	AC(V)	HB2	HB1	HB3	HB3	HB1
POINT NO	1	1	1	1	1	1	CORE	1	CORE	3	1
SIO2	44.90	45.85	44.93	44.55	44.22	55.24	44.64	51.56	43.82	52.86	51.30
TIO2	0.53	0.43	0.43	0.38	0.43	0.0	0.46	0.04	0.42	N.D.	N.D.
AL2O3	15.83	14.02	14.93	15.85	15.30	1.30	13.56	4.41	14.17	1.98	4.24
FEO	13.95	14.01	14.47	13.96	14.07	10.30	18.10	17.94	15.23	14.21	12.98
MNO	0.07	0.08	0.11	0.20	0.14	0.23	0.13	0.19	0.12	0.45	0.31
MGO	9.65	10.27	9.77	10.00	9.84	17.04	8.50	12.20	9.37	15.39	15.71
CAO	9.87	9.82	9.97	10.27	10.12	12.13	9.38	9.70	9.18	13.01	12.44
NA2O	2.97	2.80	2.88	2.66	2.70	0.33	3.57	2.40	3.07	0.43	0.80
K2O	0.50	0.40	0.45	0.42	0.46	0.09	0.38	0.13	0.35	0.06	0.11
TOTAL	98.27	97.68	97.94	98.29	97.28	96.66	98.72	98.57	95.73	98.39	97.89
ATOMIC RATIOS (O = 23.0)											
SI	6.517	6.686	6.565	6.473	6.501	7.923	6.598	7.547	6.580	7.655	7.430
TI	0.058	0.047	0.047	0.042	0.048	0.0	0.051	0.004	0.047	N.D.	N.D.
AL	2.708	2.410	2.571	2.714	2.651	0.220	2.362	0.761	2.508	0.338	0.724
FE	1.693	1.709	1.768	1.696	1.730	1.235	2.237	2.196	1.913	1.721	1.572
MN	0.009	0.010	0.014	0.025	0.017	0.028	0.016	0.024	0.015	0.055	0.038
MG	2.088	2.233	2.128	2.166	2.157	3.643	1.873	2.662	2.098	3.323	3.392
CA	1.535	1.534	1.561	1.599	1.594	1.864	1.485	1.521	1.477	2.019	1.930
NA	0.836	0.792	0.816	0.749	0.770	0.092	1.023	0.681	0.894	0.121	0.225
K	0.093	0.074	0.084	0.078	0.086	0.016	0.072	0.024	0.067	0.011	0.020
ANALYST	TH	TH	TH	TH	TH	TH	MO	MO	MO	MO	MO
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

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

SAMPLE NO	M004			M005				TH710813D		M010	
ROCK TYPE	SL			BS				BS		BS	
ZONE	BIO			BIO				BIO		BIO	
GRAIN NO	HB2	HB1	HB1	HB2	HB1	HB1	HB1	HB4	HB1	HB1	HB2
POINT NO	CORE	2	4	CORE	3	2	1	CORE	4	CORE	1
SIO2	46.66	47.55	53.75	45.40	47.43	53.26	54.70	45.43	47.49	43.10	46.54
TIO2	0.30	0.29	0.11	0.39	0.29	0.09	0.03	0.42	0.22	0.42	0.23
AL2O3	13.22	12.13	4.29	13.10	11.42	3.28	1.60	9.31	6.93	13.52	9.39
FEO	13.45	12.93	11.34	13.17	12.60	10.49	11.02	18.26	17.02	12.76	11.88
MNO	0.08	0.13	0.20	0.12	0.14	0.16	0.16	0.34	0.30	0.17	0.26
MGO	11.30	11.51	15.19	11.31	12.13	16.54	16.17	10.41	11.75	11.36	13.21
CAO	10.11	9.95	12.72	9.80	9.34	11.94	12.64	8.45	8.06	10.31	9.14
NA2O	2.77	2.89	0.91	2.95	2.87	0.60	0.58	3.64	3.57	2.84	3.23
K2O	0.29	0.28	0.25	0.31	0.25	0.05	0.06	0.73	0.35	0.30	0.19
TOTAL	98.18	97.66	98.76	96.55	96.47	96.41	96.96	96.99	95.69	94.78	94.07
ATOMIC RATIOS (O = 23.0)											
SI	6.749	6.891	7.621	6.690	6.941	7.684	7.869	6.871	7.191	6.501	7.000
TI	0.033	0.032	0.012	0.043	0.032	0.010	0.003	0.048	0.025	0.048	0.026
AL	2.254	2.072	0.717	2.275	1.970	0.558	0.271	1.659	1.237	2.404	1.665
FE	1.627	1.567	1.345	1.623	1.542	1.266	1.326	2.310	2.155	1.610	1.494
MN	0.010	0.016	0.024	0.015	0.017	0.020	0.019	0.044	0.038	0.022	0.033
MG	2.437	2.487	3.211	2.485	2.646	3.557	3.468	2.347	2.653	2.555	2.962
CA	1.567	1.545	1.932	1.547	1.464	1.846	1.948	1.369	1.308	1.666	1.473
NA	0.777	0.812	0.250	0.843	0.814	0.168	0.162	1.067	1.048	0.831	0.942
K	0.054	0.052	0.045	0.058	0.047	0.009	0.011	0.141	0.068	0.058	0.036
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	KU	KU	KU	TU	TU	TU	TU	TU	TU	TU	TU

SAMPLE NO	M011-A		M015		M016			M019			TH71080601
ROCK TYPE	BS		BS		BS			BS			BS
ZONE	BIO		BIO		BIO			BIO			BIO
GRAIN NO	HB1	HB2	HB3	HB3	HB1	HB1	HB1	HB2	HB2	HB1	HB3
POINT NO	CORE	2	CORE	3	CORE	4	1	CORE	1	2	CORE
SIO2	46.64	49.19	44.98	50.23	44.56	47.61	52.41	44.42	51.96	46.31	43.47
TIO2	0.31	0.17	0.38	0.22	0.41	0.17	0.05	0.48	0.15	0.28	0.37
AL2O3	10.25	7.41	13.15	7.78	13.71	7.88	3.24	15.12	4.53	12.23	15.26
FEO	14.45	13.08	16.42	15.58	14.57	14.20	14.68	14.38	14.12	14.03	14.55
MNO	0.21	0.17	0.26	0.21	0.16	0.19	0.17	0.08	0.19	0.09	0.24
MGO	12.27	15.28	10.12	12.30	11.03	12.65	14.80	10.53	14.28	10.87	10.78
CAO	8.96	10.09	9.04	10.42	10.02	10.36	9.94	9.86	11.17	10.25	10.35
NA2O	3.94	2.80	3.53	2.23	3.19	2.50	2.03	2.70	0.61	2.31	2.81
K2O	0.40	0.34	0.34	0.21	0.39	0.18	0.11	0.35	0.10	0.31	0.40
TOTAL	97.43	98.53	98.22	99.18	98.04	95.74	97.43	97.92	97.11	96.68	98.23
ATOMIC RATIOS (O = 23.0)											
SI	6.872	7.100	6.626	7.241	6.536	7.113	7.639	6.487	7.562	6.824	6.369
TI	0.034	0.018	0.042	0.024	0.045	0.019	0.005	0.053	0.016	0.031	0.041
AL	1.780	1.261	2.283	1.322	2.370	1.388	0.557	2.602	0.777	2.124	2.635
FE	1.781	1.579	2.023	1.878	1.787	1.774	1.789	1.756	1.719	1.729	1.783
MN	0.026	0.021	0.032	0.026	0.020	0.024	0.021	0.010	0.023	0.011	0.030
MG	2.695	3.288	2.222	2.643	2.412	2.818	3.216	2.293	3.098	2.388	2.355
CA	1.415	1.560	1.427	1.609	1.575	1.658	1.552	1.543	1.742	1.618	1.625
NA	1.126	0.784	1.008	0.623	0.907	0.724	0.574	0.765	0.172	0.660	0.798
K	0.075	0.063	0.064	0.039	0.073	0.034	0.020	0.065	0.019	0.058	0.075
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	TU	TU	TU	KU

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

SAMPLE NO	TH71080601	TH72120319		TH72120338		MO23		MO24		MO26	
ROCK TYPE	BS	BS		BS		BS		BS		BS	
ZONE	BIO	BIO		BIO		BIO		BIO		BIO	
GRAIN NO	HB3	HB1	HB3	HB2	HB1	HB2	HB1	HB1	HB2	HB1	HB2
POINT NO	2	CORE	1	CORE	1	CORE	3	CORE	3	CORE	1
SIO2	44.09	45.03	44.61	41.77	42.95	41.44	41.07	42.04	42.63	45.75	46.71
TIO2	0.22	0.59	0.37	0.0	0.88	0.66	0.58	0.44	0.31	0.40	0.31
AL2O3	12.24	12.26	10.39	14.02	12.89	15.47	14.91	14.66	11.88	10.61	8.69
FEO	14.79	18.93	19.31	19.08	19.23	18.14	18.09	17.22	18.96	13.44	12.43
MNO	0.25	N.D.	N.D.	N.D.	N.D.	0.11	0.06	0.10	0.23	0.26	0.23
MGO	11.82	8.22	9.24	7.99	8.84	8.19	8.61	8.44	8.81	12.58	14.18
CAO	11.04	10.29	9.92	9.47	9.55	9.05	9.63	9.53	8.85	9.22	10.19
NA2O	2.22	2.91	2.88	3.12	2.94	2.26	3.16	3.40	3.38	3.51	2.74
K2O	0.32	0.54	0.50	0.78	0.41	0.46	0.41	0.32	0.34	0.49	0.32
TOTAL	96.99	98.77	97.22	96.23	97.69	95.78	96.52	96.15	95.39	96.26	95.80
ATOMIC RATIOS (O = 23.0)											
SI	6.562	6.686	6.759	6.411	6.473	6.317	6.255	6.385	6.585	6.803	6.942
TI	0.025	0.066	0.042	0.0	0.100	0.076	0.066	0.050	0.036	0.045	0.035
AL	2.147	2.146	1.855	2.536	2.289	2.779	2.676	2.624	2.163	1.860	1.522
FE	1.841	2.351	2.447	2.449	2.424	2.313	2.304	2.187	2.449	1.671	1.545
MN	0.032	N.D.	N.D.	N.D.	N.D.	0.014	0.008	0.013	0.030	0.033	0.029
MG	2.623	1.820	2.087	1.828	1.986	1.861	1.955	1.911	2.029	2.789	3.142
CA	1.760	1.637	1.610	1.557	1.542	1.478	1.571	1.551	1.465	1.469	1.623
NA	0.641	0.838	0.846	0.928	0.859	0.668	0.933	1.001	1.012	1.012	0.790
K	0.061	0.102	0.097	0.153	0.079	0.089	0.080	0.062	0.067	0.093	0.061
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	KU	KU	KU	KU	KU	TU	TU	TU	TU	TU	TU

SAMPLE NO	TH71080303			MO28		TH71051007	MO33		MO35		
ROCK TYPE	BS			BS		BS	SL		SL		
ZONE	BIO			BIO		BIO	BIO		BIO		
GRAIN NO	HB5	HB2	HB1	HB3	HB1	HB2	HB1	HB1	HB1	HB1	HB2
POINT NO	CORE	3	1	CORE	3	CORE	CORE	2	CORE	5	1
SIO2	42.65	43.20	50.39	41.44	42.13	40.65	43.69	46.97	47.25	51.59	52.38
TIO2	0.57	0.44	0.12	0.56	0.40	N.D.	0.38	0.20	0.19	0.05	0.01
AL2O3	11.14	10.43	5.09	12.03	10.98	12.95	14.01	8.30	7.78	2.77	0.67
FEO	16.89	16.29	15.08	17.94	17.36	18.90	16.35	16.60	15.35	13.22	12.67
MNO	0.45	0.39	0.37	0.24	0.28	N.D.	0.10	0.18	0.25	0.23	0.20
MGO	10.12	10.76	12.48	9.03	10.02	8.56	8.84	10.96	11.94	14.91	15.99
CAO	9.13	9.42	9.69	9.80	10.00	10.52	9.57	10.08	10.69	11.68	12.32
NA2O	3.47	3.24	2.80	3.30	3.06	3.28	3.11	2.28	1.88	0.70	0.16
K2O	0.54	0.49	0.23	0.49	0.48	0.68	0.43	0.30	0.24	0.08	0.03
TOTAL	94.96	94.66	96.25	94.83	94.71	95.54	96.48	95.87	95.57	95.23	94.43
ATOMIC RATIOS (O = 23.0)											
SI	6.586	6.667	7.490	6.454	6.549	6.332	6.559	7.085	7.111	7.662	7.826
TI	0.066	0.051	0.013	0.066	0.047	N.D.	0.043	0.023	0.022	0.006	0.001
AL	2.028	1.897	0.892	2.208	2.012	2.378	2.479	1.475	1.380	0.485	0.118
FE	2.181	2.102	1.875	2.337	2.257	2.462	2.053	2.094	1.932	1.642	1.583
MN	0.059	0.051	0.047	0.032	0.037	N.D.	0.013	0.023	0.032	0.029	0.025
MG	2.330	2.475	2.766	2.097	2.322	1.988	1.979	2.464	2.679	3.301	3.562
CA	1.511	1.558	1.543	1.635	1.666	1.756	1.539	1.629	1.724	1.858	1.972
NA	1.039	0.969	0.807	0.997	0.922	0.991	0.905	0.667	0.549	0.202	0.046
K	0.106	0.096	0.044	0.097	0.095	0.135	0.082	0.058	0.046	0.015	0.006
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	TU	TU	TU	TU	TU	KU	TU	TU	TU	TU	TU

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

SAMPLE NO	MO37			MO38-A		MO40					MO41-A
ROCK TYPE	BS			BS		BS					BS
ZONE	BIO			BIO		BIO					BIO
GRAIN NO	HB1	HB4	HB5	HB1	HB2	HB4	HB1	HB1	HB1	HB2	HB2
POINT NO	CORE	2	1	CORE	1	CORE	CORE	3	1	1	CORE
SIO2	47.61	49.01	54.75	45.70	52.61	43.79	44.64	47.14	50.90	51.54	43.05
TIO2	0.30	0.12	0.02	0.33	0.08	0.36	0.35	0.19	0.0	0.0	0.45
AL2O3	10.40	6.75	1.30	11.57	4.73	12.87	12.09	8.28	3.43	3.34	12.19
FEO	13.77	14.66	11.27	15.19	13.66	16.60	16.25	17.91	16.79	18.58	16.10
MNO	0.20	0.24	0.25	0.26	0.26	0.24	N.D.	N.D.	N.D.	N.D.	0.12
MGO	12.03	13.00	16.98	10.29	14.61	9.90	9.75	10.55	12.08	11.87	10.25
CAO	7.91	8.80	10.69	7.71	8.77	9.03	9.08	7.78	8.37	7.78	9.47
NA2O	4.12	3.52	1.62	4.44	3.09	3.59	4.08	3.90	2.62	3.96	3.15
K2O	0.20	0.21	0.07	0.28	0.14	0.42	0.0	0.0	0.0	0.0	0.14
TOTAL	96.54	96.31	96.95	95.77	97.95	96.80	96.24	95.75	94.19	97.07	94.92
ATOMIC RATIOS (O = 23.0)											
SI	7.007	7.275	7.878	6.854	7.581	6.577	6.711	7.132	7.731	7.678	6.581
TI	0.033	0.013	0.002	0.037	0.009	0.041	0.040	0.022	0.0	0.0	0.052
AL	1.804	1.181	0.220	2.045	0.803	2.278	2.142	1.476	0.614	0.586	2.196
FE	1.695	1.820	1.356	1.905	1.646	2.085	2.043	2.266	2.133	2.315	2.058
MN	0.025	0.030	0.030	0.033	0.032	0.031	N.D.	N.D.	N.D.	N.D.	0.016
MG	2.640	2.877	3.642	2.301	3.139	2.217	2.185	2.379	2.735	2.636	2.336
CA	1.247	1.400	1.648	1.239	1.354	1.453	1.463	1.261	1.362	1.242	1.551
NA	1.176	1.013	0.452	1.291	0.863	1.045	1.189	1.144	0.772	1.144	0.934
K	0.038	0.040	0.013	0.054	0.026	0.080	0.0	0.0	0.0	0.0	0.027
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	TU	TU	TU	TU	TU	KU	KU	KU	KU	KU	TU

SAMPLE NO	MO41-A	MO42		MO47			MO48		MO49-A		
ROCK TYPE	BS	BS		BS			BS		BS		
ZONE	BIO	BIO		GAR			GAR		GAR		
GRAIN NO	HB1	HB1	HB2	HB3	HB2	HB1	HB1	HB3	HB1	HB1	HB2
POINT NO	3	CORE	3	CORE	2	1	CORE	1	CORE	2	CORE
SIO2	51.52	44.98	50.50	47.97	51.37	53.69	47.72	53.24	42.07	49.66	47.29
TIO2	0.02	0.24	0.13	0.09	0.14	0.06	0.17	0.01	0.21	N.D.	0.18
AL2O3	1.99	10.29	5.36	5.35	3.60	1.57	8.09	1.41	9.85	1.96	9.05
FEO	16.70	16.49	14.11	16.07	13.78	13.68	18.91	15.83	21.00	19.68	20.08
MNO	0.21	0.28	0.24	0.35	0.31	0.32	0.21	0.20	0.32	0.30	0.36
MGO	12.98	13.17	13.46	11.25	13.59	15.16	10.36	14.73	8.31	12.35	8.78
CAO	10.87	7.94	8.16	9.99	11.31	11.01	8.03	10.60	9.23	12.82	9.04
NA2O	1.34	3.57	3.43	2.47	1.43	1.64	3.72	1.66	3.51	0.55	3.00
K2O	0.13	0.24	0.12	0.23	0.16	0.10	0.27	0.05	0.42	0.23	0.42
TOTAL	95.76	97.20	95.51	93.77	95.69	97.23	97.48	97.73	94.92	97.55	98.20
ATOMIC RATIOS (O = 23.0)											
SI	7.739	6.705	7.499	7.391	7.624	7.815	7.136	7.782	6.643	7.498	7.067
TI	0.002	0.027	0.015	0.010	0.016	0.007	0.019	0.001	0.025	N.D.	0.020
AL	0.352	1.808	0.938	0.971	0.630	0.269	1.426	0.243	1.833	0.349	1.594
FE	2.098	2.056	1.752	2.071	1.710	1.665	2.365	1.935	2.773	2.485	2.510
MN	0.027	0.035	0.030	0.046	0.039	0.039	0.027	0.025	0.043	0.038	0.046
MG	2.907	2.927	2.980	2.584	3.007	3.290	2.309	3.210	1.956	2.780	1.956
CA	1.749	1.268	1.298	1.649	1.798	1.717	1.286	1.660	1.562	2.074	1.448
NA	0.390	1.032	0.988	0.738	0.411	0.463	1.078	0.470	1.075	0.161	0.869
K	0.025	0.046	0.023	0.045	0.030	0.019	0.052	0.009	0.085	0.044	0.080
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	TU	TU	TU	TU	TU	TU	KU	KU	KU	KU	KU

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

SAMPLE NO	M049-A		M051-A		M055				M058		
ROCK TYPE	BS		BS		BS				BS		
ZONE	GAR		GAR		GAR				GAR		
GRAIN NO	HB2	HB4	HB2	HB3	HB2	HB2	HB1	HB1	HB1	HB1	HB2
POINT NO	2	2	CORE	1	CORE	2	CORE	1	CORE	6	CORE
SIO2	52.32	49.80	45.48	51.81	45.36	51.77	41.60	53.12	47.81	54.21	53.40
TIO2	0.01	0.04	0.16	0.03	0.35	0.08	0.34	0.01	0.27	0.01	0.06
AL2O3	3.26	4.18	8.67	1.18	11.91	4.40	14.13	1.19	8.60	0.70	6.82
FEO	19.89	21.32	20.44	17.91	17.64	17.92	18.29	17.18	16.70	15.42	17.78
MNO	0.32	0.35	0.29	0.24	0.22	N.D.	0.13	N.D.	0.14	0.14	0.13
MGO	11.31	10.22	8.23	11.64	8.72	11.82	7.27	13.08	11.16	13.88	8.96
CAO	12.00	11.67	8.27	12.30	8.04	7.78	8.85	10.94	7.50	11.44	1.81
NA2O	0.99	1.19	3.15	0.30	3.57	3.61	3.71	1.49	4.26	0.91	6.25
K2O	0.21	0.24	0.33	0.07	0.28	0.12	0.35	0.08	0.32	0.06	0.12
TOTAL	100.31	99.01	95.02	95.48	96.09	97.50	94.67	97.09	96.76	96.77	95.33
ATOMIC RATIOS (O = 23.0)											
SI	7.610	7.427	7.055	7.850	6.841	7.635	6.455	7.860	7.126	7.964	7.906
TI	0.001	0.004	0.019	0.003	0.040	0.009	0.040	0.001	0.030	0.001	0.007
AL	0.559	0.735	1.585	0.211	2.117	0.765	2.584	0.208	1.511	0.121	1.190
FE	2.419	2.659	2.652	2.269	2.225	2.210	2.373	2.126	2.082	1.895	2.201
MN	0.039	0.044	0.038	0.031	0.028	N.D.	0.017	N.D.	0.018	0.017	0.016
MG	2.452	2.272	1.903	2.629	1.961	2.599	1.682	2.885	2.480	3.040	1.977
CA	1.870	1.865	1.375	1.997	1.299	1.229	1.471	1.734	1.198	1.801	0.287
NA	0.279	0.344	0.947	0.088	1.044	1.032	1.116	0.427	1.231	0.259	1.794
K	0.039	0.046	0.065	0.014	0.054	0.023	0.069	0.015	0.061	0.011	0.023
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	KU	KU	KU	KU	TU	KU	TU	KU	TU	TU	TU

SAMPLE NO	M058				M060-A			TH71072601			M062
ROCK TYPE	BS				BS			BS			BS
ZONE	GAR				GAR			GAR			GAR
GRAIN NO	HB2	GL2	GL2	GL2	HB4	HB1	HB3	AC1	AC1	AC1	AC1
POINT NO	3	CORE	1	3	CORE	2	2	CORE	4	1	CORE
SIO2	49.71	47.10	54.08	51.05	48.35	49.13	54.81	48.90	50.34	54.68	54.47
TIO2	0.06	0.24	0.06	0.08	0.14	0.08	0.01	0.08	0.05	0.0	0.01
AL2O3	3.41	8.18	6.38	3.37	7.83	5.67	1.51	6.07	4.86	0.32	1.33
FEO	17.56	17.71	17.94	18.51	17.54	14.61	7.04	17.32	16.21	14.02	12.10
MNO	0.20	0.21	0.09	0.22	0.26	0.38	0.25	0.27	0.29	0.21	N.D.
MGO	11.09	10.55	8.65	11.22	11.82	13.07	20.18	11.15	12.34	14.87	16.56
CAO	8.76	6.84	0.94	7.68	8.89	9.01	12.23	10.27	10.52	12.84	13.47
NA2O	3.37	4.55	6.66	3.15	3.23	2.95	0.62	1.80	2.13	0.05	0.34
K2O	0.15	0.29	0.06	0.21	0.24	0.15	0.03	0.25	0.23	0.01	0.06
TOTAL	94.31	95.67	94.86	95.49	98.30	95.05	96.68	96.11	96.97	97.00	98.34
ATOMIC RATIOS (O = 23.0)											
SI	7.639	7.143	8.025	7.725	7.125	7.384	7.772	7.356	7.468	7.969	7.786
TI	0.007	0.027	0.007	0.009	0.016	0.009	0.001	0.009	0.006	0.0	0.001
AL	0.618	1.462	1.116	0.601	1.360	1.004	0.252	1.076	0.850	0.055	0.224
FE	2.257	2.246	2.226	2.343	2.162	1.836	0.835	2.179	2.011	1.709	1.446
MN	0.026	0.027	0.011	0.028	0.032	0.048	0.030	0.034	0.036	0.026	N.D.
MG	2.541	2.385	1.913	2.531	2.597	2.928	4.266	2.500	2.729	3.231	3.529
CA	1.442	1.111	0.149	1.245	1.404	1.451	1.858	1.655	1.672	2.005	2.063
NA	1.004	1.338	1.916	0.924	0.923	0.860	0.170	0.525	0.613	0.014	0.094
K	0.029	0.056	0.011	0.041	0.045	0.029	0.005	0.048	0.044	0.002	0.011
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	TU	TU	TU	TU	KU	KU	KU	TU	TU	TU	KU

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

SAMPLE NO	MO62	MO61		MO64				MO65			MO66-A
ROCK TYPE	BS	BS		BS				BS			BS
ZONE	GAR	GAR		GAR				GAR			GAR
GRAIN NO	AC2	AC2	AC2	HB1	HB2	HB2	HB2	GL4	GL3	GL1	GL1
POINT NO	3	CORE	1	CORE	3	4	1	CORE	2	1	CORE
SIO2	54.65	52.16	49.90	46.18	46.85	50.74	53.22	56.63	51.75	53.78	55.11
TIO2	0.0	0.05	0.04	0.30	0.30	0.04	0.05	0.03	0.01	0.03	0.0
AL2O3	0.73	5.15	3.69	11.38	10.32	4.36	0.83	7.89	3.44	1.85	7.63
FEO	11.71	14.31	14.29	15.96	15.90	15.46	14.12	17.04	19.43	16.72	15.73
MNO	N.D.	0.27	0.28	0.23	0.26	0.23	0.25	0.13	0.27	0.24	N.D.
MGO	16.96	13.69	14.31	10.03	10.05	12.89	14.90	8.15	10.33	12.92	9.85
CAO	13.64	10.54	11.31	9.42	9.23	11.16	12.50	0.44	8.65	9.54	0.64
NA2O	0.19	1.19	0.34	3.28	2.91	1.27	0.29	6.99	2.87	1.78	7.25
K2O	0.04	0.19	0.10	0.22	0.23	0.16	0.04	0.02	0.25	0.10	0.0
TOTAL	97.92	97.55	94.26	97.00	96.05	96.31	96.20	97.32	97.00	96.96	96.21
ATOMIC RATIOS (O = 23.0)											
SI	7.832	7.561	7.530	6.860	7.008	7.535	7.851	8.089	7.745	7.912	7.959
TI	0.0	0.005	0.005	0.034	0.034	0.004	0.006	0.003	0.001	0.003	0.0
AL	0.123	0.880	0.656	1.992	1.819	0.763	0.144	1.328	0.607	0.321	1.299
FE	1.403	1.735	1.803	1.983	1.989	1.920	1.742	2.035	2.432	2.057	1.900
MN	N.D.	0.033	0.036	0.029	0.033	0.029	0.031	0.016	0.034	0.030	N.D.
MG	3.623	2.958	3.219	2.221	2.241	2.854	3.277	1.735	2.305	2.834	2.121
CA	2.094	1.637	1.829	1.499	1.479	1.776	1.976	0.067	1.387	1.504	0.099
NA	0.053	0.334	0.099	0.945	0.844	0.366	0.083	1.936	0.833	0.508	2.030
K	0.007	0.035	0.019	0.042	0.044	0.030	0.008	0.004	0.048	0.019	0.0
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	KU	TU	TU	TU	TU	TU	TU	KU	KU	KU	KU

SAMPLE NO	MO66-A	MO67		TH71072803		MO70		MO71		MO74	
ROCK TYPE	BS	BS		BS		BS		BS		BS	
ZONE	GAR	GAR		CHL		CHL		CHL		CHL	
GRAIN NO	GL2	GL1	GL2	GL1	AC1	AC1	AC2	AC3	AC1	GL4	GL3
POINT NO	3	CORE	3	CORE	2	CORE	1	CORE	2	CORE	CORE
SIO2	51.06	56.03	52.54	54.37	56.16	54.61	54.52	52.72	53.51	56.77	55.29
TIO2	0.06	0.06	0.03	0.05	0.0	0.08	0.05	0.01	0.0	0.0	0.06
AL2O3	5.21	8.30	2.16	7.55	0.79	2.46	0.99	2.38	1.59	7.52	6.46
FEO	15.98	14.49	15.77	13.76	9.93	12.34	12.71	14.13	14.39	16.15	19.00
MNO	N.D.	0.08	0.19	0.12	0.33	0.29	0.28	0.28	0.27	0.21	0.18
MGO	12.31	9.36	12.73	10.96	17.47	15.79	15.64	13.56	15.36	8.61	7.27
CAO	6.16	0.82	7.93	1.03	10.64	11.10	12.38	12.49	13.14	1.01	1.24
NA2O	5.10	6.90	2.77	6.84	2.60	0.94	0.56	0.41	0.44	6.84	6.67
K2O	0.0	0.02	0.08	0.03	0.07	0.04	0.05	0.07	0.03	0.01	0.01
TOTAL	95.88	96.06	94.20	94.71	97.99	97.65	97.18	96.05	98.73	97.12	96.18
ATOMIC RATIOS (O = 23.0)											
SI	7.592	8.027	7.924	7.921	7.958	7.820	7.892	7.785	7.715	8.106	8.112
TI	0.007	0.006	0.003	0.005	0.0	0.009	0.005	0.001	0.0	0.0	0.007
AL	0.913	1.401	0.384	1.296	0.132	0.415	0.169	0.414	0.270	1.266	1.117
FE	1.987	1.736	1.989	1.677	1.177	1.478	1.539	1.745	1.735	1.929	2.331
MN	N.D.	0.010	0.024	0.015	0.040	0.035	0.034	0.035	0.033	0.025	0.022
MG	2.729	1.999	2.862	2.380	3.691	3.371	3.375	2.985	3.302	1.833	1.590
CA	0.981	0.126	1.281	0.161	1.615	1.703	1.920	1.976	2.030	0.155	0.195
NA	1.470	1.917	0.810	1.932	0.714	0.261	0.157	0.117	0.123	1.894	1.897
K	0.0	0.004	0.015	0.006	0.013	0.007	0.009	0.013	0.006	0.002	0.002
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	KU	TU	TU	TU	TU	TU	TU	KU	KU	TU	TU

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

SAMPLE NO	MO74			MO75		MO79			MO80		
ROCK TYPE	BS			BS		BS			BS		
ZONE	CHL			CHL		CHL			CHL		
GRAIN NO	GL2	GL2	GL1	AC1	AC1	GL3	GL3	GL5	AC1	AC1	AC2
POINT NO	CORE	3	CORE	CORE	1	CORE	2	1	CORE	1	1
SIO2	53.07	52.92	55.43	51.66	53.53	54.32	54.44	54.69	53.19	54.59	53.28
TIO2	0.15	0.0	0.04	0.12	0.08	0.08	0.01	0.04	0.03	0.02	0.02
AL2O3	3.47	1.14	8.19	3.30	0.67	2.77	1.26	2.27	1.44	1.00	0.63
FEO	26.64	15.98	16.28	18.00	14.65	15.10	14.09	15.51	8.02	7.77	7.66
MNO	0.13	0.40	0.24	0.30	0.31	0.22	0.22	0.17	0.23	0.22	0.27
MGO	4.98	12.89	7.48	11.15	14.52	15.09	16.22	14.25	19.34	19.62	19.19
CAO	1.44	8.91	0.85	10.45	12.39	5.14	8.75	10.63	13.13	13.33	13.86
NA2O	6.78	1.52	6.74	1.16	0.15	4.42	2.67	1.83	0.59	0.53	0.42
K2O	0.03	0.05	0.01	0.16	0.02	0.13	0.16	0.05	0.05	0.05	0.05
TOTAL	96.69	93.81	95.26	96.30	96.32	97.27	97.82	99.44	96.02	97.13	95.38
ATOMIC RATIOS (O = 23.0)											
SI	8.113	8.017	8.078	7.731	7.894	7.865	7.858	7.813	7.676	7.763	7.744
TI	0.017	0.0	0.004	0.014	0.009	0.009	0.001	0.004	0.003	0.002	0.002
AL	0.625	0.204	1.407	0.582	0.116	0.473	0.214	0.382	0.245	0.168	0.108
FE	3.406	2.024	1.984	2.253	1.807	1.829	1.701	1.853	0.968	0.924	0.931
MN	0.017	0.051	0.030	0.038	0.039	0.027	0.027	0.021	0.028	0.026	0.033
MG	1.135	2.911	1.625	2.488	3.192	3.257	3.490	3.035	4.161	4.159	4.158
CA	0.236	1.446	0.133	1.676	1.958	0.797	1.353	1.627	2.030	2.031	2.158
NA	2.010	0.446	1.904	0.337	0.043	1.241	0.747	0.507	0.165	0.146	0.118
K	0.006	0.010	0.002	0.031	0.004	0.024	0.029	0.009	0.009	0.009	0.009
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	TU	TU	TU	TU	TU	KU	KU	KU	KU	KU	KU

SAMPLE NO	MO83			MO84				MO89			MO92
ROCK TYPE	BS			BS				BS			BS
ZONE	CHL			CHL				CHL			CHL
GRAIN NO	GL1	GL1	GL1	GL4	GL1	GL1	GL3	GL6	GL6	GL4	AC3
POINT NO	CORE	1	4	CORE	2	1	3	CORE	3	1	1
SIO2	53.07	52.61	52.47	54.84	52.80	52.51	52.93	51.61	54.42	52.89	52.80
TIO2	0.04	0.01	0.07	0.05	0.03	0.02	0.01	0.07	0.01	0.01	0.01
AL2O3	5.61	2.19	2.11	4.06	1.83	1.43	0.66	2.18	0.87	1.09	0.97
FEO	23.81	21.67	21.27	17.80	15.69	14.49	12.61	18.06	15.58	14.86	14.31
MNO	0.16	0.20	0.19	0.13	0.19	0.23	0.26	0.62	0.66	0.58	0.66
MGO	5.48	9.27	12.23	10.11	13.22	14.18	15.20	12.40	14.09	14.87	14.24
CAO	0.71	5.27	5.36	1.58	5.51	7.64	11.65	9.12	10.89	9.11	12.17
NA2O	6.16	4.93	5.00	6.42	4.19	2.96	0.97	2.51	1.29	2.16	0.97
K2O	0.04	0.06	0.07	0.05	0.04	0.03	0.05	0.16	0.05	0.04	0.06
TOTAL	95.08	96.21	98.77	95.04	93.50	93.49	94.34	96.73	97.86	95.61	96.19
ATOMIC RATIOS (O = 23.0)											
SI	8.079	7.977	7.756	8.140	7.997	7.940	7.909	7.728	7.925	7.864	7.830
TI	0.005	0.001	0.008	0.006	0.003	0.002	0.001	0.008	0.001	0.001	0.001
AL	1.006	0.391	0.368	0.710	0.327	0.255	0.116	0.385	0.149	0.191	0.170
FE	3.031	2.748	2.629	2.210	1.987	1.832	1.576	2.262	1.897	1.848	1.775
MN	0.021	0.026	0.024	0.016	0.024	0.029	0.033	0.079	0.081	0.073	0.083
MG	1.244	2.095	2.695	2.237	2.985	3.196	3.386	2.768	3.059	3.296	3.148
CA	0.116	0.856	0.849	0.251	0.894	1.238	1.865	1.463	1.699	1.451	1.934
NA	1.818	1.449	1.433	1.848	1.230	0.868	0.281	0.729	0.364	0.623	0.279
K	0.008	0.012	0.013	0.009	0.008	0.006	0.010	0.031	0.009	0.008	0.011
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	KU	KU	KU	TU	TU	TU	TU	KU	KU	KU	KU

TABLE 8. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF PYROXENES

SAMPLE NO	MO83		
ROCK TYPE	BS		
ZONE	CHL		
GRAIN NO	P1	P3	P1
POINT NO	4	2	2
SIO2	52.37	51.86	49.28
TIO2	0.05	0.09	1.24
AL2O3	2.11	3.61	2.69
FEO	18.30	17.87	12.69
MNO	0.16	0.22	0.26
MGO	5.71	5.10	13.53
CAO	13.90	10.69	20.49
NA2O	6.41	7.88	0.43
TOTAL	99.01	97.32	100.61
ATOMIC RATIOS (O = 6.0)			
SI	2.046	2.046	1.865
TI	0.001	0.003	0.035
AL	0.097	0.168	0.120
FE	0.598	0.590	0.402
MN	0.005	0.007	0.008
MG	0.333	0.300	0.763
CA	0.582	0.452	0.831
NA	0.485	0.603	0.032
ANALYST	MO	MO	MO
INSTRUMENT	KU	KU	KU

TABLE 9. CHEMICAL COMPOSITION AND ATOMIC RATIO OF PUMPELLYITE

SAMPLE NO	MO80
ROCK TYPE	BS
ZONE	CHL
GRAIN NO	1
POINT NO	1
SIO2	37.11
TIO2	0.04
AL2O3	24.96
FE2O3	4.79
MNO	0.44
MGO	3.26
CAO	24.02
NA2O	0.07
K2O	0.01
TOTAL	94.70
ATOMIC RATIOS (O = 24.5)	
SI	5.871
TI	0.005
AL	4.654
FE	0.570
MN	0.059
MG	0.769
CA	4.072
NA	0.021
K	0.002
ANALYST	MO
INSTRUMENT	KU

TABLE 10. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF GARNETES

SAMPLE NO	TH72113014	TH72112936					TH71081416				
ROCK TYPE	PE	PE					PE				
ZONE	GAR	GAR					BIO				
GRAIN NO	1(N)	1(N)	2(N)	3(N)	4(N)	5(N)	1(N)	2(N)	3(N)	4(N)	5(N)
POINT NO	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM
SIO2	37.58	37.97	38.04	37.80	38.07	37.60	38.38	38.64	38.25	37.92	38.12
AL2O3	21.12	21.84	20.65	20.48	20.20	20.88	21.02	21.00	21.07	20.90	20.74
FEO	23.98	23.12	27.11	27.40	25.41	25.76	30.83	30.87	30.46	30.59	29.82
MNO	5.30	5.67	3.91	3.88	4.76	5.60	0.44	0.83	1.44	0.38	1.66
MGO	0.52	0.33	0.50	0.50	0.40	0.43	1.76	1.62	1.65	1.97	1.45
CAO	11.26	11.98	10.30	9.68	10.60	10.64	8.33	8.32	8.59	8.38	8.34
TOTAL	99.76	100.91	100.51	99.74	99.44	100.91	100.76	101.28	101.46	100.14	100.13
ATOMIC RATIOS (O = 12.0)											
SI	3.009	2.997	3.036	3.042	3.064	2.999	3.038	3.045	3.018	3.021	3.043
AL	1.993	2.032	1.942	1.942	1.916	1.963	1.961	1.951	1.959	1.963	1.951
FE	1.606	1.526	1.810	1.844	1.710	1.718	2.041	2.035	2.010	2.038	1.990
MN	0.359	0.379	0.264	0.264	0.325	0.378	0.029	0.055	0.096	0.026	0.112
MG	0.062	0.039	0.059	0.060	0.048	0.051	0.208	0.190	0.194	0.234	0.173
CA	0.966	1.013	0.881	0.835	0.914	0.909	0.706	0.703	0.726	0.715	0.713
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

TABLE 10. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF GARNETES (CONTINUED)

SAMPLE NO	TH71081416	TH71081408					TH71081405				
ROCK TYPE	PE	PE					PE				
ZONE	BIO	BIO					BIO				
GRAIN NO	6(N)	1(N)	2(N)	3(N)	4(N)	5(N)	1(N)	2(N)	3(N)	4(N)	5(N)
POINT NO	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM
SIO2	37.82	37.10	37.12	37.78	37.60	36.51	37.44	37.73	37.85	37.58	37.86
AL2O3	21.25	21.60	21.80	21.21	21.56	21.66	22.21	22.26	22.09	22.04	21.87
FEO	31.17	30.22	30.33	30.40	29.76	30.92	30.65	30.49	30.50	31.02	31.10
MNO	0.36	0.34	0.26	0.26	0.43	0.54	0.33	0.35	0.41	0.30	0.31
MGO	2.06	1.95	2.21	2.24	2.33	1.92	2.16	2.22	2.26	2.17	2.16
CAO	8.12	8.54	9.56	8.13	7.98	8.02	7.71	8.36	8.10	7.63	7.84
TOTAL	100.78	99.75	101.28	100.02	99.66	99.57	100.50	101.41	101.21	100.74	101.14
ATOMIC RATIOS (O = 12.0)											
SI	2.999	2.968	2.932	3.007	2.996	2.939	2.965	2.962	2.975	2.972	2.984
AL	1.986	2.037	2.030	1.990	2.025	2.055	2.073	2.059	2.047	2.054	2.031
FE	2.067	2.022	2.004	2.024	1.983	2.081	2.030	2.002	2.005	2.052	2.050
MN	0.024	0.023	0.017	0.018	0.029	0.037	0.022	0.023	0.027	0.020	0.021
MG	0.243	0.233	0.260	0.266	0.277	0.230	0.255	0.260	0.265	0.256	0.254
CA	0.690	0.732	0.809	0.693	0.681	0.692	0.654	0.703	0.682	0.647	0.662
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	TH71081405		TH71081315								
ROCK TYPE	PE		PE								
ZONE	BIO		BIO								
GRAIN NO	6(N)	7(N)	1(N)	2(N)	3(N)	4(N)	5(N)	6(N)	7(N)	8(N)	8(N)
POINT NO	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM1	RIM2
SIO2	37.43	37.52	37.58	37.92	37.83	37.22	36.98	38.09	36.90	37.18	37.46
AL2O3	21.90	22.00	21.06	20.65	21.25	21.33	20.94	21.31	21.04	20.89	21.04
FEO	30.99	30.78	30.88	30.58	30.26	30.65	31.43	29.88	31.30	30.81	30.46
MNO	0.29	0.35	0.29	0.30	0.41	0.35	0.41	0.37	0.46	0.46	0.31
MGO	2.13	2.24	2.00	1.91	2.11	2.29	1.70	2.07	1.67	1.68	1.77
CAO	7.78	8.04	7.78	8.64	8.55	7.73	8.28	7.95	8.04	8.02	8.78
TOTAL	100.52	100.93	99.59	100.00	100.41	99.57	99.74	99.67	99.41	99.04	99.82
ATOMIC RATIOS (O = 12.0)											
SI	2.970	2.964	3.011	3.028	3.003	2.982	2.978	3.032	2.979	3.004	2.999
AL	2.048	2.048	1.989	1.943	1.988	2.014	1.987	1.999	2.002	1.989	1.985
FE	2.056	2.033	2.069	2.042	2.009	2.054	2.117	1.989	2.113	2.082	2.039
MN	0.019	0.023	0.020	0.020	0.028	0.024	0.028	0.025	0.031	0.031	0.021
MG	0.252	0.264	0.239	0.227	0.250	0.274	0.204	0.246	0.201	0.202	0.211
CA	0.661	0.680	0.668	0.739	0.727	0.664	0.714	0.678	0.695	0.694	0.753
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

TABLE 10. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF GARNETES (CONTINUED)

SAMPLE NO	TH71081315				TH72081311						
ROCK TYPE	PE				PE						
ZONE	BIO				BIO						
GRAIN NO	9(N)	9(N)	10(N)	10(N)	1(N)	2(N)	3(N)	4(N)	5(N)	6(N)	7(N)
POINT NO	RIM1	RIM2	RIM1	RIM2	RIM	RIM	RIM	RIM	RIM	RIM	RIM
SIO2	37.34	37.52	37.30	36.64	38.27	38.15	37.98	37.82	37.64	37.75	37.71
AL2O3	20.65	21.08	21.11	21.21	21.68	21.23	21.45	21.56	21.41	20.70	20.95
FEO	30.92	30.85	30.70	30.48	30.08	30.48	30.10	30.37	30.84	29.99	30.09
MNO	0.48	0.56	0.59	0.55	0.29	0.34	0.39	0.40	0.34	0.28	0.31
MGO	1.75	1.82	1.61	1.73	2.16	2.24	2.02	2.35	2.30	3.07	2.28
CAO	8.06	8.61	8.40	8.90	8.17	8.03	8.15	8.06	7.64	8.23	7.88
TOTAL	99.20	100.44	99.71	99.51	100.65	100.47	100.09	100.56	100.17	100.02	99.22
ATOMIC RATIOS (O = 12.0)											
SI	3.013	2.991	2.994	2.954	3.017	3.021	3.016	2.993	2.995	3.004	3.022
AL	1.964	1.981	1.997	2.015	2.014	1.981	2.007	2.011	2.008	1.941	1.979
FE	2.087	2.057	2.061	2.055	1.983	2.018	1.999	2.010	2.052	1.996	2.017
MN	0.033	0.038	0.040	0.038	0.019	0.023	0.026	0.027	0.023	0.019	0.021
MG	0.211	0.216	0.193	0.208	0.254	0.264	0.239	0.277	0.273	0.364	0.272
CA	0.697	0.735	0.722	0.769	0.690	0.681	0.693	0.683	0.651	0.702	0.677
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	TH71081303					TH71081422					
ROCK TYPE	PE					PE					
ZONE	BIO					BIO					
GRAIN NO	1(N)	2(N)	3(N)	4(N)	5(N)	1(N)	2(N)	3(N)	4(N)	5(N)	6(N)
POINT NO	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM
SIO2	37.26	37.26	38.45	38.11	37.77	37.80	37.82	36.92	37.92	37.60	38.21
AL2O3	21.23	21.40	21.75	21.77	21.79	20.99	21.05	20.91	20.94	21.07	21.23
FEO	31.30	30.47	29.06	29.50	29.77	30.22	29.40	29.07	30.13	29.79	29.03
MNO	0.44	1.08	0.72	0.71	1.01	0.79	1.60	1.61	0.88	1.31	1.80
MGO	2.77	2.54	3.08	3.18	2.65	1.98	2.23	2.53	2.55	1.99	2.77
CAO	7.14	7.09	7.48	7.30	7.97	8.22	8.31	7.68	7.52	8.24	7.48
TOTAL	100.14	99.84	100.54	100.57	100.96	100.00	100.41	98.72	99.94	100.00	100.52
ATOMIC RATIOS (O = 12.0)											
SI	2.973	2.978	3.018	2.998	2.976	3.016	3.005	2.984	3.020	3.003	3.019
AL	1.997	2.016	2.012	2.018	2.023	1.974	1.971	1.992	1.966	1.983	1.977
FE	2.089	2.037	1.908	1.941	1.962	2.016	1.954	1.965	2.007	1.990	1.918
MN	0.030	0.073	0.048	0.047	0.067	0.053	0.108	0.110	0.059	0.089	0.120
MG	0.330	0.303	0.360	0.373	0.311	0.235	0.264	0.305	0.303	0.237	0.326
CA	0.610	0.607	0.629	0.615	0.673	0.703	0.707	0.665	0.642	0.705	0.633
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

TABLE 10. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF GARNETES (CONTINUED)

SAMPLE NO	TH71081422				TH71081111						TH71081107
ROCK TYPE	PE				PE						PE
ZONE	BIO				BIO						BIO
GRAIN NO	7(N)	8(N)	9(N)	10(N)	1(N)	2(N)	3(N)	4(N)	5(N)	6(N)	1(N)
POINT NO	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM
SIO2	38.15	37.53	37.94	38.40	37.73	38.21	38.17	37.42	37.77	37.70	37.53
AL2O3	20.95	20.67	20.97	20.83	21.49	21.37	21.43	21.47	21.32	21.65	21.09
FEO	29.96	28.95	30.61	30.12	30.15	30.36	30.39	30.27	30.56	30.87	28.31
MNO	1.05	1.65	0.77	1.32	0.75	0.86	0.76	0.92	0.68	0.77	0.46
MGO	2.35	2.34	2.41	2.36	1.49	1.35	1.48	1.61	1.58	1.32	0.76
CAO	8.04	7.92	7.44	8.08	9.37	9.03	8.79	8.97	9.03	8.49	11.25
TOTAL	100.50	99.06	100.14	101.11	100.98	101.18	101.02	100.66	100.94	100.80	99.40
ATOMIC RATIOS (O = 12.0)											
SI	3.024	3.019	3.020	3.029	2.987	3.016	3.015	2.976	2.994	2.992	3.011
AL	1.957	1.960	1.967	1.937	2.005	1.988	1.995	2.012	1.992	2.025	1.994
FE	1.986	1.947	2.037	1.987	1.996	2.004	2.008	2.013	2.026	2.049	1.899
MN	0.070	0.112	0.052	0.088	0.050	0.058	0.051	0.062	0.046	0.052	0.031
MG	0.278	0.281	0.286	0.278	0.176	0.159	0.174	0.191	0.187	0.156	0.091
CA	0.683	0.683	0.634	0.683	0.795	0.764	0.744	0.764	0.767	0.722	0.967
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	TH71081107				TH71080201				TH71072702		
ROCK TYPE	PE				PE				PE		
ZONE	BIO				GAR				GAR		
GRAIN NO	2(N)	3(N)	4(N)	5(N)	1(N)	2(N)	3(N)	4(N)	1(N)	2(N)	3(N)
POINT NO	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM	RIM
SIO2	37.27	37.97	36.55	36.96	37.55	37.39	37.45	37.27	37.18	37.27	37.56
AL2O3	21.13	21.18	21.24	21.17	20.91	20.95	21.04	21.09	20.87	20.70	20.91
FEO	30.76	30.34	29.02	31.45	28.79	27.77	26.14	28.59	29.41	29.34	29.89
MNO	0.28	0.55	0.88	0.29	2.61	4.14	6.10	3.51	1.91	2.94	1.47
MGO	1.16	0.93	0.64	1.21	0.80	0.69	0.51	0.73	0.80	0.76	0.90
CAO	8.84	9.43	10.66	8.57	8.83	8.65	9.17	9.08	9.53	8.73	8.79
TOTAL	99.44	100.40	98.99	99.65	99.49	99.59	100.41	100.27	99.70	99.74	99.52
ATOMIC RATIOS (O = 12.0)											
SI	3.000	3.023	2.963	2.979	3.024	3.014	3.002	2.991	2.997	3.009	3.023
AL	2.005	1.988	2.029	2.011	1.985	1.991	1.988	1.995	1.983	1.969	1.984
FE	2.071	2.020	1.967	2.120	1.939	1.872	1.752	1.919	1.983	1.981	2.012
MN	0.019	0.037	0.060	0.020	0.178	0.283	0.414	0.239	0.130	0.201	0.100
MG	0.139	0.110	0.077	0.145	0.096	0.083	0.061	0.087	0.096	0.091	0.108
CA	0.763	0.804	0.926	0.740	0.762	0.747	0.788	0.781	0.823	0.755	0.758
ANALYST	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH	TH
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

TABLE 10. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF GARNETES (CONTINUED)

SAMPLE NO	TH71072714			MO03		MO04		MO10		MO19	
ROCK TYPE	PE			SL		SL		BS		BS	
ZONE	GAR			BIO		BIO		BIO		BIO	
GRAIN NO	1(N)	2(N)	3(N)	G1(N)	G2(N)	G1(N)	G2(N)	G1(N)	G1(N)	G1(N)	G1(N)
POINT NO	RIM	RIM	RIM	RIM	CORE	RIM	CORE	RIM	CORE	RIM	CORE
SIO2	37.14	37.10	38.56	36.41	36.05	37.90	37.30	36.45	35.86	37.59	37.46
AL2O3	21.02	20.94	20.51	22.16	21.89	21.69	20.12	21.13	21.03	20.72	20.42
FEO	27.66	26.17	25.71	25.28	16.95	26.89	16.76	23.98	18.48	28.56	18.45
MNO	3.62	3.70	4.54	3.87	14.52	1.86	9.31	4.58	9.40	1.79	11.13
MGO	0.71	0.61	0.58	1.51	0.60	2.08	0.96	1.62	0.73	1.94	0.70
CAO	9.59	10.07	9.54	9.97	10.91	10.23	13.83	10.66	12.19	8.70	11.68
TOTAL	99.74	98.59	99.44	99.20	100.92	100.65	98.28	98.42	97.69	99.30	99.84
ATOMIC RATIOS (O = 12.0)											
SI	2.992	3.009	3.089	2.926	2.887	2.987	3.018	2.955	2.938	3.019	3.008
AL	1.996	2.002	1.936	2.098	2.066	2.015	1.919	2.019	2.031	1.961	1.933
FE	1.863	1.775	1.722	1.699	1.135	1.772	1.134	1.626	1.266	1.918	1.239
MN	0.247	0.254	0.308	0.263	0.985	0.124	0.638	0.314	0.652	0.122	0.757
MG	0.085	0.074	0.069	0.181	0.072	0.244	0.116	0.196	0.089	0.232	0.084
CA	0.828	0.875	0.819	0.858	0.936	0.864	1.199	0.926	1.070	0.749	1.005
ANALYST	TH	TH	TH	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	TU	TU	TU	TU

SAMPLE NO	TH71080601					TH72120319		TH72120338	MO23		MO25
ROCK TYPE	BS					BS		BS	BS		BS
ZONE	BIO					BIO		BIO	BIO		BIO
GRAIN NO	G2(R)	G2(R)	G1(R)	G6(O)	G6(O)	G2(O)	G5(O)	G1(NZ)	G1(N)	G1(N)	G3(O)
POINT NO	POOR	RIM	CORE	POOR	CORE	RIM	RIM	RIM	RIM	CORE	POOR
SIO2	36.86	37.90	37.30	38.13	37.72	37.95	37.90	37.97	37.81	37.40	36.95
AL2O3	21.82	22.35	21.71	21.55	21.32	20.64	21.48	21.42	20.65	20.12	20.21
FEO	28.95	27.26	20.35	25.81	19.21	26.88	24.98	27.95	31.56	29.62	27.85
MNO	2.25	3.07	11.33	2.15	12.02	5.42	3.37	3.03	1.14	3.84	1.49
MGO	2.23	2.10	0.89	1.97	0.45	2.18	2.11	2.38	3.17	1.63	1.62
CAO	9.42	10.10	10.26	11.81	10.21	7.65	10.47	8.63	5.84	7.65	11.58
TOTAL	101.53	102.78	101.84	101.42	100.93	100.72	100.31	101.38	100.17	100.26	99.70
ATOMIC RATIOS (O = 12.0)											
SI	2.913	2.941	2.946	2.984	2.998	3.018	2.994	2.987	3.015	3.012	2.976
AL	2.033	2.044	2.021	1.987	1.997	1.934	2.000	1.986	1.941	1.910	1.918
FE	1.914	1.769	1.344	1.689	1.277	1.788	1.651	1.839	2.105	1.995	1.876
MN	0.151	0.202	0.758	0.142	0.809	0.365	0.226	0.202	0.077	0.262	0.102
MG	0.263	0.243	0.105	0.230	0.053	0.258	0.249	0.279	0.377	0.196	0.194
CA	0.798	0.840	0.868	0.990	0.869	0.652	0.886	0.727	0.499	0.660	0.999
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	TU	TU	TU

TABLE 10. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF GARNETS (CONTINUED)

SAMPLE NO	MO25	MO29			MO33			MO64	
ROCK TYPE	BS	SL			SL			BS	
ZONE	BIO	BIO			BIO			GAR	
GRAIN NO	G3(O)	G1(R)	G1(R)	G2(N)	G2(R)	G1(N)	G1(N)	G2(N)	G1(N)
POINT NO	RIM	POOR	RIM	CORE	POOR	RIM	CORE	RIM	CORE
SIO2	37.77	36.63	36.88	35.41	37.18	36.95	36.05	37.13	36.65
AL2O3	20.08	20.74	20.84	21.03	21.24	20.81	20.38	20.97	20.66
FEO	28.44	28.63	27.45	19.40	28.02	29.24	25.72	25.50	17.97
MNO	1.99	2.77	4.65	11.13	0.98	1.24	10.88	5.19	9.65
MGO	1.80	1.17	0.75	0.45	1.13	0.95	0.56	1.13	0.71
CAO	9.89	9.08	9.04	10.93	10.66	9.87	4.74	9.17	12.48
TOTAL	99.97	99.02	99.61	98.35	99.21	99.06	98.33	99.09	98.12
ATOMIC RATIOS (O = 12.0)									
SI	3.026	2.976	2.984	2.910	2.989	2.992	2.988	2.999	2.983
AL	1.896	1.986	1.987	2.037	2.012	1.986	1.991	1.996	1.982
FE	1.905	1.945	1.858	1.333	1.884	1.980	1.783	1.723	1.223
MN	0.135	0.191	0.319	0.775	0.067	0.085	0.764	0.355	0.665
MG	0.215	0.142	0.090	0.055	0.135	0.115	0.069	0.136	0.086
CA	0.849	0.790	0.784	0.962	0.918	0.856	0.421	0.794	1.088
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	TU	TU	TU	TU	TU	TU	TU	TU	TU

TABLE 11. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF EPIDOTES

SAMPLE NO	TH72102901		MO03		MO04		MO05		TH710813D		MO10
ROCK TYPE	BS		SL		SL		BS		BS		BS
ZONE	BIO		BIO		BIO		BIO		BIO		BIO
GRAIN NO	E5	E5	E1	E2	E3	E1	E1	E2	E1	E2	E1
POINT NO	1	2	3	2	2	3	3	1	1	1	3
SIO2	37.64	37.65	37.64	37.58	39.27	38.68	38.63	37.86	36.99	37.12	36.91
AL2O3	24.63	22.86	29.18	28.33	28.75	27.54	29.08	26.40	21.33	21.64	29.17
FE2O3	12.07	13.58	6.20	7.40	6.09	7.71	5.65	9.29	15.68	16.18	6.21
MNO	0.09	0.14	0.22	0.89	0.10	0.13	0.10	0.07	0.18	0.16	0.11
CAO	23.79	23.81	23.50	23.97	25.22	24.67	23.52	23.61	22.23	22.84	23.55
TOTAL	98.22	98.04	96.74	98.17	99.43	98.73	96.98	97.23	96.41	97.94	95.95
ATOMIC RATIOS (O = 12.5)											
SI	2.978	3.004	2.955	2.935	3.005	2.998	3.012	2.991	3.015	2.986	2.925
AL	2.296	2.150	2.700	2.608	2.593	2.515	2.672	2.458	2.049	2.052	2.725
FE	0.719	0.815	0.366	0.435	0.351	0.450	0.331	0.552	0.962	0.980	0.370
MN	0.006	0.009	0.015	0.059	0.006	0.009	0.007	0.005	0.012	0.011	0.007
CA	2.016	2.035	1.977	2.006	2.068	2.048	1.965	1.998	1.941	1.969	2.000
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	KU	KU	KU	KU	KU	KU	TU	TU	TU	TU	TU

TABLE 11. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF EPIDOTES (CONTINUED)

SAMPLE NO	MO10	MO11-A		MO15		MO16		MO19		TH71080601	
ROCK TYPE	BS	BS		BS		BS		BS		BS	
ZONE	BIO	BIO		BIO		BIO		BIO		BIO	
GRAIN NO	E1	E2	E1	E1	E2	E2	E1	E2	E1	E2	E2
POINT NO	2	1	2	2	2	3	2	2	1	2	3
SIO2	36.96	37.28	37.06	38.79	38.67	38.36	37.66	38.45	38.33	38.31	38.95
AL2O3	26.24	23.70	22.75	24.61	20.53	27.46	23.65	28.92	25.97	28.47	24.48
FE2O3	8.97	12.56	14.18	11.98	13.83	8.64	11.86	6.76	10.33	7.19	10.19
MNO	0.63	0.44	0.53	0.54	0.61	0.11	0.50	0.08	0.19	0.21	0.29
CAO	22.66	23.54	23.11	23.52	23.62	24.48	23.34	22.59	23.01	22.42	22.70
TOTAL	95.46	97.52	97.63	99.44	97.26	99.05	97.01	96.80	97.83	96.60	96.61
ATOMIC RATIOS (O = 12.5)											
SI	2.976	2.983	2.978	3.025	3.117	2.972	3.019	3.005	3.013	3.007	3.096
AL	2.490	2.235	2.155	2.262	1.950	2.507	2.234	2.664	2.406	2.633	2.293
FE	0.543	0.756	0.857	0.703	0.839	0.504	0.715	0.398	0.611	0.425	0.610
MN	0.043	0.030	0.036	0.036	0.042	0.007	0.034	0.005	0.013	0.014	0.020
CA	1.955	2.018	1.990	1.965	2.040	2.032	2.004	1.892	1.938	1.885	1.933
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	TU	KU	KU	KU	KU	KU	KU	TU	TU	KU	KU

SAMPLE NO	TH72120319		TH72120338		MO23		MO24		MO26		TH71080303
ROCK TYPE	BS		BS		BS		BS		BS		BS
ZONE	BIO		BIO		BIO		BIO		BIO		BIO
GRAIN NO	E5	E5	E3	E3	E1	E1	E1	E1	E2	E1	E1
POINT NO	2	1	1	2	3	2	2	3	2	1	2
SIO2	38.32	37.15	37.54	37.41	38.35	38.25	35.89	36.25	36.92	36.64	37.15
AL2O3	26.65	24.08	23.01	19.77	25.41	23.26	24.27	23.15	23.90	23.20	24.14
FE2O3	9.16	12.57	13.21	15.99	11.28	14.30	12.95	15.50	13.24	12.42	12.64
MNO	0.04	0.29	N.D.	N.D.	0.30	0.10	0.25	0.26	0.16	0.16	0.29
CAO	24.19	23.81	23.75	24.02	22.74	22.83	22.35	22.64	23.55	23.49	23.03
TOTAL	98.36	97.90	97.51	97.19	98.08	98.74	95.71	97.80	97.77	95.91	97.25
ATOMIC RATIOS (O = 12.5)											
SI	2.993	2.961	3.006	3.045	3.015	3.020	2.923	2.916	2.951	2.981	2.974
AL	2.453	2.262	2.171	1.897	2.355	2.165	2.330	2.195	2.251	2.225	2.277
FE	0.538	0.754	0.796	0.979	0.667	0.850	0.794	0.938	0.796	0.761	0.761
MN	0.003	0.020	N.D.	N.D.	0.020	0.007	0.017	0.018	0.011	0.011	0.020
CA	2.024	2.033	2.037	2.095	1.916	1.931	1.951	1.951	2.017	2.048	1.975
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	KU	KU	KU	KU	TU	TU	TU	TU	TU	TU	TU

SAMPLE NO	TH71080303	MO28		TH71051007		MO29		MO33		MO37	
ROCK TYPE	BS	BS		BS		SL		SL		BS	
ZONE	BIO	BIO		BIO		BIO		BIO		BIO	
GRAIN NO	E2	E1	E2	E4	E1	E2	E2	E1	E2	E2	E2
POINT NO	3	1	1	2	1	3	2	3	2	3	1
SIO2	36.41	36.43	36.92	37.26	37.56	37.36	37.43	38.42	37.94	37.86	37.25
AL2O3	24.65	26.04	25.17	24.14	22.74	28.76	27.25	29.68	26.42	25.06	23.19
FE2O3	14.60	11.69	11.60	11.79	12.76	6.96	7.73	5.78	9.18	11.39	14.27
MNO	0.61	0.25	0.23	N.D.	N.D.	0.09	0.18	0.15	0.07	0.26	0.20
CAO	22.36	23.16	22.82	24.12	23.91	23.65	23.05	23.48	22.60	25.08	23.33
TOTAL	98.63	97.57	96.74	97.31	96.97	96.82	95.64	97.51	96.21	99.65	98.24
ATOMIC RATIOS (O = 12.5)											
SI	2.892	2.898	2.957	2.979	3.022	2.940	2.988	2.981	3.016	2.958	2.970
AL	2.308	2.442	2.376	2.275	2.157	2.668	2.563	2.714	2.476	2.308	2.179
FE	0.873	0.700	0.699	0.709	0.773	0.412	0.464	0.337	0.549	0.670	0.856
MN	0.041	0.017	0.016	N.D.	N.D.	0.006	0.012	0.010	0.005	0.017	0.014
CA	1.903	1.974	1.958	2.066	2.061	1.994	1.971	1.952	1.925	2.100	1.993
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	TU	TU	TU	TU	KU	KU	TU	TU	TU	TU	TU

TABLE 11. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF EPIDOTES (CONTINUED)

SAMPLE NO	MO38-A		MO40		MO41-A		MO42		MO47		MO48
ROCK TYPE	BS		BS		BS		BS		BS		BS
ZONE	BIO		BIO		BIO		BIO		GAR		GAR
GRAIN NO	E1	E1	E5	E5	E1	E1	E1	E2	E1	E1	E2
POINT NO	1	2	1	4	4	2	2	2	2	3	2
SIO2	37.64	37.74	37.24	36.81	37.58	36.13	37.49	36.34	36.45	37.29	37.52
AL203	24.26	22.69	24.43	22.04	25.80	22.49	23.72	22.21	22.90	22.33	23.80
FE203	12.66	14.72	12.28	14.59	10.36	14.75	12.77	15.73	14.34	14.97	13.71
MNO	0.18	0.27	0.33	0.33	0.10	0.24	0.21	0.44	0.09	0.13	0.09
CAO	23.06	22.87	23.57	23.50	23.09	22.32	22.91	22.09	22.98	22.63	23.92
TOTAL	97.80	98.29	97.85	97.27	96.93	95.93	97.10	96.81	96.76	97.35	99.04
ATOMIC RATIOS (O = 12.5)											
SI	2.991	3.006	2.964	2.978	2.987	2.956	3.003	2.955	2.953	3.001	2.963
AL	2.272	2.130	2.291	2.101	2.417	2.169	2.239	2.128	2.187	2.118	2.215
FE	0.757	0.882	0.735	0.888	0.620	0.908	0.770	0.962	0.874	0.907	0.815
MN	0.012	0.018	0.022	0.023	0.007	0.017	0.014	0.030	0.006	0.009	0.006
CA	1.963	1.952	2.010	2.037	1.966	1.957	1.966	1.924	1.995	1.951	2.024
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	TU	TU	KU	KU	TU	TU	TU	TU	TU	TU	KU

SAMPLE NO	MO48	MO49-A		MO51-A		MO55		MO58		MO60-A	
ROCK TYPE	BS	BS		BS		BS		BS		BS	
ZONE	GAR	GAR		GAR		GAR		GAR		GAR	
GRAIN NO	E3	E1	E1	E1	E1	E1	E2	E2	E2	E1	E2
POINT NO	1	2	3	3	1	2	2	3	2	2	1
SIO2	37.36	38.05	37.48	37.53	36.90	37.13	36.97	36.89	36.45	36.77	36.57
AL203	21.98	25.93	23.38	24.30	22.49	22.56	22.06	22.63	21.61	24.91	21.60
FE203	15.94	10.87	13.75	11.53	13.73	14.51	15.33	14.34	15.59	10.91	16.19
MNO	0.19	0.34	0.23	0.21	0.38	N.D.	N.D.	0.12	0.25	0.19	0.31
CAO	23.60	24.15	23.72	23.68	23.03	23.91	23.75	22.94	22.31	22.95	23.36
TOTAL	99.07	99.34	98.56	97.25	96.53	98.11	98.11	96.92	96.21	95.73	98.03
ATOMIC RATIOS (O = 12.5)											
SI	2.974	2.966	2.976	2.996	2.994	2.973	2.968	2.982	2.982	2.972	2.951
AL	2.062	2.382	2.188	2.286	2.151	2.129	2.087	2.156	2.083	2.373	2.054
FE	0.955	0.638	0.822	0.693	0.838	0.874	0.926	0.872	0.960	0.664	0.983
MN	0.013	0.022	0.015	0.014	0.026	N.D.	N.D.	0.008	0.017	0.013	0.021
CA	2.013	2.017	2.018	2.025	2.002	2.051	2.043	1.987	1.955	1.988	2.020
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	TU	TU	KU	KU

SAMPLE NO	TH71072601		MO62		MO61		MO64		MO65		MO66-A
ROCK TYPE	BS		BS		BS		BS		BS		BS
ZONE	GAR		GAR		GAR		GAR		GAR		GAR
GRAIN NO	E2	E2	E1	E2	E1	E1	E2	E1	E2	E2	E2
POINT NO	2	3	2	3	1	2	2	1	3	2	3
SIO2	37.10	36.66	38.17	38.20	37.64	37.42	37.26	37.47	38.64	37.98	36.73
AL203	28.14	27.13	27.88	26.75	28.38	27.37	28.02	26.16	24.07	22.77	23.31
FE203	8.18	9.20	6.02	7.97	6.95	8.08	7.42	10.11	12.77	14.17	14.47
MNO	0.18	0.12	N.D.	N.D.	0.14	0.16	0.43	0.10	0.49	0.45	N.D.
CAO	23.67	23.38	24.89	24.39	23.54	23.65	23.76	23.57	23.70	23.61	23.84
TOTAL	97.27	96.49	96.96	97.31	96.65	96.68	96.89	97.41	99.67	98.98	98.35
ATOMIC RATIOS (O = 12.5)											
SI	2.922	2.922	2.999	3.007	2.966	2.964	2.943	2.966	3.018	3.007	2.933
AL	2.612	2.549	2.582	2.481	2.636	2.555	2.608	2.440	2.216	2.125	2.194
FE	0.485	0.552	0.356	0.472	0.412	0.482	0.441	0.602	0.750	0.844	0.869
MN	0.012	0.008	N.D.	N.D.	0.009	0.011	0.029	0.007	0.032	0.030	N.D.
CA	1.998	1.997	2.095	2.057	1.987	2.007	2.011	1.999	1.983	2.003	2.040
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	MO	TU	KU	KU	TU	TU	TU	TU	KU	KU	KU

TABLE 11. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF EPIDOTES (CONTINUED)

SAMPLE NO	MO66-A	MO67		TH71072803		MO70		MO71		MO74	
ROCK TYPE	BS	BS		BS		BS		BS		BS	
ZONE	GAR	GAR		CHL		CHL		CHL		CHL	
GRAIN NO	E1	E2	E1	E1	E1	E2	E2	E2	E1	E1	E1
POINT NO	3	2	3	2	1	2	1	2	2	3	2
SIO2	36.60	36.62	36.06	36.63	37.21	38.41	38.04	39.26	38.30	37.70	37.69
AL2O3	22.29	23.47	21.54	22.47	22.15	26.26	22.58	27.86	24.26	22.76	20.94
FE2O3	15.12	13.82	15.65	14.66	15.44	9.54	14.56	7.98	12.13	13.24	15.72
MNO	N.D.	0.16	0.38	0.56	0.76	0.27	0.14	0.14	0.13	0.44	0.18
CAO	23.98	23.20	23.75	23.00	22.66	23.84	23.15	25.07	23.95	22.72	22.29
TOTAL	97.99	97.27	97.38	97.32	98.22	98.32	98.47	100.31	98.77	96.86	96.82
ATOMIC RATIOS (O = 12.5)											
SI	2.945	2.947	2.934	2.961	2.983	3.005	3.022	2.997	3.012	3.035	3.056
AL	2.114	2.226	2.066	2.141	2.093	2.421	2.114	2.506	2.249	2.159	2.001
FE	0.915	0.837	0.958	0.892	0.931	0.562	0.870	0.458	0.718	0.802	0.959
MN	N.D.	0.011	0.026	0.038	0.052	0.018	0.009	0.009	0.009	0.030	0.012
CA	2.067	2.000	2.070	1.992	1.946	1.998	1.970	2.050	2.018	1.959	1.936
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	KU	TU	TU	TU	TU	TU	TU	KU	KU	TU	TU

SAMPLE NO	MO75		MO79		MO80		MO83		MO84		MO89
ROCK TYPE	BS		BS		BS		BS		BS		BS
ZONE	CHL		CHL		CHL		CHL		CHL		CHL
GRAIN NO	E1	E2	E3	E3	E1	E2	E2	E1	E3	E1	E3
POINT NO	2	2	3	1	1	2	1	2	3	1	1
SIO2	38.06	37.78	37.09	36.67	36.84	36.14	36.45	36.86	36.12	36.37	37.52
AL2O3	24.68	24.00	22.88	21.89	24.36	23.07	21.66	21.04	22.01	19.99	21.46
FE2O3	11.63	12.23	13.84	14.73	12.07	14.07	15.98	16.66	14.39	17.17	16.48
MNO	0.15	0.15	0.65	0.56	0.13	0.04	0.16	0.35	0.51	0.11	0.33
CAO	23.68	23.39	23.69	22.15	24.52	24.42	23.84	23.44	22.60	22.69	23.46
TOTAL	98.20	97.55	98.15	96.00	97.92	97.74	98.09	98.35	95.63	96.33	99.25
ATOMIC RATIOS (O = 12.5)											
SI	3.004	3.008	2.968	2.998	2.938	2.912	2.941	2.970	2.970	2.994	2.987
AL	2.296	2.252	2.158	2.110	2.289	2.191	2.060	1.998	2.133	1.939	2.014
FE	0.691	0.733	0.834	0.906	0.724	0.853	0.970	1.010	0.890	1.063	0.987
MN	0.010	0.010	0.044	0.039	0.009	0.003	0.011	0.024	0.036	0.008	0.022
CA	2.002	1.996	2.031	1.941	2.095	2.108	2.061	2.024	1.991	2.001	2.001
ANALYST	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
INSTRUMENT	TU	TU	KU	KU	KU	KU	KU	KU	TU	TU	KU

SAMPLE NO	MO89	MO92	
ROCK TYPE	BS	BS	
ZONE	CHL	CHL	
GRAIN NO	E1	E2	E2
POINT NO	2	3	1
SIO2	35.93	37.66	37.58
AL2O3	20.74	24.16	20.33
FE2O3	17.00	13.10	17.44
MNO	0.35	0.15	0.15
CAO	23.28	24.21	23.85
TOTAL	97.30	99.28	99.35
ATOMIC RATIOS (O = 12.5)			
SI	2.936	2.963	3.002
AL	1.998	2.240	1.914
FE	1.045	0.776	1.048
MN	0.024	0.010	0.010
CA	2.038	2.041	2.041
ANALYST	MO	MO	MO
INSTRUMENT	KU	KU	KU

TABLE 12. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF ILMENITES

SAMPLE NO	TH72112922			TH72112911	TH72112908	TH71081418
ROCK TYPE	PE			PE	PE	PE
ZONE	GAR			BIO	BIO	BIO
GRAIN NO	1(S)	2(S)	3(S)	1(D)	1(S)	1(D)
POINT NO	1	1	1	1	1	1
SIO2	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
TIO2	53.04	52.70	52.66	52.68	52.37	52.94
AL2O3	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
FEO	42.29	42.39	40.89	42.69	43.37	42.54
MNO	3.68	4.16	5.29	4.27	3.25	3.84
TOTAL	99.01	99.25	98.84	99.64	98.99	99.32
ATOMIC RATIOS (O = 3.0)						
SI	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
TI	1.012	1.006	1.008	1.003	1.003	1.008
AL	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
FE	0.897	0.899	0.870	0.903	0.924	0.901
MN	0.079	0.089	0.114	0.092	0.070	0.082
ANALYST	TI	TI	TI	TI	TI	TI
INSTRUMENT	KU	KU	KU	KU	KU	KU

TABLE 12. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF ILMENITES (CONTINUED)

SAMPLE NO	TH71081416	TH71081414	TH71081408			TH71081405					TH71081403
ROCK TYPE	PE	PE	PE			PE					PE
ZONE	BIO	BIO	BIO			BIO					BIO
GRAIN NO	1(S)	1(D)	1(R)	2(R)	3(R)	1(R)	2(R)	3(R)	4(R)	5(R)	1(D)
POINT NO	1	1	1	1	1	1	1	1	1	1	1
SIO2	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
TIO2	52.71	52.80	52.86	53.04	52.74	52.24	52.07	52.68	52.68	52.68	52.67
AL2O3	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
FEO	44.47	44.47	42.93	42.86	42.29	43.50	43.32	43.17	43.56	44.05	46.26
MNO	2.01	2.04	3.29	3.18	2.94	3.01	3.29	3.42	3.27	2.81	1.52
TOTAL	99.19	99.31	99.08	99.08	97.97	98.75	98.68	99.27	99.51	99.54	100.45
ATOMIC RATIOS (O = 3.0)											
SI	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
TI	1.006	1.007	1.009	1.011	1.015	1.003	1.001	1.005	1.004	1.003	0.997
AL	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
FE	0.944	0.943	0.911	0.909	0.905	0.929	0.926	0.916	0.923	0.933	0.974
MN	0.043	0.044	0.071	0.068	0.064	0.065	0.071	0.074	0.070	0.060	0.032
ANALYST	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	TH71081315			TH71081311						TH71081310	TH71081309
ROCK TYPE	PE			PE						PE	PE
ZONE	BIO			BIO						BIO	BIO
GRAIN NO	1(R)	2(D)	3(R)	1(R)	2(R)	3(R)	4(R)	5(R)	6(D)	1(R)	1(D)
POINT NO	1	1	1	1	1	1	1	1	1	1	1
SIO2	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
TIO2	52.83	52.73	52.72	52.10	51.77	52.43	52.68	52.71	52.70	52.74	52.76
AL2O3	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
FEO	45.49	45.19	45.14	45.18	45.52	46.22	45.73	44.65	45.71	44.74	45.81
MNO	1.60	1.33	1.39	1.57	1.48	1.49	1.67	1.89	1.43	2.51	1.14
TOTAL	99.92	99.25	99.25	98.85	98.77	100.14	100.08	99.25	99.84	99.99	99.71
ATOMIC RATIOS (O = 3.0)											
SI	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
TI	1.003	1.006	1.006	1.001	0.997	0.996	1.000	1.006	1.002	1.001	1.003
AL	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
FE	0.960	0.959	0.958	0.965	0.975	0.976	0.965	0.948	0.966	0.944	0.969
MN	0.034	0.029	0.030	0.034	0.032	0.032	0.036	0.041	0.031	0.054	0.024
ANALYST	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	TH71081309		TH71081307		TH71081306		TH71081303	TH71081421			TH71081424
ROCK TYPE	PE		PE		PE		PE	PE			PE
ZONE	BIO		BIO		BIO		BIO	BIO			BIO
GRAIN NO	2(R)	3(R)	1(R)	2(R)	1(R)	2(R)	1(R)	1(R)	2(R)	3(R)	1(R)
POINT NO	1	1	1	1	1	1	1	1	1	1	1
SIO2	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
TIO2	52.71	52.72	52.72	52.72	52.69	52.70	52.70	53.07	52.46	52.64	52.51
AL2O3	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
FEO	45.83	45.67	45.00	40.49	42.47	42.44	42.83	40.65	41.36	40.57	39.74
MNO	1.09	1.14	1.57	4.62	3.89	3.62	3.37	5.69	3.93	5.88	6.23
TOTAL	99.63	99.53	99.29	97.83	99.05	98.76	98.90	99.41	97.75	99.09	98.48
ATOMIC RATIOS (O = 3.0)											
SI	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
TI	1.003	1.004	1.006	1.016	1.007	1.009	1.008	1.009	1.013	1.006	1.008
AL	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
FE	0.970	0.967	0.955	0.868	0.903	0.904	0.911	0.860	0.888	0.862	0.849
MN	0.023	0.024	0.034	0.100	0.084	0.078	0.073	0.122	0.085	0.127	0.135
ANALYST	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

TABLE 12. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF ILMENITES (CONTINUED)

SAMPLE NO	TH71081424	TH71081111	TH71081108			TH71081102					
ROCK TYPE	PE	PE	PE			PE					
ZONE	BIO	BIO	BIO			BIO					
GRAIN NO	2(R)	1(RS)	1(S)	2(S)	3(S)	1(S)	2(S)	3(S)	4(S)	5(S)	6(S)
POINT NO	1	1	1	1	1	1	1	1	1	1	1
SIO2	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
TIO2	51.77	54.19	52.65	52.63	52.89	52.64	52.69	52.75	52.69	52.73	52.51
AL2O3	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
FEO	39.97	38.71	40.69	42.24	43.38	43.31	43.02	44.33	43.04	43.29	43.04
MNO	5.90	5.81	5.71	4.93	3.34	4.08	3.36	1.43	3.33	2.59	3.68
TOTAL	97.64	98.71	99.05	99.80	99.61	100.03	99.07	98.51	99.06	98.61	99.23
ATOMIC RATIOS (O = 3.0)											
SI	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
TI	1.004	1.029	1.006	1.001	1.006	0.999	1.007	1.012	1.007	1.011	1.003
AL	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
FE	0.862	0.818	0.865	0.893	0.917	0.914	0.914	0.946	0.915	0.923	0.914
MN	0.129	0.124	0.123	0.106	0.072	0.087	0.072	0.031	0.072	0.056	0.079
ANALYST	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	TH71081101		TH71081004	TH71080201			MO09				
ROCK TYPE	PE		PE	PE			BS				
ZONE	BIO		GAR	GAR			BIO				
GRAIN NO	1(RS)	2(RS)	1(S)	1(R)	2(R)	3(R)	1(R)	2(R)	3(R)	4(R)	5(R)
POINT NO	1	1	1	1	1	1	1	1	1	1	1
SIO2	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.24	0.24	0.24	0.16	0.18
TIO2	52.64	52.63	52.74	52.59	52.58	52.68	50.40	51.75	51.63	50.84	50.65
AL2O3	N.D.	N.D.	N.D.	N.D.	N,D.	N.D.	0.07	0.04	0.11	0.08	0.03
FEO	40.43	40.25	44.04	37.67	39.16	39.19	42.46	42.51	42.35	42.03	42.50
MNO	6.02	6.34	1.90	8.66	7.94	7.78	3.93	4.14	4.23	4.31	4.46
TOTAL	99.09	99.22	98.68	98.92	99.68	99.65	97.10	98.68	98.56	97.42	97.82
ATOMIC RATIOS (O = 3.0)											
SI	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.006	0.006	0.006	0.004	0.005
TI	1.006	1.005	1.010	1.006	1.001	1.002	0.987	0.994	0.993	0.991	0.986
AL	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.002	0.001	0.003	0.002	0.001
FE	0.859	0.854	0.938	0.801	0.829	0.829	0.924	0.908	0.906	0.911	0.920
MN	0.130	0.136	0.041	0.187	0.170	0.167	0.087	0.090	0.092	0.095	0.098
ANALYST	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	MO09					MO15		TH72120319		TH72120338	MO24
ROCK TYPE	BS					BS		BS		BS	BS
ZONE	BIO					BIO		BIO		BIO	BIO
GRAIN NO	6(R)	7(R)	8(R)	9(R)	10(R)	1(R)	2(R)	1(R)	2(R)	1(D)	1(D)
POINT NO	1	1	1	1	1	1	1	1	1	1	1
SIO2	0.22	0.18	0.11	0.14	0.25	0.42	0.73	0.90	0.73	0.75	0.29
TIO2	51.43	51.40	50.72	50.99	50.88	48.13	49.96	48.28	49.96	41.53	43.99
AL2O3	0.08	0.04	0.04	0.05	0.05	0.20	0.15	0.11	0.15	0.10	0.11
FEO	42.48	42.21	41.96	41.56	41.24	43.50	39.25	44.35	39.25	52.18	52.63
MNO	4.60	4.75	4.87	5.10	6.75	3.63	8.25	3.78	8.25	1.78	1.46
TOTAL	98.81	98.58	97.70	97.84	99.17	95.88	98.34	97.42	98.34	96.34	98.48
ATOMIC RATIOS (O = 3.0)											
SI	0.006	0.005	0.003	0.004	0.006	0.011	0.019	0.023	0.019	0.021	0.008
TI	0.989	0.991	0.988	0.991	0.978	0.961	0.966	0.948	0.966	0.857	0.885
AL	0.002	0.001	0.001	0.002	0.002	0.006	0.005	0.003	0.005	0.003	0.003
FE	0.908	0.905	0.909	0.898	0.882	0.966	0.844	0.968	0.844	1.198	1.177
MN	0.100	0.103	0.107	0.112	0.146	0.082	0.180	0.084	0.180	0.041	0.033
ANALYST	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

TABLE 12. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF ILMENITES (CONTINUED)

SAMPLE NO	MO24		MO28	MO38-B	MO40	MO52	TH72102203	MO55
ROCK TYPE	BS		BS	SL	BS	SL	SL	BS
ZONE	BIO		BIO	BIO	BIO	GAR	GAR	GAR
GRAIN NO	2(L)	3(L)	1(D)	1(D)	1(D)	1(D)	1(D)	1(D)
POINT NO	1	1	1	1	1	1	1	1
SIO2	0.24	0.23	1.08	2.35	0.16	0.42	1.16	1.53
TIO2	47.80	49.02	49.37	49.20	47.17	50.38	49.43	47.68
AL203	0.16	0.11	0.36	0.32	0.09	0.12	0.22	0.65
FEO	48.20	48.60	45.26	36.85	45.34	23.26	35.64	44.96
MNO	1.81	1.72	3.27	11.03	5.21	24.05	11.74	4.76
TOTAL	98.21	99.68	99.34	99.75	97.97	98.23	98.19	99.58
ATOMIC RATIOS (O = 3.0)								
SI	0.006	0.006	0.028	0.059	0.004	0.011	0.030	0.039
TI	0.942	0.949	0.947	0.929	0.935	0.974	0.955	0.915
AL	0.005	0.003	0.011	0.009	0.003	0.004	0.007	0.020
FE	1.056	1.047	0.965	0.774	1.000	0.500	0.766	0.960
MN	0.040	0.038	0.071	0.235	0.116	0.524	0.255	0.103
ANALYST	TI	TI	TI	TI	TI	TI	TI	TI
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU

TABLE 13. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF RUTILES

SAMPLE NO	TH71081414	TH71081407	TH71081317	TH71081307	TH71081424	TH72120319	TH72120338	MO24	MO28	MO48	MO52
ROCK TYPE	PE	PE	PE	PE	PE	BS	BS	BS	BS	BS	SL
ZONE	BIO	BIO	BIO	BIO	BIO	BIO	BIO	BIO	BIO	GAR	GAR
GRAIN NO	1	1	1	1	1	1	1	1	1	1	1
POINT NO	1	1	1	1	1	1	1	1	1	1	1
SIO2	0.17	0.20	0.16	N.D.	0.16	0.57	0.58	0.26	1.19	0.19	0.42
TIO2	98.93	98.67	99.35	99.64	98.57	97.96	97.10	98.16	96.46	97.45	96.65
AL203	0.04	0.05	0.04	N.D.	0.05	0.18	0.21	0.13	0.47	0.13	0.25
FEO	0.50	0.43	0.41	0.36	0.33	0.75	0.46	0.87	0.97	0.75	1.07
MNO	N.D.	N.D.	N.D.	N.D.	N.D.	0.26	0.21	0.02	0.0	0.0	0.52
TOTAL	99.64	99.35	99.96	100.00	99.11	99.72	98.56	99.44	99.09	98.52	98.91
ATOMIC RATIOS (O = 2.0)											
SI	0.002	0.003	0.002	N.D.	0.002	0.008	0.008	0.003	0.016	0.003	0.006
TI	0.994	0.994	0.995	0.998	0.995	0.985	0.986	0.990	0.973	0.992	0.982
AL	0.001	0.001	0.001	N.D.	0.001	0.003	0.003	0.002	0.007	0.002	0.004
FE	0.006	0.005	0.005	0.004	0.004	0.008	0.005	0.010	0.011	0.008	0.012
MN	N.D.	N.D.	N.D.	N.D.	N.D.	0.003	0.002	0.000	0.0	0.0	0.006
ANALYST	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	TH72102203	MO58	MO65
ROCK TYPE	SL	BS	BS
ZONE	GAR	GAR	GAR
GRAIN NO	1	1	1
POINT NO	1	1	1
SIO2	0.45	0.21	0.40
TIO2	96.13	97.87	96.96
AL203	0.24	0.16	0.09
FEO	1.21	0.79	0.66
MNO	0.41	0.0	0.0
TOTAL	98.44	99.03	98.11
ATOMIC RATIOS (O = 2.0)			
SI	0.006	0.003	0.005
TI	0.982	0.991	0.990
AL	0.004	0.003	0.001
FE	0.014	0.009	0.007
MN	0.005	0.0	0.0
ANALYST	TI	TI	TI
INSTRUMENT	KU	KU	KU

TABLE 14. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF MAGNETITES

SAMPLE NO	TH71081 3D	TH72120319	TH72120338	MO24	MO28	MO38-B
ROCK TYPE	BS	BS	BS	BS	BS	SL
ZONE	BIO	BIO	BIO	BIO	BIO	BIO
GRAIN NO	1	1	1	1	1	1
POINT NO	1	1	1	1	1	1
SIO2	0.19	0.86	0.59	0.36	0.75	4.62
TIO2	0.02	0.01	0.02	0.02	0.01	0.06
FE203	67.42	67.17	66.95	67.13	65.96	58.81
FEO	30.44	32.34	31.60	31.16	31.52	37.57
MNO	0.07	0.06	0.0	0.0	0.03	0.07
TOTAL	98.14	100.44	99.16	98.67	98.27	101.13
ATOMIC RATIOS (O = 4.0)						
SI	0.007	0.033	0.023	0.014	0.029	0.172
TI	0.001	0.000	0.001	0.001	0.000	0.002
FE3+	1.989	1.932	1.953	1.970	1.940	1.651
FE2+	0.998	1.034	1.024	1.016	1.030	1.172
MN	0.002	0.002	0.0	0.0	0.001	0.002
ANALYST	TI	TI	TI	TI	TI	TI
INSTRUMENT	KU	KU	KU	KU	KU	KU

TABLE 14. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF MAGNETITES (CONTINUED)

SAMPLE NO	MO40	MO48	MO52	MO55	MO58	MO65
ROCK TYPE	BS	BS	SL	BS	BS	BS
ZONE	BIO	GAR	GAR	GAR	GAR	GAR
GRAIN NO	1	1	1	1	1	1
POINT NO	1	1	1	1	1	1
SIO2	0.21	1.74	0.39	1.89	0.29	1.88
TIO2	0.01	0.02	0.02	0.04	0.0	0.05
FE2O3	67.48	64.19	67.17	63.45	67.77	64.15
FEO	30.85	33.30	30.98	33.58	31.12	33.75
MNO	0.06	0.01	0.21	0.05	0.03	0.0
TOTAL	98.61	99.26	98.77	99.01	99.21	99.83
ATOMIC RATIOS (O = 4.0)						
SI	0.008	0.067	0.015	0.073	0.011	0.072
TI	0.000	0.001	0.001	0.001	0.0	0.001
FE3+	1.983	1.861	1.968	1.844	1.978	1.848
FE2+	1.007	1.073	1.009	1.084	1.009	1.081
MN	0.002	0.000	0.007	0.002	0.001	0.0
ANALYST	TI	TI	TI	TI	TI	TI
INSTRUMENT	KU	KU	KU	KU	KU	KU

TABLE 15. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF HEMATITES

SAMPLE NO	TH71C813D		MO11-B
ROCK TYPE	BS		SL
ZONE	BIO		BIO
GRAIN NO	1(D)	1(D)	1(D)
POINT NO	CORE	RIM	CORE
SIO2	0.11	0.17	1.48
TIO2	12.43	10.65	10.48
FE2O3	73.26	76.93	76.04
FEO	10.95	9.65	9.75
MNO	0.24	0.05	1.40
TOTAL	96.99	97.45	99.15
ATOMIC RATIOS (O = 3.0)			
SI	0.003	0.005	0.039
TI	0.253	0.216	0.208
FE3+	1.490	1.560	1.507
FE2+	0.248	0.218	0.215
MN	0.005	0.001	0.031
ANALYST	TI	TI	TI
INSTRUMENT	KU	KU	KU

TABLE 15. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF HEMATITES (CONTINUED)

SAMPLE NO	MO11-B		TH72120338	MO24				MO38-B			MO39
ROCK TYPE	SL		BS	BS				SL			SL
ZONE	BIO		BIO	BIO				BIO			BIO
GRAIN NO	1(D)	1(D)	1(I)	1(I)	2(L)	3(L)	3(L)	1(D)	1(D)	1(D)	1(D)
POINT NO	RIM1	RIM2	CORE	CORE	1	1	2	CORE	RIM1	RIM2	CORE
SIO2	1.49	1.43	0.76	0.30	0.27	0.23	0.29	2.28	2.62	4.25	0.31
TIO2	8.67	9.19	18.24	16.88	7.00	10.02	10.77	12.61	8.51	6.71	14.26
FE2O3	78.57	78.33	62.93	67.15	85.59	79.94	77.92	71.09	77.14	78.47	69.87
FEO	9.30	9.48	16.72	15.16	6.49	9.19	10.03	12.10	10.08	11.02	13.04
MNO	0.26	0.45	0.53	0.36	0.13	0.09	0.10	1.91	0.67	0.07	0.10
TOTAL	98.29	98.88	99.18	99.85	99.48	99.47	99.11	99.99	99.02	100.52	97.58
ATOMIC RATIOS (O = 3.0)											
SI	0.040	0.038	0.020	0.008	0.007	0.006	0.008	0.059	0.069	0.109	0.008
TI	0.174	0.183	0.360	0.332	0.139	0.199	0.215	0.246	0.168	0.130	0.287
FE3+	1.574	1.559	1.242	1.321	1.707	1.590	1.554	1.389	1.526	1.521	1.409
FE2+	0.207	0.210	0.367	0.331	0.144	0.203	0.222	0.263	0.222	0.237	0.292
MN	0.006	0.010	0.012	0.008	0.003	0.002	0.002	0.042	0.015	0.002	0.002
ANALYST	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	MO40					MO48					
ROCK TYPE	BS					BS					
ZONE	BIO					GAR					
GRAIN NO	1(D)	1(D)	2(D)	3(D)	3(D)	1(D)	1(D)	1(D)	1(D)	2(D)	2(D)
POINT NO	CORE	RIM	RIM	RIM1	RIM2	CORE	RIM1	RIM2	RIM3	RIM1	RIM2
SIO2	0.20	0.19	0.40	0.20	0.59	1.77	1.71	1.78	1.82	1.75	1.90
TIO2	13.74	7.52	2.87	4.99	0.69	12.17	2.30	2.36	9.66	3.14	1.88
FE2O3	72.01	83.97	92.72	88.93	95.67	71.29	91.36	91.19	77.34	89.41	92.64
FEO	11.72	6.85	3.01	4.60	1.23	12.88	4.09	4.16	10.75	4.94	3.94
MNO	0.80	0.07	0.02	0.07	0.07	0.15	N.D.	0.06	0.09	0.0	0.0
TOTAL	98.47	98.60	99.02	98.79	98.25	98.26	99.46	99.55	99.66	99.24	100.36
ATOMIC RATIOS (O = 3.0)											
SI	0.005	0.005	0.011	0.005	0.016	0.047	0.045	0.047	0.048	0.046	0.050
TI	0.275	0.151	0.058	0.100	0.014	0.243	0.046	0.047	0.190	0.063	0.037
FE3+	1.441	1.689	1.864	1.789	1.941	1.422	1.818	1.813	1.524	1.782	1.827
FE2+	0.261	0.153	0.067	0.103	0.028	0.285	0.090	0.092	0.235	0.109	0.086
MN	0.018	0.002	0.000	0.002	0.002	0.003	N.D.	0.001	0.002	0.0	0.0
ANALYST	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

TABLE 15. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF HEMATITES (CONTINUED)

SAMPLE NO	MO48						MO52	TH72102203		MO55	
ROCK TYPE	BS						SL	SL		BS	
ZONE	GAR						GAR	GAR		GAR	
GRAIN NO	3(D)	4(D)	4(D)	4(D)	4(D)	5(D)	1(D)	1(D)	1(D)	1(D)	2(D)
POINT NO	RIM	RIM1	RIM2	RIM3	RIM4	RIM	CORE	CORE	RIM	CORE	RIM
SIO2	1.12	2.19	2.25	2.31	2.25	2.56	0.45	1.01	1.07	1.75	1.99
TIO2	1.54	2.50	1.08	0.60	7.17	0.25	10.13	10.71	7.38	9.57	6.91
FE2O3	92.81	89.87	92.51	93.78	80.74	93.03	77.97	75.82	81.36	75.77	80.59
FEO	2.70	4.84	3.64	3.28	8.93	3.26	7.40	9.56	6.46	10.37	8.33
MNO	0.0	0.0	0.0	0.0	0.18	0.0	2.09	1.24	1.34	0.30	0.23
TOTAL	98.17	99.40	99.48	99.97	99.27	99.10	98.04	98.34	97.61	97.76	98.05
ATOMIC RATIOS (O = 3.0)											
SI	0.030	0.058	0.059	0.061	0.059	0.068	0.012	0.027	0.029	0.047	0.053
TI	0.031	0.050	0.021	0.012	0.142	0.005	0.204	0.214	0.149	0.192	0.139
FE3+	1.878	1.785	1.839	1.855	1.598	1.855	1.570	1.518	1.646	1.523	1.617
FE2+	0.061	0.107	0.080	0.072	0.196	0.072	0.166	0.213	0.145	0.232	0.186
MN	0.0	0.0	0.0	0.0	0.004	0.0	0.047	0.028	0.031	0.007	0.005
ANALYST	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	MO55	MO58							MO65		
ROCK TYPE	BS	BS							BS		
ZONE	GAR	GAR							GAR		
GRAIN NO	3(D)	1(D)	1(D)	1(D)	1(D)	1(D)	2(D)	2(D)	1(D)	2(D)	2(D)
POINT NO	RIM	CORE	RIM1	RIM2	RIM3	RIM4	RIM1	RIM2	CORE	RIM1	RIM2
SIO2	2.33	0.16	0.22	0.25	0.78	0.25	0.17	0.16	1.78	1.77	1.68
TIO2	0.36	13.74	7.49	1.67	7.81	7.23	9.80	4.74	2.12	1.17	0.01
FE2O3	93.31	72.66	84.21	95.90	82.02	84.00	80.42	89.43	90.28	91.83	94.10
FEO	3.06	11.77	6.90	1.36	7.65	6.63	8.54	4.28	4.00	3.13	1.98
MNO	0.02	0.69	0.07	0.04	0.21	0.13	0.28	0.03	0.01	0.01	0.0
TOTAL	99.08	99.02	98.89	99.22	98.47	98.24	99.21	98.64	98.19	97.91	97.77
ATOMIC RATIOS (O = 3.0)											
SI	0.062	0.004	0.006	0.007	0.021	0.007	0.005	0.004	0.048	0.048	0.045
TI	0.007	0.273	0.150	0.034	0.157	0.146	0.195	0.095	0.043	0.024	0.000
FE3+	1.862	1.446	1.689	1.926	1.646	1.695	1.603	1.803	1.820	1.858	1.910
FE2+	0.068	0.260	0.154	0.030	0.171	0.149	0.189	0.096	0.090	0.070	0.045
MN	0.000	0.015	0.002	0.001	0.005	0.003	0.006	0.001	0.000	0.000	0.0
ANALYST	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU	KU

SAMPLE NO	MO65	MO84			
ROCK TYPE	BS	BS			
ZONE	GAR	CHL			
GRAIN NO	3(D)	1(D)	1(D)	1(D)	2(D)
POINT NO	RIM	CORE	RIM1	RIM2	RIM
SIO2	1.66	0.34	0.35	0.35	0.33
TIO2	1.31	1.05	0.88	0.68	0.35
FE2O3	92.64	96.59	96.09	96.34	96.79
FEO	3.13	1.22	1.04	0.85	0.57
MNO	0.01	0.0	0.0	0.0	0.0
TOTAL	98.75	99.20	98.36	98.22	98.04
ATOMIC RATIOS (O = 3.0)					
SI	0.044	0.009	0.009	0.009	0.009
TI	0.026	0.021	0.018	0.014	0.007
FE3+	1.859	1.942	1.948	1.956	1.970
FE2+	0.070	0.027	0.023	0.019	0.013
MN	0.000	0.0	0.0	0.0	0.0
ANALYST	TI	TI	TI	TI	TI
INSTRUMENT	KU	KU	KU	KU	KU

TABLE 16. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF PYRRHOTITES

SAMPLE NO	TH72113026	TH71081407	TH71081315	TH71081313
ROCK TYPE	PE	PE	PE	PE
ZONE	GAR	BIO	BIO	BIO
GRAIN NO	1	1	1	1
POINT NO	1	1	1	1
FE	58.9	58.5	59.6	59.1
S	38.8	38.7	38.4	39.1
TOTAL	97.7	97.2	98.0	98.2
ATOMIC RATIOS (FE + S = 100.0)				
FE	46.6	46.5	47.1	46.5
S	53.4	53.5	52.9	53.5
ANALYST	TI	TI	TI	TI
INSTRUMENT	KU	KU	KU	KU

TABLE 16. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF PYRRHOTITES (CONTINUED)

SAMPLE NO	TH71081311	TH71081310	TH71081424	TH71080202	TH71080205	TH71072713	TH71072805	TH71072813
ROCK TYPE	PE	PE	PE	PE	PE	PE	PE	PE
ZONE	BIO	BIO	BIO	GAR	GAR	GAR	GAR	CHL
GRAIN NO	1	1	1	1	1	1	1	1
POINT NO	1	1	1	1	1	1	1	1
FE	59.7	59.5	58.8	59.1	58.6	58.8	59.2	59.6
S	38.8	39.1	38.8	38.9	38.5	38.7	37.9	38.1
TOTAL	98.5	98.6	97.6	98.0	97.1	97.5	97.1	97.7
ATOMIC RATIOS (FE + S = 100.0)								
FE	46.9	46.6	46.5	46.6	46.6	46.6	47.3	47.3
S	53.1	53.4	53.5	53.4	53.4	53.4	52.7	52.7
ANALYST	TI	TI	TI	TI	TI	TI	TI	TI
INSTRUMENT	KU	KU	KU	KU	KU	KU	KU	KU

TABLE 17. CHEMICAL COMPOSITIONS AND ATOMIC RATIOS OF CARBONACEOUS MATTERS

SAMPLE NO	TH72112922	TH71081407	TH71081313	TH71080203	TI77110828	TI77110804	TI77110801	TH71073011	TH71072907	TH71103102
ROCK TYPE	PE	PE	PE	PE	PE	PE	PE	PE	PE	PE
ZONE	GAR	BIO	BIO	GAR	GAR	CHL	CHL	CHL	CHL	CHL
C	94.26	92.84	91.27	92.43	86.88	88.43	81.42	81.02	90.00	85.24
H	0.48	0.34	0.22	0.50	0.43	0.75	0.78	0.89	1.07	1.27
O	2.60	1.76	1.67	2.58	1.67	2.71	2.69	3.48	3.28	3.02
ASH	5.39	6.43	9.37	7.66	12.80	10.90	14.69	13.90	5.87	10.52
TOTAL	102.73	101.37	102.53	103.17	101.78	102.79	99.58	99.29	100.22	100.05
ATOMIC RATIOS (C + H + O = 100.0)										
C	92.5	94.5	95.9	92.1	93.2	89.0	87.8	86.0	85.5	83.0
H	5.6	4.1	2.8	5.9	5.5	9.0	10.0	11.3	12.1	14.7
O	1.9	1.3	1.3	1.9	1.3	2.0	2.2	2.8	2.3	2.2
ANALYST	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI
INSTRUMENT	SM	SM	SM	SM	SM	SM	SM	SM	SM	SM

Table 18 • Mineral assemblages and correlations between Sample Nos used in this paper and those given in the referred papers. All minerals present in the samples are listed in the table but not all of them were in equilibrium during the prograde metamorphism. Chemical compositions of the minerals marked with ● or star (e.g. st*) are listed in this paper.

Abbreviations: Pe =pelitic schist, Bs=basic schist, Sl=siliceous schist, Chl=chlorite zone, Gar=garnet zone, Bio=biotite zone, Qz=quartz, Ab=albite, Ms=muscovite, Pa=paragonite, Bt=biotite, St=stilpnomelane, Ch=chlorite, Am=amphibole, Hb=hornblende, Ac=actinolite, Px=pyroxene, Pu=pumpellyite, Ga=garnet, Ep=epidote, Al=allanite, Cc=calcite, To=tourmaline, Ap=apatite, Sp=sphene, Il=ilmenite, Ru=rutile, Mt=magnetite, Hm=hematite, Po=pyrrhotite, Py=pyrite, Cp=chalcopyrite, Bo=bornite, Cv=covelline, Cm=carbonaceous matter, ○,● =present, −=absent, / =not determined.

(a) *pelitic schists*

Sample No.	Rock type	Mineral zone	Qz	Ab	Ms	Bi	Ch	Hb	Ga	Ep	Cc	To	Ap	Sp	Il	Ru	Po	Py	Cp	CM	others	Higashino (1975)	Itaya (1975)	Itaya (1978a)	Itaya (1978b)	Itaya & Banno (1980)	Itaya (1981)
TH72113026	Pe	Gar	/	/	/	/	/	/	/	/	/	/	/	o	–	o	●	o	o	o			2				
TH72113014	Pe	Gar	o	o	o	–	●	–	●	o	–	o	o	o	/	/	o	/	/	o	A1	19	13				
TH72112936	Pe	Gar	o	o	o	–	●	–	●	o	–	o	o	o	/	/	/	/	/	o		18					
TH72112922	Pe	Gar	o	o	o	–	o	o	o	o	–	o	o	o	●	–	o	o	–	●			27			27	A64
TH72112911	Pe	Bio	o	o	o	o	o	o	o	o	–	o	o	o	●	–	o	o	o	o	A1		33			33	
TH72112908	Pe	Bio	o	o	o	–	o	o	o	o	–	o	o	o	●	o	o	o	o	o			34			34	
TH71081418	Pe	Bio	o	o	o	–	o	o	o	o	–	o	o	o	●	–	o	o	o	o			38			38	
TH71081416	Pe	Bio	o	o	●	●	●	o	●	o	–	o	o	o	●	o	o	o	o	o		17	40	40		40	
TH71081414	Pe	Bio	o	o	o	o	o	–	o	o	–	o	o	o	●	●	o	–	o	o			42			42	
TH71081408	Pe	Bio	o	o	o	●	●	o	●	o	–	o	o	o	●	o	o	o	o	o	A1	16	48	48		48	
TH71081407	Pe	Bio	o	o	o	o	o	o	o	o	o	o	o	o	o	●	●	o	o	●			49				A62
TH71081405	Pe	Bio	o	o	o	–	●	o	●	o	o	o	o	o	●	o	o	–	–	o	A1	15	51			51	
TH71081403	Pe	Bio	o	o	o	o	o	o	o	–	o	o	o	o	●	o	o	o	o	o			53			53	
TH71081317	Pe	Bio	o	o	o	o	o	o	o	o	o	o	o	o	o	●	o	o	o	o			56				
TH71081315	Pe	Bio	o	o	●	●	●	●	●	o	–	o	o	o	●	o	●	–	o	o			58	58		58	
TH71081313	Pe	Bio	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	–	o	●		14	60				A59
TH71081311	Pe	Bio	o	o	●	●	●	o	●	o	o	o	o	o	●	o	●	–	o	o		13	62			62	
TH71081310	Pe	Bio	o	o	o	o	o	o	o	o	–	–	o	o	●	o	o	–	o	o			63			63	
TH71081309	Pe	Bio	o	o	o	o	o	o	o	o	–	o	o	o	●	o	o	o	–	o			64			64	
TH&L081307	Pe	Bio	o	o	o	o	o	o	o	o	o	o	o	o	●	o	o	–	o	o	A1	TH71081307	66			66	
TH71081306	Pe	Bio	o	o	o	o	o	o	o	o	o	o	o	o	●	o	o	–	o	o		TH71081306	67			67	
TH71081303	Pe	Bio	o	o	●	●	●	●	●	o	–	o	o	o	●	o	o	–	o	o	Ac	12	70			70	
TH71081421	Pe	Bio	o	o	o	o	o	o	o	o	o	o	o	o	●	o	o	o	o	o			73			73	
TH71081422	Pe	Bio	o	o	o	●	●	–	●	o	o	o	o	o	o	o	o	o	o	o		11	74				
TH71081424	Pe	Bio	o	o	o	o	o	o	o	o	–	o	o	o	●	●	●	o	o	o			76			76	
TH71081111	Pe	Bio	o	o	●	–	●	–	●	o	–	o	o	o	●	o	–	–	o	o	A1	10	79			79	
TH71081108	Pe	Bio	o	o	o	o	o	o	o	o	o	o	o	o	●	o	o	–	o	o			82			82	
TH71081107	Pe	Bio	o	o	●	●	●	–	●	o	–	o	o	o	o	o	o	–	–	o		9	83				
TH71081102	Pe	Bio	o	o	o	o	o	o	o	o	–	o	o	o	●	o	o	o	o	o	A1		88	88			
TH71081101	Pe	Bio	o	o	o	o	o	–	o	o	–	o	o	o	●	o	o	–	o	o			89		89	89	

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TH71081004	Pe	Gar	○	○	○	–	○	–	○	○	–	○	○	○	●	○	–	○	–	○			92		92	92	
TH71080201	Pe	Gar	○	○	●	–	●	–	●	○	–	–	○	○	●	○	○	○	○	○		8	95			95	
TH71080202	Pe	Gar	○	○	○	–	○	–	○	○	–	○	○	○	–	–	●	○	○	○			96				
TH71080203	Pe	Gar	○	○	○	–	○	–	○	○	–	○	○	○	–	○	–	○	–	●	A1		97				A52
TH71080205	Pe	Gar	○	○	○	–	○	–	○	○	–	○	○	○	–	○	●	○	○	○			99			99	
TH71072702	Pe	Gar	○	○	○	–	●	–	●	○	–	○	○	○	–	○	○	–	–	○	A1	7	101				
TI77110828	Pe	Gar	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	●							A50
TH71072713	Pe	Gar	○	○	○	–	○	–	○	○	–	○	○	○	–	○	●	○	○	○			106				
TH71072714	Pe	Gar	○	○	○	–	○	–	●	○	–	○	○	○	–	–	○	○	○	○		6	107				
TH71072721	Pe	Gar	○	○	○	–	●	–	–	○	○	○	○	○	○	○	○	–	○	○		5	108				
TH71072805	Pe	Gar	○	○	○	–	○	–	○	○	○	○	○	○	–	○	●	○	○	○			109				
TH71072813	Pe	Chl	○	○	○	–	●	–	–	○	○	○	○	○	–	–	●	○	–	○		4	113				
TI77110804	Pe	Chl	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	●							A28
TI77110801	Pe	Chl	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	●							A26
TH71073012	Pe	Chl	○	○	●	–	●	–	–	○	–	○	○	○	–	–	○	○	○	○		3	114				
TH71073011	Pe	Chl	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	●							A25
TH71072922	Pe	Chl	○	○	●	–	●	–	–	–	○	–	○	○	–	–	–	○	○	○		2	115				
TH71072907	Pe	Chl	○	○	○	–	○	–	–	–	–	○	○	○	–	–	–	○	○	●			126				A14
TH71072918	Pe	Chl	○	○	○	–	●	–	–	○	○	○	○	○	–	–	–	○	○	○		1	130				
TH71103102	Pe	Chl	○	○	○	–	○	–	–	○	○	○	○	○	–	–	–	○	○	●			132				A11

(b) *Basic and siliceous schists*

Sample No.	Rock type	Mineral zone	Qz	Ab	Ms	Bi	Ch	Am	Ga	Ep	Cc	To	Ap	Sp	Il	Ru	Mt	Hm	Po	Py	Cp	others	Itaya & Otsuki (1978)	Otsuki (1980b)	Otsuki & Banno (in prep.)
TH72102901	Bs	Bio	o	o	●	–	●	●	–	●	o	–	o	o	o	o	–	–	o	–	o				
MO03	Sl	Bio	o	o	o	–	●	●	●	●	o	o	–	o	–	–	–	–	o	–	o	Cm			
MO04	Sl	Bio	o	o	●	–	●	●	●	●	o	o	–	o	–	o	–	–	o	–	o				
MO05	Bs	Bio	o	o	●	–	●	●	–	o	o	–	–	o	–	o	–	–	–	–	o				
MO09	Bs	Bio	o	o	o	–	o	o	–	o	o	–	o	o	●	o	–	–	–	–	o	Bo,Cv	9		
TH710813D	Bs	Bio	o	●	●	–	●	●	–	●	o	–	o	o	–	o	●	●	–	–	o	Bo,Cv	TH9		TH9
MO10	Bs	Bio	o	o	o	–	●	●	●	●	–	–	–	o	–	–	–	–	o	–	o	Pa			
MO11-a	Bs	Bio	–	o	●	–	●	●	–	●	o	–	o	o	–	o	–	o	–	o	–				
MO11-b	Sl	Bio	o	o	o	–	o	o	o	o	o	–	o	o	–	o	–	●	–	–	–		11		
MO15	Bs	Bio	–	o	o	–	●	●	–	●	o	–	o	o	●	o	–	–	–	–	–		15		
MO16	Bs	Bio	o	o	o	–	●	●	–	●	o	–	–	o	o	o	o	o	–	–	–		16		
MO19	Bs	Bio	o	o	●	●	●	●	●	●	–	–	o	o	o	o	–	–	o	o	o		19		
TH71080601	Bs	Bio	o	●	●	●	●	●	●	●	–	–	o	o	o	o	–	–	o	–	–				
TH72120319	Bs	Bio	o	o	o	–	●	●	●	●	–	–	o	o	●	●	●	–	–	o	o		TH14		
TH72120338	Bs	Bio	o	o	o	–	●	●	o	●	–	–	o	o	●	●	●	●	–	–	o		TH17		TH17
MO23	Bs	Bio	o	o	●	–	●	●	●	●	–	o	o	o	o	o	–	o	–	o	–		23		23
MO24	Bs	Bio	o	o	●	–	●	●	o	●	–	–	o	–	●	●	●	●	–	o	–		24		24
MO25	Bs	Bio	o	o	o	–	o	o	●	o	–	–	o	o	o	o	–	–	–	o	o	St			
MO26	Bs	Bio	o	●	●	–	●	●	–	●	o	o	o	–	–	o	–	o	–	–	–				26
TH71080303	Bs	Bio	o	●	●	o	●	●	–	●	o	–	o	o	–	o	–	o	–	–	–				TH22
MO28	Bs	Bio	o	o	●	o	●	●	–	●	–	–	o	o	●	●	●	–	–	o	o		28		28
TH71051007	Bs	Bio	o	o	o	o	●	●	–	●	–	–	o	o	o	o	–	–	–	o	–			TH25	
MO29	Sl	Bio	o	o	●	–	●	o	●	●	o	–	–	o	o	o	–	–	o	–	o				
MO33	Sl	Bio	o	o	o	●	●	●	●	●	o	o	o	o	o	o	–	–	o	o	o				
MO35	Sl	Bio	o	o	●	●	●	●	–	o	o	–	o	o	o	–	–	–	o	–	o				
MO37	Bs	Bio	o	o	●	–	●	●	–	●	o	o	o	o	–	o	–	o	–	–	o				37
MO38-a	Bs	Bio	o	o	●	–	●	●	–	●	o	–	–	o	–	o	–	o	–	–	o				38
MO38-b	Sl	Bio	o	o	o	–	o	–	o	o	–	o	o	–	●	o	●	●	–	–	–		38		
MO39	Sl	Bio	o	o	o	–	o	–	o	o	–	o	o	–	–	o	–	●	–	–	–		39		
MO40	Bs	Bio	o	o	o	–	●	●	–	●	–	o	–	o	●	o	●	●	–	–	–		40	MO40	40
MO41-a	Bs	Bio	o	o	o	–	●	●	–	●	o	o	–	o	–	o	–	–	–	–	o				41
MO42	Bs	Bio	o	o	●	–	●	●	–	●	o	o	–	o	–	o	–	o	–	–	–				42

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M047	Bs	Gar	○	–	–	–	●	●	–	●	–	–	○	○	○	○	–	–	–	–	–				
M048	Bs	Gar	○	○	●	–	●	●	–	●	–	○	○	○	–	●	●	●	–	–	–		48		48
M049-a	Bs	Gar	○	○	○	–	●	●	–	●	–	–	○	○	–	○	–	–	–	–	–	St*			
M051-a	Bs	Gar	○	○	●	–	●	●	–	●	–	–	○	○	–	–	–	–	–	–	–	St*			
M052	Sl	Gar	○	○	○	–	○	–	○	○	○	○	○	○	●	●	●	●	–	–	○		52		
TH72102203	Sl	Gar	/	/	/	/	/	/	/	/	/	/	/	○	●	●	–	●	–	–	–		TH32		
M055	Bs	Gar	○	○	●	–	●	●	–	●	○	–	○	○	●	–	●	●	–	–	○		55	M055	55
M058	Bs	Gar	○	○	●	–	●	●	–	●	○	–	–	○	–	●	●	●	–	–	–		58		58
TH71072601	Bs	Gar	○	○	–	–	●	●	–	●	–	–	–	○	–	–	–	–	○	–	–				
M060-a	Bs	Gar	○	○	○	–	●	●	–	●	○	–	○	○	–	○	–	–	–	–	–				
M062	Bs	Gar	○	○	○	–	●	●	–	●	○	–	○	○	–	–	–	–	–	–	–				
M061	Bs	Gar	○	○	○	–	●	●	–	●	–	–	–	○	–	–	–	–	○	–	○				
M064	Bs	Gar	○	○	○	–	●	●	●	●	○	–	○	○	–	○	–	–	○	–	○				
M065	Bs	Gar	○	○	●	–	●	●	–	●	○	○	○	○	–	●	●	●	–	–	○		65		65
M066-a	Bs	Gar	○	○	○	–	●	●	–	●	○	○	–	○	–	–	–	○	–	–	○				66
M067	Bs	Gar	○	○	●	–	●	●	–	●	○	–	○	○	–	–	–	○	–	–	○				67
M068	Sl	Gar	○	●	○	–	○	○	–	○	–	–	○	○	–	○	–	○	–	–	–				68
TH71072803	Bs	Chl	○	○	●	–	●	●	–	●	○	○	○	○	–	○	–	○	–	–	–				TH45
M070	Bs	Chl	○	○	○	–	●	●	–	●	○	–	–	○	–	–	–	–	–	○	○				
M071	Bs	Chl	○	○	○	–	●	●	–	●	○	–	–	○	–	–	–	–	○	○	○				
M074	Bs	Chl	○	○	●	–	●	●	–	●	–	–	○	○	–	–	–	○	–	–	○				74
M075	Bs	Chl	○	○	–	–	●	●	–	●	–	–	–	○	–	–	–	–	–	○	○				
M079	Bs	Chl	○	○	●	–	●	●	–	●	○	–	○	○	–	–	–	○	–	–	–				79
M080	Bs	Chl	○	○	○	–	●	●	–	●	○	–	–	○	–	–	–	–	–	–	–	Pu*,Bo			
M083	Bs	Chl	○	○	–	–	●	●	–	●	–	–	○	○	–	–	–	○	–	○	○	St*,Bo,Px*			83
M084	Bs	Chl	○	●	●	–	●	●	–	●	○	○	○	○	–	–	–	○	–	–	–				84
M089	Bs	Chl	○	○	○	–	●	●	–	●	○	–	–	○	–	–	–	○	–	–	○	Bo,Cv			89
M092	Bs	Chl	○	○	○	–	●	●	–	●	–	–	○	○	–	–	–	–	–	–	–				