ABSTRACT

MAGMATIC WATER CONTENT OF PACAYA VOLCANO, GUATEMALA, DETERMINED FROM A THERMODYNAMIC MODEL FOR THE PLAGIOCLASE-LIQUID HYGROMETER

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Pacaya Volcano is an active composite volcano located in southern Guatemala, about 30 km from the nation's capital, Guatemala City. This volcano has variable eruptive styles ranging from non-explosive to moderately explosive. Volcanic rocks from Pacaya are mostly basaltic to basaltic andesite and tend to be porphyritic, containing approximately 25-35% crystals, dominantly plagioclase. Previous data from olivine-hosted melt inclusions in Pacaya's tephras suggest relatively low magmatic water contents for a subduction zone volcano, particularly compared to neighboring composite volcanoes along the Central American Volcanic Arc.

The goal of this research was to use plagioclase phenocrysts in basaltic andesite lavas from Pacaya as a secondary method to verify the unusually low magmatic water contents reported previously. Water contents were estimated using a plagioclase-liquid hygrometer. Plagioclase crystals were selected from thin sections made of lavas from five different eruptive events. Phenocrysts were analyzed using the electron microprobe at Northern Illinois University. Plagioclase crystallization temperatures were obtained using a geothermometer. Water contents were calculated to be ≤ 3.6 wt. % H_2O for lavas erupted from Pacaya and are consistent with olivine-hosted melt inclusion data, but low for subduction zone volcanoes.

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CHAPTER 1

INTRODUCTION

Introduction and Background: Central American Volcanic Zone

Recent volcanism in Central America begins at the Mexico/Guatemala border and continues 1100 km along the west coast to central Costa Rica (Walker, 1981; Morgan et al., 2013). The volcanism observed here is a result of the Cocos Plate subducting beneath the Caribbean Plate (Figure 1), beginning 16-17 Ma (Syracuse and Abers, 2006) at an angle of about 89-94 °W and at a rate of about 7 to 9 cm/yr (DeMets, 2001). Crustal thickness varies from about 25 km beneath Nicaragua, where it is thinnest, to approximately 50 km on the edges of the arc beneath Santa María in northwestern Guatemala (Carr et al., 2003; Jicha et al., 2010). Volcanism along the Central American Volcanic Zone (CAVZ) can be grouped into two geochemically distinct zones, the volcanic front (VF) and the back-arc (behind the volcanic front, BVF). These zones not only differ in geochemistry but also in the melting processes that produce the extruded lavas (Walker et al., 1995; Carr et al., 2007). The volcanic front is located approximately 165-190 km inland from the Middle American trench (Carr et al., 2007). Most of the volcanic centers in this region are complexes constructed of basaltic to andesitic lavas, as is the case with the Pacaya Complex in Guatemala (Carr et al., 2007).

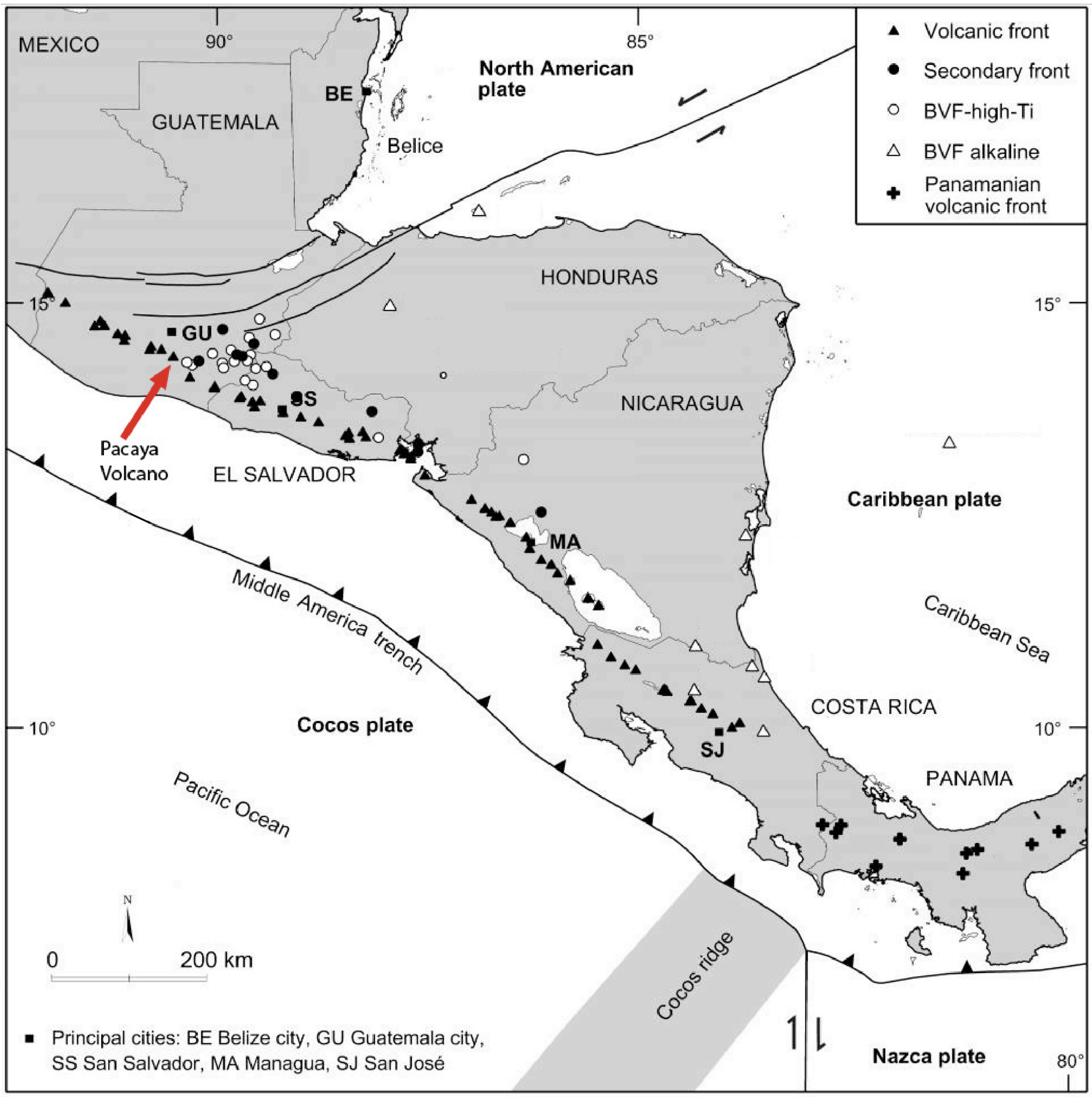

Figure 1. Regional tectonic map of the Central American Volcanic Zone. Black triangles represent volcanoes on the volcanic front; Pacaya Volcano is marked with the red arrow (modified from Carr et al., 2007).

Magma is generated by one of two main processes in Central America: flux melting or decompression melting (Carr et al., 2003). Although neither of these are mutually exclusive, it is thought that flux melting is the dominant process that produces the magmas erupted on the volcanic front (Patino et al., 2000), whereas decompression melting generates the magmas behind the volcanic front (Walker et al., 1995, Walker et al., 2003).

Melt inclusions are small portions of magma that became trapped in a crystal as it formed and they provide measurements of the pre-eruptive magmatic composition, including concentrations of volatiles (H_2O, CO_2, S, etc.). Without analyzing both CO_2 and H_2O, it is difficult to evaluate whether or not the analyzed lavas have been degassed as they made their way toward the Earth's surface (e.g., Wallace, 2005). Mafic magmas produced at subduction zones have H_2O concentrations of about 4-6 wt. %, which is what has been measured in olivine-hosted melt inclusions at a number of volcanic centers along the Central American Volcanic Zone (CAVZ) (Roggensack et al., 1997; Roggensack, 2001b; Sadofsky et al., 2008; Plank et al., 2013). A notable exception is Pacaya Volcano. Preliminary data from olivine-hosted melt inclusions from Pacaya suggest relatively low water contents (up to 2.4 wt. % H_2O) for a subduction zone volcano, particularly compared to neighboring composite volcanoes in Guatemala (Roggensack, 2001b; Walker et al., 2003). The inferred water contents at Pacaya are more similar to those in Guatemalan BVF basalts than to basalts on the volcanic front (Walker et al., 2003).

Here, the low subduction zone H_2O concentrations measured from olivine-hosted melt inclusions at Pacaya Volcano are confirmed through the use of a relatively new plagioclase-liquid hygrometer. The possible causes and consequences of Pacaya's low magmatic H_2O concentrations are also explored.

Eruptive History of Pacaya Volcano

Pacaya Complex is located in Southeastern Guatemala on the southern rim of the 14x16 km Pleistocene Amatitlán caldera (Wunderman and Rose 1984; Bardintzeff and Deniel, 1992), along the Central American volcanic zone on the volcanic front. The horseshoe-shaped Amatitlán caldera formed as the result of the collapse of a pre-existing volcanic edifice, approximately 400-2,000 yr. B.P. (Wunderman and Rose, 1984; Kitamura and Matías, 1995; Vallance et al., 1995). The Pacaya region is currently undergoing extension caused by interaction between the Jalpataugua fault and the Guatemala City graben (Cameron et al., 2002). The complex is comprised of several cones: Cerro Grande, Cerro Chiquito, Cerro Chino, Pacaya Viejo and Cerro MacKenny (Eggers, 1971 and Bardintzeff and Deniel, 1992). Present day activity is constrained to the modern day basaltic composite volcano, Cerro MacKenny, and has been consistent since 1961 (Vallance et al., 1995) after a 100-year period of dormancy from about 1861 to 1961 (Conway et al., 1992; Kitamura and Matías, 1995; Cameron, 1998).

The complex itself is no more than approximately 23 thousand years old (Kitamura and Matías, 1995; Rose et al., 2013). Eruptive episodes may last less than 100 years but as long as 300 years (Conway et al., 1992; Cameron, 1998). Lava flow durations range from a few hours up to hundreds of days and emanate from multiple vents (Rose et al., 2013). Lava flows typically flow no farther than 2 km, which under the right conditions is far enough to reach some towns on the north side of the complex (Rose et al., 2013). Guatemala City, the capital of the Republic of Guatemala, is located about 30 kilometers from the Pacaya Complex and ash from some eruptions has blanketed the town, causing the Guatemala City

Airport to temporarily close (Cameron, 1998).

Cerro MacKenny is located in the southern portion of the volcanic complex, is 2552 meters tall and it is one of three active volcanoes in Guatemala (Fuego and Santa Maria – Santiaguito are the others) (Bardintzeff and Deniel, 1992; Volcán de Pacaya, 2013). Pacaya's modern cone is accessible, and the bulk rock compositions have been well documented (Cameron, 1998; Rose et al., 2013). Lavas from Pacaya are porphyritic, medium-K basaltic to basaltic andesites with major element compositions similar to neighboring BVF lavas in southeastern Guatemala. Pacaya's lavas have notably higher FeO contents than BVF lavas, giving them an enhanced tholeiitic character (Walker, 1989). The volcanic rocks contain approximately 20-30% phenocrysts, and the crystals may be as large as approximately 1.5mm. Most of the eruptions at Pacaya are Strombolian or Vulcanian in nature, and bombs and ashfall are common (Bardintzeff, and Deniel, 1992; Conway et al., 1992). Investigations of historic flows have revealed that the eruptive style can change quickly (Conway et al., 1992). Current activity at Cerro MacKenny began in 1961 and Strombolian eruptions and intermittent lava flows accompanied by rarer large explosions, which destroy portions of the summit, have been consistent over the last 53 years (2013, Pacaya). This high level of activity paired with the unstable cone makes Pacaya Volcano potentially quite hazardous (Dalton et al., 2010).

On May 27, 2010, a Strombolian eruption began from Cerro MacKenny and lasted approximately three to four months. There were fumarolic plumes in addition to ash, tephra, and blocks, which were ejected from the volcano. During that May, over 1,600 people in Guatemala City were evacuated, La Aurora International Airport was closed, and people were told to refrain from driving because of the ash (Pacaya, 2013). Recently, the Instituto

Nacional de Sismologia, Vulcanologia, Meterologia e Hidrologia (INSIVUMEH) reported gas-and-ash plumes rising from Cerro MacKenney (Pacaya, 2013). Currently, there is seismic activity and very weak explosions (Strombolian eruptions) coming from Cerro MacKenney, which is visibly incandescent at night (Pacaya, 2013).

CHAPTER 2

METHODOLOGY

Sample Preparation and Petrographic Analysis

Fresh basalt samples were collected from historic eruptions (from the years 1775, 1961, 1987, 1991 and 1996) on the southern flank of Pacaya Volcano in 1996 from the locations marked in Figure 2. The five samples were cut into thin sections by Spectrum Petrographics Inc. to be used for the petrographic and electron microprobe analyses. All samples were then observed in thin section using a petrographic microscope.

In hand specimen, all five samples have 25-35 modal % visible plagioclase phenocrysts on the order of mm to cm. Vesicles are also present, making up at least 40% of the lavas. In thin section, at a magnification of 20x, the matrix consists of plagioclase crystals and very little olivine and clinopyroxene of equal size (on the order of tens of micrometers). Plagioclase crystals analyzed in this study range in size from 40 to 1300 micrometers. The plagioclase crystals are smaller than those observed in the hand specimen but are still larger than those in the matrix. These smaller crystals are more likely to have grown from the liquid they are embedded in, meaning that there is less of a chance that they may be xenocrysts and thus would most accurately reflect the melt composition of their hosts. For all five samples, nearly all plagioclase crystals are euhedral, and many show Carlsbad and albitic twinning (Figure 3). Zoning was observed in many of the plagioclase crystals. Plagioclase crystals make up at least 65% of the total minerals present in each of the samples. Olivine is the next most abundant mineral observed, and minor clinopyroxene (<5%) is also present.

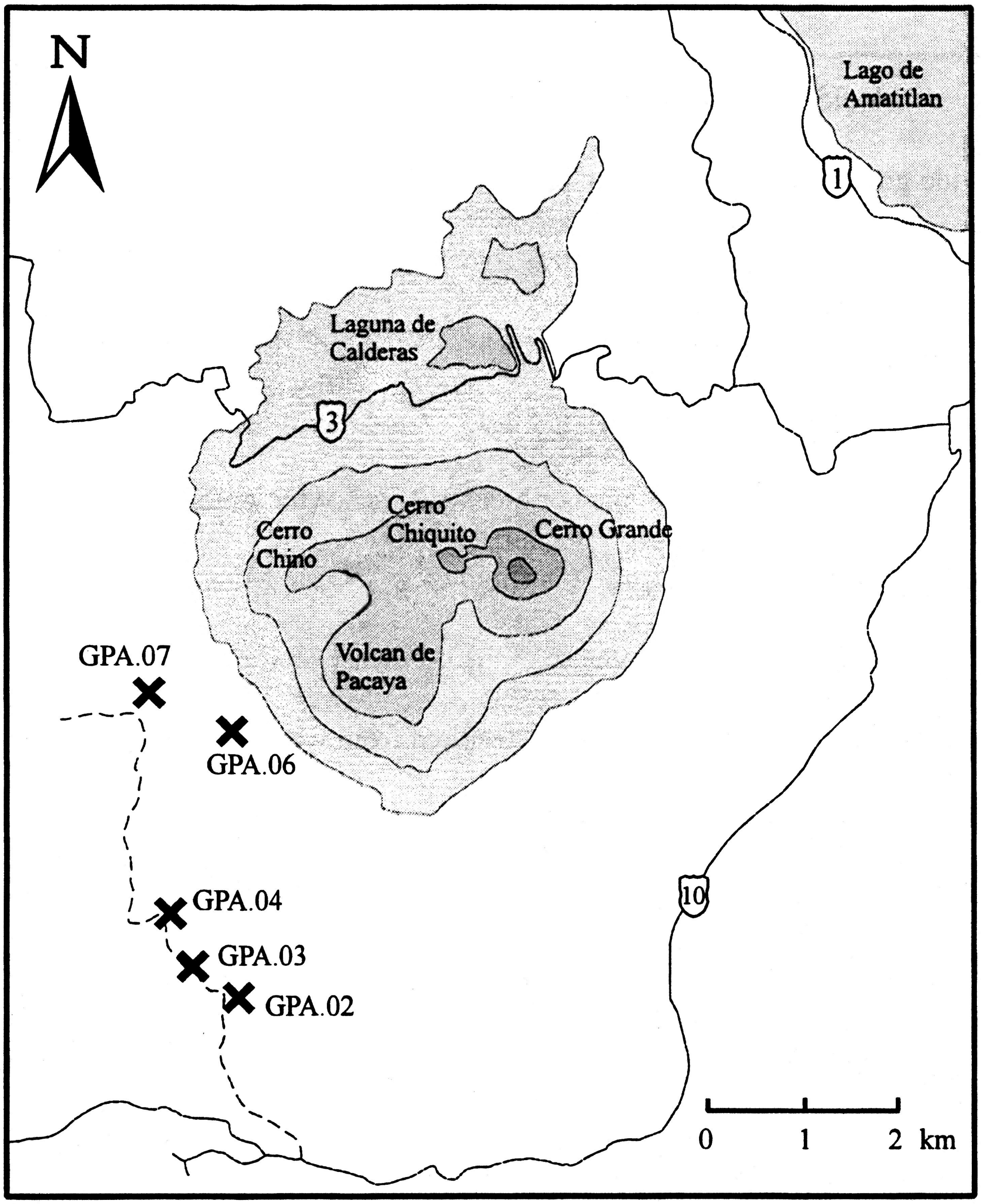

Figure 2. Sample location map. Modified from Cameron, 1998.

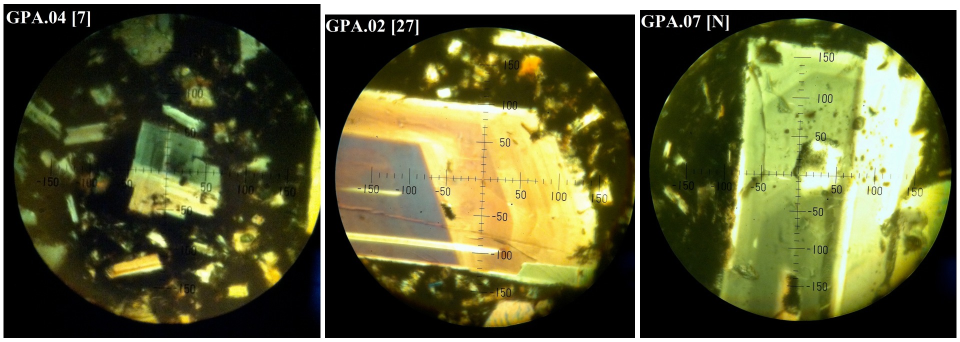

Figure 3. Photographs of plagioclase crystals from Pacaya Volcano. A. Sample GPA.

Electron Microprobe Analysis

The five thin sections were carbon coated at Northern Illinois University on the JOEL JEE 4C carbon coater. Microprobe analyses were conducted at Northern Illinois University on the JEOL 733 electron microprobe to find the composition of the plagioclase crystals. For all analyses, the beam size was set at 10 micrometers, the accelerating potential was 15 keV and the current was set to 15 nA (Crabtree and Lange, 2011; Ruprecht et al., 2012). Plagioclase crystals from each of the five samples were analyzed for Fe, Mg, Al, Si, Ca, Na, and K. A transect was made from the core of the crystal to the rim, with 20 micrometer spacing. Transects were made parallel to the short axis, if the crystal was lath shaped. Acceptable analytical totals were 100 ± 1.5 wt. %. Crystals and spectrometers used for each element are listed in Table 1, as well as the order in which the elements were analyzed. Elements were standardized using scapolite and osumilite, standards from the Smithsonian, catalog numbers NMNH R 6600-1 and NMNH 143967, respectively. Na, Ca and Al were standardized using scapolite, and K, Si, Mg, and Fe were standardized using osumilite. Both of these standards were from Structure Probe Inc. and are included on a standard mount. Table 2 shows the totals for the two standards.

Table 1. List of Elements Analyzed on Microprobe. Elements are listed with the spectrometer and crystal and the order in which they were analyzed.

Element	Spectrometer	Crystal	Order	L-value
Al kα	2	Tap	2	90.66
Si kα	1	Pet	1	228.66
Ca kα	3	Lif	1	233.53
Na kα	2	Tap	1	129.47
K kα	1	Pet	2	119.83
Fe kα	3	Lif	2	134.62
Mg kα	2	Tap	3	107.51

Table 2. Composition of Standards.

Standard	Al_2O_3	CaO	FeO	K_2O	MgO	Na_2O	SiO_2	TiO_2	Total
Scapolite	25.05	13.58	0.17	0.94	-	5.20	49.78	-	94.720
Osumilite	22.60	<0.03	6.38	4.00	5.83	0.39	60.20	0.18	99.43

Analyses where the beam current drifted below 15 nA or that had totals not in the range of 100 ± 1.5 wt. % or that gave plagioclase compositions outside of the An_{93} -An_{37} range (as required for the Lange et al. [2009] hygrometer, described later), were not used to determine wt. % H_2O. Microprobe error is one standard deviation (σ) from the mean. Standardization data and calculations for one sigma can be found in Appendix C.

The plagioclase compositions determined by microprobe analysis were used to calculate the X_{An} and X_{Ab} for each analyzed point within a given crystal, and to calculate the average X_{An} and X_{Ab} for each of the five samples. An example of these calculations can be found in Appendix C, along with the complete data tables with all calculations for all analyzed points (Appendix A). The average weight percent of each of the seven oxides was also calculated for all five samples to determine an average plagioclase composition for each sample.

Calculation of Liquid Compositions

The hygrometer of Lange et al. (2009) requires knowledge of the bulk composition of the melt from which the plagioclase crystals grew. Cameron (1998) provides whole rock major element data for the five samples under study; however, because there is a significant percent of plagioclase phenocrysts present in the samples, the whole rock compositions likely deviate substantially from melt compositions (e.g., Walker and Carr, 1986). Thus for each sample, the average normalized plagioclase compositions were multiplied by the modal percentage of plagioclase and the result was subtracted from the normalized bulk rock data to obtain a liquid composition. An example of this calculation can be found in Appendix D. The calculated liquid compositions are given in Table 3, and Figure 4 shows that the five calculated liquid compositions match well with compositions of olivine-hosted melt inclusions from Pacaya Volcano (Walker, unpublished data, corrected for post-entrapment crystallization).

Table 3. Calculated Average Normalized Liquid Compositions

	Average Normalized Liquid Composition									
Sample	SiO_2	Al_2O_3	FeO^T	MgO	CaO	Na_2O	K_2O	TiO_2	MnO	P_2O_5
GPA.04-01	51.73	15.35	12.46	5.71	7.86	3.55	1.16	1.63	0.23	0.33
GPA.02-02	51.48	15.04	13.27	5.75	7.40	3.60	1.19	1.69	0.25	0.34
GPA.07-03	52.33	15.18	12.69	4.87	7.50	4.10	1.15	1.62	0.22	0.35
GPA.03-04	51.83	14.78	12.68	5.30	8.35	3.78	1.12	1.60	0.23	0.33
GPA.06-05	51.18	16.92	11.75	4.72	8.76	3.53	1.06	1.54	0.22	0.32

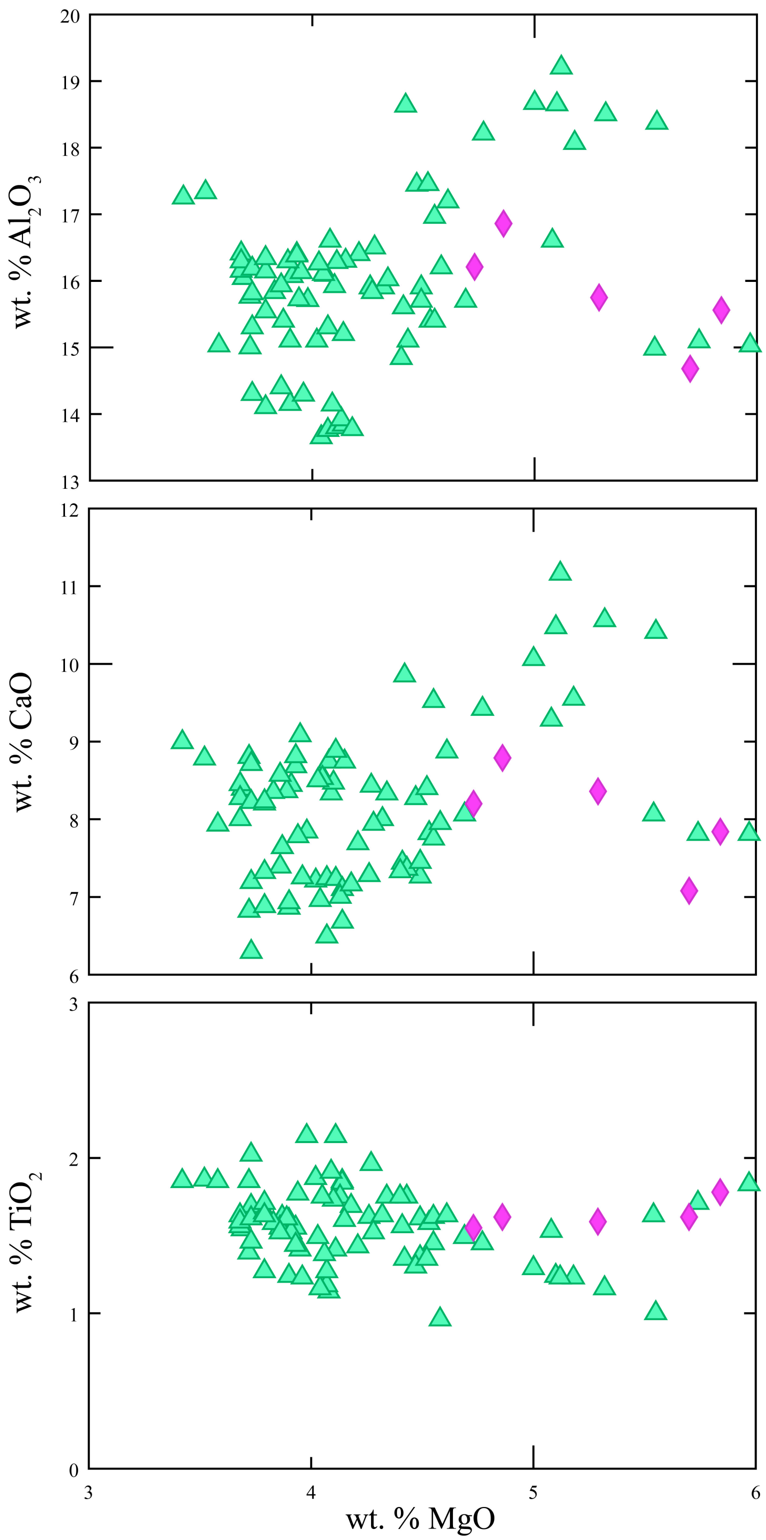

Figure 4. Liquid compositions: Al_2O_3 vs. MgO, CaO vs. MgO and TiO_2 vs. MgO. Liquid compositions calculated in this study are the diamonds and the liquid compositions measured in olivine-hosted melt inclusions are the triangles.

Thermobarometry

Along with the *mol % An* and *mol % Ab*, the plagioclase-liquid hygrometer requires an independent temperature of plagioclase crystallization in order to determine the *wt. %* H_2O. To determine the temperature of the magma at the time of plagioclase formation, a pressure estimate was required. An initial estimated pressure was determined using an amphibole thermobarometer (Equation 1), developed for subduction zone volcanoes (Ridolfi et al., 2009). In this equation, P is the pressure at which the amphiboles formed measured in MPa, and Al_T is the total aluminum in amphibole.

(Eq. 1)

$$P = 19.209e^{(1.438Al_T)}$$

Lavas from Cerro MacKenny do not have amphiboles, so compositions from hornblende crystals in two rocks from Cerro Chiquito (see Figure 2) were used with the thermobarometer. Results for the two samples yielded pressures of 338 ± 37 and 366 ± 40 MPa. However, it is quite likely that the amphibole-bearing lavas have a crystallization history different from the plagioclase-bearing lavas analyzed in this study, even though they are from the same volcanic complex. In addition, the pressures calculated using the Ridolfi et al. (2009) barometer are too high to be used with the hygrometer, which is only calibrated for pressures between 100-300 MPa (Lange et al., 2009). There are no geophysical or geochemical data at present that constrains the magmatic plumbing system and thus crystallization depth below Pacaya. As a result, three distinct pressures were used to calculate temperatures: 100 MPa, 200 MPa and 300 MPa. Many subduction zone volcanoes are believed to have storage/crystallizations depths within this pressure range (Ridolfi et al., 2009; Ruprecht et al., 2012; Coombs et al., 2013; Mann et al., 2013). Temperatures were determined using a geothermometer developed by Yang and Kinzler, (1996) and then further modified by Putirka (2008) (Equation 2). Here, *T* is the temperature in degrees Celsius; $X_{SiO_2}^{liq}$, $X_{Al_2O_3}^{liq}$ and X_{MgO}^{liq} are the mole fractions of SiO_2, Al_2O_3 and MgO in the liquid, respectively; and *P* is the pressure measured in GPa. Standard estimate of error for the thermometer is ± 26 °C. The calculated liquid compositions from Table 2 were used to determine the mole fractions of the necessary oxides.

(Eq. 2)

$$T(°C) = -583 + 3141\left[X_{SiO_2}^{liq}\right] + 15779\left[X_{Al_2O_3}^{liq}\right] + 1338.6\left[X_{MgO}^{liq}\right] - 31440\left[X_{SiO_2}^{liq} \cdot X_{Al_2O_3}^{liq}\right] + 77.67\left[P(GPa)\right]$$

Hygrometry

The plagioclase-liquid hygrometer developed by Lange et al. (2009) was used to calculate the *wt. %* H_2O for each of the analyzed points in all five samples. The hygrometer is a semi-empirical model based on thermodynamic data which quantifies the relationship between the An content in plagioclase and the water concentration in the melt in which it formed. Experimental studies have shown that a high An content reflects a high magmatic water content (Housh and Luhr, 1991; Sisson and Grove, 1993a, 1993b). The addition of water to a melt is one of three ways to increase the An content of crystallizing plagioclase (the other two ways being to increase the aluminum content of the melt or to reduce its Na content [Marsh et al., 1990]). The hygrometer works for plagioclase compositions of An_{93}-An_{37}, for liquid compositions of 46-74 wt. % SiO_2, for temperatures between 825 – 1230 °C, and at pressures between 0.10 and 0.30 GPa.

In the hygrometer equation (Equation 3), *wt. %* H_2O is the weight percent of water in the magma at the time of plagioclase formation; *m'* is a constant model parameter; *x* is an equation which takes into account enthalpy (*H*), entropy (*S*), the volume (*V*), pressure (*P*), temperature (*T*) and the equilibrium constant (*K*); *a"*, *b"*, and d_i'' are constant model parameters; *T* is the temperature in degrees Celsius; and $\sum d_i X_i$ is the sum of the each of the mole fractions of each oxide multiplied by a specific constant for each of the oxides. For the determination of *x*, $\Delta H^o(T)$ is the change in the enthalpy of fusion at a give temperature between anorthite and albite; $\Delta S^o(T)$ is the change in the entropy of fusion between anorthite and albite; $\Delta S°(T)$ is the sum of the volume of liquid anorthite, the volume of crystal anorthite, the volume of liquid albite, and the volume of crystal albite, all at a 1 bar (all at a given temperature), multiplied by the pressure in bars.

The hygrometer requires the liquid composition for each sample, the temperature calculated at each pressure, the corresponding pressure, and the X_{An} and X_{Ab} for each spot on all of the analyzed crystals. The constants for Equation 3 can be found in Appendix E. Lange et al. (2009) show that pressure has a minimal effect on the wt. % H_2O for this hygrometer. This is confirmed below.

(Eq. 3)

$$wt.\%H_2O = m'x + a'' + \frac{b''}{T} + \sum d_i'' X_i$$

where

$$x = \left[\frac{\Delta H^\circ(T)}{RT} - \frac{\Delta S^\circ(T)}{RT} + \frac{\int_1^P \Delta V_T^0(P)dP}{RT} + \ln K^* \right]$$

CHAPTER 3

RESULTS

Plagioclase Compositions

Complete plagioclase compositional data for the five Pacaya lavas are given in Appendix A. The frequency of a given X_{An} for all five samples is shown in Figure 5. Most of the analyzed points had $X_{An_{0.6-0.9}}$. Plagioclase crystals in subduction zone volcanic rocks are noted for their variable zoning patterns (Ruprecht and Wörner, 2007; Shcherbakov et al., 2010; Crabtree and Lange, 2011). Two main types of zoning trends were observed in the analyzed plagioclase crystals. The most abundant type of zoning is one in which the X_{An} decreases only slightly from the core out towards the rim and then significantly drops at the rim (Figure 6). Figure 7 shows a few select crystals with constant X_{An}, where there was no significant change in the anorthite content from core to rim. This was the second most abundant type of zoning pattern. In addition, a few crystals exhibited overall reverse zoning. Figure 8a shows that the FeO^T content in the plagioclase crystals exhibits a good negative correlation with X_{An}; this is also true for the MgO content of the plagioclase (Figure 8b). The correlation between FeO^T and X_{An} is unusual for subduction zone volcanic suites (Ginibre et al., 2002; Humphreys et al., 2006; Ruprecht and Wörner, 2007) but is consistent with the partitioning data of Bindeman et al. (1998) in which the partitioning of Fe^{3+} into plagioclase is enhanced at lower X_{An}. The observed negative correlation between FeO^T and X_{An} could be

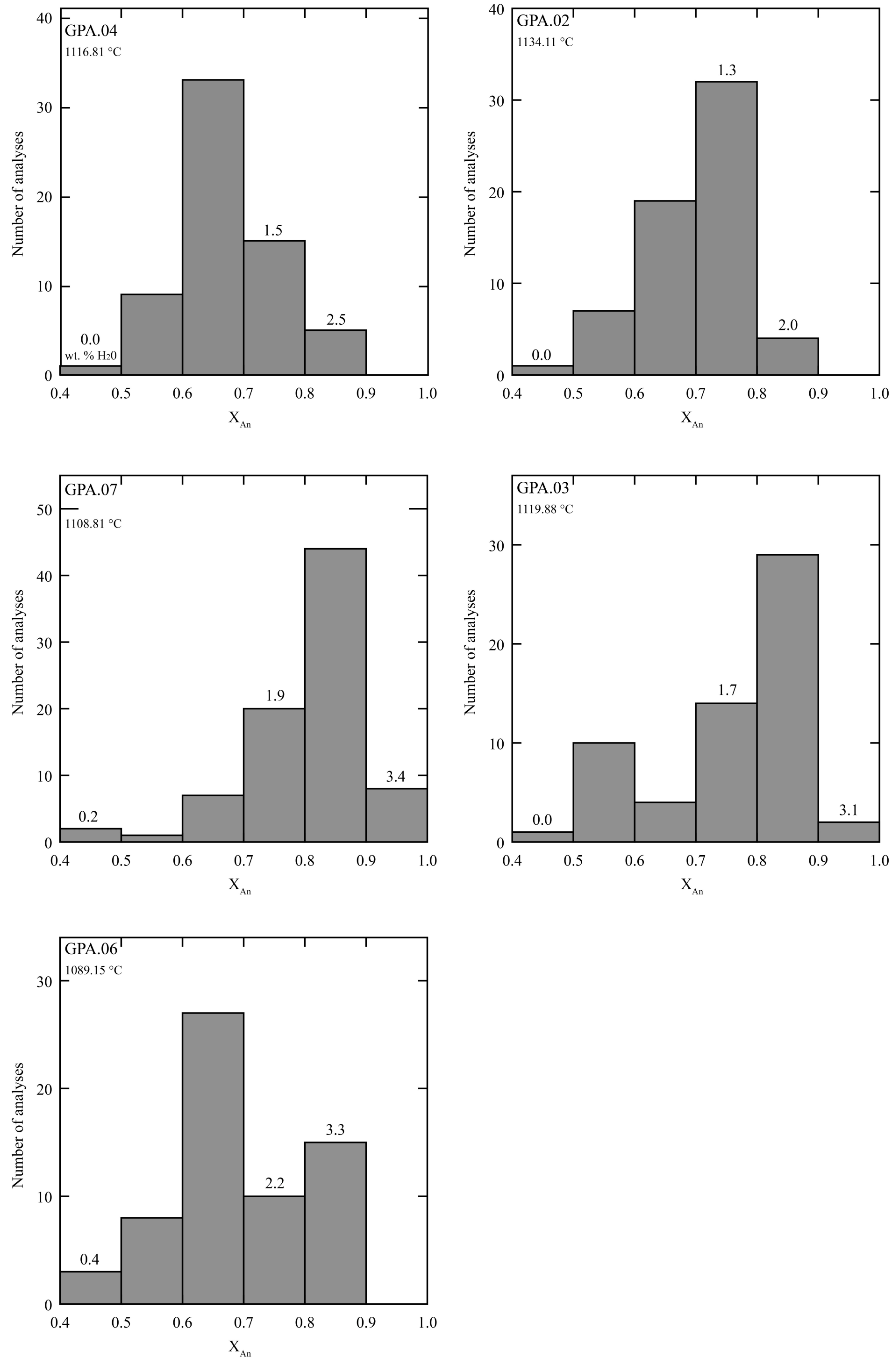

Figure 5. Histograms of plagioclase analyses as a function of X_{An} for each lava. Also shown are representative wt. % H_2O values in the melt determined by the geohygrometer.

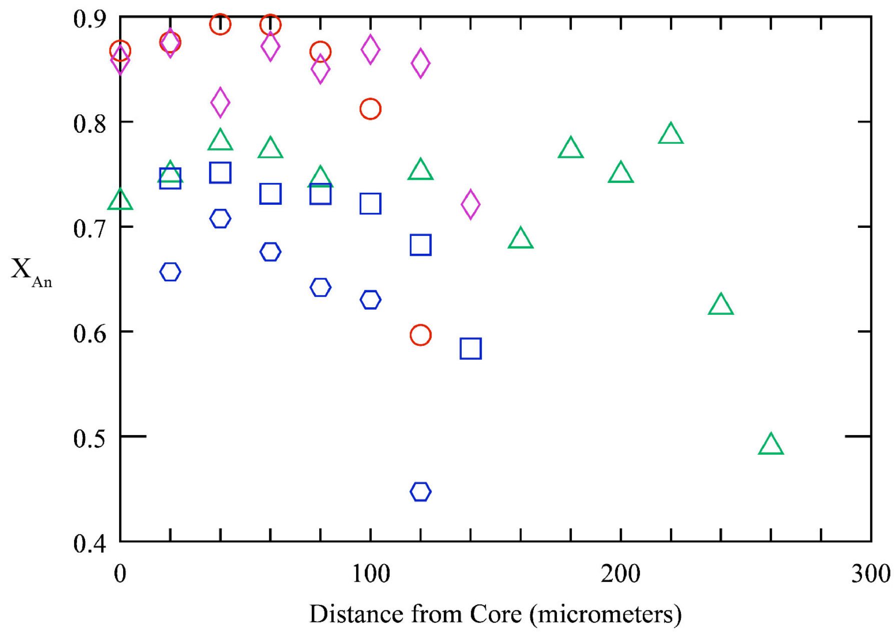

Figure 6. X_{An} vs. distance from core for representative individual crystals which show relatively constant X_{An}. X_{An} is constant across most of the crystal, with a significant drop in X_{An} at the rim. (Hexagons represent GPA.06, diamonds represent GPA.07, triangles represent GPA.04, circles represent GPA.03, and squares represent GPA.02).

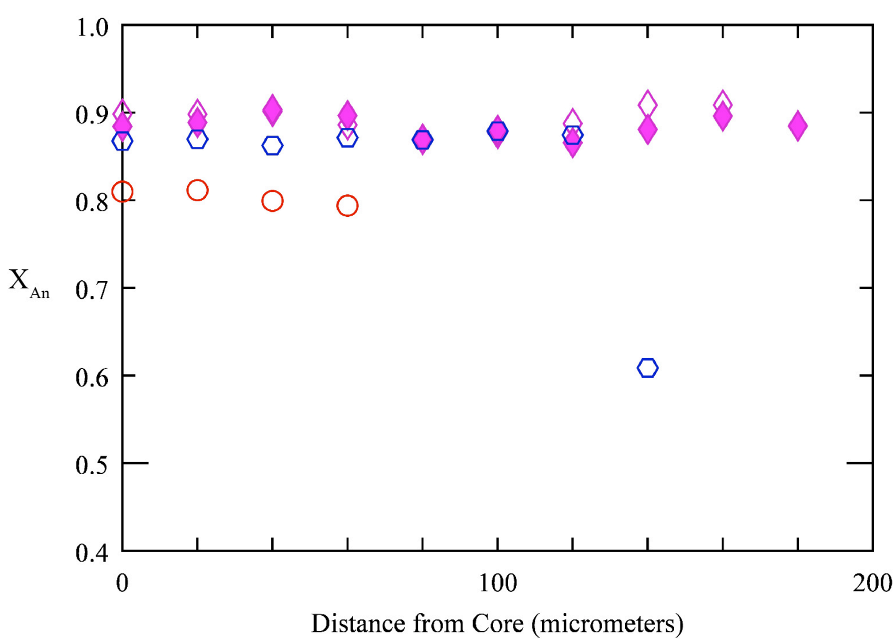

Figure 7. X_{An} vs. distance from core for representative individual crystals which show no significant change in X_{An}, from core to rim. (Hexagons represent GPA.06, open and solid diamonds represent GPA.07, and circles represent GPA.03).

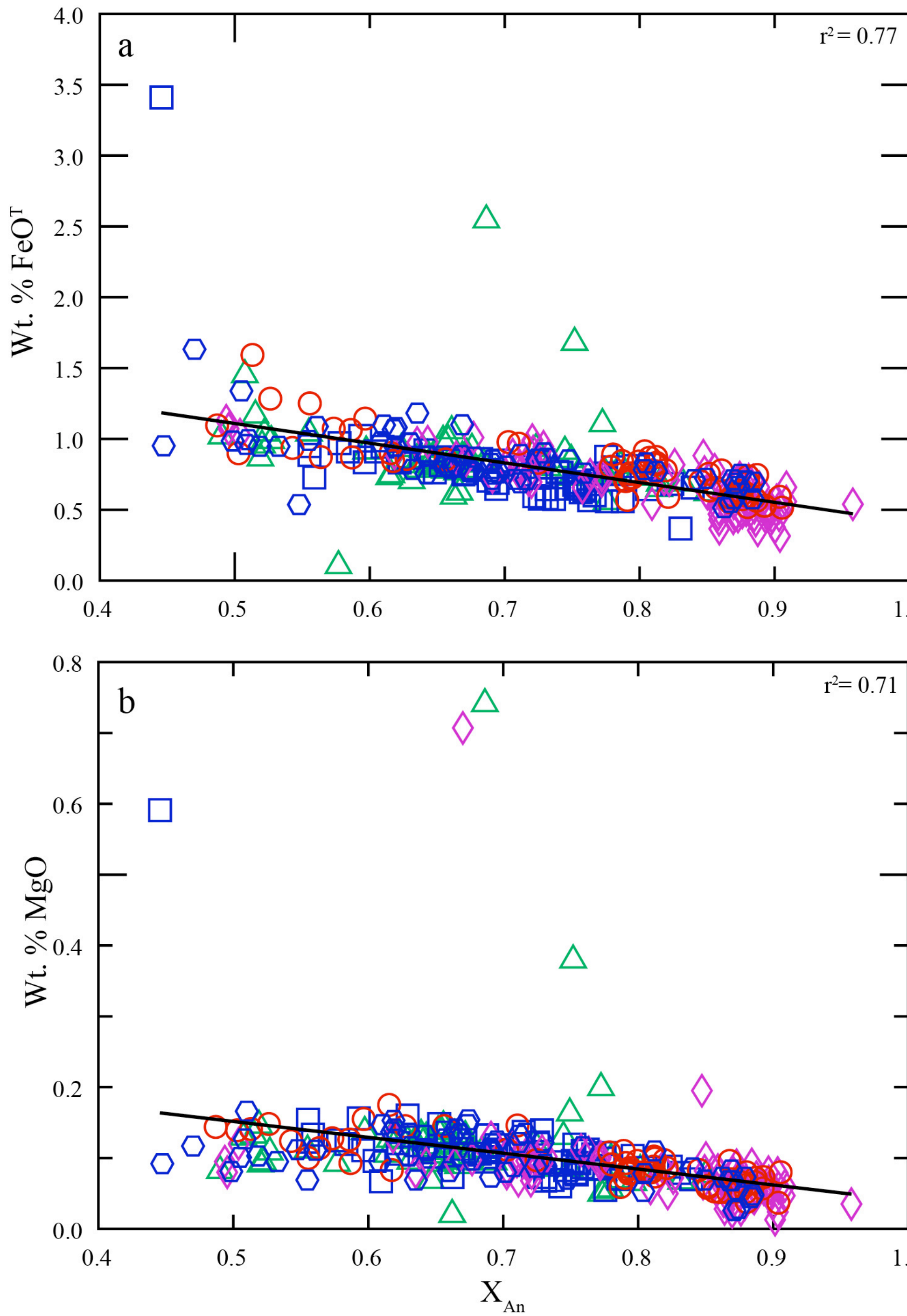

Figure 8. X_{An} vs. wt. % FeO^T and MgO. a) X_{An} vs. wt. % FeO^T for all analyzed crystals. b) X_{An} vs. wt. % MgO for all analyzed crystals. (Hexagons represent GPA.06, diamonds represent GPA.07, triangles represent GPA.04, circles represent GPA.03, and squares represent GPA.02).

the result of increasing fO_2 during crystallization as some experiments show increasing iron contents in plagioclase with increasing fO_2 (Phinney, 1992; Wike and Behrens, 1999; Feig et al., 2010). Alternatively, the cause of the negative correlation in Figure 8a might be increasing SiO_2 contents during progressive crystallization, as Lundgaard and Tegner (2004) suggest more polymerized melts have higher iron activities. Figure 8b shows that the MgO content in the plagioclase crystals also has a negative correlation with X_{An}. The negative correlation between MgO and X_{An} is not unusual for subduction zone volcanoes (e.g., Ruprechet et al., 2012) and reflects increasing partitioning of Mg into plagioclase with decreasing X_{An} (Bindeman et al., 1998).

Temperature Estimates

Calculated temperatures vary between 1090-1150 °C (Table 4). For a given sample the temperatures increase only slightly from 0.100 to 0.300 GPa, almost within error of the thermobarometer (Table 4). These calculated temperatures are consistent with estimated temperatures of basaltic andesite magmas (Sisson and Grove, 1993b; Pichavant et al., 2002; Bouvet de Maisonneuve et al., 2012; Scott et al., 2012). According to the INSUVMEH, lavas from Cerro MacKenny erupt at approximately 850-970 °C, which also makes the calculated crystallization temperatures seem reasonable (Volcán de Pacaya, 2013).

Table 4. Temperatures at Various Pressures for the Plagiolase-Liquid Hygrometer. Temperatures were calculated using the thermobarometer of Putirka (2008) for all five of the samples. SEE= ± 26 °C.

		Mole fraction of phase in the liquid			
Sample #	P (GPa)	X liq SiO_2	X liq Al_2O_3	X liq MgO	T (˚C)
GPA.04-01	0.100	0.548	0.102	0.088	1120
GPA.02-02	0.100	0.551	0.094	0.092	1130
GPA.07-03	0.100	0.557	0.098	0.078	1110
GPA.03-04	0.100	0.550	0.097	0.084	1120
GPA.06-05	0.100	0.546	0.110	0.076	1090
GPA.04-01	0.200	0.548	0.102	0.088	1120
GPA.02-02	0.200	0.551	0.094	0.092	1140
GPA.07-03	0.200	0.557	0.098	0.078	1120
GPA.03-04	0.200	0.550	0.097	0.084	1130
GPA.06-05	0.200	0.546	0.110	0.076	1100
GPA.04-01	0.300	0.548	0.102	0.088	1130
GPA.02-02	0.300	0.551	0.094	0.092	1150
GPA.07-03	0.300	0.557	0.098	0.078	1120
GPA.03-04	0.300	0.550	0.097	0.084	1140
GPA.06-05	0.300	0.546	0.110	0.076	1100

Geohygrometry

Appendix F has the calculated water contents for every analyzed point. The average and maximum calculated wt. % H_2O for each sample at the three different pressures (and temperatures) can be found in Table 5. It is clear that the calculated water contents for each sample negligibly changed over the pressure range of the geohygrometer. Figure 5 shows that the overall range of calculated water contents is from 0.0-3.6 wt. % H_2O. Figure 5 shows that, as a result of the abundant normal zoning shown by individual crystals, plagioclase cores yield the maximum calculated water contents.

Table 5. Average and Maximum wt. % H_2O for Each Sample at Different Temperatures (and Three Different Pressures). SEE = ± 0.32 wt. % H_2O.

			wt. % H_2O	
Sample	Pressure (GPa)	Temp. (°C)	Average	Maximum
GPA.04-01	0.1	1120	0.9	2.3
	0.2	1120	1.0	2.4
	0.3	1130	1.0	2.4
GPA.02-02	0.1	1130	1.0	2.1
	0.2	1140	1.0	2.1
	0.3	1150	1.0	2.0
GPA.07-03	0.1	1110	2.5	3.6
	0.2	1120	2.3	3.4
	0.3	1120	2.4	3.5
GPA.03-04	0.1	1120	1.7	3.1
	0.2	1130	1.7	3.0
	0.3	1140	1.7	3.0
GPA.06-05	0.1	1090	1.8	3.5
	0.2	1100	1.8	3.5
	0.3	1100	1.9	3.5

CHAPTER 4

DISCUSSION

Pacaya's Magmatic Water Contents

Water concentration in lavas from Pacaya Volcano were calculated to be ≤ 3.6 ± 0.32 wt. %, which, while low for subduction zones, overlap with the low H_2O measured in olivine-hosted melt inclusions reported in Walker et al. (2003). The maximum values are somewhat low for volcanoes on the Central American volcanic front, which have water contents between 1.0-6.2 wt. % H_2O (Roggensack, 2001a; Sadofsky et al., 2008; Plank et al., 2013). The global average water content for all arc volcanoes measured from olivine-hosted melt inclusions is 3.9 ± 0.4 wt. % H_2O (Plank et al., 2013), whereas the average water content calculated for Pacaya Volcano using the plagioclase-liquid hygrometer is only 1.6 ± 0.32 wt. % H_2O.

The low water concentrations at Pacaya Volcano could be caused by decompression melting induced by extension in the southern Guatemala region. Decompression melting would allow for melts to be created without the addition of water, thus resulting in magmas with lower water contents than magmas formed through flux melting (e.g., Sisson and Bronto, 1998). Indeed, the rare occurrences of subduction zone mafic rocks whose olivine-hosted melt inclusions have low (≤ 2.5 wt. % H_2O) water contents have been attributed to decompression melting (Sisson and Bronto, 1998; Walker et al., 2003; Kohut et al., 2006).

Decompression melting may be caused by the enhanced extension in southeastern

Guatemala. Northern Central America has at minimum thirteen north-south trending grabens, two of them being the Guatemala City graben (where the Pacaya Complex is located) and the Ipala graben (Guzman-Speziale, 2001), both of which are very close to Pacaya Volcano (Figure 9). Deformation associated with the relative motions along the North American-Caribbean plate boundary results in extension within the grabens in southern Guatemala (Guzman-Speziale, 2001; Rodriguez et al., 2009). An estimated 60% of the plate motion along both the Motagua and Polochic faults in eastern Guatemala is transferred to the grabens in southern Guatemala, where the Pacaya Complex is located (Rodriguez et al., 2009). Extension within the Guatemalan grabens trends east-west and can range from at least 8 mm/yr in the Guatemala City graben to as fast as 20 mm/yr (Guzman-Speziale, 2001; Lyon-Caen et al., 2006; Rodriguez et al., 2009). Comparatively, extension at mid-ocean ridges ranges from about 10-150 mm/yr and extension in the Rio Grande Rift has been estimated to be about 0.3-5.0 mm/yr (Berglund et al., 2012; Woodward, 1977). Research has shown that magmas are generated by decompression melting in the Rio Grande Rift (Reid et al., 2012). It is therefore plausible that decompression melts are being produced in or near the Guatemala City graben where extension is greater than that in the Rio Grande Rift. Furthermore, the subducting slab input and degree of melting were assessed in a previous study by Cameron et al. (2002) to determine the major cause of melt generation beneath the Pacaya Complex. Trace element ratios, Ba/La and La/Yb, in lavas from Pacaya were compared, and these data suggest that decompression melting plays a large role in generating magmas which erupt from Pacaya (Cameron et al., 2002).

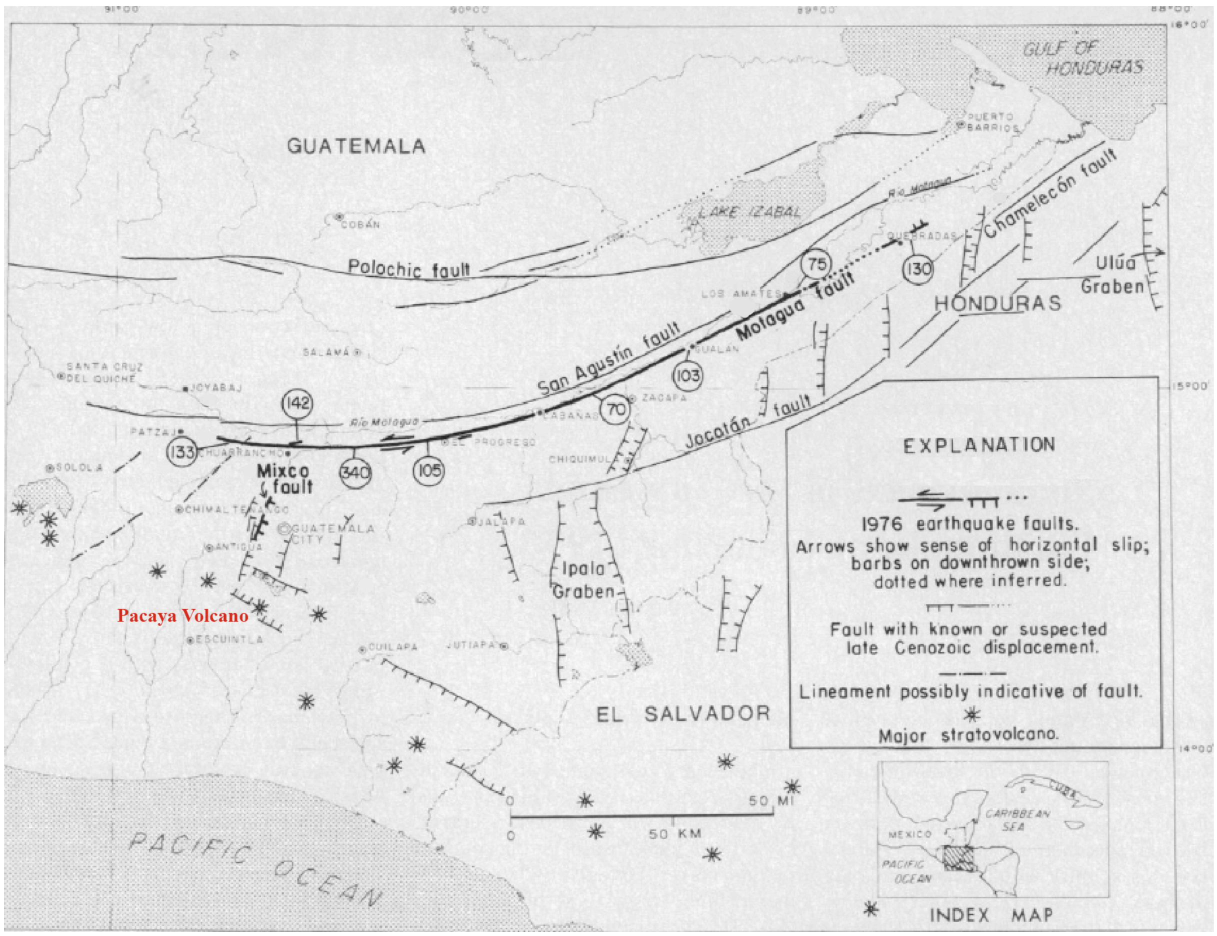

Figure 9. Structural map of southeastern Guatemala. Modified from Plafker, 1976.

Another possible cause of the unusually low magmatic water contents at Pacaya is extensive subterranean degassing. Both open- and closed-system degassing models for mafic magmas show that unlike CO_2, which can begin degassing at significant depths (>500 MPa), H_2O is only substantially affected by degassing below approximately 200 MPa (Figure 10) (e.g., Wallace, 2005). Nevertheless, Pacaya's plagioclase crystals could have largely formed at relatively shallow depths.

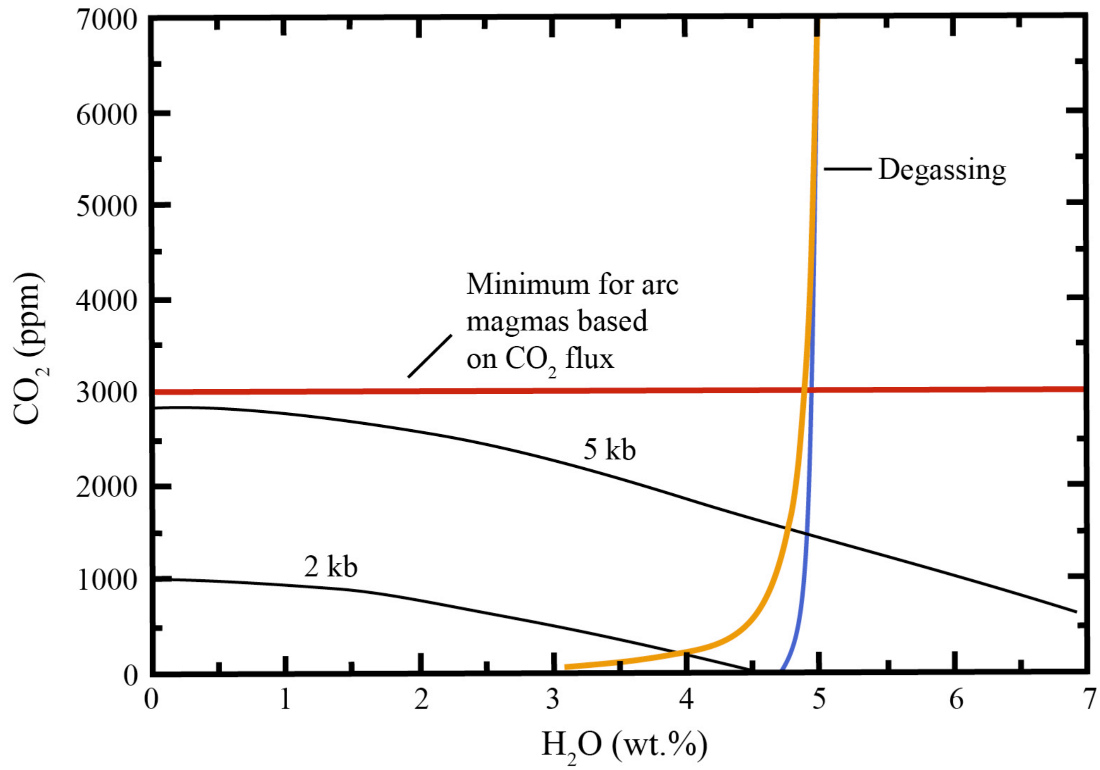

Figure 10. Degassing of CO_2 and H_2O. Modified from Wallace (2005). The orange curve represents closed-system degassing and the blue curve represents open-system degassing.

Cerro MacKenny's Recent Magma Differentiation

The water content of mafic magmas exerts a strong influence on magmatic differentiation specifically; plagioclase crystallization is enhanced at lower magmatic water contents (Sisson and Grove, 1993a; Müntener et al., 2001). This could explain the plethora of plagioclase crystals found in the lavas from Pacaya Volcano and their tholeiitic character (Sisson and Grove, 1993a). Cerro MacKenny of Pacaya has exclusively erupted basaltic andesites, showing little compositional variation for centuries (Eggers, 1971; Bardintzeff and Deniel, 1992; Cameron et al., 2002; Rose et al., 2013). Relative compositional homogeneity is seen at a number of other basaltic andesite arc volcanoes such as North Sister Volcano and Mount Hood in the Cascades and Masaya in Nicaragua (Walker et al., 1993; Schmidt and Grunder, 2011; Koleszar et al., 2012). Such volcanoes require the existence of a magma reservoir at depth that is maintained and buffered by periodic mafic recharge (e.g., Kent et al., 2010; Schmidt and Grunder, 2011). The presence of a single trend of FeO^T variation with X_{An} (Figure 8) suggests that Pacaya's recent lavas emanate from such a single, compositionally-buffered magmatic reservoir (Hattori and Sato, 1996; Ginibre et al., 2002; Ruprecht and Wörner, 2007; Humphreys et al., 2006). The paucity of reverse zoning in most of the plagioclase crystals analyzed in this study suggests that they crystallized after the magmas left this buffered environment.

CHAPTER 5

CONCLUSIONS

Water contents calculated using the geohygrometer of Lange et al. (2009) indicate that the water concentrations in the lavas from Pacaya Volcano are lower than typical subduction zone volcanoes on the volcanic front (e.g., Plank et al., 2013). This is consistent with the low water contents found in olivine-hosted melt inclusions by Walker et al. (2003). Lower water contents at Pacaya Volcano could in part be due to decompression melting caused by the regional extension in southern Guatemala caused by interactions along the North American-Caribbean plate boundary. Lower water contents also could be the result of significant degassing at relatively low pressures (≤ 200 MPa). Preliminary results indicate that analyzed plagioclase crystals formed from the same magmatic system, as there is a single trend in the iron content vs. the mole fraction An.

To better understand the mechanism(s) by which magmas are generated at Pacaya Volcano and, therefore, the cause of the low water contents, further investigation is necessary. There are numerous avenues of future work on the Pacaya Complex that can be explored so that the complex is better understood and hazards can be assessed more accurately. Plagioclase-hosted melt inclusions in tephras could be analyzed for further confirmation of inherently low water contents in Pacaya's mafic magmas. Geophysical data would help to identify and locate possible magma chambers beneath Pacaya Volcano, which would provide additional constraints on the P-T regime of magmatic differentiation. In addition, a more extensive look at the zoning in the plagioclase crystals could lend further insight into crystallization processes beneath Pacaya (e.g., Ruprecht and Wörner, 2007; Crabtree and Lange, 2011; Shcherbakov et al., 2011). Additionally, the largest phenocrysts (those greater than a few centimeters) in Pacaya's lavas could be analyzed to determine if they indeed formed from the magma in which they are embedded or if they are perhaps antecrysts or xenocrysts. As stated earlier, estimates of pre-eruptive magmatic CO_2 concentrations for Pacaya Volcano do not exist. To adequately determine the extent of pre-eruptive magmatic degassing, the CO_2 contents of melt inclusions should be analyzed.

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APPENDIX A

NORTHERN ILLINOIS UNIVERSITY ELECTRON MICROPROBE

PLAGIOCLASE ANALYSES FOR PACYA VOLCANO

Table A.1
Electron Microprobe Data

Crystal	Weight Percent									Dist. From
GPA.04	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO	Total	Beam	Core (μm)
1	29.665	52.716	13.173	3.902	0.115	0.870	0.104	100.586	15.660	0
	29.657	52.838	12.476	3.790	0.156	0.844	0.126	99.887	15.650	20
	30.039	52.868	13.281	3.743	0.169	0.778	0.145	101.023	15.623	40
2	30.083	51.349	12.937	3.676	0.177	0.806	0.092	99.121	15.519	0
	30.245	51.721	13.803	3.748	0.152	0.765	0.116	100.550	15.507	20
	29.526	52.210	12.614	4.237	0.165	0.745	0.126	99.623	15.506	40
	30.089	50.872	12.865	3.815	0.204	0.886	0.129	98.859	15.492	60
	29.930	50.832	13.132	3.766	0.171	0.805	0.138	98.773	15.481	80
3	31.880	49.909	14.598	2.887	0.105	0.795	0.085	100.258	15.689	0
	32.372	49.549	16.169	2.443	0.132	0.748	0.056	101.468	15.672	20
	32.785	48.667	16.869	2.059	0.091	0.685	0.080	101.237	15.674	40
	33.347	47.909	16.576	2.026	0.093	0.648	0.079	100.678	15.665	60
	33.092	49.055	15.798	2.186	0.069	0.728	0.065	100.992	15.656	80
	30.635	51.520	13.594	3.477	0.169	0.782	0.112	100.290	15.642	100
	30.495	52.377	13.135	3.634	0.138	0.794	0.095	100.667	15.614	120
	30.528	52.757	13.034	3.576	0.187	1.056	0.096	101.233	15.608	140
	30.757	51.383	13.039	3.442	0.196	0.876	0.101	99.794	15.580	160
5	27.158	54.407	10.484	5.187	0.399	1.166	0.132	99.033	15.407	0
	27.734	54.340	10.366	5.016	0.348	1.039	0.094	98.936	15.410	20
6	29.743	51.888	13.184	3.746	0.157	0.987	0.137	99.834	15.426	0
	29.728	52.974	12.843	3.885	0.188	0.925	0.133	100.676	15.421	20
	28.859	54.049	11.868	4.295	0.192	0.913	0.137	100.314	15.396	40
7	31.495	49.470	15.243	3.128	0.145	0.931	0.120	100.532	15.396	0
	32.104	49.490	15.031	2.711	0.104	0.852	0.163	100.454	15.395	20
	32.731	48.217	16.261	2.460	0.116	0.731	0.099	100.616	15.390	40
	32.192	48.593	15.853	2.462	0.181	1.106	0.199	100.586	15.382	60
	32.325	48.402	14.328	2.616	0.152	0.910	0.130	98.863	15.375	80
	31.061	48.882	15.275	2.661	0.192	1.680	0.379	100.130	15.379	120
	29.057	49.304	14.029	3.182	0.547	2.544	0.741	99.403	15.402	160
	32.611	47.679	15.848	2.477	0.155	0.750	0.050	99.570	15.373	180
	32.237	48.512	15.866	2.900	0.056	0.728	0.085	100.384	15.367	200
	33.189	48.204	15.824	2.324	0.086	0.810	0.069	100.506	15.402	220
	30.198	51.585	12.633	4.105	0.172	0.930	0.132	99.755	15.402	240
	27.958	54.045	9.719	5.342	0.374	1.019	0.082	98.540	15.367	260
t	29.105	50.718	14.147	3.719	0.153	0.897	0.131	98.870	15.181	0
	29.029	51.566	13.920	3.803	0.138	0.827	0.133	99.416	15.163	40
	26.663	55.583	10.994	5.244	0.319	0.986	0.108	99.898	15.140	60
u	30.132	51.778	14.443	3.779	0.131	0.821	0.120	101.206	15.605	0
	29.934	52.575	13.648	3.827	0.122	0.834	0.118	101.057	15.588	20
	29.644	53.105	12.833	4.081	0.149	0.851	0.124	100.788	15.590	40

(continued on following page).

Table A.1 (continued).

	29.546	52.846	13.277	4.115	0.165	0.816	0.124	100.889	15.589	80
y	30.220	51.973	14.448	3.564	0.180	0.827	0.110	101.321	15.163	20
	29.612	51.939	14.176	3.904	0.140	0.594	0.020	100.456	15.146	40
	29.837	52.338	14.166	3.814	0.155	0.622	0.089	101.021	15.124	60
	29.085	52.559	12.871	4.039	0.181	0.703	0.095	99.532	15.099	80
z	30.165	51.274	14.863	3.550	0.134	0.754	0.094	100.833	15.267	0
	30.118	51.912	13.991	3.637	0.113	0.931	0.094	100.795	15.255	20
aa	27.376	54.433	11.259	4.823	0.251	1.039	0.111	99.292	15.595	0
	27.011	54.632	10.636	5.218	0.350	0.863	0.146	98.857	15.586	20
ba	26.625	55.748	11.032	5.399	0.340	0.955	0.091	100.189	15.597	0
	26.527	55.709	10.557	5.425	0.359	1.451	0.129	100.157	15.597	20
ca	31.917	49.151	16.536	2.604	0.093	0.761	0.079	101.141	15.587	0
	31.680	49.781	15.674	2.743	0.116	0.753	0.088	100.835	15.576	20
	31.779	48.632	16.309	2.540	0.105	0.556	0.054	99.976	15.582	40
	32.368	48.142	16.703	2.241	0.068	0.810	0.083	100.415	15.597	60
	32.861	47.529	17.331	1.880	0.087	0.686	0.067	100.441	15.582	80
	33.280	46.916	17.992	1.719	0.051	0.618	0.076	100.641	15.598	100
	27.772	54.663	12.488	4.889	0.266	0.103	0.092	101.203	15.587	160
da	28.752	52.886	12.838	4.325	0.194	0.731	0.105	99.830	15.593	0
	28.522	52.759	13.494	4.140	0.179	0.783	0.113	99.989	15.605	20
	29.215	52.056	12.967	3.828	0.156	0.800	0.117	99.139	15.591	40
	29.047	52.713	13.601	3.995	0.176	0.826	0.068	100.426	15.582	60
	29.249	52.600	14.139	3.914	0.214	0.989	0.109	101.215	15.590	80

Crystal	Weight Percent									Dist. From
GPA.02	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO	Total	Beam	Core (μm)
23	31.870	49.151	14.927	2.757	0.082	0.649	0.083	99.519	15.852	20
	31.562	50.142	15.911	2.855	0.080	0.676	0.096	101.321	15.841	40
	31.400	49.554	15.777	3.116	0.133	0.581	0.073	100.634	15.842	60
	31.346	50.791	15.469	3.091	0.078	0.645	0.068	101.488	15.820	80
	31.567	50.466	14.937	3.115	0.099	0.596	0.088	100.868	15.840	100
	29.984	49.894	14.500	3.631	0.142	0.858	0.106	99.116	15.834	120
	28.888	53.353	11.502	4.426	0.160	0.911	0.120	99.361	15.834	140
25	31.864	48.442	15.924	2.552	0.173	0.707	0.104	99.765	15.829	20
	31.406	48.896	15.841	2.460	0.110	0.559	0.055	99.328	15.832	40
	31.121	49.551	15.009	2.855	0.113	0.768	0.094	99.510	15.822	60
	29.110	51.922	13.561	3.886	0.276	0.764	0.102	99.620	15.857	80
	27.718	54.302	11.117	4.706	0.216	0.727	0.133	98.919	15.838	100
26	31.922	48.024	15.712	2.517	0.189	0.602	0.105	99.071	15.856	40
	30.891	48.966	14.821	3.387	0.321	0.690	0.118	99.194	15.838	60
	31.846	47.681	15.463	2.562	0.230	0.649	0.110	98.541	15.832	80
	31.500	48.928	15.023	2.891	0.120	0.575	0.069	99.105	15.835	100
	31.659	49.569	15.719	2.760	0.121	0.673	0.079	100.580	15.864	120

(continued on following page).

Table A.1 (continued).

	31.967	49.028	16.479	2.401	0.088	0.559	0.071	100.591	15.851	140
	32.428	48.392	16.750	2.329	0.069	0.809	0.103	100.879	15.837	160
27	31.847	49.003	15.869	2.806	0.053	0.694	0.093	100.365	15.829	0
	31.906	49.116	15.407	2.760	0.056	0.668	0.119	100.032	15.847	40
	32.241	49.251	15.739	2.719	0.067	0.634	0.087	100.738	15.817	60
	31.674	50.021	15.545	2.935	0.075	0.762	0.060	101.070	15.818	80
	28.868	54.230	12.379	4.577	0.183	1.021	0.156	101.414	15.821	100
15	31.893	49.083	15.872	2.782	0.109	0.650	0.077	100.465	15.853	0
	31.414	50.520	15.322	3.119	0.115	0.579	0.073	101.142	15.867	20
	32.080	48.862	16.100	2.667	0.157	0.568	0.112	100.547	15.832	40
	31.451	49.529	15.624	3.093	0.222	0.749	0.104	100.772	15.849	60
	29.970	51.873	13.507	4.071	0.161	0.920	0.108	100.611	15.850	100
	28.575	52.561	12.602	4.477	0.361	0.835	0.111	99.522	15.847	120
17	32.384	49.020	15.627	2.459	0.068	0.874	0.107	100.539	15.847	0
	32.405	49.235	16.034	2.550	0.049	0.756	0.099	101.127	15.840	20
	31.491	49.125	15.754	2.741	0.097	0.623	0.093	99.924	15.851	40
	32.270	48.980	15.738	2.617	0.095	0.681	0.085	100.465	15.854	60
	28.107	54.967	11.310	4.848	0.240	0.887	0.154	100.514	15.854	100
ea	28.862	52.376	12.519	4.434	0.137	0.912	0.096	99.336	15.503	0
	22.689	57.050	8.807	5.373	1.035	3.410	0.591	98.955	15.505	20
fa	32.064	48.454	16.327	2.479	0.097	0.799	0.089	100.308	15.505	0
	30.822	49.888	14.661	3.149	0.118	0.802	0.137	99.576	15.514	20
ga	30.944	49.737	15.434	3.176	0.085	0.838	0.096	100.311	15.527	20
	30.064	51.551	14.182	3.995	0.098	0.846	0.136	100.871	15.512	40
	30.395	51.014	14.279	3.534	0.097	0.781	0.095	100.195	15.512	80
	30.391	51.141	14.258	3.491	0.124	0.706	0.132	100.244	15.507	100
	29.506	51.364	13.683	3.935	0.138	0.870	0.117	99.614	15.524	120
	29.175	51.530	12.599	4.086	0.223	0.850	0.106	98.570	15.511	140
ha	32.676	46.544	17.990	1.989	0.067	0.367	0.079	99.710	15.528	0
	32.096	48.244	16.335	2.416	0.080	0.752	0.071	99.993	15.530	20
	31.041	49.129	15.079	3.018	0.128	0.850	0.139	99.383	15.542	40
	29.774	51.705	14.172	3.886	0.160	0.867	0.073	100.637	15.543	60
ia	32.722	46.751	16.870	1.962	0.040	0.682	0.088	99.115	15.539	0
	32.979	46.675	16.938	1.752	0.063	0.657	0.070	99.133	158.54	20
	32.415	48.059	16.746	2.214	0.033	0.645	0.086	100.199	15.533	40
ja	29.923	51.024	13.886	3.700	0.137	0.75	0.113	99.512	15.544	0
	28.665	52.169	13.172	4.488	0.268	0.945	0.067	99.774	15.532	20
	30.247	50.529	14.030	3.736	0.101	0.757	0.105	99.506	15.535	40
	30.959	49.547	15.288	3.126	0.099	0.724	0.122	99.866	15.528	60
	30.58	50.146	14.526	3.426	0.100	0.848	0.111	99.736	15.536	80
ka	29.887	50.035	14.580	3.488	0.106	0.647	0.108	98.851	15.530	0
	28.007	53.181	11.795	4.655	0.170	0.970	0.125	98.903	15.558	40
	28.951	52.147	13.298	4.347	0.176	0.834	0.121	99.874	15.546	60
la	28.925	52.389	13.514	4.300	0.156	0.867	0.160	100.310	15.552	0

(continued on following page).

Table A.1 (continued).

Crystal GPA.07	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO	Total	Beam	Dist. From Core (μm)
	29.759	51.869	13.917	3.999	0.146	0.814	0.148	100.653	15.557	20
	27.480	54.240	11.672	4.984	0.276	0.949	0.123	99.723	15.561	40
33	26.910	55.788	10.411	5.429	0.356	1.030	0.120	100.044	15.381	0
	26.846	56.251	10.481	5.627	0.415	1.071	0.080	100.769	15.373	20
35	26.476	56.475	10.447	5.693	0.346	1.128	0.095	100.659	15.121	0
34	31.641	47.844	16.479	2.647	0.070	0.703	0.091	99.476	15.760	0
	32.029	47.946	15.352	2.452	0.076	0.747	0.101	98.703	15.735	40
	31.823	48.509	15.023	2.432	0.034	0.743	0.098	98.611	15.785	60
	31.390	48.770	15.440	2.680	0.077	0.657	0.111	99.125	15.795	80
	30.580	49.611	14.707	3.119	0.118	0.710	0.108	98.953	15.777	100
	28.632	51.996	12.716	4.213	0.188	0.898	0.130	98.773	15.767	120
36	33.450	45.357	18.166	1.733	0.076	0.627	0.082	99.491	15.791	0
	33.603	45.928	18.284	1.606	0.079	0.366	0.083	99.950	15.780	20
	33.970	46.374	17.871	1.518	0.039	0.573	0.059	100.404	15.769	40
	34.139	46.153	18.202	1.347	0.057	0.496	0.035	100.428	15.761	60
	33.710	46.006	17.014	1.450	0.063	0.593	0.039	98.875	15.756	80
	34.237	46.085	17.218	1.431	0.062	0.592	0.068	99.692	15.736	100
37	34.180	44.942	18.701	0.453	0.000	0.539	0.035	98.849	15.759	0
	33.800	45.353	19.309	1.213	0.023	0.498	0.067	100.334	15.790	20
	33.389	46.569	18.130	1.614	0.051	0.430	0.070	100.253	15.784	60
	33.297	46.963	18.170	1.642	0.022	0.469	0.057	99.620	15.791	80
	33.235	46.184	17.326	1.413	0.016	0.463	0.079	98.716	15.800	100
	33.504	46.253	18.391	1.456	0.036	0.452	0.090	100.182	15.776	120
	33.346	46.226	17.456	1.500	0.027	0.649	0.062	99.266	15.754	140
	29.855	51.158	14.287	3.447	0.129	0.732	0.129	99.736	15.757	160
j	33.753	45.813	18.235	1.622	0.056	0.504	0.082	100.065	15.209	0
	34.162	46.301	18.467	1.433	0.040	0.488	0.047	100.938	15.205	20
	32.835	47.317	16.373	1.970	0.062	0.715	0.087	99.357	15.209	40
	33.705	46.217	18.570	1.477	0.049	0.589	0.056	100.664	15.198	60
	33.707	46.628	17.545	1.676	0.049	0.615	0.100	100.320	15.185	80
	33.759	46.506	17.103	1.403	0.039	0.598	0.051	99.458	15.185	100
	33.623	46.155	17.727	1.622	0.047	0.782	0.082	100.038	15.202	120
	30.838	50.113	14.844	3.101	0.108	0.910	0.079	99.992	15.179	140
k	33.755	44.808	18.340	1.118	0.047	0.447	0.057	98.572	15.173	0
	33.889	44.620	18.766	1.150	0.040	0.452	0.058	98.975	15.181	20
	33.783	45.011	19.105	1.106	0.075	0.566	0.013	99.660	15.144	40
	32.491	43.874	18.119	1.218	0.109	0.424	0.043	96.279	15.167	60
	33.367	46.580	18.446	1.485	0.066	0.546	0.024	100.516	15.144	80
	33.368	46.236	17.870	1.356	0.062	0.482	0.027	99.400	15.131	100
	33.763	45.438	18.198	1.222	0.080	0.355	0.073	99.128	15.123	120

Weight Percent: Al_2O_3 through MgO.

(continued on following page).

Table A.1 (continued).

	33.881	45.744	18.837	1.012	0.054	0.558	0.047	100.133	15.117	140
	33.705	45.830	19.480	1.030	0.079	0.659	0.061	100.842	15.141	160
l	29.915	50.677	15.502	3.144	0.069	0.944	0.110	100.361	15.220	20
	30.251	50.819	14.890	3.149	0.149	0.926	0.096	100.280	15.188	40
	29.379	51.190	15.074	3.324	0.090	0.751	0.068	99.876	15.163	60
	29.695	50.249	14.799	3.131	0.077	0.696	0.098	98.746	15.188	80
	30.112	50.131	14.275	3.007	0.080	0.992	0.068	98.666	15.161	100
	30.283	49.704	16.348	2.764	0.057	0.748	0.108	100.012	15.151	120
n	34.435	45.102	18.919	1.139	0.029	0.377	0.037	100.036	15.149	0
	34.803	45.421	19.210	1.096	0.047	0.315	0.058	100.951	15.159	20
	34.818	46.042	18.834	1.103	0.016	0.461	0.024	101.298	15.150	40
	33.909	46.197	17.811	1.732	0.050	0.766	0.064	100.529	15.135	60
	31.423	50.001	15.352	3.066	0.055	0.872	0.102	100.873	15.144	80
o	33.809	45.246	18.268	1.311	0.017	0.707	0.091	99.449	15.132	0
	33.894	45.744	18.522	1.253	0.046	0.659	0.053	100.170	15.131	20
	34.207	45.251	19.366	1.131	0.022	0.515	0.079	100.572	15.139	40
	33.906	45.863	18.315	1.150	0.029	0.524	0.080	99.867	15.124	60
	33.332	45.926	18.582	1.516	0.040	0.440	0.035	99.867	15.128	80
	33.902	46.079	18.495	1.388	0.014	0.658	0.064	100.598	15.158	100
	33.918	46.170	17.309	1.474	0.015	0.591	0.063	99.541	15.148	120
	34.154	46.027	17.963	1.302	0.063	0.711	0.065	100.285	15.170	140
	34.194	45.811	19.529	1.230	0.034	0.467	0.056	101.321	15.159	160
	34.060	46.163	18.518	1.302	0.046	0.459	0.052	100.600	15.144	180
p	31.175	50.383	15.043	3.155	0.125	0.778	0.089	100.747	15.550	0
	30.607	50.679	14.600	3.315	0.152	0.782	0.078	100.213	15.528	40
	30.872	51.269	14.370	3.255	0.142	0.796	0.083	100.787	15.518	60
	30.906	50.978	14.936	3.289	0.130	0.774	0.099	101.114	15.506	80
	29.794	52.889	13.463	4.013	0.182	0.980	0.092	101.411	15.518	100
q	33.195	47.058	17.585	2.006	0.064	0.818	0.072	100.798	15.503	0
	34.408	46.799	18.140	1.279	0.036	0.516	0.045	101.223	15.516	20
	32.360	47.774	16.507	2.082	0.106	0.540	0.057	99.426	15.534	40
	33.298	47.347	16.838	1.992	0.036	0.708	0.050	100.267	15.523	60
	31.417	49.230	15.105	3.086	0.106	0.845	0.095	99.883	15.514	80
r	29.908	50.991	14.203	3.772	0.140	0.828	0.707	99.921	15.523	0
	29.505	52.448	12.777	3.981	0.116	0.972	0.080	99.879	15.514	20
	29.919	51.350	14.341	3.722	0.092	1.010	0.098	100.532	15.507	40
	30.789	49.289	14.396	3.172	0.116	0.797	0.095	98.653	15.500	60
	29.717	50.497	14.072	3.834	0.150	0.870	0.092	99.232	15.512	100
s	33.828	45.128	17.354	1.342	0.057	0.727	0.074	98.510	15.520	0
	33.933	45.689	17.282	1.367	0.207	0.530	0.028	99.035	15.514	20
	33.489	47.164	17.696	1.633	0.199	0.882	0.195	101.260	15.480	40
	34.343	46.213	18.269	1.354	0.150	0.703	0.061	101.094	15.509	80
	34.279	45.620	18.081	1.149	0.070	0.450	0.056	99.705	15.505	100
	30.773	49.985	14.402	3.171	0.219	0.889	0.116	99.555	15.518	120

(continued on following page).

Table A.1 (continued).

Crystal	Weight Percent									Dist. From
GPA.03	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO	Total	Beam	Core (μm)
40	34.036	46.660	18.578	1.277	0.046	0.746	0.072	101.414	15.461	0
	33.611	47.676	17.525	1.658	0.036	0.636	0.061	101.201	15.453	20
	33.316	47.587	17.858	1.583	0.024	0.778	0.052	101.197	15.424	40
	31.885	49.388	16.269	2.381	0.081	0.844	0.059	100.908	15.369	60
41	28.566	54.000	12.736	4.799	0.240	0.869	0.093	101.303	15.354	0
	27.601	54.261	11.157	5.027	0.257	0.937	0.124	99.364	15.347	20
	26.864	56.100	10.437	5.479	0.340	0.899	0.139	100.259	15.377	40
	28.124	54.681	11.954	4.942	0.257	0.872	0.114	100.944	15.314	60
	28.967	53.188	12.823	4.311	0.178	0.900	0.175	100.541	15.306	80
42	34.542	46.421	17.946	1.331	0.034	0.519	0.052	100.917	15.292	0
	34.326	47.488	17.518	1.302	0.019	0.692	0.038	101.384	15.326	20
	34.521	46.564	18.331	1.275	0.032	0.564	0.066	101.354	15.341	40
	33.832	47.427	17.634	1.747	0.064	0.701	0.083	101.489	15.301	60
	33.912	47.157	17.032	1.628	0.025	0.754	0.058	100.567	15.302	80
	30.604	51.641	14.021	3.186	0.138	0.978	0.112	100.681	15.272	120
44	33.100	48.266	16.253	1.918	0.059	0.591	0.086	100.272	15.292	40
	31.479	48.529	16.040	2.252	0.060	0.726	0.080	99.167	15.312	60
	32.696	48.135	16.890	2.018	0.061	0.779	0.097	100.676	15.311	80
	32.514	48.937	15.687	2.410	0.081	0.804	0.108	100.541	15.294	100
	26.623	55.488	10.095	5.582	0.450	1.096	0.144	99.478	15.284	120
45	34.198	45.468	17.956	1.469	0.066	0.584	0.096	99.837	15.397	0
	34.287	45.353	17.209	1.334	0.022	0.574	0.066	98.846	15.403	20
	34.585	46.399	18.370	1.201	0.028	0.529	0.073	101.186	15.380	40
	34.637	46.121	17.945	1.189	0.014	0.529	0.057	100.492	15.324	60
	34.605	45.796	17.271	1.432	0.055	0.555	0.051	99.765	15.340	80
	33.053	48.434	16.368	2.052	0.060	0.873	0.099	100.939	15.369	100
	28.902	52.292	12.211	4.419	0.218	1.143	0.155	99.338	15.422	120
46	30.792	50.296	16.091	2.062	0.093	0.867	0.080	100.281	15.425	0
	31.691	48.781	17.977	1.605	0.091	0.654	0.053	100.853	15.423	60
	31.231	49.571	16.015	2.014	0.046	0.832	0.074	99.782	15.414	80
47	32.014	49.861	16.443	2.114	0.031	0.757	0.080	101.299	15.389	0
	31.538	48.960	16.520	2.078	0.062	0.772	0.102	100.033	15.404	20
	31.340	48.761	16.381	2.229	0.066	0.841	0.096	99.714	15.392	40
	31.668	50.232	15.871	2.233	0.067	0.753	0.086	100.911	15.399	60
48	34.595	46.442	18.305	1.075	0.003	0.592	0.037	101.049	15.413	0
	34.823	45.277	17.855	1.003	0.041	0.515	0.080	99.594	15.391	20
	34.393	46.384	17.959	1.277	0.027	0.586	0.048	100.674	15.416	40
	34.608	46.398	17.004	1.260	0.028	0.596	0.080	99.973	15.427	60
	33.127	48.787	16.109	2.033	0.056	0.819	0.088	101.020	15.440	80
	28.000	54.842	11.777	4.728	0.176	1.073	0.128	100.723	15.445	100
50	34.897	45.811	18.397	1.476	0.079	0.599	0.070	101.329	15.324	20

(continued on following page).

Table A.1 (continued).

	35.047	46.263	17.849	1.384	0.028	0.606	0.054	101.231	15.323	40
	34.958	43.707	17.914	1.322	0.035	0.737	0.062	98.736	15.317	60
	34.837	43.568	18.200	1.422	0.042	0.633	0.053	98.755	15.312	80
	33.545	48.036	16.055	2.287	0.041	0.757	0.078	100.799	15.289	100
ma	32.921	48.885	16.327	2.314	0.072	0.727	0.083	101.329	15.617	0
	92.955	48.630	15.843	2.291	0.051	0.703	0.072	100.544	15.571	20
	92.928	47.836	15.682	2.237	0.085	0.570	0.093	99.400	15.550	40
	33.033	48.360	16.200	2.350	0.063	0.703	0.110	100.819	15.529	60
	30.318	51.989	12.984	3.668	0.135	0.856	0.145	100.095	15.477	80
na	31.785	48.834	14.696	2.998	0.133	0.831	0.097	99.344	15.528	0
	31.711	50.067	13.894	3.064	0.099	0.966	0.146	99.946	15.604	20
	27.077	56.346	9.777	4.842	0.434	1.593	0.141	100.211	15.613	40
oa	29.113	54.948	10.915	4.677	0.225	1.251	0.100	101.230	15.417	0
	28.581	55.633	10.133	4.879	0.245	1.284	0.148	100.902	15.338	40
pa	30.205	53.448	12.560	4.019	0.156	0.859	0.145	101.392	15.283	0
	29.133	53.393	12.478	4.183	0.137	0.844	0.083	100.251	15.257	20
	29.425	54.696	11.480	4.347	0.208	1.063	0.126	101.346	15.244	40
qa	33.169	48.889	15.739	2.086	0.057	0.913	0.08	100.934	15.133	0
	32.371	49.989	15.445	2.384	0.028	0.89	0.091	101.198	15.144	20

Crystal	Weight Percent									Dist. From
GPA.06	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO	Total	Beam	Core (μm)
53	30.385	50.561	15.886	2.747	0.067	0.758	0.116	100.520	15.047	0
	29.931	51.402	15.899	2.911	0.092	0.852	0.070	101.156	15.523	20
	29.416	51.906	15.748	3.112	0.143	0.865	0.091	101.281	15.543	40
	24.598	57.023	9.652	5.685	0.496	1.633	0.117	99.204	15.508	60
54	28.321	52.467	12.656	4.182	0.194	0.949	0.153	98.921	15.392	0
	28.287	52.609	13.786	4.127	0.174	0.877	0.113	99.972	15.403	20
	28.307	52.467	13.085	4.073	0.216	0.785	0.116	99.050	15.392	60
	28.153	52.364	12.920	4.048	0.221	0.973	0.103	98.782	15.416	80
58	30.425	51.426	14.789	3.187	0.080	0.713	0.135	100.760	15.886	0
	29.613	52.441	14.114	3.636	0.117	0.871	0.097	100.889	15.885	40
	29.279	53.172	13.905	3.780	0.139	0.801	0.141	101.218	15.383	60
	29.640	52.671	13.949	3.658	0.120	0.770	0.147	100.956	15.846	80
	28.882	53.534	13.741	4.098	0.165	0.880	0.110	101.410	18.836	100
56	31.758	47.602	17.145	2.143	0.074	0.771	0.110	99.602	15.310	0
	31.319	47.600	16.505	2.181	0.053	0.832	0.078	98.568	15.283	20
	26.898	54.146	12.038	4.076	0.255	1.098	0.147	99.290	15.305	60
59	28.798	56.080	13.458	4.471	0.200	1.066	0.137	101.209	15.957	0
	26.927	56.147	10.605	5.391	0.364	0.995	0.166	100.545	15.972	20
60	33.041	46.086	18.911	1.341	0.032	0.695	0.048	100.154	15.589	0
	32.861	47.589	18.854	1.339	0.051	0.577	0.044	101.315	15.565	20
	29.540	52.035	15.051	3.627	0.112	0.752	0.109	101.226	15.467	80

(continued on following page).

Table A.1 (continued).

	29.886	50.952	15.082	3.297	0.127	0.690	0.122	100.156	15.506	100
	29.883	50.270	15.545	3.194	0.124	0.857	0.087	99.960	15.514	120
	26.393	55.843	11.948	5.088	0.317	0.989	0.069	100.647	15.506	140
61	33.142	47.262	18.293	1.448	0.031	0.665	0.055	100.895	15.752	0
	27.435	55.928	11.502	4.785	0.293	1.088	0.111	101.143	15.711	20
64	26.727	57.011	10.655	5.282	0.285	0.948	0.103	101.012	15.712	0
	26.588	57.469	10.189	5.439	0.344	0.986	0.081	101.095	15.705	20
65	30.06	51.817	14.286	3.434	0.169	0.827	0.109	100.701	15.734	20
	29.89	50.236	14.555	3.405	0.179	0.759	0.124	99.148	15.729	40
	26.82	56.066	10.532	5.376	0.384	0.961	0.127	100.266	15.741	60
a	29.54	51.249	13.472	3.78	0.093	0.792	0.081	99.006	15.354	0
	29.532	52.027	14.403	3.762	0.131	0.784	0.154	100.793	15.347	20
	25.969	55.814	10.543	5.478	0.357	1.339	0.101	99.601	15.336	40
c	29.939	52.868	13.615	3.76	0.122	0.801	0.13	101.235	15.292	0
	29.954	52.122	13.59	3.7473	1.32	1.081	0.141	101.132	15.287	20
	29.158	51.288	14.05	3.777	0.127	0.883	0.134	99.417	15.273	40
	30.608	51.756	14.518	3.34	0.115	0.809	0.08	101.226	15.283	60
	29.284	52.587	13.128	4.048	0.176	1.182	0.069	100.476	15.257	120
e	33.413	47.031	16.863	1.753	0.028	0.713	0.086	99.887	15.453	0
	32.694	47.791	17.252	2.299	0.046	0.783	0.053	100.917	15.455	40
	33.502	17.106	17.863	1.730	0.034	0.722	0.069	101.025	15.411	60
	27.722	54.292	11.416	5.007	0.311	0.537	0.112	99.398	15.401	80
f	28.177	52.735	15.556	4.138	0.190	1.100	0.127	99.023	15.193	20
	26.618	56.074	11.295	5.282	0.303	0.948	0.095	100.615	15.155	40
g	33.353	45.647	18.246	1.514	0.039	0.552	0.068	99.420	15.595	0
	33.273	46.179	17.773	1.449	0.034	0.579	0.068	99.355	15.599	20
	33.479	45.966	17.474	1.521	0.029	0.515	0.073	99.056	15.556	40
	33.449	46.020	18.640	1.492	0.045	0.687	0.026	100.358	15.512	60
	33.368	46.062	17.913	1.464	0.045	0.711	0.083	99.646	15.473	80
	33.815	45.512	18.169	1.358	0.039	0.703	0.073	99.760	15.445	100
	33.408	46.328	18.229	1.445	0.002	0.750	0.029	100.190	15.453	120
	28.340	52.888	12.106	4.186	0.180	0.980	0.096	98.777	15.442	140
h	29.198	52.386	13.711	3.865	0.140	0.811	0.127	100.238	15.355	20
	30.395	50.172	14.630	3.278	0.096	0.714	0.088	99.373	15.340	40
	29.767	51.367	13.799	3.573	0.127	0.766	0.107	99.506	15.357	60
	29.422	52.058	12.957	3.883	0.167	0.755	0.132	99.374	15.360	80
	28.842	52.790	12.648	3.963	0.204	0.969	0.135	99.551	15.351	100
	25.361	58.049	9.328	5.983	0.589	0.951	0.092	100.352	15.341	120
i	30.239	50.692	14.301	3.447	0.148	0.714	0.114	99.658	15.284	0
	30.765	49.566	14.489	2.903	0.110	0.901	0.122	98.857	15.272	20
	30.472	50.105	14.460	3.475	0.151	0.852	0.073	99.587	15.250	40
	31.016	50.441	15.005	3.275	0.130	0.890	0.132	100.889	15.228	60

(continued on following page).

Table A.1 (continued).

Crystal		Molecular Proportions							Cation Proportions						
GPA.04	Spot	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO
1	1	0.291	0.878	0.235	0.063	0.001	0.012	0.003	0.582	0.878	0.235	0.126	0.002	0.012	0.003
	2	0.291	0.880	0.222	0.061	0.002	0.012	0.003	0.582	0.880	0.222	0.122	0.003	0.012	0.003
	3	0.295	0.880	0.237	0.060	0.002	0.011	0.004	0.589	0.880	0.237	0.121	0.004	0.011	0.004
2	1	0.295	0.855	0.231	0.059	0.002	0.011	0.002	0.590	0.855	0.231	0.119	0.004	0.011	0.002
	2	0.297	0.861	0.246	0.060	0.002	0.011	0.003	0.593	0.861	0.246	0.121	0.003	0.011	0.003
	3	0.290	0.869	0.225	0.068	0.002	0.010	0.003	0.579	0.869	0.225	0.137	0.004	0.010	0.003
	4	0.295	0.847	0.229	0.062	0.002	0.012	0.003	0.590	0.847	0.229	0.123	0.004	0.012	0.003
	5	0.294	0.846	0.234	0.061	0.002	0.011	0.003	0.587	0.846	0.234	0.122	0.004	0.011	0.003
3	1	0.313	0.831	0.260	0.047	0.001	0.011	0.002	0.625	0.831	0.260	0.093	0.002	0.011	0.002
	2	0.317	0.825	0.288	0.039	0.001	0.010	0.001	0.635	0.825	0.288	0.079	0.003	0.010	0.001
	3	0.322	0.810	0.301	0.033	0.001	0.010	0.002	0.643	0.810	0.301	0.066	0.002	0.010	0.002
	4	0.327	0.798	0.296	0.033	0.001	0.009	0.002	0.654	0.798	0.296	0.065	0.002	0.009	0.002
	5	0.325	0.817	0.282	0.035	0.001	0.010	0.002	0.649	0.817	0.282	0.071	0.001	0.010	0.002
	6	0.300	0.858	0.242	0.056	0.002	0.011	0.003	0.601	0.858	0.242	0.112	0.004	0.011	0.003
	7	0.299	0.872	0.234	0.059	0.001	0.011	0.002	0.598	0.872	0.234	0.117	0.003	0.011	0.002
	8	0.299	0.878	0.232	0.058	0.002	0.015	0.002	0.599	0.878	0.232	0.115	0.004	0.015	0.002
	9	0.302	0.855	0.233	0.056	0.002	0.012	0.003	0.603	0.855	0.233	0.111	0.004	0.012	0.003
5	1	0.266	0.906	0.187	0.084	0.004	0.016	0.003	0.533	0.906	0.187	0.167	0.008	0.016	0.003
	2	0.272	0.905	0.185	0.081	0.004	0.014	0.002	0.544	0.905	0.185	0.162	0.007	0.014	0.002
6	1	0.292	0.864	0.235	0.060	0.002	0.014	0.003	0.583	0.864	0.235	0.121	0.003	0.014	0.003
	2	0.292	0.882	0.229	0.063	0.002	0.013	0.003	0.583	0.882	0.229	0.125	0.004	0.013	0.003
	3	0.283	0.900	0.212	0.069	0.002	0.013	0.003	0.566	0.900	0.212	0.139	0.004	0.013	0.003
7	1	0.309	0.823	0.272	0.050	0.002	0.013	0.003	0.618	0.823	0.272	0.101	0.003	0.013	0.003
	2	0.315	0.824	0.268	0.044	0.001	0.012	0.004	0.630	0.824	0.268	0.087	0.002	0.012	0.004
	3	0.321	0.803	0.290	0.040	0.001	0.010	0.002	0.642	0.803	0.290	0.079	0.002	0.010	0.002
	4	0.316	0.809	0.283	0.040	0.002	0.015	0.005	0.631	0.809	0.283	0.079	0.004	0.015	0.005
	5	0.317	0.806	0.256	0.042	0.002	0.013	0.003	0.634	0.806	0.256	0.084	0.003	0.013	0.003
	7	0.305	0.814	0.272	0.043	0.002	0.023	0.009	0.609	0.814	0.272	0.086	0.004	0.023	0.009
	9	0.285	0.821	0.250	0.051	0.006	0.035	0.018	0.570	0.821	0.250	0.103	0.012	0.035	0.018
	10	0.320	0.794	0.283	0.040	0.002	0.010	0.001	0.640	0.794	0.283	0.080	0.003	0.010	0.001
	11	0.316	0.808	0.283	0.047	0.001	0.010	0.002	0.632	0.808	0.283	0.094	0.001	0.010	0.002
	12	0.326	0.802	0.282	0.037	0.001	0.011	0.002	0.651	0.802	0.282	0.075	0.002	0.011	0.002
	13	0.296	0.859	0.225	0.066	0.002	0.013	0.003	0.592	0.859	0.225	0.132	0.004	0.013	0.003
	14	0.274	0.900	0.173	0.086	0.004	0.014	0.002	0.548	0.900	0.173	0.172	0.008	0.014	0.002
t	1	0.285	0.844	0.252	0.060	0.002	0.012	0.003	0.571	0.844	0.252	0.120	0.003	0.012	0.003
	3	0.285	0.858	0.248	0.061	0.001	0.012	0.003	0.569	0.858	0.248	0.123	0.003	0.012	0.003
	4	0.262	0.925	0.196	0.085	0.003	0.014	0.003	0.523	0.925	0.196	0.169	0.007	0.014	0.003
u	1	0.296	0.862	0.258	0.061	0.001	0.011	0.003	0.591	0.862	0.258	0.122	0.003	0.011	0.003
	2	0.294	0.875	0.243	0.062	0.001	0.012	0.003	0.587	0.875	0.243	0.123	0.003	0.012	0.003
	3	0.291	0.884	0.229	0.066	0.002	0.012	0.003	0.581	0.884	0.229	0.132	0.003	0.012	0.003

(continued on following page).

Table A.1 (continued).

	5	0.290	0.880	0.237	0.066	0.002	0.011	0.003	0.580	0.880	0.237	0.133	0.004	0.011	0.003
y	2	0.296	0.865	0.258	0.058	0.002	0.012	0.003	0.593	0.865	0.258	0.115	0.004	0.012	0.003
	3	0.290	0.865	0.253	0.063	0.001	0.008	0.000	0.581	0.865	0.253	0.126	0.003	0.008	0.000
	4	0.293	0.871	0.253	0.062	0.002	0.009	0.002	0.585	0.871	0.253	0.123	0.003	0.009	0.002
	5	0.285	0.875	0.230	0.065	0.002	0.010	0.002	0.571	0.875	0.230	0.130	0.004	0.010	0.002
z	1	0.296	0.854	0.265	0.057	0.001	0.010	0.002	0.592	0.854	0.265	0.115	0.003	0.010	0.002
	2	0.295	0.864	0.249	0.059	0.001	0.013	0.002	0.591	0.864	0.249	0.117	0.002	0.013	0.002
aa	1	0.268	0.906	0.201	0.078	0.003	0.014	0.003	0.537	0.906	0.201	0.156	0.005	0.014	0.003
	2	0.265	0.909	0.190	0.084	0.004	0.012	0.004	0.530	0.909	0.190	0.168	0.007	0.012	0.004
ba	1	0.261	0.928	0.197	0.087	0.004	0.013	0.002	0.522	0.928	0.197	0.174	0.007	0.013	0.002
	2	0.260	0.927	0.188	0.088	0.004	0.020	0.003	0.520	0.927	0.188	0.175	0.008	0.020	0.003
ca	1	0.313	0.818	0.295	0.042	0.001	0.011	0.002	0.626	0.818	0.295	0.084	0.002	0.011	0.002
	2	0.311	0.829	0.280	0.044	0.001	0.010	0.002	0.621	0.829	0.280	0.089	0.002	0.010	0.002
	3	0.312	0.810	0.291	0.041	0.001	0.008	0.001	0.623	0.810	0.291	0.082	0.002	0.008	0.001
	4	0.317	0.801	0.298	0.036	0.001	0.011	0.002	0.635	0.801	0.298	0.072	0.001	0.011	0.002
	5	0.322	0.791	0.309	0.030	0.001	0.010	0.002	0.645	0.791	0.309	0.061	0.002	0.010	0.002
	6	0.326	0.781	0.321	0.028	0.001	0.009	0.002	0.653	0.781	0.321	0.055	0.001	0.009	0.002
	9	0.272	0.910	0.223	0.079	0.003	0.001	0.002	0.545	0.910	0.223	0.158	0.006	0.001	0.002
da	1	0.282	0.880	0.229	0.070	0.002	0.010	0.003	0.564	0.880	0.229	0.140	0.004	0.010	0.003
	2	0.280	0.878	0.241	0.067	0.002	0.011	0.003	0.559	0.878	0.241	0.134	0.004	0.011	0.003
	3	0.287	0.867	0.231	0.062	0.002	0.011	0.003	0.573	0.867	0.231	0.124	0.003	0.011	0.003
	4	0.285	0.877	0.243	0.064	0.002	0.011	0.002	0.570	0.877	0.243	0.129	0.004	0.011	0.002
	5	0.287	0.876	0.252	0.063	0.002	0.014	0.003	0.574	0.876	0.252	0.126	0.005	0.014	0.003

Crystal		Molecular Proportions							Cation Proportions						
GPA.02	Spot	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO
23	2	0.313	0.818	0.266	0.044	0.001	0.009	0.002	0.625	0.818	0.266	0.089	0.002	0.009	0.002
	3	0.310	0.835	0.284	0.046	0.001	0.009	0.002	0.619	0.835	0.284	0.092	0.002	0.009	0.002
	4	0.308	0.825	0.281	0.050	0.001	0.008	0.002	0.616	0.825	0.281	0.101	0.003	0.008	0.002
	5	0.307	0.845	0.276	0.050	0.001	0.009	0.002	0.615	0.845	0.276	0.100	0.002	0.009	0.002
	6	0.310	0.840	0.266	0.050	0.001	0.008	0.002	0.619	0.840	0.266	0.101	0.002	0.008	0.002
	7	0.294	0.831	0.259	0.059	0.002	0.012	0.003	0.588	0.831	0.259	0.117	0.003	0.012	0.003
	8	0.283	0.888	0.205	0.071	0.002	0.013	0.003	0.567	0.888	0.205	0.143	0.003	0.013	0.003
25	2	0.313	0.806	0.284	0.041	0.002	0.010	0.003	0.625	0.806	0.284	0.082	0.004	0.010	0.003
	3	0.308	0.814	0.282	0.040	0.001	0.008	0.001	0.616	0.814	0.282	0.079	0.002	0.008	0.001
	4	0.305	0.825	0.268	0.046	0.001	0.011	0.002	0.610	0.825	0.268	0.092	0.002	0.011	0.002
	5	0.286	0.864	0.242	0.063	0.003	0.011	0.003	0.571	0.864	0.242	0.125	0.006	0.011	0.003
	6	0.272	0.904	0.198	0.076	0.002	0.010	0.003	0.544	0.904	0.198	0.152	0.005	0.010	0.003
26	3	0.313	0.799	0.280	0.041	0.002	0.008	0.003	0.626	0.799	0.280	0.081	0.004	0.008	0.003
	4	0.303	0.815	0.264	0.055	0.003	0.010	0.003	0.606	0.815	0.264	0.109	0.007	0.010	0.003
	5	0.312	0.794	0.276	0.041	0.002	0.009	0.003	0.625	0.794	0.276	0.083	0.005	0.009	0.003
	6	0.309	0.814	0.268	0.047	0.001	0.008	0.002	0.618	0.814	0.268	0.093	0.003	0.008	0.002
	7	0.311	0.825	0.280	0.045	0.001	0.009	0.002	0.621	0.825	0.280	0.089	0.003	0.009	0.002

(continued on following page).

Table A.1 (continued).

	8	0.314	0.816	0.294	0.039	0.001	0.008	0.002	0.627	0.816	0.294	0.077	0.002	0.008	0.002
	9	0.318	0.806	0.299	0.038	0.001	0.011	0.003	0.636	0.806	0.299	0.075	0.001	0.011	0.003
27	1	0.312	0.816	0.283	0.045	0.001	0.010	0.002	0.625	0.816	0.283	0.091	0.001	0.010	0.002
	3	0.313	0.818	0.275	0.045	0.001	0.009	0.003	0.626	0.818	0.275	0.089	0.001	0.009	0.003
	4	0.316	0.820	0.281	0.044	0.001	0.009	0.002	0.632	0.820	0.281	0.088	0.001	0.009	0.002
	5	0.311	0.833	0.277	0.047	0.001	0.011	0.001	0.621	0.833	0.277	0.095	0.002	0.011	0.001
	6	0.283	0.903	0.221	0.074	0.002	0.014	0.004	0.566	0.903	0.221	0.148	0.004	0.014	0.004
15	1	0.313	0.817	0.283	0.045	0.001	0.009	0.002	0.626	0.817	0.283	0.090	0.002	0.009	0.002
	2	0.308	0.841	0.273	0.050	0.001	0.008	0.002	0.616	0.841	0.273	0.101	0.002	0.008	0.002
	3	0.315	0.813	0.287	0.043	0.002	0.008	0.003	0.629	0.813	0.287	0.086	0.003	0.008	0.003
	4	0.308	0.824	0.279	0.050	0.002	0.010	0.003	0.617	0.824	0.279	0.100	0.005	0.010	0.003
	6	0.294	0.863	0.241	0.066	0.002	0.013	0.003	0.588	0.863	0.241	0.131	0.003	0.013	0.003
	7	0.280	0.875	0.225	0.072	0.004	0.012	0.003	0.561	0.875	0.225	0.144	0.008	0.012	0.003
17	1	0.318	0.816	0.279	0.040	0.001	0.012	0.003	0.635	0.816	0.279	0.079	0.001	0.012	0.003
	2	0.318	0.820	0.286	0.041	0.001	0.011	0.002	0.636	0.820	0.286	0.082	0.001	0.011	0.002
	3	0.309	0.818	0.281	0.044	0.001	0.009	0.002	0.618	0.818	0.281	0.088	0.002	0.009	0.002
	4	0.316	0.815	0.281	0.042	0.001	0.009	0.002	0.633	0.815	0.281	0.084	0.002	0.009	0.002
	6	0.276	0.915	0.202	0.078	0.003	0.012	0.004	0.551	0.915	0.202	0.156	0.005	0.012	0.004
ea	1	0.283	0.872	0.223	0.072	0.001	0.013	0.002	0.566	0.872	0.223	0.143	0.003	0.013	0.002
	2	0.223	0.950	0.157	0.087	0.011	0.047	0.015	0.445	0.950	0.157	0.173	0.022	0.047	0.015
fa	1	0.314	0.807	0.291	0.040	0.001	0.011	0.002	0.629	0.807	0.291	0.080	0.002	0.011	0.002
	2	0.302	0.830	0.261	0.051	0.001	0.011	0.003	0.605	0.830	0.261	0.102	0.003	0.011	0.003
ga	2	0.303	0.828	0.275	0.051	0.001	0.012	0.002	0.607	0.828	0.275	0.102	0.002	0.012	0.002
	3	0.295	0.858	0.253	0.064	0.001	0.012	0.003	0.590	0.858	0.253	0.129	0.002	0.012	0.003
	5	0.298	0.849	0.255	0.057	0.001	0.011	0.002	0.596	0.849	0.255	0.114	0.002	0.011	0.002
	6	0.298	0.851	0.254	0.056	0.001	0.010	0.003	0.596	0.851	0.254	0.113	0.003	0.010	0.003
	7	0.289	0.855	0.244	0.063	0.001	0.012	0.003	0.579	0.855	0.244	0.127	0.003	0.012	0.003
	8	0.286	0.858	0.225	0.066	0.002	0.012	0.003	0.572	0.858	0.225	0.132	0.005	0.012	0.003
ha	1	0.320	0.775	0.321	0.032	0.001	0.005	0.002	0.641	0.775	0.321	0.064	0.001	0.005	0.002
	2	0.315	0.803	0.291	0.039	0.001	0.010	0.002	0.630	0.803	0.291	0.078	0.002	0.010	0.002
	3	0.304	0.818	0.269	0.049	0.001	0.012	0.003	0.609	0.818	0.269	0.097	0.003	0.012	0.003
	4	0.292	0.861	0.253	0.063	0.002	0.012	0.002	0.584	0.861	0.253	0.125	0.003	0.012	0.002
ia	1	0.321	0.778	0.301	0.032	0.000	0.009	0.002	0.642	0.778	0.301	0.063	0.001	0.009	0.002
	2	0.323	0.777	0.302	0.028	0.001	0.009	0.002	0.647	0.777	0.302	0.057	0.001	0.009	0.002
	3	0.318	0.800	0.299	0.036	0.000	0.009	0.002	0.636	0.800	0.299	0.071	0.001	0.009	0.002
ja	1	0.293	0.849	0.248	0.060	0.001	0.010	0.003	0.587	0.849	0.248	0.119	0.003	0.010	0.003
	2	0.281	0.868	0.235	0.072	0.003	0.013	0.002	0.562	0.868	0.235	0.145	0.006	0.013	0.002
	3	0.297	0.841	0.250	0.060	0.001	0.011	0.003	0.593	0.841	0.250	0.121	0.002	0.011	0.003
	4	0.304	0.825	0.273	0.050	0.001	0.010	0.003	0.607	0.825	0.273	0.101	0.002	0.010	0.003
	5	0.300	0.835	0.259	0.055	0.001	0.012	0.003	0.600	0.835	0.259	0.111	0.002	0.012	0.003
ka	1	0.293	0.833	0.260	0.056	0.001	0.009	0.003	0.586	0.833	0.260	0.113	0.002	0.009	0.003
	3	0.275	0.885	0.210	0.075	0.002	0.014	0.003	0.549	0.885	0.210	0.150	0.004	0.014	0.003
	4	0.284	0.868	0.237	0.070	0.002	0.012	0.003	0.568	0.868	0.237	0.140	0.004	0.012	0.003
la	1	0.284	0.872	0.241	0.069	0.002	0.012	0.004	0.567	0.872	0.241	0.139	0.003	0.012	0.004

(continued on following page).

Table A.1 (continued).

	2	0.292	0.863	0.248	0.065	0.002	0.011	0.004	0.584	0.863	0.248	0.129	0.003	0.011	0.004
	3	0.270	0.903	0.208	0.080	0.003	0.013	0.003	0.539	0.903	0.208	0.161	0.006	0.013	0.003

Crystal		Molecular Proportions							Cation Proportions						
GPA.07	Spot	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO
33	1	0.264	0.929	0.186	0.088	0.004	0.014	0.003	0.528	0.929	0.186	0.175	0.008	0.014	0.003
	2	0.263	0.936	0.187	0.091	0.004	0.015	0.002	0.527	0.936	0.187	0.182	0.009	0.015	0.002
35	1	0.260	0.940	0.186	0.092	0.004	0.016	0.002	0.519	0.940	0.186	0.184	0.007	0.016	0.002
34	1	0.310	0.796	0.294	0.043	0.001	0.010	0.002	0.621	0.796	0.294	0.085	0.001	0.010	0.002
	3	0.314	0.798	0.274	0.040	0.001	0.010	0.003	0.628	0.798	0.274	0.079	0.002	0.010	0.003
	4	0.312	0.807	0.268	0.039	0.000	0.010	0.002	0.624	0.807	0.268	0.078	0.001	0.010	0.002
	5	0.308	0.812	0.275	0.043	0.001	0.009	0.003	0.616	0.812	0.275	0.086	0.002	0.009	0.003
	6	0.300	0.826	0.262	0.050	0.001	0.010	0.003	0.600	0.826	0.262	0.101	0.003	0.010	0.003
	7	0.281	0.866	0.227	0.068	0.002	0.012	0.003	0.562	0.866	0.227	0.136	0.004	0.012	0.003
36	1	0.328	0.755	0.324	0.028	0.001	0.009	0.002	0.656	0.755	0.324	0.056	0.002	0.009	0.002
	2	0.330	0.765	0.326	0.026	0.001	0.005	0.002	0.659	0.765	0.326	0.052	0.002	0.005	0.002
	3	0.333	0.772	0.319	0.024	0.000	0.008	0.001	0.666	0.772	0.319	0.049	0.001	0.008	0.001
	4	0.335	0.768	0.325	0.022	0.001	0.007	0.001	0.670	0.768	0.325	0.043	0.001	0.007	0.001
	5	0.331	0.766	0.303	0.023	0.001	0.008	0.001	0.661	0.766	0.303	0.047	0.001	0.008	0.001
	6	0.336	0.767	0.307	0.023	0.001	0.008	0.002	0.672	0.767	0.307	0.046	0.001	0.008	0.002
37	1	0.335	0.748	0.333	0.007	0.000	0.008	0.001	0.670	0.748	0.333	0.015	0.000	0.008	0.001
	2	0.331	0.755	0.344	0.020	0.000	0.007	0.002	0.663	0.755	0.344	0.039	0.000	0.007	0.002
	4	0.327	0.775	0.323	0.026	0.001	0.006	0.002	0.655	0.775	0.323	0.052	0.001	0.006	0.002
	5	0.327	0.782	0.324	0.026	0.000	0.007	0.001	0.653	0.782	0.324	0.053	0.000	0.007	0.001
	6	0.326	0.769	0.309	0.023	0.000	0.006	0.002	0.652	0.769	0.309	0.046	0.000	0.006	0.002
	7	0.329	0.770	0.328	0.023	0.000	0.006	0.002	0.657	0.770	0.328	0.047	0.001	0.006	0.002
	8	0.327	0.769	0.311	0.024	0.000	0.009	0.002	0.654	0.769	0.311	0.048	0.001	0.009	0.002
	9	0.293	0.852	0.255	0.056	0.001	0.010	0.003	0.586	0.852	0.255	0.111	0.003	0.010	0.003
j	1	0.331	0.763	0.325	0.026	0.001	0.007	0.002	0.662	0.763	0.325	0.052	0.001	0.007	0.002
	2	0.335	0.771	0.329	0.023	0.000	0.007	0.001	0.670	0.771	0.329	0.046	0.001	0.007	0.001
	3	0.322	0.788	0.292	0.032	0.001	0.010	0.002	0.644	0.788	0.292	0.064	0.001	0.010	0.002
	4	0.331	0.769	0.331	0.024	0.001	0.008	0.001	0.661	0.769	0.331	0.048	0.001	0.008	0.001
	5	0.331	0.776	0.313	0.027	0.001	0.009	0.002	0.661	0.776	0.313	0.054	0.001	0.009	0.002
	6	0.331	0.774	0.305	0.023	0.000	0.008	0.001	0.662	0.774	0.305	0.045	0.001	0.008	0.001
	7	0.330	0.768	0.316	0.026	0.000	0.011	0.002	0.660	0.768	0.316	0.052	0.001	0.011	0.002
	8	0.302	0.834	0.265	0.050	0.001	0.013	0.002	0.605	0.834	0.265	0.100	0.002	0.013	0.002
k	1	0.331	0.746	0.327	0.018	0.000	0.006	0.001	0.662	0.746	0.327	0.036	0.001	0.006	0.001
	2	0.332	0.743	0.335	0.019	0.000	0.006	0.001	0.665	0.743	0.335	0.037	0.001	0.006	0.001
	3	0.331	0.749	0.341	0.018	0.001	0.008	0.000	0.663	0.749	0.341	0.036	0.002	0.008	0.000
	4	0.319	0.730	0.323	0.020	0.001	0.006	0.001	0.637	0.730	0.323	0.039	0.002	0.006	0.001
	5	0.327	0.775	0.329	0.024	0.001	0.008	0.001	0.655	0.775	0.329	0.048	0.001	0.008	0.001
	6	0.327	0.770	0.319	0.022	0.001	0.007	0.001	0.655	0.770	0.319	0.044	0.001	0.007	0.001
	7	0.331	0.756	0.325	0.020	0.001	0.005	0.002	0.662	0.756	0.325	0.039	0.002	0.005	0.002

(continued on following page).

Table A.1 (continued).

	8	0.332	0.761	0.336	0.016	0.001	0.008	0.001	0.665	0.761	0.336	0.033	0.001	0.008	0.001
	9	0.331	0.763	0.347	0.017	0.001	0.009	0.002	0.661	0.763	0.347	0.033	0.002	0.009	0.002
l	2	0.293	0.844	0.276	0.051	0.001	0.013	0.003	0.587	0.844	0.276	0.101	0.001	0.013	0.003
	3	0.297	0.846	0.266	0.051	0.002	0.013	0.002	0.593	0.846	0.266	0.102	0.003	0.013	0.002
	4	0.288	0.852	0.269	0.054	0.001	0.010	0.002	0.576	0.852	0.269	0.107	0.002	0.010	0.002
	5	0.291	0.836	0.264	0.051	0.001	0.010	0.002	0.582	0.836	0.264	0.101	0.002	0.010	0.002
	6	0.295	0.834	0.255	0.049	0.001	0.014	0.002	0.591	0.834	0.255	0.097	0.002	0.014	0.002
	7	0.297	0.827	0.292	0.045	0.001	0.010	0.003	0.594	0.827	0.292	0.089	0.001	0.010	0.003
n	1	0.338	0.751	0.337	0.018	0.000	0.005	0.001	0.675	0.751	0.337	0.037	0.001	0.005	0.001
	2	0.341	0.756	0.343	0.018	0.000	0.004	0.001	0.683	0.756	0.343	0.035	0.001	0.004	0.001
	3	0.341	0.766	0.336	0.018	0.000	0.006	0.001	0.683	0.766	0.336	0.036	0.000	0.006	0.001
	4	0.333	0.769	0.318	0.028	0.001	0.011	0.002	0.665	0.769	0.318	0.056	0.001	0.011	0.002
	5	0.308	0.832	0.274	0.049	0.001	0.012	0.003	0.616	0.832	0.274	0.099	0.001	0.012	0.003
o	1	0.332	0.753	0.326	0.021	0.000	0.010	0.002	0.663	0.753	0.326	0.042	0.000	0.010	0.002
	2	0.332	0.761	0.330	0.020	0.000	0.009	0.001	0.665	0.761	0.330	0.040	0.001	0.009	0.001
	3	0.335	0.753	0.345	0.018	0.000	0.007	0.002	0.671	0.753	0.345	0.036	0.000	0.007	0.002
	4	0.333	0.763	0.327	0.019	0.000	0.007	0.002	0.665	0.763	0.327	0.037	0.001	0.007	0.002
	5	0.327	0.764	0.331	0.024	0.000	0.006	0.001	0.654	0.764	0.331	0.049	0.001	0.006	0.001
	6	0.332	0.767	0.330	0.022	0.000	0.009	0.002	0.665	0.767	0.330	0.045	0.000	0.009	0.002
	7	0.333	0.769	0.309	0.024	0.000	0.008	0.002	0.665	0.769	0.309	0.048	0.000	0.008	0.002
	8	0.335	0.766	0.320	0.021	0.001	0.010	0.002	0.670	0.766	0.320	0.042	0.001	0.010	0.002
	9	0.335	0.763	0.348	0.020	0.000	0.007	0.001	0.671	0.763	0.348	0.040	0.001	0.007	0.001
	10	0.334	0.768	0.330	0.021	0.000	0.006	0.001	0.668	0.768	0.330	0.042	0.001	0.006	0.001
p	1	0.306	0.839	0.268	0.051	0.001	0.011	0.002	0.612	0.839	0.268	0.102	0.003	0.011	0.002
	3	0.300	0.844	0.260	0.053	0.002	0.011	0.002	0.600	0.844	0.260	0.107	0.003	0.011	0.002
	4	0.303	0.853	0.256	0.053	0.002	0.011	0.002	0.606	0.853	0.256	0.105	0.003	0.011	0.002
	5	0.303	0.849	0.266	0.053	0.001	0.011	0.002	0.606	0.849	0.266	0.106	0.003	0.011	0.002
	6	0.292	0.880	0.240	0.065	0.002	0.014	0.002	0.584	0.880	0.240	0.129	0.004	0.014	0.002
q	1	0.326	0.783	0.314	0.032	0.001	0.011	0.002	0.651	0.783	0.314	0.065	0.001	0.011	0.002
	2	0.337	0.779	0.323	0.021	0.000	0.007	0.001	0.675	0.779	0.323	0.041	0.001	0.007	0.001
	3	0.317	0.795	0.294	0.034	0.001	0.008	0.001	0.635	0.795	0.294	0.067	0.002	0.008	0.001
	4	0.327	0.788	0.300	0.032	0.000	0.010	0.001	0.653	0.788	0.300	0.064	0.001	0.010	0.001
	5	0.308	0.819	0.269	0.050	0.001	0.012	0.002	0.616	0.819	0.269	0.100	0.002	0.012	0.002
r	1	0.293	0.849	0.253	0.061	0.001	0.012	0.018	0.587	0.849	0.253	0.122	0.003	0.012	0.018
	2	0.289	0.873	0.228	0.064	0.001	0.014	0.002	0.579	0.873	0.228	0.128	0.002	0.014	0.002
	3	0.293	0.855	0.256	0.060	0.001	0.014	0.002	0.587	0.855	0.256	0.120	0.002	0.014	0.002
	4	0.302	0.820	0.257	0.051	0.001	0.011	0.002	0.604	0.820	0.257	0.102	0.002	0.011	0.002
	6	0.291	0.841	0.251	0.062	0.002	0.012	0.002	0.583	0.841	0.251	0.124	0.003	0.012	0.002
s	1	0.332	0.751	0.309	0.022	0.001	0.010	0.002	0.664	0.751	0.309	0.043	0.001	0.010	0.002
	2	0.333	0.761	0.308	0.022	0.002	0.007	0.001	0.666	0.761	0.308	0.044	0.004	0.007	0.001
	3	0.328	0.785	0.316	0.026	0.002	0.012	0.005	0.657	0.785	0.316	0.053	0.004	0.012	0.005
	5	0.337	0.769	0.326	0.022	0.002	0.010	0.002	0.674	0.769	0.326	0.044	0.003	0.010	0.002
	6	0.336	0.759	0.322	0.019	0.001	0.006	0.001	0.672	0.759	0.322	0.037	0.001	0.006	0.001
	7	0.302	0.832	0.257	0.051	0.002	0.012	0.003	0.604	0.832	0.257	0.102	0.005	0.012	0.003

(continued on following page).

Table A.1 (continued).

Crystal		Molecular Proportions							Cation Proportions						
GPA.03	Spot	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO
40	1	0.334	0.777	0.331	0.021	0.000	0.010	0.002	0.668	0.777	0.331	0.041	0.001	0.010	0.002
	2	0.330	0.794	0.313	0.027	0.000	0.009	0.002	0.659	0.794	0.313	0.054	0.001	0.009	0.002
	3	0.327	0.792	0.318	0.026	0.000	0.011	0.001	0.654	0.792	0.318	0.051	0.001	0.011	0.001
	4	0.313	0.822	0.290	0.038	0.001	0.012	0.001	0.625	0.822	0.290	0.077	0.002	0.012	0.001
41	1	0.280	0.899	0.227	0.077	0.003	0.012	0.002	0.560	0.899	0.227	0.155	0.005	0.012	0.002
	2	0.271	0.903	0.199	0.081	0.003	0.013	0.003	0.541	0.903	0.199	0.162	0.005	0.013	0.003
	3	0.263	0.934	0.186	0.088	0.004	0.013	0.003	0.527	0.934	0.186	0.177	0.007	0.013	0.003
	4	0.276	0.910	0.213	0.080	0.003	0.012	0.003	0.552	0.910	0.213	0.159	0.005	0.012	0.003
	5	0.284	0.885	0.229	0.070	0.002	0.013	0.004	0.568	0.885	0.229	0.139	0.004	0.013	0.004
42	1	0.339	0.773	0.320	0.021	0.000	0.007	0.001	0.678	0.773	0.320	0.043	0.001	0.007	0.001
	2	0.337	0.790	0.312	0.021	0.000	0.010	0.001	0.673	0.790	0.312	0.042	0.000	0.010	0.001
	3	0.339	0.775	0.327	0.021	0.000	0.008	0.002	0.677	0.775	0.327	0.041	0.001	0.008	0.002
	4	0.332	0.789	0.314	0.028	0.001	0.010	0.002	0.664	0.789	0.314	0.056	0.001	0.010	0.002
	5	0.333	0.785	0.304	0.026	0.000	0.010	0.001	0.665	0.785	0.304	0.053	0.001	0.010	0.001
	7	0.300	0.860	0.250	0.051	0.001	0.014	0.003	0.600	0.860	0.250	0.103	0.003	0.014	0.003
44	3	0.325	0.803	0.290	0.031	0.001	0.008	0.002	0.649	0.803	0.290	0.062	0.001	0.008	0.002
	4	0.309	0.808	0.286	0.036	0.001	0.010	0.002	0.617	0.808	0.286	0.073	0.001	0.010	0.002
	5	0.321	0.801	0.301	0.033	0.001	0.011	0.002	0.641	0.801	0.301	0.065	0.001	0.011	0.002
	6	0.319	0.815	0.280	0.039	0.001	0.011	0.003	0.638	0.815	0.280	0.078	0.002	0.011	0.003
	7	0.261	0.924	0.180	0.090	0.005	0.015	0.004	0.522	0.924	0.180	0.180	0.010	0.015	0.004
45	1	0.335	0.757	0.320	0.024	0.001	0.008	0.002	0.671	0.757	0.320	0.047	0.001	0.008	0.002
	2	0.336	0.755	0.307	0.022	0.000	0.008	0.002	0.673	0.755	0.307	0.043	0.000	0.008	0.002
	3	0.339	0.772	0.328	0.019	0.000	0.007	0.002	0.678	0.772	0.328	0.039	0.001	0.007	0.002
	4	0.340	0.768	0.320	0.019	0.000	0.007	0.001	0.679	0.768	0.320	0.038	0.000	0.007	0.001
	5	0.339	0.762	0.308	0.023	0.001	0.008	0.001	0.679	0.762	0.308	0.046	0.001	0.008	0.001
	6	0.324	0.806	0.292	0.033	0.001	0.012	0.002	0.648	0.806	0.292	0.066	0.001	0.012	0.002
	7	0.283	0.870	0.218	0.071	0.002	0.016	0.004	0.567	0.870	0.218	0.143	0.005	0.016	0.004
46	1	0.302	0.837	0.287	0.033	0.001	0.012	0.002	0.604	0.837	0.287	0.067	0.002	0.012	0.002
	4	0.311	0.812	0.321	0.026	0.001	0.009	0.001	0.622	0.812	0.321	0.052	0.002	0.009	0.001
	5	0.306	0.825	0.286	0.032	0.000	0.012	0.002	0.613	0.825	0.286	0.065	0.001	0.012	0.002
47	1	0.314	0.830	0.293	0.034	0.000	0.011	0.002	0.628	0.830	0.293	0.068	0.001	0.011	0.002
	2	0.309	0.815	0.295	0.034	0.001	0.011	0.003	0.619	0.815	0.295	0.067	0.001	0.011	0.003
	3	0.307	0.812	0.292	0.036	0.001	0.012	0.002	0.615	0.812	0.292	0.072	0.001	0.012	0.002
	4	0.311	0.836	0.283	0.036	0.001	0.010	0.002	0.621	0.836	0.283	0.072	0.001	0.010	0.002
48	1	0.339	0.773	0.326	0.017	0.000	0.008	0.001	0.679	0.773	0.326	0.035	0.000	0.008	0.001
	2	0.342	0.754	0.318	0.016	0.000	0.007	0.002	0.683	0.754	0.318	0.032	0.001	0.007	0.002
	3	0.337	0.772	0.320	0.021	0.000	0.008	0.001	0.675	0.772	0.320	0.041	0.001	0.008	0.001
	4	0.339	0.772	0.303	0.020	0.000	0.008	0.002	0.679	0.772	0.303	0.041	0.001	0.008	0.002
	5	0.325	0.812	0.287	0.033	0.001	0.011	0.002	0.650	0.812	0.287	0.066	0.001	0.011	0.002
	6	0.275	0.913	0.210	0.076	0.002	0.015	0.003	0.549	0.913	0.210	0.153	0.004	0.015	0.003
50	2	0.342	0.763	0.328	0.024	0.001	0.008	0.002	0.685	0.763	0.328	0.048	0.002	0.008	0.002

(continued on following page).

Table A.1 (continued).

	3	0.344	0.770	0.318	0.022	0.000	0.008	0.001	0.687	0.770	0.318	0.045	0.001	0.008	0.001
	4	0.343	0.728	0.319	0.021	0.000	0.010	0.002	0.686	0.728	0.319	0.043	0.001	0.010	0.002
	5	0.342	0.725	0.325	0.023	0.000	0.009	0.001	0.683	0.725	0.325	0.046	0.001	0.009	0.001
	6	0.329	0.800	0.286	0.037	0.000	0.011	0.002	0.658	0.800	0.286	0.074	0.001	0.011	0.002
ma	1	0.323	0.814	0.291	0.037	0.001	0.010	0.002	0.646	0.814	0.291	0.075	0.002	0.010	0.002
	2	0.912	0.810	0.283	0.037	0.001	0.010	0.002	1.823	0.810	0.283	0.074	0.001	0.010	0.002
	3	0.911	0.796	0.280	0.036	0.001	0.008	0.002	1.823	0.796	0.280	0.072	0.002	0.008	0.002
	4	0.324	0.805	0.289	0.038	0.001	0.010	0.003	0.648	0.805	0.289	0.076	0.001	0.010	0.003
	5	0.297	0.865	0.232	0.059	0.001	0.012	0.004	0.595	0.865	0.232	0.118	0.003	0.012	0.004
na	1	0.312	0.813	0.262	0.048	0.001	0.012	0.002	0.623	0.813	0.262	0.097	0.003	0.012	0.002
	2	0.311	0.833	0.248	0.049	0.001	0.013	0.004	0.622	0.833	0.248	0.099	0.002	0.013	0.004
	3	0.266	0.938	0.174	0.078	0.005	0.022	0.003	0.531	0.938	0.174	0.156	0.009	0.022	0.003
oa	1	0.286	0.915	0.195	0.075	0.002	0.017	0.002	0.571	0.915	0.195	0.151	0.005	0.017	0.002
	3	0.280	0.926	0.181	0.079	0.003	0.018	0.004	0.561	0.926	0.181	0.157	0.005	0.018	0.004
pa	1	0.296	0.890	0.224	0.065	0.002	0.012	0.004	0.592	0.890	0.224	0.130	0.003	0.012	0.004
	2	0.286	0.889	0.223	0.067	0.001	0.012	0.002	0.571	0.889	0.223	0.135	0.003	0.012	0.002
	3	0.289	0.910	0.205	0.070	0.002	0.015	0.003	0.577	0.910	0.205	0.140	0.004	0.015	0.003
qa	1	0.325	0.814	0.281	0.034	0.001	0.013	0.002	0.651	0.814	0.281	0.067	0.001	0.013	0.002
	2	0.317	0.832	0.275	0.038	0.000	0.012	0.002	0.635	0.832	0.275	0.077	0.001	0.012	0.002

Crystal		Molecular Proportions							Cation Proportions						
GPA.06	Spot	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO
53	1	0.298	0.842	0.283	0.044	0.001	0.011	0.003	0.596	0.842	0.283	0.089	0.001	0.011	0.003
	2	0.294	0.856	0.284	0.047	0.001	0.012	0.002	0.587	0.856	0.284	0.094	0.002	0.012	0.002
	3	0.289	0.864	0.281	0.050	0.002	0.012	0.002	0.577	0.864	0.281	0.100	0.003	0.012	0.002
	4	0.241	0.949	0.172	0.092	0.005	0.023	0.003	0.482	0.949	0.172	0.183	0.011	0.023	0.003
54	1	0.278	0.873	0.226	0.067	0.002	0.013	0.004	0.556	0.873	0.226	0.135	0.004	0.013	0.004
	2	0.277	0.876	0.246	0.067	0.002	0.012	0.003	0.555	0.876	0.246	0.133	0.004	0.012	0.003
	4	0.278	0.873	0.233	0.066	0.002	0.011	0.003	0.555	0.873	0.233	0.131	0.005	0.011	0.003
	5	0.276	0.872	0.230	0.065	0.002	0.014	0.003	0.552	0.872	0.230	0.131	0.005	0.014	0.003
58	1	0.298	0.856	0.264	0.051	0.001	0.010	0.003	0.597	0.856	0.264	0.103	0.002	0.010	0.003
	3	0.290	0.873	0.252	0.059	0.001	0.012	0.002	0.581	0.873	0.252	0.117	0.002	0.012	0.002
	4	0.287	0.885	0.248	0.061	0.001	0.011	0.003	0.574	0.885	0.248	0.122	0.003	0.011	0.003
	5	0.291	0.877	0.249	0.059	0.001	0.011	0.004	0.581	0.877	0.249	0.118	0.003	0.011	0.004
	6	0.283	0.891	0.245	0.066	0.002	0.012	0.003	0.567	0.891	0.245	0.132	0.004	0.012	0.003
56	1	0.311	0.792	0.306	0.035	0.001	0.011	0.003	0.623	0.792	0.306	0.069	0.002	0.011	0.003
	2	0.307	0.792	0.294	0.035	0.001	0.012	0.002	0.614	0.792	0.294	0.070	0.001	0.012	0.002
	4	0.264	0.901	0.215	0.066	0.003	0.015	0.004	0.528	0.901	0.215	0.132	0.005	0.015	0.004
59	1	0.282	0.934	0.240	0.072	0.002	0.015	0.003	0.565	0.934	0.240	0.144	0.004	0.015	0.003
	2	0.264	0.935	0.189	0.087	0.004	0.014	0.004	0.528	0.935	0.189	0.174	0.008	0.014	0.004
60	1	0.324	0.767	0.337	0.022	0.000	0.010	0.001	0.648	0.767	0.337	0.043	0.001	0.010	0.001
	2	0.322	0.792	0.336	0.022	0.001	0.008	0.001	0.645	0.792	0.336	0.043	0.001	0.008	0.001
	5	0.290	0.866	0.268	0.059	0.001	0.010	0.003	0.579	0.866	0.268	0.117	0.002	0.010	0.003

(continued on following page).

Table A.1 (continued).

	6	0.293	0.848	0.269	0.053	0.001	0.010	0.003	0.586	0.848	0.269	0.106	0.003	0.010	0.003
	7	0.293	0.837	0.277	0.052	0.001	0.012	0.002	0.586	0.837	0.277	0.103	0.003	0.012	0.002
	8	0.259	0.930	0.213	0.082	0.003	0.014	0.002	0.518	0.930	0.213	0.164	0.007	0.014	0.002
61	1	0.325	0.787	0.326	0.023	0.000	0.009	0.001	0.650	0.787	0.326	0.047	0.001	0.009	0.001
	2	0.269	0.931	0.205	0.077	0.003	0.015	0.003	0.538	0.931	0.205	0.154	0.006	0.015	0.003
64	1	0.262	0.949	0.190	0.085	0.003	0.013	0.003	0.524	0.949	0.190	0.170	0.006	0.013	0.003
	2	0.261	0.957	0.182	0.088	0.004	0.014	0.002	0.522	0.957	0.182	0.176	0.007	0.014	0.002
65	2	0.295	0.863	0.255	0.055	0.002	0.012	0.003	0.590	0.863	0.255	0.111	0.004	0.012	0.003
	3	0.293	0.836	0.260	0.055	0.002	0.011	0.003	0.586	0.836	0.260	0.110	0.004	0.011	0.003
	4	0.263	0.933	0.188	0.087	0.004	0.013	0.003	0.526	0.933	0.188	0.173	0.008	0.013	0.003
a	1	0.290	0.853	0.240	0.061	0.001	0.011	0.002	0.579	0.853	0.240	0.122	0.002	0.011	0.002
	2	0.290	0.866	0.257	0.061	0.001	0.011	0.004	0.579	0.866	0.257	0.121	0.003	0.011	0.004
	3	0.255	0.929	0.188	0.088	0.004	0.019	0.003	0.509	0.929	0.188	0.177	0.008	0.019	0.003
c	1	0.294	0.880	0.243	0.061	0.001	0.011	0.003	0.587	0.880	0.243	0.121	0.003	0.011	0.003
	2	0.294	0.868	0.242	0.060	0.014	0.015	0.003	0.588	0.868	0.242	0.121	0.028	0.015	0.003
	3	0.286	0.854	0.251	0.061	0.001	0.012	0.003	0.572	0.854	0.251	0.122	0.003	0.012	0.003
	4	0.300	0.862	0.259	0.054	0.001	0.011	0.002	0.600	0.862	0.259	0.108	0.002	0.011	0.002
	7	0.287	0.875	0.234	0.065	0.002	0.016	0.002	0.574	0.875	0.234	0.131	0.004	0.016	0.002
e	1	0.328	0.783	0.301	0.028	0.000	0.010	0.002	0.655	0.783	0.301	0.057	0.001	0.010	0.002
	3	0.321	0.796	0.308	0.037	0.000	0.011	0.001	0.641	0.796	0.308	0.074	0.001	0.011	0.001
	4	0.329	0.285	0.319	0.028	0.000	0.010	0.002	0.657	0.285	0.319	0.056	0.001	0.010	0.002
	5	0.272	0.904	0.204	0.081	0.003	0.007	0.003	0.544	0.904	0.204	0.162	0.007	0.007	0.003
f	2	0.276	0.878	0.277	0.067	0.002	0.015	0.003	0.553	0.878	0.277	0.134	0.004	0.015	0.003
	3	0.261	0.933	0.201	0.085	0.003	0.013	0.002	0.522	0.933	0.201	0.170	0.006	0.013	0.002
g	1	0.327	0.760	0.325	0.024	0.000	0.008	0.002	0.654	0.760	0.325	0.049	0.001	0.008	0.002
	2	0.326	0.769	0.317	0.023	0.000	0.008	0.002	0.653	0.769	0.317	0.047	0.001	0.008	0.002
	3	0.328	0.765	0.312	0.025	0.000	0.007	0.002	0.657	0.765	0.312	0.049	0.001	0.007	0.002
	4	0.328	0.766	0.332	0.024	0.000	0.010	0.001	0.656	0.766	0.332	0.048	0.001	0.010	0.001
	5	0.327	0.767	0.319	0.024	0.000	0.010	0.002	0.655	0.767	0.319	0.047	0.001	0.010	0.002
	6	0.332	0.758	0.324	0.022	0.000	0.010	0.002	0.663	0.758	0.324	0.044	0.001	0.010	0.002
	7	0.328	0.771	0.325	0.023	0.000	0.010	0.001	0.655	0.771	0.325	0.047	0.000	0.010	0.001
	8	0.278	0.880	0.216	0.068	0.002	0.014	0.002	0.556	0.880	0.216	0.135	0.004	0.014	0.002
h	2	0.286	0.872	0.245	0.062	0.001	0.011	0.003	0.573	0.872	0.245	0.125	0.003	0.011	0.003
	3	0.298	0.835	0.261	0.053	0.001	0.010	0.002	0.596	0.835	0.261	0.106	0.002	0.010	0.002
	4	0.292	0.855	0.246	0.058	0.001	0.011	0.003	0.584	0.855	0.246	0.115	0.003	0.011	0.003
	5	0.289	0.867	0.231	0.063	0.002	0.011	0.003	0.577	0.867	0.231	0.125	0.004	0.011	0.003
	6	0.283	0.879	0.226	0.064	0.002	0.013	0.003	0.566	0.879	0.226	0.128	0.004	0.013	0.003
	7	0.249	0.966	0.166	0.097	0.006	0.013	0.002	0.497	0.966	0.166	0.193	0.013	0.013	0.002
i	1	0.297	0.844	0.255	0.056	0.002	0.010	0.003	0.593	0.844	0.255	0.111	0.003	0.010	0.003
	2	0.302	0.825	0.258	0.047	0.001	0.013	0.003	0.603	0.825	0.258	0.094	0.002	0.013	0.003
	3	0.299	0.834	0.258	0.056	0.002	0.012	0.002	0.598	0.834	0.258	0.112	0.003	0.012	0.002
	4	0.304	0.840	0.268	0.053	0.001	0.012	0.003	0.608	0.840	0.268	0.106	0.003	0.012	0.003

(continued on following page).

Table A.1 (continued).

Crystal		Number of Oxygens							Total	Oxygen
GPA.04	Spot	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO	Oxygen	Factor
1	1	0.873	1.755	0.235	0.063	0.001	0.012	0.003	2.942	2.720
	2	0.873	1.759	0.222	0.061	0.002	0.012	0.003	2.932	2.729
	3	0.884	1.760	0.237	0.060	0.002	0.011	0.004	2.957	2.705
2	1	0.885	1.710	0.231	0.059	0.002	0.011	0.002	2.900	2.759
	2	0.890	1.722	0.246	0.060	0.002	0.011	0.003	2.934	2.727
	3	0.869	1.738	0.225	0.068	0.002	0.010	0.003	2.915	2.744
	4	0.885	1.694	0.229	0.062	0.002	0.012	0.003	2.888	2.770
	5	0.881	1.692	0.234	0.061	0.002	0.011	0.003	2.884	2.774
3	1	0.938	1.662	0.260	0.047	0.001	0.011	0.002	2.921	2.739
	2	0.952	1.650	0.288	0.039	0.001	0.010	0.001	2.943	2.718
	3	0.965	1.620	0.301	0.033	0.001	0.010	0.002	2.931	2.729
	4	0.981	1.595	0.296	0.033	0.001	0.009	0.002	2.916	2.743
	5	0.974	1.633	0.282	0.035	0.001	0.010	0.002	2.936	2.725
	6	0.901	1.715	0.242	0.056	0.002	0.011	0.003	2.931	2.730
	7	0.897	1.744	0.234	0.059	0.001	0.011	0.002	2.949	2.713
	8	0.898	1.756	0.232	0.058	0.002	0.015	0.002	2.964	2.699
	9	0.905	1.711	0.233	0.056	0.002	0.012	0.003	2.920	2.739
5	1	0.799	1.811	0.187	0.084	0.004	0.016	0.003	2.905	2.754
	2	0.816	1.809	0.185	0.081	0.004	0.014	0.002	2.911	2.748
6	1	0.875	1.727	0.235	0.060	0.002	0.014	0.003	2.917	2.743
	2	0.875	1.764	0.229	0.063	0.002	0.013	0.003	2.948	2.714
	3	0.849	1.799	0.212	0.069	0.002	0.013	0.003	2.948	2.714
7	1	0.927	1.647	0.272	0.050	0.002	0.013	0.003	2.913	2.746
	2	0.945	1.648	0.268	0.044	0.001	0.012	0.004	2.921	2.739
	3	0.963	1.605	0.290	0.040	0.001	0.010	0.002	2.912	2.747
	4	0.947	1.618	0.283	0.040	0.002	0.015	0.005	2.910	2.749
	5	0.951	1.611	0.256	0.042	0.002	0.013	0.003	2.878	2.780
	7	0.914	1.627	0.272	0.043	0.002	0.023	0.009	2.891	2.767
	9	0.855	1.641	0.250	0.051	0.006	0.035	0.018	2.858	2.800
	10	0.960	1.587	0.283	0.040	0.002	0.010	0.001	2.883	2.775
	11	0.949	1.615	0.283	0.047	0.001	0.010	0.002	2.906	2.753
	12	0.977	1.605	0.282	0.037	0.001	0.011	0.002	2.915	2.744
	13	0.889	1.717	0.225	0.066	0.002	0.013	0.003	2.915	2.744
	14	0.823	1.799	0.173	0.086	0.004	0.014	0.002	2.902	2.757
t	1	0.856	1.689	0.252	0.060	0.002	0.012	0.003	2.875	2.783
	3	0.854	1.717	0.248	0.061	0.001	0.012	0.003	2.897	2.762
	4	0.785	1.850	0.196	0.085	0.003	0.014	0.003	2.935	2.725
u	1	0.887	1.724	0.258	0.061	0.001	0.011	0.003	2.945	2.717
	2	0.881	1.750	0.243	0.062	0.001	0.012	0.003	2.952	2.710
	3	0.872	1.768	0.229	0.066	0.002	0.012	0.003	2.951	2.711

(continued on following page).

Table A.1 (continued).

	5	0.869	1.759	0.237	0.066	0.002	0.011	0.003	2.948	2.714
y	2	0.889	1.730	0.258	0.058	0.002	0.012	0.003	2.951	2.711
	3	0.871	1.729	0.253	0.063	0.001	0.008	0.000	2.926	2.734
	4	0.878	1.742	0.253	0.062	0.002	0.009	0.002	2.947	2.715
	5	0.856	1.750	0.230	0.065	0.002	0.010	0.002	2.914	2.745
z	1	0.888	1.707	0.265	0.057	0.001	0.010	0.002	2.931	2.729
	2	0.886	1.728	0.249	0.059	0.001	0.013	0.002	2.939	2.722
aa	1	0.805	1.812	0.201	0.078	0.003	0.014	0.003	2.916	2.743
	2	0.795	1.819	0.190	0.084	0.004	0.012	0.004	2.907	2.752
ba	1	0.783	1.856	0.197	0.087	0.004	0.013	0.002	2.942	2.719
	2	0.781	1.855	0.188	0.088	0.004	0.020	0.003	2.938	2.723
ca	1	0.939	1.636	0.295	0.042	0.001	0.011	0.002	2.926	2.734
	2	0.932	1.657	0.280	0.044	0.001	0.010	0.002	2.927	2.733
	3	0.935	1.619	0.291	0.041	0.001	0.008	0.001	2.896	2.762
	4	0.952	1.603	0.298	0.036	0.001	0.011	0.002	2.903	2.756
	5	0.967	1.582	0.309	0.030	0.001	0.010	0.002	2.901	2.758
	6	0.979	1.562	0.321	0.028	0.001	0.009	0.002	2.901	2.758
	9	0.817	1.820	0.223	0.079	0.003	0.001	0.002	2.945	2.716
da	1	0.846	1.761	0.229	0.070	0.002	0.010	0.003	2.920	2.740
	2	0.839	1.756	0.241	0.067	0.002	0.011	0.003	2.919	2.741
	3	0.860	1.733	0.231	0.062	0.002	0.011	0.003	2.901	2.757
	4	0.855	1.755	0.243	0.064	0.002	0.011	0.002	2.932	2.729
	5	0.861	1.751	0.252	0.063	0.002	0.014	0.003	2.946	2.716

Crystal		Number of Oxygens							Total	Oxygen
GPA.02	Spot	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO	Oxygen	Factor
23	2	0.938	1.636	0.266	0.044	0.001	0.009	0.002	2.897	2.762
	3	0.929	1.669	0.284	0.046	0.001	0.009	0.002	2.940	2.721
	4	0.924	1.650	0.281	0.050	0.001	0.008	0.002	2.917	2.743
	5	0.922	1.691	0.276	0.050	0.001	0.009	0.002	2.950	2.711
	6	0.929	1.680	0.266	0.050	0.001	0.008	0.002	2.937	2.724
	7	0.882	1.661	0.259	0.059	0.002	0.012	0.003	2.877	2.781
	8	0.850	1.776	0.205	0.071	0.002	0.013	0.003	2.920	2.740
25	2	0.938	1.613	0.284	0.041	0.002	0.010	0.003	2.890	2.768
	3	0.924	1.628	0.282	0.040	0.001	0.008	0.001	2.884	2.774
	4	0.916	1.650	0.268	0.046	0.001	0.011	0.002	2.893	2.765
	5	0.857	1.729	0.242	0.063	0.003	0.011	0.003	2.906	2.753
	6	0.816	1.808	0.198	0.076	0.002	0.010	0.003	2.913	2.746
26	3	0.939	1.599	0.280	0.041	0.002	0.008	0.003	2.872	2.786
	4	0.909	1.630	0.264	0.055	0.003	0.010	0.003	2.874	2.784
	5	0.937	1.587	0.276	0.041	0.002	0.009	0.003	2.856	2.801
	6	0.927	1.629	0.268	0.047	0.001	0.008	0.002	2.881	2.777
	7	0.932	1.650	0.280	0.045	0.001	0.009	0.002	2.919	2.740

(continued on following page).

Table A.1 (continued).

	8	0.941	1.632	0.294	0.039	0.001	0.008	0.002	2.916	2.744
	9	0.954	1.611	0.299	0.038	0.001	0.011	0.003	2.916	2.743
27	1	0.937	1.631	0.283	0.045	0.001	0.010	0.002	2.909	2.750
	3	0.939	1.635	0.275	0.045	0.001	0.009	0.003	2.906	2.753
	4	0.949	1.640	0.281	0.044	0.001	0.009	0.002	2.925	2.735
	5	0.932	1.665	0.277	0.047	0.001	0.011	0.001	2.935	2.726
	6	0.849	1.805	0.221	0.074	0.002	0.014	0.004	2.969	2.694
15	1	0.938	1.634	0.283	0.045	0.001	0.009	0.002	2.913	2.747
	2	0.924	1.682	0.273	0.050	0.001	0.008	0.002	2.941	2.720
	3	0.944	1.627	0.287	0.043	0.002	0.008	0.003	2.913	2.746
	4	0.925	1.649	0.279	0.050	0.002	0.010	0.003	2.918	2.741
	6	0.882	1.727	0.241	0.066	0.002	0.013	0.003	2.933	2.728
	7	0.841	1.750	0.225	0.072	0.004	0.012	0.003	2.906	2.753
17	1	0.953	1.632	0.279	0.040	0.001	0.012	0.003	2.919	2.741
	2	0.953	1.639	0.286	0.041	0.001	0.011	0.002	2.933	2.727
	3	0.927	1.635	0.281	0.044	0.001	0.009	0.002	2.899	2.759
	4	0.949	1.631	0.281	0.042	0.001	0.009	0.002	2.916	2.744
	6	0.827	1.830	0.202	0.078	0.003	0.012	0.004	2.956	2.707
ea	1	0.849	1.744	0.223	0.072	0.001	0.013	0.002	2.904	2.755
	2	0.668	1.899	0.157	0.087	0.011	0.047	0.015	2.884	2.774
fa	1	0.943	1.613	0.291	0.040	0.001	0.011	0.002	2.902	2.757
	2	0.907	1.661	0.261	0.051	0.001	0.011	0.003	2.896	2.763
ga	2	0.910	1.656	0.275	0.051	0.001	0.012	0.002	2.908	2.751
	3	0.885	1.716	0.253	0.064	0.001	0.012	0.003	2.934	2.726
	5	0.894	1.698	0.255	0.057	0.001	0.011	0.002	2.919	2.741
	6	0.894	1.703	0.254	0.056	0.001	0.010	0.003	2.922	2.738
	7	0.868	1.710	0.244	0.063	0.001	0.012	0.003	2.902	2.757
	8	0.858	1.716	0.225	0.066	0.002	0.012	0.003	2.881	2.776
ha	1	0.961	1.550	0.321	0.032	0.001	0.005	0.002	2.872	2.786
	2	0.944	1.606	0.291	0.039	0.001	0.010	0.002	2.894	2.764
	3	0.913	1.636	0.269	0.049	0.001	0.012	0.003	2.883	2.775
	4	0.876	1.721	0.253	0.063	0.002	0.012	0.002	2.928	2.732
ia	1	0.963	1.556	0.301	0.032	0.000	0.009	0.002	2.864	2.793
	2	0.970	1.554	0.302	0.028	0.001	0.009	0.002	2.866	2.791
	3	0.954	1.600	0.299	0.036	0.000	0.009	0.002	2.900	2.759
ja	1	0.880	1.699	0.248	0.060	0.001	0.010	0.003	2.901	2.758
	2	0.843	1.737	0.235	0.072	0.003	0.013	0.002	2.905	2.754
	3	0.890	1.682	0.250	0.060	0.001	0.011	0.003	2.897	2.762
	4	0.911	1.650	0.273	0.050	0.001	0.010	0.003	2.898	2.761
	5	0.900	1.669	0.259	0.055	0.001	0.012	0.003	2.899	2.759
ka	1	0.879	1.666	0.260	0.056	0.001	0.009	0.003	2.874	2.783
	3	0.824	1.771	0.210	0.075	0.002	0.014	0.003	2.898	2.760
	4	0.852	1.736	0.237	0.070	0.002	0.012	0.003	2.912	2.748
la	1	0.851	1.744	0.241	0.069	0.002	0.012	0.004	2.923	2.737

(continued on following page).

Table A.1 (continued).

	2	0.876	1.727	0.248	0.065	0.002	0.011	0.004	2.932	2.729
	3	0.809	1.806	0.208	0.080	0.003	0.013	0.003	2.922	2.738

Crystal		Number of Oxygens							Total	Oxygen
GPA.07	Spot	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO	Oxygen	Factor
33	1	0.792	1.857	0.186	0.088	0.004	0.014	0.003	2.943	2.718
	2	0.790	1.873	0.187	0.091	0.004	0.015	0.002	2.962	2.701
35	1	0.779	1.880	0.186	0.092	0.004	0.016	0.002	2.959	2.704
34	1	0.931	1.593	0.294	0.043	0.001	0.010	0.002	2.873	2.784
	3	0.942	1.596	0.274	0.040	0.001	0.010	0.003	2.866	2.792
	4	0.936	1.615	0.268	0.039	0.000	0.010	0.002	2.872	2.786
	5	0.924	1.624	0.275	0.043	0.001	0.009	0.003	2.879	2.779
	6	0.900	1.652	0.262	0.050	0.001	0.010	0.003	2.878	2.780
	7	0.842	1.731	0.227	0.068	0.002	0.012	0.003	2.886	2.772
36	1	0.984	1.510	0.324	0.028	0.001	0.009	0.002	2.858	2.799
	2	0.989	1.529	0.326	0.026	0.001	0.005	0.002	2.878	2.780
	3	0.999	1.544	0.319	0.024	0.000	0.008	0.001	2.896	2.762
	4	1.004	1.537	0.325	0.022	0.001	0.007	0.001	2.896	2.763
	5	0.992	1.532	0.303	0.023	0.001	0.008	0.001	2.860	2.797
	6	1.007	1.534	0.307	0.023	0.001	0.008	0.002	2.882	2.776
37	1	1.006	1.496	0.333	0.007	0.000	0.008	0.001	2.851	2.806
	2	0.994	1.510	0.344	0.020	0.000	0.007	0.002	2.877	2.781
	4	0.982	1.550	0.323	0.026	0.001	0.006	0.002	2.890	2.768
	5	0.980	1.564	0.324	0.026	0.000	0.007	0.001	2.902	2.757
	6	0.978	1.538	0.309	0.023	0.000	0.006	0.002	2.856	2.801
	7	0.986	1.540	0.328	0.023	0.000	0.006	0.002	2.886	2.772
	8	0.981	1.539	0.311	0.024	0.000	0.009	0.002	2.866	2.791
	9	0.878	1.703	0.255	0.056	0.001	0.010	0.003	2.907	2.752
j	1	0.993	1.525	0.325	0.026	0.001	0.007	0.002	2.879	2.778
	2	1.005	1.541	0.329	0.023	0.000	0.007	0.001	2.907	2.752
	3	0.966	1.575	0.292	0.032	0.001	0.010	0.002	2.878	2.780
	4	0.992	1.539	0.331	0.024	0.001	0.008	0.001	2.895	2.763
	5	0.992	1.552	0.313	0.027	0.001	0.009	0.002	2.896	2.763
	6	0.993	1.548	0.305	0.023	0.000	0.008	0.001	2.879	2.779
	7	0.989	1.537	0.316	0.026	0.000	0.011	0.002	2.882	2.776
	8	0.907	1.668	0.265	0.050	0.001	0.013	0.002	2.906	2.753
k	1	0.993	1.492	0.327	0.018	0.000	0.006	0.001	2.838	2.819
	2	0.997	1.486	0.335	0.019	0.000	0.006	0.001	2.844	2.813
	3	0.994	1.499	0.341	0.018	0.001	0.008	0.000	2.860	2.797
	4	0.956	1.461	0.323	0.020	0.001	0.006	0.001	2.768	2.891
	5	0.982	1.551	0.329	0.024	0.001	0.008	0.001	2.894	2.764
	6	0.982	1.539	0.319	0.022	0.001	0.007	0.001	2.870	2.788
	7	0.993	1.513	0.325	0.020	0.001	0.005	0.002	2.858	2.799

(continued on following page).

Table A.1 (continued).

	8	0.997	1.523	0.336	0.016	0.001	0.008	0.001	2.882	2.776
	9	0.992	1.526	0.347	0.017	0.001	0.009	0.002	2.893	2.765
l	2	0.880	1.687	0.276	0.051	0.001	0.013	0.003	2.911	2.748
	3	0.890	1.692	0.266	0.051	0.002	0.013	0.002	2.915	2.744
	4	0.864	1.704	0.269	0.054	0.001	0.010	0.002	2.904	2.755
	5	0.874	1.673	0.264	0.051	0.001	0.010	0.002	2.874	2.784
	6	0.886	1.669	0.255	0.049	0.001	0.014	0.002	2.874	2.783
	7	0.891	1.655	0.292	0.045	0.001	0.010	0.003	2.896	2.763
n	1	1.013	1.502	0.337	0.018	0.000	0.005	0.001	2.877	2.781
	2	1.024	1.512	0.343	0.018	0.000	0.004	0.001	2.903	2.756
	3	1.024	1.533	0.336	0.018	0.000	0.006	0.001	2.918	2.741
	4	0.998	1.538	0.318	0.028	0.001	0.011	0.002	2.894	2.764
	5	0.925	1.665	0.274	0.049	0.001	0.012	0.003	2.928	2.733
o	1	0.995	1.506	0.326	0.021	0.000	0.010	0.002	2.860	2.797
	2	0.997	1.523	0.330	0.020	0.000	0.009	0.001	2.882	2.776
	3	1.006	1.507	0.345	0.018	0.000	0.007	0.002	2.886	2.772
	4	0.998	1.527	0.327	0.019	0.000	0.007	0.002	2.879	2.778
	5	0.981	1.529	0.331	0.024	0.000	0.006	0.001	2.873	2.785
	6	0.997	1.534	0.330	0.022	0.000	0.009	0.002	2.895	2.764
	7	0.998	1.537	0.309	0.024	0.000	0.008	0.002	2.877	2.780
	8	1.005	1.532	0.320	0.021	0.001	0.010	0.002	2.891	2.767
	9	1.006	1.525	0.348	0.020	0.000	0.007	0.001	2.908	2.751
	10	1.002	1.537	0.330	0.021	0.000	0.006	0.001	2.898	2.760
p	1	0.917	1.677	0.268	0.051	0.001	0.011	0.002	2.928	2.732
	3	0.901	1.687	0.260	0.053	0.002	0.011	0.002	2.916	2.743
	4	0.908	1.707	0.256	0.053	0.002	0.011	0.002	2.939	2.722
	5	0.909	1.697	0.266	0.053	0.001	0.011	0.002	2.941	2.721
	6	0.877	1.761	0.240	0.065	0.002	0.014	0.002	2.960	2.703
q	1	0.977	1.567	0.314	0.032	0.001	0.011	0.002	2.903	2.756
	2	1.012	1.558	0.323	0.021	0.000	0.007	0.001	2.923	2.737
	3	0.952	1.591	0.294	0.034	0.001	0.008	0.001	2.881	2.777
	4	0.980	1.576	0.300	0.032	0.000	0.010	0.001	2.900	2.759
	5	0.924	1.639	0.269	0.050	0.001	0.012	0.002	2.898	2.761
r	1	0.880	1.698	0.253	0.061	0.001	0.012	0.018	2.922	2.738
	2	0.868	1.746	0.228	0.064	0.001	0.014	0.002	2.923	2.737
	3	0.880	1.710	0.256	0.060	0.001	0.014	0.002	2.923	2.737
	4	0.906	1.641	0.257	0.051	0.001	0.011	0.002	2.869	2.788
	6	0.874	1.681	0.251	0.062	0.002	0.012	0.002	2.884	2.774
s	1	0.995	1.502	0.309	0.022	0.001	0.010	0.002	2.841	2.815
	2	0.998	1.521	0.308	0.022	0.002	0.007	0.001	2.860	2.797
	3	0.985	1.570	0.316	0.026	0.002	0.012	0.005	2.917	2.743
	5	1.010	1.539	0.326	0.022	0.002	0.010	0.002	2.910	2.750
	6	1.009	1.519	0.322	0.019	0.001	0.006	0.001	2.877	2.781
	7	0.905	1.664	0.257	0.051	0.002	0.012	0.003	2.895	2.763

(continued on following page).

Table A.1 (continued).

Crystal		Number of Oxygens							Total	Oxygen
GPA.03	Spot	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO	Oxygen	Factor
40	1	1.001	1.553	0.331	0.021	0.000	0.010	0.002	2.919	2.740
	2	0.989	1.587	0.313	0.027	0.000	0.009	0.002	2.926	2.734
	3	0.980	1.584	0.318	0.026	0.000	0.011	0.001	2.921	2.739
	4	0.938	1.644	0.290	0.038	0.001	0.012	0.001	2.925	2.735
41	1	0.840	1.798	0.227	0.077	0.003	0.012	0.002	2.960	2.703
	2	0.812	1.806	0.199	0.081	0.003	0.013	0.003	2.918	2.742
	3	0.790	1.868	0.186	0.088	0.004	0.013	0.003	2.952	2.710
	4	0.827	1.820	0.213	0.080	0.003	0.012	0.003	2.959	2.704
	5	0.852	1.771	0.229	0.070	0.002	0.013	0.004	2.940	2.721
42	1	1.016	1.545	0.320	0.021	0.000	0.007	0.001	2.912	2.747
	2	1.010	1.581	0.312	0.021	0.000	0.010	0.001	2.935	2.726
	3	1.016	1.550	0.327	0.021	0.000	0.008	0.002	2.923	2.737
	4	0.995	1.579	0.314	0.028	0.001	0.010	0.002	2.930	2.731
	5	0.998	1.570	0.304	0.026	0.000	0.010	0.001	2.910	2.749
	7	0.900	1.719	0.250	0.051	0.001	0.014	0.003	2.939	2.722
44	3	0.974	1.607	0.290	0.031	0.001	0.008	0.002	2.913	2.747
	4	0.926	1.616	0.286	0.036	0.001	0.010	0.002	2.877	2.781
	5	0.962	1.603	0.301	0.033	0.001	0.011	0.002	2.912	2.747
	6	0.957	1.629	0.280	0.039	0.001	0.011	0.003	2.919	2.740
	7	0.783	1.847	0.180	0.090	0.005	0.015	0.004	2.924	2.736
45	1	1.006	1.514	0.320	0.024	0.001	0.008	0.002	2.875	2.783
	2	1.009	1.510	0.307	0.022	0.000	0.008	0.002	2.857	2.800
	3	1.018	1.545	0.328	0.019	0.000	0.007	0.002	2.919	2.741
	4	1.019	1.535	0.320	0.019	0.000	0.007	0.001	2.903	2.756
	5	1.018	1.525	0.308	0.023	0.001	0.008	0.001	2.884	2.774
	6	0.973	1.612	0.292	0.033	0.001	0.012	0.002	2.925	2.735
	7	0.850	1.741	0.218	0.071	0.002	0.016	0.004	2.902	2.756
46	1	0.906	1.674	0.287	0.033	0.001	0.012	0.002	2.916	2.744
	4	0.932	1.624	0.321	0.026	0.001	0.009	0.001	2.914	2.745
	5	0.919	1.650	0.286	0.032	0.000	0.012	0.002	2.901	2.757
47	1	0.942	1.660	0.293	0.034	0.000	0.011	0.002	2.942	2.719
	2	0.928	1.630	0.295	0.034	0.001	0.011	0.003	2.900	2.759
	3	0.922	1.623	0.292	0.036	0.001	0.012	0.002	2.888	2.770
	4	0.932	1.672	0.283	0.036	0.001	0.010	0.002	2.936	2.724
48	1	1.018	1.546	0.326	0.017	0.000	0.008	0.001	2.917	2.743
	2	1.025	1.507	0.318	0.016	0.000	0.007	0.002	2.876	2.781
	3	1.012	1.544	0.320	0.021	0.000	0.008	0.001	2.907	2.752
	4	1.018	1.545	0.303	0.020	0.000	0.008	0.002	2.897	2.761
	5	0.975	1.624	0.287	0.033	0.001	0.011	0.002	2.933	2.727
	6	0.824	1.826	0.210	0.076	0.002	0.015	0.003	2.956	2.706
50	2	1.027	1.525	0.328	0.024	0.001	0.008	0.002	2.915	2.745

(continued on following page).

Table A.1 (continued).

	3	1.031	1.540	0.318	0.022	0.000	0.008	0.001	2.922	2.738
	4	1.029	1.455	0.319	0.021	0.000	0.010	0.002	2.837	2.820
	5	1.025	1.450	0.325	0.023	0.000	0.009	0.001	2.834	2.823
	6	0.987	1.599	0.286	0.037	0.000	0.011	0.002	2.922	2.738
ma	1	0.969	1.628	0.291	0.037	0.001	0.010	0.002	2.938	2.723
	2	2.735	1.619	0.283	0.037	0.001	0.010	0.002	4.686	1.707
	3	2.734	1.593	0.280	0.036	0.001	0.008	0.002	4.654	1.719
	4	0.972	1.610	0.289	0.038	0.001	0.010	0.003	2.922	2.738
	5	0.892	1.731	0.232	0.059	0.001	0.012	0.004	2.931	2.730
na	1	0.935	1.626	0.262	0.048	0.001	0.012	0.002	2.887	2.771
	2	0.933	1.667	0.248	0.049	0.001	0.013	0.004	2.915	2.744
	3	0.797	1.876	0.174	0.078	0.005	0.022	0.003	2.955	2.707
oa	1	0.857	1.829	0.195	0.075	0.002	0.017	0.002	2.978	2.686
	3	0.841	1.852	0.181	0.079	0.003	0.018	0.004	2.977	2.688
pa	1	0.889	1.779	0.224	0.065	0.002	0.012	0.004	2.974	2.690
	2	0.857	1.778	0.223	0.067	0.001	0.012	0.002	2.940	2.721
	3	0.866	1.821	0.205	0.070	0.002	0.015	0.003	2.982	2.683
qa	1	0.976	1.628	0.281	0.034	0.001	0.013	0.002	2.933	2.727
	2	0.952	1.664	0.275	0.038	0.000	0.012	0.002	2.946	2.716

Crystal		Number of Oxygens							Total	Oxygen
GPA.06	Spot	Al_2O_3	SiO_2	CaO	Na_2O	K_2O	FeO	MgO	Oxygen	Factor
53	1	0.894	1.683	0.283	0.044	0.001	0.011	0.003	2.919	2.741
	2	0.881	1.711	0.284	0.047	0.001	0.012	0.002	2.937	2.724
	3	0.866	1.728	0.281	0.050	0.002	0.012	0.002	2.940	2.721
	4	0.724	1.898	0.172	0.092	0.005	0.023	0.003	2.917	2.743
54	1	0.833	1.747	0.226	0.067	0.002	0.013	0.004	2.892	2.766
	2	0.832	1.751	0.246	0.067	0.002	0.012	0.003	2.913	2.746
	4	0.833	1.747	0.233	0.066	0.002	0.011	0.003	2.895	2.764
	5	0.828	1.743	0.230	0.065	0.002	0.014	0.003	2.886	2.772
58	1	0.895	1.712	0.264	0.051	0.001	0.010	0.003	2.937	2.724
	3	0.871	1.746	0.252	0.059	0.001	0.012	0.002	2.943	2.718
	4	0.861	1.770	0.248	0.061	0.001	0.011	0.003	2.957	2.706
	5	0.872	1.754	0.249	0.059	0.001	0.011	0.004	2.949	2.713
	6	0.850	1.782	0.245	0.066	0.002	0.012	0.003	2.960	2.703
56	1	0.934	1.585	0.306	0.035	0.001	0.011	0.003	2.874	2.784
	2	0.921	1.585	0.294	0.035	0.001	0.012	0.002	2.850	2.807
	4	0.791	1.803	0.215	0.066	0.003	0.015	0.004	2.896	2.762
59	1	0.847	1.867	0.240	0.072	0.002	0.015	0.003	3.047	2.626
	2	0.792	1.869	0.189	0.087	0.004	0.014	0.004	2.959	2.703
60	1	0.972	1.534	0.337	0.022	0.000	0.010	0.001	2.877	2.781
	2	0.967	1.584	0.336	0.022	0.001	0.008	0.001	2.919	2.741
	5	0.869	1.732	0.268	0.059	0.001	0.010	0.003	2.943	2.718

(continued on following page).

Table A.1 (continued).

	6	0.879	1.696	0.269	0.053	0.001	0.010	0.003	2.912	2.747
	7	0.879	1.674	0.277	0.052	0.001	0.012	0.002	2.897	2.761
	8	0.777	1.859	0.213	0.082	0.003	0.014	0.002	2.950	2.712
61	1	0.975	1.573	0.326	0.023	0.000	0.009	0.001	2.909	2.750
	2	0.807	1.862	0.205	0.077	0.003	0.015	0.003	2.973	2.691
64	1	0.786	1.898	0.190	0.085	0.003	0.013	0.003	2.978	2.686
	2	0.782	1.913	0.182	0.088	0.004	0.014	0.002	2.984	2.681
65	2	0.884	1.725	0.255	0.055	0.002	0.012	0.003	2.936	2.725
	3	0.879	1.672	0.260	0.055	0.002	0.011	0.003	2.882	2.776
	4	0.789	1.867	0.188	0.087	0.004	0.013	0.003	2.951	2.711
a	1	0.869	1.706	0.240	0.061	0.001	0.011	0.002	2.891	2.768
	2	0.869	1.732	0.257	0.061	0.001	0.011	0.004	2.935	2.726
	3	0.764	1.858	0.188	0.088	0.004	0.019	0.003	2.924	2.736
c	1	0.881	1.760	0.243	0.061	0.001	0.011	0.003	2.960	2.703
	2	0.881	1.735	0.242	0.060	0.014	0.015	0.003	2.952	2.710
	3	0.858	1.708	0.251	0.061	0.001	0.012	0.003	2.894	2.764
	4	0.901	1.723	0.259	0.054	0.001	0.011	0.002	2.951	2.711
	7	0.862	1.751	0.234	0.065	0.002	0.016	0.002	2.932	2.729
e	1	0.983	1.566	0.301	0.028	0.000	0.010	0.002	2.890	2.768
	3	0.962	1.591	0.308	0.037	0.000	0.011	0.001	2.910	2.749
	4	0.986	0.570	0.319	0.028	0.000	0.010	0.002	1.914	4.180
	5	0.816	1.808	0.204	0.081	0.003	0.007	0.003	2.921	2.739
f	2	0.829	1.756	0.277	0.067	0.002	0.015	0.003	2.949	2.712
	3	0.783	1.867	0.201	0.085	0.003	0.013	0.002	2.955	2.707
g	1	0.981	1.520	0.325	0.024	0.000	0.008	0.002	2.861	2.797
	2	0.979	1.537	0.317	0.023	0.000	0.008	0.002	2.867	2.791
	3	0.985	1.530	0.312	0.025	0.000	0.007	0.002	2.861	2.796
	4	0.984	1.532	0.332	0.024	0.000	0.010	0.001	2.883	2.774
	5	0.982	1.534	0.319	0.024	0.000	0.010	0.002	2.871	2.787
	6	0.995	1.515	0.324	0.022	0.000	0.010	0.002	2.868	2.789
	7	0.983	1.542	0.325	0.023	0.000	0.010	0.001	2.885	2.773
	8	0.834	1.761	0.216	0.068	0.002	0.014	0.002	2.896	2.762
h	2	0.859	1.744	0.245	0.062	0.001	0.011	0.003	2.926	2.734
	3	0.894	1.670	0.261	0.053	0.001	0.010	0.002	2.892	2.767
	4	0.876	1.710	0.246	0.058	0.001	0.011	0.003	2.904	2.754
	5	0.866	1.733	0.231	0.063	0.002	0.011	0.003	2.908	2.751
	6	0.849	1.758	0.226	0.064	0.002	0.013	0.003	2.915	2.745
	7	0.746	1.933	0.166	0.097	0.006	0.013	0.002	2.963	2.700
i	1	0.890	1.688	0.255	0.056	0.002	0.010	0.003	2.902	2.756
	2	0.905	1.650	0.258	0.047	0.001	0.013	0.003	2.877	2.780
	3	0.897	1.668	0.258	0.056	0.002	0.012	0.002	2.894	2.764
	4	0.913	1.679	0.268	0.053	0.001	0.012	0.003	2.929	2.731

(continued on following page).

Table A.1 (continued).

Crystal		Cations on the basis of 8 Oxygens										
GPA.04	Spot	Al	Si	Ca	Na	K	Fe	Mg	X_{An}	X_{Ab}	X_{Or}	% An
1	1	1.582	2.386	0.639	0.342	0.007	0.033	0.007	0.647	0.347	0.007	64.67
	2	1.587	2.400	0.607	0.334	0.009	0.032	0.009	0.639	0.351	0.010	63.91
	3	1.594	2.381	0.641	0.327	0.010	0.029	0.010	0.656	0.334	0.010	65.57
2	1	1.628	2.358	0.636	0.327	0.010	0.031	0.006	0.653	0.336	0.011	65.34
	2	1.618	2.348	0.671	0.330	0.009	0.029	0.008	0.665	0.327	0.009	66.47
	3	1.589	2.385	0.617	0.375	0.010	0.028	0.009	0.616	0.374	0.010	61.60
	4	1.635	2.346	0.636	0.341	0.012	0.034	0.009	0.643	0.345	0.012	64.29
	5	1.628	2.347	0.650	0.337	0.010	0.031	0.009	0.652	0.338	0.010	65.17
3	1	1.713	2.276	0.713	0.255	0.006	0.030	0.006	0.732	0.262	0.006	73.18
	2	1.726	2.242	0.784	0.214	0.008	0.028	0.004	0.779	0.213	0.008	77.93
	3	1.755	2.211	0.821	0.181	0.005	0.026	0.005	0.815	0.180	0.005	81.48
	4	1.794	2.188	0.811	0.179	0.005	0.025	0.005	0.814	0.180	0.005	81.44
	5	1.769	2.225	0.768	0.192	0.004	0.028	0.004	0.796	0.199	0.004	79.64
	6	1.640	2.341	0.662	0.306	0.010	0.030	0.008	0.677	0.313	0.010	67.68
	7	1.623	2.365	0.635	0.318	0.008	0.030	0.006	0.661	0.331	0.008	66.09
	8	1.616	2.370	0.627	0.311	0.011	0.040	0.006	0.661	0.328	0.011	66.07
	9	1.653	2.343	0.637	0.304	0.011	0.033	0.007	0.669	0.319	0.012	66.86
5	1	1.467	2.494	0.515	0.461	0.023	0.045	0.009	0.515	0.461	0.023	51.53
	2	1.495	2.486	0.508	0.445	0.020	0.040	0.006	0.522	0.457	0.021	52.20
6	1	1.600	2.369	0.645	0.332	0.009	0.038	0.009	0.654	0.336	0.009	65.43
	2	1.582	2.393	0.621	0.340	0.011	0.035	0.009	0.639	0.350	0.011	63.91
	3	1.536	2.442	0.574	0.376	0.011	0.034	0.009	0.597	0.391	0.012	59.73
7	1	1.696	2.261	0.746	0.277	0.008	0.036	0.008	0.723	0.269	0.008	72.32
	2	1.725	2.256	0.734	0.240	0.006	0.032	0.011	0.749	0.245	0.006	74.93
	3	1.764	2.205	0.797	0.218	0.007	0.028	0.007	0.780	0.213	0.007	77.99
	4	1.736	2.224	0.777	0.218	0.011	0.042	0.014	0.772	0.217	0.011	77.24
	5	1.763	2.240	0.710	0.235	0.009	0.035	0.009	0.745	0.246	0.009	74.46
	7	1.686	2.251	0.754	0.238	0.011	0.065	0.026	0.752	0.237	0.011	75.18
	9	1.596	2.298	0.700	0.287	0.033	0.099	0.051	0.686	0.282	0.032	68.64
	10	1.775	2.203	0.784	0.222	0.009	0.029	0.003	0.773	0.218	0.009	77.25
	11	1.741	2.223	0.779	0.258	0.003	0.028	0.006	0.749	0.248	0.003	74.91
	12	1.787	2.202	0.774	0.206	0.005	0.031	0.005	0.786	0.209	0.005	78.60
	13	1.625	2.356	0.618	0.363	0.010	0.036	0.009	0.623	0.367	0.010	62.34
	14	1.512	2.480	0.478	0.475	0.022	0.039	0.006	0.490	0.487	0.022	49.01
t	1	1.589	2.350	0.702	0.334	0.009	0.035	0.009	0.672	0.320	0.009	67.18
	3	1.573	2.371	0.686	0.339	0.008	0.032	0.009	0.664	0.328	0.008	66.39
	4	1.425	2.522	0.534	0.461	0.018	0.037	0.007	0.527	0.455	0.018	52.70
u	1	1.606	2.342	0.700	0.331	0.008	0.031	0.008	0.674	0.319	0.007	67.37
	2	1.591	2.372	0.660	0.335	0.007	0.031	0.008	0.659	0.334	0.007	65.87
	3	1.576	2.396	0.620	0.357	0.009	0.032	0.008	0.629	0.362	0.009	62.92

(continued on following page).

Table A.1 (continued).

Crystal	Spot	Al	Si	Ca	Na	K	Fe	Mg	X_{An}	X_{Ab}	X_{Or}	% An
	5	1.573	2.387	0.642	0.360	0.010	0.031	0.008	0.635	0.356	0.009	63.47
y	2	1.607	2.346	0.699	0.312	0.010	0.031	0.007	0.684	0.305	0.010	68.44
	3	1.588	2.363	0.691	0.344	0.008	0.023	0.001	0.662	0.330	0.008	66.22
	4	1.589	2.365	0.686	0.334	0.009	0.024	0.006	0.667	0.325	0.009	66.66
	5	1.566	2.402	0.630	0.358	0.011	0.027	0.006	0.631	0.358	0.011	63.11
z	1	1.615	2.330	0.723	0.313	0.008	0.029	0.006	0.693	0.300	0.007	69.30
	2	1.608	2.352	0.679	0.319	0.007	0.035	0.006	0.676	0.318	0.006	67.57
aa	1	1.473	2.486	0.551	0.427	0.015	0.040	0.008	0.555	0.430	0.015	55.50
	2	1.458	2.503	0.522	0.463	0.020	0.033	0.010	0.519	0.461	0.020	51.90
ba	1	1.420	2.523	0.535	0.474	0.020	0.036	0.006	0.520	0.461	0.019	52.02
	2	1.417	2.525	0.513	0.477	0.021	0.055	0.009	0.508	0.472	0.021	50.75
ca	1	1.712	2.237	0.806	0.230	0.005	0.029	0.005	0.774	0.221	0.005	77.42
	2	1.698	2.265	0.764	0.242	0.007	0.029	0.006	0.754	0.239	0.007	75.44
	3	1.722	2.236	0.803	0.226	0.006	0.021	0.004	0.775	0.219	0.006	77.55
	4	1.750	2.208	0.821	0.199	0.004	0.031	0.006	0.802	0.195	0.004	80.15
	5	1.778	2.182	0.852	0.167	0.005	0.026	0.005	0.832	0.163	0.005	83.18
	6	1.800	2.154	0.885	0.153	0.003	0.024	0.005	0.850	0.147	0.003	85.01
	9	1.480	2.472	0.605	0.429	0.015	0.004	0.006	0.577	0.409	0.015	57.68
da	1	1.545	2.412	0.627	0.382	0.011	0.028	0.007	0.614	0.375	0.011	61.44
	2	1.533	2.407	0.660	0.366	0.010	0.030	0.008	0.637	0.353	0.010	63.65
	3	1.580	2.389	0.638	0.341	0.009	0.031	0.008	0.646	0.345	0.009	64.58
	4	1.555	2.394	0.662	0.352	0.010	0.031	0.005	0.646	0.344	0.010	64.64
	5	1.558	2.378	0.685	0.343	0.012	0.037	0.007	0.658	0.330	0.012	65.83

Crystal		Cations on the basis of 8 Oxygens										
GPA.02	Spot	Al	Si	Ca	Na	K	Fe	Mg	X_{An}	X_{Ab}	X_{Or}	% An
23	2	1.726	2.260	0.735	0.246	0.005	0.025	0.006	0.746	0.249	0.005	74.58
	3	1.684	2.271	0.772	0.251	0.005	0.026	0.006	0.751	0.244	0.004	75.15
	4	1.689	2.263	0.772	0.276	0.008	0.022	0.005	0.731	0.261	0.007	73.13
	5	1.667	2.292	0.748	0.270	0.004	0.024	0.005	0.731	0.264	0.004	73.12
	6	1.687	2.288	0.726	0.274	0.006	0.023	0.006	0.722	0.272	0.006	72.19
	7	1.636	2.310	0.719	0.326	0.008	0.033	0.007	0.683	0.309	0.008	68.27
	8	1.552	2.433	0.562	0.391	0.009	0.035	0.008	0.584	0.407	0.010	58.38
25	2	1.730	2.232	0.786	0.228	0.010	0.027	0.007	0.767	0.223	0.010	76.75
	3	1.709	2.257	0.783	0.220	0.006	0.022	0.004	0.776	0.218	0.006	77.56
	4	1.688	2.281	0.740	0.255	0.007	0.030	0.006	0.739	0.254	0.007	73.90
	5	1.572	2.380	0.666	0.345	0.016	0.029	0.007	0.648	0.336	0.016	64.82
	6	1.493	2.482	0.544	0.417	0.013	0.028	0.009	0.559	0.428	0.013	55.89
26	3	1.744	2.227	0.780	0.226	0.011	0.023	0.007	0.767	0.222	0.011	76.67
	4	1.687	2.269	0.736	0.304	0.019	0.027	0.008	0.695	0.287	0.018	69.48
	5	1.750	2.224	0.772	0.232	0.014	0.025	0.008	0.759	0.228	0.013	75.90
	6	1.716	2.261	0.744	0.259	0.007	0.022	0.005	0.737	0.256	0.007	73.65
	7	1.702	2.261	0.768	0.244	0.007	0.026	0.005	0.754	0.239	0.007	75.36

(continued on following page).

Table A.1 (continued).

	8	1.720	2.239	0.806	0.213	0.005	0.021	0.005	0.787	0.208	0.005	78.74
	9	1.745	2.210	0.819	0.206	0.004	0.031	0.007	0.796	0.200	0.004	79.59
27	1	1.718	2.243	0.778	0.249	0.003	0.027	0.006	0.755	0.242	0.003	75.53
	3	1.723	2.251	0.756	0.245	0.003	0.026	0.008	0.753	0.244	0.003	75.27
	4	1.730	2.243	0.768	0.240	0.004	0.024	0.006	0.759	0.237	0.004	75.89
	5	1.694	2.270	0.756	0.258	0.004	0.029	0.004	0.742	0.254	0.004	74.22
	6	1.526	2.432	0.595	0.398	0.010	0.038	0.010	0.593	0.397	0.010	59.29
15	1	1.718	2.244	0.777	0.247	0.006	0.025	0.005	0.755	0.239	0.006	75.45
	2	1.676	2.288	0.743	0.274	0.007	0.022	0.005	0.726	0.267	0.006	72.61
	3	1.728	2.234	0.788	0.236	0.009	0.022	0.008	0.763	0.229	0.009	76.26
	4	1.691	2.260	0.764	0.274	0.013	0.029	0.007	0.727	0.261	0.012	72.72
	6	1.604	2.356	0.657	0.358	0.009	0.035	0.007	0.641	0.350	0.009	64.12
	7	1.543	2.409	0.619	0.398	0.021	0.032	0.008	0.596	0.383	0.020	59.63
17	1	1.741	2.237	0.764	0.217	0.004	0.033	0.007	0.775	0.221	0.004	77.52
	2	1.734	2.235	0.780	0.224	0.003	0.029	0.007	0.774	0.223	0.003	77.43
	3	1.704	2.256	0.775	0.244	0.006	0.024	0.006	0.756	0.238	0.006	75.63
	4	1.737	2.237	0.770	0.232	0.006	0.026	0.006	0.764	0.230	0.005	76.45
	6	1.492	2.477	0.546	0.423	0.014	0.033	0.010	0.555	0.431	0.014	55.53
ea	1	1.559	2.402	0.615	0.394	0.008	0.035	0.007	0.605	0.388	0.008	60.46
	2	1.235	2.635	0.436	0.481	0.061	0.132	0.041	0.446	0.492	0.062	44.56
fa	1	1.734	2.223	0.803	0.221	0.006	0.031	0.006	0.780	0.214	0.006	78.01
	2	1.670	2.294	0.722	0.281	0.007	0.031	0.009	0.715	0.278	0.007	71.52
ga	2	1.670	2.278	0.757	0.282	0.005	0.032	0.007	0.725	0.270	0.005	72.52
	3	1.608	2.340	0.689	0.351	0.006	0.032	0.009	0.659	0.336	0.005	65.88
	5	1.634	2.328	0.698	0.313	0.006	0.030	0.006	0.687	0.308	0.006	68.68
	6	1.632	2.331	0.696	0.308	0.007	0.027	0.009	0.688	0.305	0.007	68.80
	7	1.595	2.357	0.673	0.350	0.008	0.033	0.008	0.653	0.340	0.008	65.26
	8	1.589	2.382	0.624	0.366	0.013	0.033	0.007	0.622	0.365	0.013	62.19
ha	1	1.786	2.158	0.894	0.179	0.004	0.014	0.005	0.830	0.166	0.004	83.02
	2	1.740	2.220	0.805	0.216	0.005	0.029	0.005	0.785	0.210	0.005	78.53
	3	1.689	2.269	0.746	0.270	0.008	0.033	0.010	0.729	0.264	0.007	72.87
	4	1.595	2.351	0.690	0.343	0.009	0.033	0.005	0.662	0.329	0.009	66.24
ia	1	1.793	2.174	0.840	0.177	0.002	0.027	0.006	0.824	0.173	0.002	82.42
	2	1.806	2.169	0.843	0.158	0.004	0.026	0.005	0.839	0.157	0.004	83.92
	3	1.754	2.207	0.824	0.197	0.002	0.025	0.006	0.805	0.193	0.002	80.54
ja	1	1.619	2.342	0.683	0.329	0.008	0.029	0.008	0.669	0.323	0.008	66.94
	2	1.548	2.391	0.647	0.399	0.016	0.036	0.005	0.609	0.376	0.015	60.95
	3	1.638	2.323	0.691	0.333	0.006	0.029	0.007	0.671	0.323	0.006	67.09
	4	1.677	2.277	0.753	0.278	0.006	0.028	0.008	0.726	0.269	0.006	72.58
	5	1.655	2.303	0.715	0.305	0.006	0.033	0.008	0.697	0.297	0.006	69.69
ka	1	1.632	2.318	0.724	0.313	0.006	0.025	0.007	0.694	0.300	0.006	69.37
	3	1.516	2.443	0.581	0.415	0.010	0.037	0.009	0.578	0.412	0.010	57.76
	4	1.560	2.385	0.652	0.385	0.010	0.032	0.008	0.622	0.368	0.010	62.22
la	1	1.553	2.387	0.660	0.380	0.009	0.033	0.011	0.629	0.362	0.009	62.91

(continued on following page).

Table A.1 (continued).

Crystal GPA.07	Spot	Al	Si	Ca	Na	K	Fe	Mg	X_{An}	X_{Ab}	X_{Or}	% An
	2	1.593	2.356	0.677	0.352	0.008	0.031	0.010	0.653	0.339	0.008	65.25
	3	1.476	2.472	0.570	0.440	0.016	0.036	0.008	0.555	0.429	0.016	55.53

Crystal		Cations on the basis of 8 Oxygens										
GPA.07	Spot	Al	Si	Ca	Na	K	Fe	Mg	X_{An}	X_{Ab}	X_{Or}	% An
33	1	1.435	2.524	0.505	0.476	0.021	0.039	0.008	0.504	0.476	0.021	50.39
	2	1.422	2.529	0.505	0.490	0.024	0.040	0.005	0.495	0.481	0.023	49.54
35	1	1.404	2.542	0.504	0.497	0.020	0.042	0.006	0.494	0.487	0.019	49.37
34	1	1.728	2.218	0.818	0.238	0.004	0.027	0.006	0.772	0.224	0.004	77.18
	3	1.754	2.228	0.764	0.221	0.005	0.029	0.007	0.772	0.223	0.005	77.23
	4	1.739	2.250	0.746	0.219	0.002	0.029	0.007	0.772	0.226	0.002	77.18
	5	1.711	2.256	0.765	0.240	0.005	0.025	0.008	0.758	0.238	0.004	75.76
	6	1.667	2.296	0.729	0.280	0.007	0.027	0.007	0.718	0.275	0.007	71.77
	7	1.557	2.399	0.629	0.377	0.011	0.035	0.009	0.618	0.371	0.011	61.84
36	1	1.837	2.114	0.907	0.157	0.005	0.024	0.006	0.849	0.147	0.004	84.92
	2	1.832	2.125	0.906	0.144	0.005	0.014	0.006	0.859	0.137	0.004	85.90
	3	1.840	2.132	0.880	0.135	0.002	0.022	0.004	0.865	0.133	0.002	86.48
	4	1.850	2.123	0.897	0.120	0.003	0.019	0.002	0.879	0.118	0.003	87.90
	5	1.849	2.142	0.849	0.131	0.004	0.023	0.003	0.863	0.133	0.004	86.31
	6	1.864	2.129	0.852	0.128	0.004	0.023	0.005	0.866	0.130	0.004	86.60
37	1	1.881	2.099	0.936	0.041	0.000	0.021	0.002	0.958	0.042	0.000	95.80
	2	1.843	2.099	0.957	0.109	0.001	0.019	0.005	0.897	0.102	0.001	89.68
	4	1.813	2.146	0.895	0.144	0.003	0.017	0.005	0.859	0.138	0.003	85.88
	5	1.801	2.155	0.893	0.146	0.001	0.018	0.004	0.858	0.140	0.001	85.84
	6	1.826	2.154	0.866	0.128	0.001	0.018	0.005	0.871	0.128	0.001	87.06
	7	1.822	2.134	0.909	0.130	0.002	0.017	0.006	0.873	0.125	0.002	87.29
	8	1.826	2.148	0.869	0.135	0.002	0.025	0.004	0.864	0.134	0.002	86.41
	9	1.612	2.344	0.701	0.306	0.008	0.028	0.009	0.691	0.302	0.007	69.09
j	1	1.840	2.119	0.903	0.145	0.003	0.019	0.006	0.859	0.138	0.003	85.87
	2	1.844	2.121	0.906	0.127	0.002	0.019	0.003	0.875	0.123	0.002	87.49
	3	1.790	2.189	0.812	0.177	0.004	0.028	0.006	0.818	0.178	0.004	81.82
	4	1.827	2.126	0.915	0.132	0.003	0.023	0.004	0.872	0.125	0.003	87.18
	5	1.827	2.144	0.864	0.149	0.003	0.024	0.007	0.850	0.147	0.003	85.02
	6	1.840	2.151	0.847	0.126	0.002	0.023	0.004	0.869	0.129	0.002	86.87
	7	1.831	2.133	0.878	0.145	0.003	0.030	0.006	0.856	0.142	0.003	85.56
	8	1.665	2.296	0.729	0.275	0.006	0.035	0.005	0.721	0.273	0.006	72.11
k	1	1.866	2.102	0.922	0.102	0.003	0.018	0.004	0.898	0.099	0.003	89.82
	2	1.870	2.089	0.941	0.104	0.002	0.018	0.004	0.898	0.100	0.002	89.81
	3	1.854	2.096	0.953	0.100	0.004	0.022	0.001	0.901	0.094	0.004	90.14
	4	1.842	2.111	0.934	0.114	0.007	0.017	0.003	0.886	0.108	0.006	88.59
	5	1.809	2.143	0.909	0.132	0.004	0.021	0.002	0.870	0.127	0.004	86.96
	6	1.825	2.146	0.888	0.122	0.004	0.019	0.002	0.876	0.120	0.004	87.61
	7	1.854	2.117	0.908	0.110	0.005	0.014	0.005	0.888	0.108	0.005	88.75

(continued on following page).

Table A.1 (continued).

	8	1.845	2.114	0.933	0.091	0.003	0.022	0.003	0.909	0.088	0.003	90.86
	9	1.828	2.110	0.961	0.092	0.005	0.025	0.004	0.909	0.087	0.004	90.87
l	2	1.613	2.318	0.760	0.279	0.004	0.036	0.008	0.729	0.267	0.004	72.87
	3	1.628	2.322	0.729	0.279	0.009	0.035	0.007	0.717	0.274	0.009	71.70
	4	1.587	2.347	0.740	0.295	0.005	0.029	0.005	0.711	0.284	0.005	71.12
	5	1.621	2.328	0.735	0.281	0.005	0.027	0.007	0.720	0.276	0.004	71.99
	6	1.644	2.323	0.708	0.270	0.005	0.038	0.005	0.721	0.275	0.005	72.05
	7	1.641	2.286	0.805	0.246	0.003	0.029	0.007	0.763	0.234	0.003	76.33
n	1	1.878	2.088	0.938	0.102	0.002	0.015	0.003	0.900	0.098	0.002	90.03
	2	1.881	2.084	0.944	0.097	0.003	0.012	0.004	0.904	0.093	0.003	90.40
	3	1.872	2.101	0.921	0.098	0.001	0.018	0.002	0.903	0.096	0.001	90.34
	4	1.839	2.126	0.878	0.154	0.003	0.029	0.004	0.848	0.149	0.003	84.80
	5	1.684	2.274	0.748	0.270	0.003	0.033	0.007	0.732	0.265	0.003	73.22
o	1	1.855	2.107	0.911	0.118	0.001	0.028	0.006	0.884	0.115	0.001	88.42
	2	1.846	2.114	0.917	0.112	0.003	0.025	0.004	0.889	0.109	0.003	88.86
	3	1.860	2.088	0.957	0.101	0.001	0.020	0.005	0.903	0.095	0.001	90.33
	4	1.848	2.121	0.907	0.103	0.002	0.020	0.006	0.896	0.102	0.002	89.65
	5	1.821	2.129	0.923	0.136	0.002	0.017	0.002	0.869	0.128	0.002	86.94
	6	1.838	2.120	0.911	0.124	0.001	0.025	0.004	0.880	0.119	0.001	87.97
	7	1.850	2.137	0.858	0.132	0.001	0.023	0.004	0.866	0.133	0.001	86.57
	8	1.854	2.120	0.886	0.116	0.004	0.027	0.004	0.881	0.116	0.004	88.08
	9	1.845	2.098	0.958	0.109	0.002	0.018	0.004	0.896	0.102	0.002	89.60
	10	1.844	2.121	0.911	0.116	0.003	0.018	0.004	0.885	0.113	0.003	88.48
p	1	1.671	2.291	0.733	0.278	0.007	0.030	0.006	0.720	0.273	0.007	71.97
	3	1.647	2.314	0.714	0.293	0.009	0.030	0.005	0.703	0.289	0.009	70.26
	4	1.649	2.323	0.698	0.286	0.008	0.030	0.006	0.703	0.288	0.008	70.34
	5	1.649	2.309	0.725	0.289	0.008	0.029	0.007	0.710	0.283	0.007	70.98
	6	1.579	2.379	0.649	0.350	0.010	0.037	0.006	0.643	0.347	0.010	64.29
q	1	1.794	2.159	0.864	0.178	0.004	0.031	0.005	0.826	0.170	0.004	82.59
	2	1.847	2.132	0.885	0.113	0.002	0.020	0.003	0.885	0.113	0.002	88.50
	3	1.763	2.209	0.817	0.187	0.006	0.021	0.004	0.809	0.185	0.006	80.91
	4	1.802	2.174	0.828	0.177	0.002	0.027	0.003	0.822	0.176	0.002	82.19
	5	1.701	2.262	0.744	0.275	0.006	0.032	0.007	0.726	0.268	0.006	72.57
r	1	1.606	2.324	0.693	0.333	0.008	0.032	0.048	0.670	0.322	0.008	67.01
	2	1.584	2.389	0.624	0.352	0.007	0.037	0.005	0.635	0.358	0.007	63.51
	3	1.606	2.339	0.700	0.329	0.005	0.038	0.007	0.677	0.318	0.005	67.69
	4	1.684	2.287	0.716	0.285	0.007	0.031	0.007	0.710	0.283	0.007	71.01
	6	1.617	2.331	0.696	0.343	0.009	0.034	0.006	0.664	0.327	0.008	66.41
s	1	1.868	2.115	0.871	0.122	0.003	0.028	0.005	0.874	0.122	0.003	87.42
	2	1.862	2.127	0.862	0.123	0.012	0.021	0.002	0.864	0.124	0.012	86.40
	3	1.802	2.153	0.866	0.145	0.012	0.034	0.013	0.847	0.141	0.011	84.72
	5	1.852	2.115	0.896	0.120	0.009	0.027	0.004	0.874	0.117	0.009	87.42
	6	1.870	2.112	0.897	0.103	0.004	0.017	0.004	0.893	0.103	0.004	89.32
	7	1.668	2.299	0.710	0.283	0.013	0.034	0.008	0.706	0.281	0.013	70.59

(continued on following page).

Table A.1 (continued).

Crystal		Cations on the basis of 8 Oxygens										
GPA.03	Spot	Al	Si	Ca	Na	K	Fe	Mg	X_{An}	X_{Ab}	X_{Or}	% An
40	1	1.829	2.128	0.908	0.113	0.003	0.028	0.005	0.887	0.110	0.003	88.70
	2	1.802	2.170	0.854	0.146	0.002	0.024	0.004	0.852	0.146	0.002	85.20
	3	1.790	2.170	0.872	0.140	0.001	0.030	0.004	0.861	0.138	0.001	86.06
	4	1.711	2.249	0.793	0.210	0.005	0.032	0.004	0.787	0.208	0.005	78.69
41	1	1.515	2.430	0.614	0.419	0.014	0.033	0.006	0.587	0.400	0.013	58.68
	2	1.485	2.477	0.546	0.445	0.015	0.036	0.008	0.543	0.442	0.015	54.27
	3	1.428	2.531	0.504	0.479	0.020	0.034	0.009	0.503	0.478	0.020	50.28
	4	1.492	2.461	0.576	0.431	0.015	0.033	0.008	0.564	0.422	0.014	56.38
	5	1.546	2.409	0.622	0.379	0.010	0.034	0.012	0.615	0.374	0.010	61.54
42	1	1.861	2.123	0.879	0.118	0.002	0.020	0.004	0.880	0.118	0.002	87.99
	2	1.835	2.155	0.851	0.115	0.001	0.026	0.003	0.880	0.118	0.001	88.04
	3	1.853	2.121	0.895	0.113	0.002	0.021	0.004	0.887	0.112	0.002	88.66
	4	1.812	2.156	0.859	0.154	0.004	0.027	0.006	0.845	0.151	0.004	84.49
	5	1.829	2.158	0.835	0.144	0.001	0.029	0.004	0.851	0.147	0.001	85.13
	7	1.634	2.340	0.681	0.280	0.008	0.037	0.008	0.703	0.289	0.008	70.28
44	3	1.783	2.207	0.796	0.170	0.003	0.023	0.006	0.821	0.175	0.004	82.11
	4	1.717	2.246	0.795	0.202	0.004	0.028	0.006	0.795	0.202	0.004	79.46
	5	1.762	2.201	0.827	0.179	0.004	0.030	0.007	0.819	0.177	0.004	81.93
	6	1.748	2.232	0.767	0.213	0.005	0.031	0.007	0.779	0.216	0.005	77.87
	7	1.429	2.527	0.492	0.493	0.026	0.042	0.010	0.487	0.487	0.026	48.69
45	1	1.867	2.106	0.891	0.132	0.004	0.023	0.007	0.868	0.128	0.004	86.77
	2	1.883	2.114	0.859	0.121	0.001	0.022	0.005	0.876	0.123	0.001	87.58
	3	1.859	2.117	0.898	0.106	0.002	0.020	0.005	0.893	0.106	0.002	89.28
	4	1.872	2.116	0.882	0.106	0.001	0.020	0.004	0.892	0.107	0.001	89.22
	5	1.883	2.115	0.854	0.128	0.003	0.021	0.004	0.867	0.130	0.003	86.67
	6	1.773	2.205	0.798	0.181	0.003	0.033	0.007	0.812	0.184	0.004	81.22
	7	1.563	2.399	0.600	0.393	0.013	0.044	0.011	0.597	0.391	0.013	59.66
46	1	1.657	2.297	0.787	0.183	0.005	0.033	0.005	0.807	0.187	0.006	80.73
	4	1.706	2.229	0.880	0.142	0.005	0.025	0.004	0.856	0.138	0.005	85.65
	5	1.689	2.275	0.787	0.179	0.003	0.032	0.005	0.812	0.185	0.003	81.24
47	1	1.708	2.257	0.797	0.185	0.002	0.029	0.005	0.810	0.188	0.002	80.98
	2	1.707	2.248	0.813	0.185	0.004	0.030	0.007	0.812	0.185	0.004	81.16
	3	1.703	2.248	0.809	0.199	0.004	0.032	0.007	0.799	0.197	0.004	79.93
	4	1.692	2.278	0.771	0.196	0.004	0.029	0.006	0.794	0.202	0.004	79.39
48	1	1.861	2.120	0.895	0.095	0.000	0.023	0.003	0.904	0.096	0.000	90.38
	2	1.900	2.096	0.886	0.090	0.002	0.020	0.006	0.905	0.092	0.002	90.55
	3	1.857	2.125	0.881	0.113	0.002	0.022	0.003	0.885	0.114	0.002	88.46
	4	1.875	2.133	0.837	0.112	0.002	0.023	0.005	0.880	0.118	0.002	88.02
	5	1.772	2.215	0.783	0.179	0.003	0.031	0.006	0.811	0.185	0.003	81.14
	6	1.486	2.471	0.568	0.413	0.010	0.040	0.009	0.573	0.416	0.010	57.33
50	2	1.879	2.093	0.900	0.131	0.005	0.023	0.005	0.869	0.126	0.004	86.93

(continued on following page).

Table A.1 (continued).

	3	1.882	2.108	0.871	0.122	0.002	0.023	0.004	0.876	0.123	0.002	87.55
	4	1.934	2.052	0.901	0.120	0.002	0.029	0.004	0.880	0.118	0.002	88.04
	5	1.929	2.048	0.916	0.130	0.003	0.025	0.004	0.874	0.124	0.002	87.40
	6	1.801	2.189	0.784	0.202	0.002	0.029	0.005	0.793	0.204	0.002	79.31
ma	1	1.759	2.216	0.793	0.203	0.004	0.028	0.006	0.793	0.203	0.004	79.26
	2	3.113	1.382	0.482	0.126	0.002	0.017	0.003	0.790	0.207	0.003	79.02
	3	3.134	1.369	0.481	0.124	0.003	0.014	0.004	0.791	0.204	0.005	79.08
	4	1.774	2.204	0.791	0.208	0.004	0.027	0.007	0.789	0.207	0.004	78.92
	5	1.623	2.362	0.632	0.323	0.008	0.033	0.010	0.656	0.336	0.008	65.63
na	1	1.728	2.253	0.726	0.268	0.008	0.032	0.007	0.725	0.268	0.008	72.47
	2	1.707	2.287	0.680	0.271	0.006	0.037	0.010	0.710	0.284	0.006	71.05
	3	1.438	2.539	0.472	0.423	0.025	0.060	0.009	0.513	0.460	0.027	51.31
oa	1	1.534	2.457	0.523	0.405	0.013	0.047	0.007	0.556	0.431	0.014	55.56
	3	1.507	2.489	0.486	0.423	0.014	0.048	0.010	0.526	0.459	0.015	52.63
pa	1	1.594	2.393	0.602	0.349	0.009	0.032	0.010	0.627	0.363	0.009	62.74
	2	1.555	2.418	0.605	0.367	0.008	0.032	0.006	0.617	0.375	0.008	61.74
	3	1.549	2.443	0.549	0.376	0.012	0.040	0.008	0.586	0.401	0.013	58.59
qa	1	1.775	2.220	0.765	0.184	0.003	0.035	0.005	0.804	0.193	0.003	80.38
	2	1.725	2.260	0.748	0.209	0.002	0.034	0.006	0.780	0.218	0.002	78.04

Crystal		Cations on the basis of 8 Oxygens										
GPA.06	Spot	Al	Si	Ca	Na	K	Fe	Mg	X_{An}	X_{Ab}	X_{Or}	% An
53	1	1.633	2.307	0.776	0.243	0.004	0.029	0.008	0.759	0.237	0.004	75.88
	2	1.599	2.331	0.772	0.256	0.005	0.032	0.005	0.747	0.248	0.005	74.73
	3	1.570	2.351	0.764	0.273	0.008	0.033	0.006	0.731	0.261	0.008	73.08
	4	1.323	2.603	0.472	0.503	0.029	0.062	0.008	0.470	0.501	0.029	47.01
54	1	1.537	2.416	0.624	0.373	0.011	0.037	0.011	0.619	0.370	0.011	61.87
	2	1.524	2.405	0.675	0.366	0.010	0.034	0.008	0.642	0.348	0.010	64.24
	4	1.534	2.414	0.645	0.363	0.013	0.030	0.008	0.632	0.356	0.012	63.17
	5	1.531	2.416	0.639	0.362	0.013	0.038	0.007	0.630	0.357	0.013	63.00
58	1	1.626	2.332	0.718	0.280	0.005	0.027	0.009	0.716	0.279	0.005	71.61
	3	1.579	2.373	0.684	0.319	0.007	0.033	0.007	0.677	0.316	0.007	67.75
	4	1.554	2.395	0.671	0.330	0.008	0.030	0.009	0.665	0.327	0.008	66.50
	5	1.577	2.378	0.675	0.320	0.007	0.029	0.010	0.673	0.320	0.007	67.35
	6	1.531	2.409	0.662	0.357	0.009	0.033	0.007	0.644	0.347	0.009	64.35
56	1	1.734	2.206	0.851	0.193	0.004	0.030	0.008	0.812	0.184	0.004	81.21
	2	1.725	2.224	0.826	0.198	0.003	0.033	0.005	0.805	0.192	0.003	80.45
	4	1.457	2.490	0.593	0.363	0.015	0.042	0.010	0.611	0.374	0.015	61.05
59	1	1.483	2.451	0.630	0.379	0.011	0.039	0.009	0.618	0.371	0.011	61.77
	2	1.428	2.526	0.511	0.470	0.021	0.037	0.011	0.510	0.469	0.021	51.00
60	1	1.802	2.134	0.938	0.120	0.002	0.027	0.003	0.885	0.114	0.002	88.47
	2	1.767	2.171	0.922	0.118	0.003	0.022	0.003	0.884	0.114	0.003	88.36
	5	1.575	2.355	0.730	0.318	0.006	0.028	0.007	0.692	0.302	0.006	69.21

(continued on following page).

Table A.1 (continued).

	6	1.611	2.330	0.739	0.292	0.007	0.026	0.008	0.711	0.281	0.007	71.14
	7	1.619	2.311	0.765	0.285	0.007	0.033	0.006	0.724	0.269	0.007	72.40
	8	1.404	2.521	0.578	0.445	0.018	0.037	0.005	0.555	0.428	0.018	55.49
61	1	1.788	2.163	0.897	0.128	0.002	0.025	0.004	0.873	0.125	0.002	87.32
	2	1.448	2.506	0.552	0.416	0.017	0.041	0.007	0.561	0.422	0.017	56.08
64	1	1.408	2.549	0.510	0.458	0.016	0.035	0.007	0.518	0.465	0.017	51.84
	2	1.398	2.564	0.487	0.470	0.020	0.037	0.005	0.498	0.481	0.020	49.85
65	2	1.607	2.351	0.694	0.302	0.010	0.031	0.007	0.690	0.300	0.010	69.01
	3	1.628	2.321	0.720	0.305	0.011	0.029	0.009	0.695	0.294	0.010	69.54
	4	1.426	2.530	0.509	0.470	0.022	0.036	0.009	0.508	0.470	0.022	50.84
a	1	1.604	2.361	0.665	0.338	0.005	0.031	0.006	0.660	0.335	0.005	65.97
	2	1.579	2.361	0.700	0.331	0.008	0.030	0.010	0.674	0.319	0.007	67.41
	3	1.394	2.542	0.514	0.484	0.021	0.051	0.007	0.505	0.475	0.020	50.49
c	1	1.587	2.378	0.656	0.328	0.007	0.030	0.009	0.662	0.331	0.007	66.21
	2	1.592	2.351	0.657	0.328	0.076	0.041	0.009	0.619	0.309	0.072	61.93
	3	1.581	2.360	0.693	0.337	0.007	0.034	0.009	0.668	0.325	0.007	66.79
	4	1.628	2.336	0.702	0.292	0.007	0.031	0.005	0.701	0.292	0.007	70.14
	7	1.567	2.389	0.639	0.356	0.010	0.045	0.005	0.635	0.355	0.010	63.53
e	1	1.814	2.167	0.832	0.157	0.002	0.027	0.006	0.840	0.158	0.002	84.03
	3	1.763	2.187	0.846	0.204	0.003	0.030	0.004	0.804	0.194	0.003	80.37
	4	2.747	1.190	1.332	0.233	0.003	0.042	0.007	0.849	0.149	0.002	84.92
	5	1.489	2.475	0.558	0.442	0.018	0.020	0.008	0.548	0.435	0.018	54.76
f	2	1.499	2.381	0.752	0.362	0.011	0.042	0.009	0.668	0.322	0.010	66.85
	3	1.413	2.527	0.545	0.461	0.017	0.036	0.006	0.532	0.451	0.017	53.24
g	1	1.830	2.125	0.910	0.137	0.002	0.021	0.005	0.868	0.130	0.002	86.75
	2	1.821	2.145	0.884	0.130	0.002	0.022	0.005	0.870	0.128	0.002	86.97
	3	1.836	2.140	0.871	0.137	0.002	0.020	0.005	0.862	0.136	0.002	86.25
	4	1.820	2.125	0.922	0.134	0.003	0.027	0.002	0.871	0.126	0.003	87.13
	5	1.824	2.137	0.890	0.132	0.003	0.028	0.006	0.869	0.129	0.003	86.89
	6	1.850	2.113	0.904	0.122	0.002	0.027	0.005	0.879	0.119	0.002	87.89
	7	1.817	2.139	0.901	0.129	0.000	0.029	0.002	0.874	0.125	0.000	87.45
	8	1.536	2.432	0.596	0.373	0.011	0.038	0.007	0.608	0.381	0.011	60.85
h	2	1.566	2.384	0.669	0.341	0.008	0.031	0.009	0.657	0.335	0.008	65.69
	3	1.649	2.311	0.722	0.293	0.006	0.027	0.006	0.708	0.287	0.006	70.76
	4	1.608	2.355	0.678	0.318	0.007	0.029	0.007	0.676	0.317	0.007	67.59
	5	1.588	2.384	0.636	0.345	0.010	0.029	0.009	0.642	0.348	0.010	64.20
	6	1.553	2.412	0.619	0.351	0.012	0.037	0.009	0.630	0.357	0.012	63.04
	7	1.343	2.609	0.449	0.521	0.034	0.036	0.006	0.447	0.519	0.034	44.73
i	1	1.635	2.326	0.703	0.307	0.009	0.027	0.008	0.690	0.301	0.009	69.04
	2	1.678	2.294	0.718	0.260	0.006	0.035	0.008	0.729	0.264	0.007	72.91
	3	1.652	2.306	0.713	0.310	0.009	0.033	0.005	0.691	0.300	0.009	69.09
	4	1.661	2.293	0.731	0.289	0.008	0.034	0.009	0.712	0.281	0.007	71.16

APPENDIX B

STANDARDIZATION DATA, CALCULATION OF ELECTRON MICROPROBE ERROR, ONE SIGMA

To calculate the standard error estimate (SEE), the mean for each oxide analyzed on each standard was calculated. Next, the deviation of each oxide's measurement from the mean was calculated, and then the calculated deviation from the mean was squared. To find the standard deviation, the square root of the sum of the squared deviations divided by one less than the number of unknown standard analyses was calculated. To find the standard error, the standard deviation was divided by the square root of the sample size. The SEE for each oxide on each standard can be found in below (Table B.1).

Table B.1

Standard Estimate Error (SEE)

	wt. % Al_2O_3	wt. % SiO_2	wt. % CaO	wt. % Na_2O	wt. % K_2O	wt. % FeO^T	wt. % MgO	Total (wt. %)
Scapolite	± 0.034	± 0.086	± 0.089	± 0.017	± 0.005	± 0.010	± 0.002	± 0.127
Osumilite	± 0.017	± 0.101	± 0.008	± 0.005	± 0.010	± 0.036	± 0.019	± 0.106

APPENDIX C

CALCULATIONS TO CONVERT FROM WT. % OF A GIVEN OXIDE to X_{An}, X_{Ab} AND X_{Or}

Step 1: $Molecular\ proportion = \frac{wt.\%}{oxide\ weight}$

Step 2: $Cation\ proportion\ of\ each\ oxide = oxide\ molecular\ proportion * number\ of\ cations$

Step 3: $Number\ of\ oxygens\ for\ each\ oxide = oxide\ molecular\ proportion * number\ of\ oxygens$

Step 4: $Total\ oxygens = sum\ of\ all\ oxygens\ for\ each\ oxide$, from Step 3

Step 5: Oxygen Factor $= \frac{number\ of\ oxygens}{total\ oxygen}$, in this case, number of oxygens = 8

Step 6: $Cation\ on\ the\ basis\ of\ 8\ oxygens = oxygen\ factor * cation\ proportion$

Step 7: $X_{An} = \frac{Ca\ cation\ on\ the\ basis\ of\ 8\ oxygens}{Ca + Na + K\ cations\ on\ the\ basis\ of\ 8\ oxygens}$

Step 8: $X_{Ab} = \frac{Na\ cation\ on\ the\ basis\ of\ 8\ oxygens}{Ca + Na + K\ cations\ on\ the\ basis\ of\ 8\ oxygens}$

Step 9: $X_{Or} = \dfrac{K \ \ cation \ \ on \ \ the \ \ basis \ \ of \ \ 8 \ \ oxygens}{Ca + Na + K \ \ cations \ \ on \ \ the \ \ basis \ \ of \ \ 8 \ \ oxygens}$

Table C.1

Calculations from wt. % of a given oxide to XAn, XAb and XOr.

Microprobe Data

Wt. % Al2O3	Wt. % SiO2	Wt. % CaO	Wt. % Na2O	Wt. % K2O	Wt. % FeO	Wt. % MgO
29.665	52.716	13.173	3.902	0.115	0.87	0.104

Molecular Proportions

Al2O3	SiO2	CaO	Na2O	K2O	FeO	MgO
0.2909	0.8775	0.2349	0.0630	0.0012	0.0121	0.0026

Cation Proportions

Al2O3	SiO2	CaO	Na2O	K2O	FeO	MgO
0.5819	0.8775	0.2349	0.1259	0.0024	0.0121	0.0026

Number of Oxygens

Al2O3	SiO2	CaO	Na2O	K2O	FeO	MgO
0.8728	1.7551	0.2349	0.0630	0.0012	0.0121	0.0026

Total Oxygen	Oxygen Factor
2.9417	2.7196

Cations on the Basis of 8 Oxygens

Al	Si	Ca	Na	K	Fe	Mg
1.5825	2.3865	0.6388	0.3424	0.0066	0.0329	0.0070

XAn	XAb	XOr
0.6467	0.3466	0.0067

APPENDIX D

LIQUID COMPOSITION CALCULATIONS

Table D.1

Calculation of Average Normalized Liquid Composition

Sample	BULK ROCK DATA (Cameron, 1998)									
	SiO_2	Al_2O_3	FeO*	MgO	CaO	Na_2O	K_2O	TiO_2	MnO	P_2O_5
GPA.02-02	50.36	20.22	8.76	3.72	9.74	3.42	0.81	1.08	0.16	0.22
GPA.03-04	49.96	20.00	8.97	3.68	10.23	3.34	0.80	1.1	0.16	0.23
GPA.04-01	50.79	19.48	8.84	3.97	9.50	3.50	0.85	1.12	0.16	0.23
GPA.06-05	50.38	19.85	8.89	3.51	10.02	3.46	0.83	1.14	0.16	0.24
GPA.07-03	50.46	20.18	8.80	3.39	10.18	3.48	0.82	1.12	0.15	0.24

Normalized Bulk Rock Data									
SiO_2	Al_2O_3	FeO*	MgO	CaO	Na_2O	K_2O	TiO_2	MnO	P_2O_5
51.13	20.53	8.89	3.78	9.89	3.47	0.82	1.10	0.16	0.22
50.74	20.31	9.11	3.74	10.39	3.39	0.81	1.12	0.16	0.23
51.59	19.79	8.98	4.03	9.65	3.56	0.86	1.14	0.16	0.23
51.16	20.16	9.03	3.56	10.17	3.51	0.84	1.16	0.16	0.24
51.06	20.42	8.91	3.43	10.30	3.52	0.83	1.13	0.15	0.24

Sample	AVERAGE PLAGIOCLASE DATA (Knudson)									
	SiO_2	Al_2O_3	FeO*	MgO	CaO	Na_2O	K_2O	TiO_2	MnO	P_2O_5
GPA.02-02	51.14	31.14	0.79	0.11	14.71	3.29	0.15	0	0	0
GPA.03-04	50.23	34.63	0.81	0.09	15.78	2.60	0.10	0	0	0
GPA.04-01	52.21	30.69	0.88	0.12	14.08	3.64	0.18	0	0	0
GPA.06-05	51.79	30.28	0.86	0.10	14.62	3.52	0.18	0	0	0
GPA.07-03	48.38	32.83	0.08	0.08	16.93	2.18	0.09	0	0	0

Normalized Average Plag Data									
SiO_2	Al_2O_3	FeO*	MgO	CaO	Na_2O	K_2O	TiO_2	MnO	P_2O_5
50.48	30.73	0.78	0.11	14.51	3.24	0.14	0.00	0.00	0.00
48.19	33.22	0.77	0.09	15.14	2.49	0.10	0.00	0.00	0.00
51.29	30.14	0.87	0.12	13.83	3.58	0.18	0.00	0.00	0.00
51.09	29.87	0.85	0.10	14.43	3.48	0.18	0.00	0.00	0.00
48.10	32.65	0.08	0.08	16.83	2.17	0.09	0.00	0.00	0.00

Sample	% Plag. Phenocrysts	Normalized Average Plag Data Adjusted for % plag phenocrysts									
		SiO_2	Al_2O_3	FeO*	MgO	CaO	Na_2O	K_2O	TiO_2	MnO	P_2O_5
GPA.02-02	0.35	17.67	10.76	0.27	0.04	5.08	1.13	0.05	0.00	0.00	0.00
GPA.03-04	0.3	14.46	9.97	0.23	0.03	4.54	0.75	0.03	0.00	0.00	0.00
GPA.04-01	0.3	15.39	9.04	0.26	0.04	4.15	1.07	0.05	0.00	0.00	0.00
GPA.06-05	0.25	12.77	7.47	0.21	0.03	3.61	0.87	0.04	0.00	0.00	0.00
GPA.07-03	0.3	14.43	9.79	0.02	0.02	5.05	0.65	0.03	0.00	0.00	0.00

Sample	Liquid Composition									
	SiO_2	Al_2O_3	FeO*	MgO	CaO	Na_2O	K_2O	TiO_2	MnO	P_2O_5
GPA.02-02	33.46	9.77	8.62	3.74	4.81	2.34	0.77	1.10	0.16	0.22
GPA.03-04	36.28	10.34	8.88	3.71	5.85	2.64	0.78	1.12	0.16	0.23
GPA.04-01	36.21	10.75	8.72	4.00	5.50	2.48	0.81	1.14	0.16	0.23
GPA.06-05	38.38	12.69	8.81	3.54	6.57	2.64	0.80	1.16	0.16	0.24
GPA.07-03	36.63	10.63	8.88	3.41	5.25	2.87	0.80	1.13	0.15	0.24

Average Normalized Liquid Composition									
SiO_2	Al_2O_3	FeO*	MgO	CaO	Na_2O	K_2O	TiO_2	MnO	P_2O_5
51.48	15.04	13.27	5.75	7.40	3.60	1.19	1.69	0.25	0.34
51.83	14.78	12.68	5.30	8.35	3.78	1.12	1.60	0.23	0.33
51.73	15.35	12.46	5.71	7.86	3.55	1.16	1.63	0.23	0.33
51.18	16.92	11.75	4.72	8.76	3.53	1.06	1.54	0.22	0.32
52.33	15.18	12.69	4.87	7.50	4.10	1.15	1.62	0.22	0.35

Sample	Liquid Composition for Lange et al., 2009 Hygrometer							
	SiO_2	Al_2O_3	FeO*	MgO	CaO	Na_2O	K_2O	TiO_2
GPA.02-02	51.48	15.04	13.27	5.75	7.40	3.60	1.19	1.69
GPA.03-04	51.83	14.78	12.68	5.30	8.35	3.78	1.12	1.60
GPA.04-01	51.73	15.35	12.46	5.71	7.86	3.55	1.16	1.63
GPA.06-05	51.18	16.92	11.75	4.72	8.76	3.53	1.06	1.54
GPA.07-03	52.33	15.18	12.69	4.87	7.50	4.10	1.15	1.62

APPENDIX E

VARIABLES FOR HYGROMETER EQUATION

Table E.1
Hyrgometer Model Constants

Model Constants	Values
m’	1.91
a”	-13.53
b”	2.95
d” (SiO2)	-9.82
d” (Al2O3)	25.49
d” (FeOT)	-5.87
d” (MgO)	-15.56
d” (CaO)	17.1

APPENDIX F

PACAYA VOLCANO WATER CONCENTRATION DATA, CALCULATED USING THE PLAGIOCLASE-LIQUID HYGROMETER FOR 1000 BARS, 2000 BARS AND 3000 BARS

Table F.1

Pacaya Volcano water concentration data

	Sample	GPA.04[1]0	GPA.04[1]20	GPA.04[1]40	GPA.04[2]0	GPA.04[2]20	GPA.04[2]40	GPA.04[2]60
	X_{An}	0.6467	0.6391	0.6557	0.6534	0.6647	0.6160	0.6429
	X_{Ab}	0.3466	0.3513	0.3344	0.3360	0.3266	0.3744	0.3450
L	SiO_2 wt. %	51.72	51.72	51.72	51.72	51.72	51.72	51.72
I	TiO_2 wt. %	1.63	1.63	1.63	1.63	1.63	1.63	1.63
Q	Al_2O_3 wt. %	15.36	15.36	15.36	15.36	15.36	15.36	15.36
U	FeO^T wt. %	12.46	12.46	12.46	12.46	12.46	12.46	12.46
I C	MgO wt. %	5.71	5.71	5.71	5.71	5.71	5.71	5.71
D O	CaO wt. %	7.86	7.86	7.86	7.86	7.86	7.86	7.86
M	Na_2O wt. %	3.54	3.54	3.54	3.54	3.54	3.54	3.54
P	K_2O wt. %	1.16	1.16	1.16	1.16	1.16	1.16	1.16
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	0.7	0.6	0.8	0.7	0.8	0.5	0.7
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	0.8	0.7	0.8	0.8	0.9	0.6	0.8
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	0.8	0.7	0.8	0.8	0.9	0.6	0.8

(continued on following page).

Table F.1 (continued).

	Sample	GPA.04[2]80	GPA.04[3]0	GPA.04[3]20	GPA.04[3]40	GPA.04[3]60	GPA.04[3]80	GPA.04[3]100
	X_{An}	0.6517	0.7318	0.7793	0.8148	0.8144	0.7964	0.6768
	X_{Ab}	0.3382	0.2619	0.2131	0.1800	0.1801	0.1994	0.3132
L	SiO_2 wt. %	51.72	51.72	51.72	51.72	51.72	51.72	51.72
I	TiO_2 wt. %	1.63	1.63	1.63	1.63	1.63	1.63	1.63
Q	Al_2O_3 wt. %	15.36	15.36	15.36	15.36	15.36	15.36	15.36
U	FeO^T wt. %	12.46	12.46	12.46	12.46	12.46	12.46	12.46
I C	MgO wt. %	5.71	5.71	5.71	5.71	5.71	5.71	5.71
D O	CaO wt. %	7.86	7.86	7.86	7.86	7.86	7.86	7.86
M	Na_2O wt. %	3.54	3.54	3.54	3.54	3.54	3.54	3.54
P	K_2O wt. %	1.16	1.16	1.16	1.16	1.16	1.16	1.16
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	0.7	1.3	1.7	2.0	2.0	1.8	0.9
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	0.8	1.4	1.8	2.1	2.1	1.9	1.0
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	0.8	1.4	1.8	2.1	2.1	1.9	1.0

(continued on following page).

Table F.1 (continued).

	Sample	GPA.04[3]120	GPA.04[3]140	GPA.04[3]160	GPA.04[5]0	GPA.04[5]20	GPA.04[6]0	GPA.04[6]20
	X_{An}	0.6609	0.6607	0.6686	0.5153	0.5220	0.6543	0.6391
	X_{Ab}	0.3309	0.3280	0.3194	0.4613	0.4571	0.3364	0.3498
L	SiO_2 wt. %	51.72	51.72	51.72	51.72	51.72	51.72	51.72
I	TiO_2 wt. %	1.63	1.63	1.63	1.63	1.63	1.63	1.63
Q	Al_2O_3 wt. %	15.36	15.36	15.36	15.36	15.36	15.36	15.36
U	FeO^T wt. %	12.46	12.46	12.46	12.46	12.46	12.46	12.46
I C	MgO wt. %	5.71	5.71	5.71	5.71	5.71	5.71	5.71
D O	CaO wt. %	7.86	7.86	7.86	7.86	7.86	7.86	7.86
M	Na_2O wt. %	3.54	3.54	3.54	3.54	3.54	3.54	3.54
P	K_2O wt. %	1.16	1.16	1.16	1.16	1.16	1.16	1.16
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	0.8	0.8	0.8	0.0	0.0	0.7	0.6
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	0.8	1.4	1.8	2.1	2.1	1.9	1.0
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	0.9	0.9	0.9	0.0	0.1	0.8	0.7

(continued on following page).

Table F.1 (continued).

	Sample	GPA.04[6]40	GPA.04[7]0	GPA.04[7]20	GPA.04[7]40	GPA.04[7]60	GPA.04[7]80	GPA.04[7]120
	X_{An}	0.5973	0.7232	0.7493	0.7799	0.7724	0.7446	0.7518
	X_{Ab}	0.3912	0.2686	0.2445	0.2135	0.2171	0.2460	0.2370
L	SiO_2 wt. %	51.72	51.72	51.72	51.72	51.72	51.72	51.72
I	TiO_2 wt. %	1.63	1.63	1.63	1.63	1.63	1.63	1.63
Q	Al_2O_3 wt. %	15.36	15.36	15.36	15.36	15.36	15.36	15.36
U	FeO^T wt. %	12.46	12.46	12.46	12.46	12.46	12.46	12.46
I C	MgO wt. %	5.71	5.71	5.71	5.71	5.71	5.71	5.71
D O	CaO wt. %	7.86	7.86	7.86	7.86	7.86	7.86	7.86
M	Na_2O wt. %	3.54	3.54	3.54	3.54	3.54	3.54	3.54
P	K_2O wt. %	1.16	1.16	1.16	1.16	1.16	1.16	1.16
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	0.4	1.2	1.4	1.7	1.6	1.4	1.5
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	0.5	1.3	1.5	1.8	1.7	1.5	1.6
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	0.5	1.3	1.5	1.7	1.7	1.5	1.5

(continued on following page).

Table F.1 (continued).

	Sample	GPA.04[7]160	GPA.04[7]180	GPA.04[7]200	GPA.04[7]220	GPA.04[7]240	GPA.04[7]260	GPA.04[t]0
	X_{An}	0.6864	0.7725	0.7491	0.7860	0.6234	0.4901	0.6718
	X_{Ab}	0.2817	0.2185	0.2478	0.2089	0.3665	0.4875	0.3196
LIQUID COMP	SiO_2 wt. %	51.72	51.72	51.72	51.72	51.72	51.72	51.72
	TiO_2 wt. %	1.63	1.63	1.63	1.63	1.63	1.63	1.63
	Al_2O_3 wt. %	15.36	15.36	15.36	15.36	15.36	15.36	15.36
	FeO^T wt. %	12.46	12.46	12.46	12.46	12.46	12.46	12.46
	MgO wt. %	5.71	5.71	5.71	5.71	5.71	5.71	5.71
	CaO wt. %	7.86	7.86	7.86	7.86	7.86	7.86	7.86
	Na_2O wt. %	3.54	3.54	3.54	3.54	3.54	3.54	3.54
	K_2O wt. %	1.16	1.16	1.16	1.16	1.16	1.16	1.16
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	1.1	1.6	1.4	1.7	0.5	0.0	0.9
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	1.2	1.7	1.5	1.8	0.6	0.0	1.0
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	1.2	1.7	1.5	1.8	0.6	0.0	0.9

(continued on following page).

Table F.1 (continued).

	Sample	GPA.04[t]40	GPA.04[t]60	GPA.04[u]0	GPA.04[u]20	GPA.04[u]40	GPA.04[u]80	GPA.04[y]20
	X_{An}	0.6639	0.5270	0.6737	0.6587	0.6292	0.6347	0.6844
	X_{Ab}	0.3282	0.4548	0.3190	0.3343	0.3621	0.3559	0.3055
L	SiO_2 wt. %	51.72	51.72	51.72	51.72	51.72	51.72	51.72
I	TiO_2 wt. %	1.63	1.63	1.63	1.63	1.63	1.63	1.63
Q	Al_2O_3 wt. %	15.36	15.36	15.36	15.36	15.36	15.36	15.36
U	FeO^T wt. %	12.46	12.46	12.46	12.46	12.46	12.46	12.46
I C	MgO wt. %	5.71	5.71	5.71	5.71	5.71	5.71	5.71
D O	CaO wt. %	7.86	7.86	7.86	7.86	7.86	7.86	7.86
M	Na_2O wt. %	3.54	3.54	3.54	3.54	3.54	3.54	3.54
P	K_2O wt. %	1.16	1.16	1.16	1.16	1.16	1.16	1.16
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	0.8	0.0	0.9	0.8	0.6	0.6	0.9
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	0.9	0.1	1.0	0.9	0.7	0.7	1.0
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	0.9	0.1	0.9	0.8	0.7	0.7	1.0

(continued on following page).

Table F.1 (continued).

	Sample	GPA.04[y]40	GPA.04[y]60	GPA.04[y]80	GPA.04[z]0	GPA-04[z]20	GPA.04[aa]0	GPA.04[aa]20
	X_{An}	0.6622	0.6666	0.6311	0.6930	0.6757	0.5550	0.5190
	X_{Ab}	0.3300	0.3248	0.3584	0.2995	0.3178	0.4302	0.4607
L	SiO_2 wt. %	51.72	51.72	51.72	51.72	51.72	51.72	51.72
I	TiO_2 wt. %	1.63	1.63	1.63	1.63	1.63	1.63	1.63
Q	Al_2O_3 wt. %	15.36	15.36	15.36	15.36	15.36	15.36	15.36
U	FeO^T wt. %	12.46	12.46	12.46	12.46	12.46	12.46	12.46
I C	MgO wt. %	5.71	5.71	5.71	5.71	5.71	5.71	5.71
D O	CaO wt. %	7.86	7.86	7.86	7.86	7.86	7.86	7.86
M	Na_2O wt. %	3.54	3.54	3.54	3.54	3.54	3.54	3.54
P	K_2O wt. %	1.16	1.16	1.16	1.16	1.16	1.16	1.16
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	0.8	0.8	0.6	1.0	0.9	0.1	0.0
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	0.9	0.9	0.7	1.1	1.0	0.2	0.1
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	0.9	0.9	0.7	1.1	1.0	0.2	0.0

(continued on following page).

Table F.1 (continued).

	Sample	GPA.04[ba]0	GPA.04[ba]20	GPA.04[ca]0	GPA.04[ca]20	GPA.04[ca]40	GPA.04[ca]60	GPA.04[ca]80
	X_{An}	0.5202	0.5075	0.7742	0.7544	0.7755	0.8015	0.8318
	X_{Ab}	0.4607	0.4719	0.2206	0.2389	0.2186	0.1946	0.1633
L	SiO_2 wt. %	51.72	51.72	51.72	51.72	51.72	51.72	51.72
I	TiO_2 wt. %	1.63	1.63	1.63	1.63	1.63	1.63	1.63
Q	Al_2O_3 wt. %	15.36	15.36	15.36	15.36	15.36	15.36	15.36
U	FeO^T wt. %	12.46	12.46	12.46	12.46	12.46	12.46	12.46
I C	MgO wt. %	5.71	5.71	5.71	5.71	5.71	5.71	5.71
D O	CaO wt. %	7.86	7.86	7.86	7.86	7.86	7.86	7.86
M	Na_2O wt. %	3.54	3.54	3.54	3.54	3.54	3.54	3.54
P	K_2O wt. %	1.16	1.16	1.16	1.16	1.16	1.16	1.16
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	0.0	0.0	1.6	1.5	1.6	1.8	2.1
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	0.1	0.0	1.7	1.6	1.7	1.9	2.2
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	0.0	0.0	1.7	1.5	1.7	1.9	2.2

(continued on following page).

Table F.1 (continued).

	Sample	GPA.04[ca]100	GPA.04[ca]160	GPA.04[da]0	GPA.04[da]20	GPA.04[da]40	GPA.04[da]60	GPA-04[da]80
	X_{An}	0.8501	0.5768	0.6144	0.6365	0.6458	0.6464	0.6583
	X_{Ab}	0.1470	0.4086	0.3746	0.3534	0.3450	0.3436	0.3298
LIQUID COMP	SiO_2 wt. %	51.72	51.72	51.72	51.72	51.72	51.72	51.72
	TiO_2 wt. %	1.63	1.63	1.63	1.63	1.63	1.63	1.63
	Al_2O_3 wt. %	15.36	15.36	15.36	15.36	15.36	15.36	15.36
	FeO^T wt. %	12.46	12.46	12.46	12.46	12.46	12.46	12.46
	MgO wt. %	5.71	5.71	5.71	5.71	5.71	5.71	5.71
	CaO wt. %	7.86	7.86	7.86	7.86	7.86	7.86	7.86
	Na_2O wt. %	3.54	3.54	3.54	3.54	3.54	3.54	3.54
	K_2O wt. %	1.16	1.16	1.16	1.16	1.16	1.16	1.16
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	2.3	0.3	0.5	0.6	0.7	0.7	0.8
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	2.4	0.4	0.6	0.7	0.8	0.8	0.9
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	2.4	0.4	0.6	0.7	0.8	0.8	0.9

(continued on following page).

Table F.1 (continued).

	Sample	GPA.02[15]0	GPA.02[15]20	GPA.02[15]40	GPA.02[15]60	GPA.02[15]100	GPA.02[15]120	GPA.02[17]0
	X_{An}	0.7545	0.7261	0.7626	0.7272	0.6412	0.5963	0.7752
	X_{Ab}	0.2393	0.2675	0.2286	0.2605	0.3497	0.3833	0.2207
L	SiO_2 wt. %	51.47	51.47	51.47	51.47	51.47	51.47	51.47
I	TiO_2 wt. %	1.69	1.69	1.69	1.69	1.69	1.69	1.69
Q	Al_2O_3 wt. %	15.04	15.04	15.04	15.04	15.04	15.04	15.04
U	FeO^T wt. %	13.27	13.27	13.27	13.27	13.27	13.27	13.27
I C	MgO wt. %	5.75	5.75	5.75	5.75	5.75	5.75	5.75
D O	CaO wt. %	7.40	7.40	7.40	7.40	7.40	7.40	7.40
M	Na_2O wt. %	3.59	3.59	3.59	3.59	3.59	3.59	3.59
P	K_2O wt. %	1.19	1.19	1.19	1.19	1.19	1.19	1.19
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	1.3	1.1	1.4	1.1	0.5	0.3	1.5
	Temperature (°C)	1140	1140	1140	1140	1140	1140	1140
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	1.3	1.1	1.4	1.1	0.5	0.3	1.5
	Temperature (°C)	1150	1150	1150	1150	1150	1150	1150
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	1.3	1.1	1.4	1.1	0.5	0.2	1.4

(continued on following page).

Table F.1 (continued).

	Sample	GPA.02[17]20	GPA.02[17]40	GPA.02[17]60	GPA.02[17]100	GPA.02[23]20	GPA.02[23]40	GPA.02[23]60
	X_{An}	0.7743	0.7563	0.7645	0.5553	0.7458	0.7515	0.7313
	X_{Ab}	0.2228	0.2381	0.2300	0.4307	0.2493	0.2440	0.2614
L	SiO_2 wt. %	51.47	51.47	51.47	51.47	51.47	51.47	51.47
I	TiO_2 wt. %	1.69	1.69	1.69	1.69	1.69	1.69	1.69
Q	Al_2O_3 wt. %	15.04	15.04	15.04	15.04	15.04	15.04	15.04
U	FeO^T wt. %	13.27	13.27	13.27	13.27	13.27	13.27	13.27
I C	MgO wt. %	5.75	5.75	5.75	5.75	5.75	5.75	5.75
D O	CaO wt. %	7.40	7.40	7.40	7.40	7.40	7.40	7.40
M	Na_2O wt. %	3.59	3.59	3.59	3.59	3.59	3.59	3.59
P	K_2O wt. %	1.19	1.19	1.19	1.19	1.19	1.19	1.19
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	1.5	1.3	1.4	0.0	1.2	1.3	1.1
	Temperature (°C)	1140	1140	1140	1140	1140	1140	1140
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	1.4	1.3	1.4	0.0	1.2	1.3	1.1
	Temperature (°C)	1150	1150	1150	1150	1150	1150	1150
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	1.4	1.3	1.4	0.0	1.2	1.2	1.1

(continued on following page).

Table F.1 (continued).

	Sample	GPA.02[23]80	GPA.02[23]100	GPA.02[23]120	GPA.02[23]140	GPA.02[25]20	GPA.02[25]40	GPA.02[25]60
	X_{An}	0.7312	0.7219	0.6827	0.5838	0.7675	0.7756	0.7390
	X_{Ab}	0.2644	0.2724	0.3094	0.4065	0.2226	0.2180	0.2544
L	SiO_2 wt. %	51.47	51.47	51.47	51.47	51.47	51.47	51.47
I	TiO_2 wt. %	1.69	1.69	1.69	1.69	1.69	1.69	1.69
Q	Al_2O_3 wt. %	15.04	15.04	15.04	15.04	15.04	15.04	15.04
U	FeO^T wt. %	13.27	13.27	13.27	13.27	13.27	13.27	13.27
I C	MgO wt. %	5.75	5.75	5.75	5.75	5.75	5.75	5.75
D O	CaO wt. %	7.40	7.40	7.40	7.40	7.40	7.40	7.40
M	Na_2O wt. %	3.59	3.59	3.59	3.59	3.59	3.59	3.59
P	K_2O wt. %	1.19	1.19	1.19	1.19	1.19	1.19	1.19
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	1.1	1.1	0.8	0.2	1.4	1.5	1.2
	Temperature (°C)	1140	1140	1140	1140	1140	1140	1140
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	1.1	1.0	0.8	0.1	1.4	1.5	1.2
	Temperature (°C)	1150	1150	1150	1150	1150	1150	1150
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	1.1	1.0	0.8	0.1	1.4	1.5	1.2

(continued on following page).

Table F.1 (continued).

	Sample	GPA.02[25]80	GPA.02[25]100	GPA.02[26]40	GPA.02[26]60	GPA.02[26]80	GPA.02[26]100	GPA.02[26]120
	X_{An}	0.6482	0.5589	0.7667	0.6948	0.7590	0.7365	0.7536
	X_{Ab}	0.3361	0.4281	0.2223	0.2873	0.2276	0.2565	0.2395
LIQUID COMP	SiO_2 wt. %	51.47	51.47	51.47	51.47	51.47	51.47	51.47
	TiO_2 wt. %	1.69	1.69	1.69	1.69	1.69	1.69	1.69
	Al_2O_3 wt. %	15.04	15.04	15.04	15.04	15.04	15.04	15.04
	FeO^T wt. %	13.27	13.27	13.27	13.27	13.27	13.27	13.27
	MgO wt. %	5.75	5.75	5.75	5.75	5.75	5.75	5.75
	CaO wt. %	7.40	7.40	7.40	7.40	7.40	7.40	7.40
	Na_2O wt. %	3.59	3.59	3.59	3.59	3.59	3.59	3.59
	K_2O wt. %	1.19	1.19	1.19	1.19	1.19	1.19	1.19
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	0.6	0.0	1.4	0.9	1.4	1.2	1.3
	Temperature (°C)	1140	1140	1140	1140	1140	1140	1140
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	0.6	0.0	1.4	0.9	1.4	1.2	1.3
	Temperature (°C)	1150	1150	1150	1150	1150	1150	1150
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	0.6	0.0	1.4	0.9	1.4	1.1	1.3

(continued on following page).

Table F.1 (continued).

	Sample	GPA.02[26]140	GPA.02[26]160	GPA.02[27]0	GPA.02[27]40	GPA.02[27]60	GPA.02[27]80	GPA.02[27]100
	X_{An}	0.7874	0.7959	0.7553	0.7527	0.7589	0.7422	0.5929
	X_{Ab}	0.2076	0.2002	0.2417	0.2440	0.2372	0.2536	0.3967
L	SiO_2 wt. %	51.47	51.47	51.47	51.47	51.47	51.47	51.47
I	TiO_2 wt. %	1.69	1.69	1.69	1.69	1.69	1.69	1.69
Q	Al_2O_3 wt. %	15.04	15.04	15.04	15.04	15.04	15.04	15.04
U	FeO^T wt. %	13.27	13.27	13.27	13.27	13.27	13.27	13.27
I C	MgO wt. %	5.75	5.75	5.75	5.75	5.75	5.75	5.75
D O	CaO wt. %	7.40	7.40	7.40	7.40	7.40	7.40	7.40
M	Na_2O wt. %	3.59	3.59	3.59	3.59	3.59	3.59	3.59
P	K_2O wt. %	1.19	1.19	1.19	1.19	1.19	1.19	1.19
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	1.6	1.6	1.3	1.3	1.3	1.2	0.2
	Temperature (°C)	1140	1140	1140	1140	1140	1140	1140
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	1.6	1.6	1.3	1.3	1.3	1.2	0.2
	Temperature (°C)	1150	1150	1150	1150	1150	1150	1150
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	1.6	1.6	1.3	1.3	1.3	1.2	0.2

(continued on following page).

Table F.1 (continued).

	Sample	GPA.02[ea]0	GPA.02[ea]20	GPA.02[fa]0	GPA.02[fa]20	GPA.02[ga]20	GPA.02[ga]40	GPA.02[ga]80
	X_{An}	0.6046	0.4456	0.7801	0.7152	0.7252	0.6588	0.6868
	X_{Ab}	0.3875	0.4920	0.2143	0.2780	0.2700	0.3358	0.3076
L	SiO_2 wt. %	51.47	51.47	51.47	51.47	51.47	51.47	51.47
I	TiO_2 wt. %	1.69	1.69	1.69	1.69	1.69	1.69	1.69
Q	Al_2O_3 wt. %	15.04	15.04	15.04	15.04	15.04	15.04	15.04
U	FeO^T wt. %	13.27	13.27	13.27	13.27	13.27	13.27	13.27
I C	MgO wt. %	5.75	5.75	5.75	5.75	5.75	5.75	5.75
D O	CaO wt. %	7.40	7.40	7.40	7.40	7.40	7.40	7.40
M	Na_2O wt. %	3.59	3.59	3.59	3.59	3.59	3.59	3.59
P	K_2O wt. %	1.19	1.19	1.19	1.19	1.19	1.19	1.19
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	0.3	0.0	1.5	1.0	1.1	0.6	0.8
	Temperature (°C)	1140	1140	1140	1140	1140	1140	1140
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	0.3	0.0	1.5	1.0	1.1	0.6	0.8
	Temperature (°C)	1150	1150	1150	1150	1150	1150	1150
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	0.2	0.0	1.5	1.0	1.1	0.6	0.8

(continued on following page).

Table F.1 (continued).

	Sample	GPA.02[ga]100	GPA.02[ga]120	GPA.02[ga]140	GPA.02[ha]0	GPA.02[ha]20	GPA.02[ha]40	GPA.02[ha]60
	X_{An}	0.6880	0.6526	0.6219	0.8320	0.7853	0.7287	0.6624
	X_{Ab}	0.3048	0.3396	0.3650	0.1661	0.2102	0.2639	0.3287
LIQUID COMP	SiO_2 wt. %	51.47	51.47	51.47	51.47	51.47	51.47	51.47
	TiO_2 wt. %	1.69	1.69	1.69	1.69	1.69	1.69	1.69
	Al_2O_3 wt. %	15.04	15.04	15.04	15.04	15.04	15.04	15.04
	FeO^T wt. %	13.27	13.27	13.27	13.27	13.27	13.27	13.27
	MgO wt. %	5.75	5.75	5.75	5.75	5.75	5.75	5.75
	CaO wt. %	7.40	7.40	7.40	7.40	7.40	7.40	7.40
	Na_2O wt. %	3.59	3.59	3.59	3.59	3.59	3.59	3.59
	K_2O wt. %	1.19	1.19	1.19	1.19	1.19	1.19	1.19
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	0.8	0.6	0.4	2.0	1.6	1.1	0.6
	Temperature (°C)	1140	1140	1140	1140	1140	1140	1140
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	0.8	0.6	0.4	2.0	1.5	1.1	0.6
	Temperature (°C)	1150	1150	1150	1150	1150	1150	1150
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	0.8	0.6	0.4	1.9	1.5	1.1	0.6

(continued on following page).

Table F.1 (continued).

		Sample	GPA.02[ia]0	GPA.02[ia]20	GPA.02[ia]40	GPA.02[ja]0	GPA.02[ja]20	GPA.02[ja]40	GPA.02[ja]60
		X_{An}	0.8242	0.8392	0.8054	0.6694	0.6095	0.6709	0.7258
		X_{Ab}	0.1735	0.1571	0.1927	0.3228	0.3758	0.3233	0.2686
L		SiO_2 wt. %	51.47	51.47	51.47	51.47	51.47	51.47	51.47
I		TiO_2 wt. %	1.69	1.69	1.69	1.69	1.69	1.69	1.69
Q		Al_2O_3 wt. %	15.04	15.04	15.04	15.04	15.04	15.04	15.04
U		FeO^T wt. %	13.27	13.27	13.27	13.27	13.27	13.27	13.27
I	C	MgO wt. %	5.75	5.75	5.75	5.75	5.75	5.75	5.75
D	O	CaO wt. %	7.40	7.40	7.40	7.40	7.40	7.40	7.40
	M	Na_2O wt. %	3.59	3.59	3.59	3.59	3.59	3.59	3.59
	P	K_2O wt. %	1.19	1.19	1.19	1.19	1.19	1.19	1.19
		Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
		Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
		calc. wt. % H_2O	1.9	2.1	1.7	0.7	0.3	0.7	1.1
		Temperature (°C)	1140	1140	1140	1140	1140	1140	1140
		Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
		calc. wt. % H_2O	1.9	2.1	1.7	0.7	0.3	0.7	1.1
		Temperature (°C)	1150	1150	1150	1150	1150	1150	1150
		Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
		calc. wt. % H_2O	1.9	2.0	1.7	0.7	0.3	0.7	1.1

(continued on following page).

Table F.1 (continued).

	Sample	GPA.02[ja]80	GPA.02[ka]0	GPA.02[ka]40	GPA.02[ka]60	GPA.02[la]0	GPA.02[la]20	GPA.02[la]40
	X_{An}	0.6969	0.6937	0.5776	0.6222	0.6291	0.6525	0.5553
	X_{Ab}	0.2974	0.3003	0.4125	0.3680	0.3622	0.3393	0.4291
L	SiO_2 wt. %	51.47	51.47	51.47	51.47	51.47	51.47	51.47
I	TiO_2 wt. %	1.69	1.69	1.69	1.69	1.69	1.69	1.69
Q	Al_2O_3 wt. %	15.04	15.04	15.04	15.04	15.04	15.04	15.04
U	FeO^T wt. %	13.27	13.27	13.27	13.27	13.27	13.27	13.27
I C	MgO wt. %	5.75	5.75	5.75	5.75	5.75	5.75	5.75
D O	CaO wt. %	7.40	7.40	7.40	7.40	7.40	7.40	7.40
M	Na_2O wt. %	3.59	3.59	3.59	3.59	3.59	3.59	3.59
P	K_2O wt. %	1.19	1.19	1.19	1.19	1.19	1.19	1.19
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	0.9	0.8	0.1	0.4	0.4	0.6	0.0
	Temperature (°C)	1140	1140	1140	1140	1140	1140	1140
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	0.9	0.8	0.1	0.4	0.4	0.6	0.0
	Temperature (°C)	1150	1150	1150	1150	1150	1150	1150
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	0.8	0.8	0.1	0.4	0.4	0.6	0.0

(continued on following page).

Table F.1 (continued).

	Sample	GPA.07[33]0	GPA.07[33]20	GPA.07[34]0	GPA.07[34]40	GPA.07[34]60	GPA.07[34]80	GPA.07[34]100
	X_{An}	0.5039	0.4954	0.7718	0.7723	0.7718	0.7576	0.7177
	X_{Ab}	0.4755	0.4813	0.2243	0.2232	0.2261	0.2379	0.2754
L	SiO_2 wt. %	52.19	52.19	52.19	52.19	52.19	52.19	52.19
I	TiO_2 wt. %	1.62	1.62	1.62	1.62	1.62	1.62	1.62
Q	Al_2O_3 wt. %	15.28	15.28	15.28	15.28	15.28	15.28	15.28
U	FeO^T wt. %	12.68	12.68	12.68	12.68	12.68	12.68	12.68
I C	MgO wt. %	4.86	4.86	4.86	4.86	4.86	4.86	4.86
D O	CaO wt. %	7.63	7.63	7.63	7.63	7.63	7.63	7.63
M	Na_2O wt. %	4.02	4.02	4.02	4.02	4.02	4.02	4.02
P	K_2O wt. %	1.14	1.14	1.14	1.14	1.14	1.14	1.14
	Temperature (°C)	1110	1110	1110	1110	1110	1110	1110
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	0.4	0.3	2.1	2.1	2.1	2.0	1.7
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	0.2	0.2	2.0	2.0	1.9	1.8	1.5
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	0.3	0.3	2.0	2.1	2.0	1.9	1.6

(continued on following page).

Table F.1 (continued).

		Sample	GPA.07[34]120	GPA.07[35]0	GPA.07[36]0	GPA.07[36]20	GPA.07[36]40	GPA.07[36]60	GPA.07[36]80
		X_{An}	0.6184	0.4937	0.8492	0.8590	0.8648	0.8790	0.8631
		X_{Ab}	0.3707	0.4868	0.1466	0.1365	0.1329	0.1177	0.1331
L		SiO_2 wt. %	52.19	52.19	52.19	52.19	52.19	52.19	52.19
I		TiO_2 wt. %	1.62	1.62	1.62	1.62	1.62	1.62	1.62
Q		Al_2O_3 wt. %	15.28	15.28	15.28	15.28	15.28	15.28	15.28
U		FeO^T wt. %	12.68	12.68	12.68	12.68	12.68	12.68	12.68
I	C	MgO wt. %	4.86	4.86	4.86	4.86	4.86	4.86	4.86
D	O	CaO wt. %	7.63	7.63	7.63	7.63	7.63	7.63	7.63
	M	Na_2O wt. %	4.02	4.02	4.02	4.02	4.02	4.02	4.02
	P	K_2O wt. %	1.14	1.14	1.14	1.14	1.14	1.14	1.14
		Temperature (°C)	1110	1110	1110	1110	1110	1110	1110
		Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
		calc. wt. % H_2O	1.0	0.3	2.8	2.9	3.0	3.2	3.0
		Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
		Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
		calc. wt. % H_2O	0.9	0.2	2.7	2.8	2.8	3.0	2.8
		Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
		Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
		calc. wt. % H_2O	1.0	0.3	2.8	2.9	2.9	3.1	2.9

(continued on following page).

Table F.1 (continued).

		Sample	GPA.07[36]100	GPA.07[37]20	GPA.07[37]60	GPA.07[37]80	GPA.07[37]100	GPA.07[37]120	GPA.07[37]140
		X_{An}	0.8660	0.8968	0.8588	0.8584	0.8706	0.8729	0.8641
		X_{Ab}	0.1302	0.1019	0.1383	0.1404	0.1285	0.1251	0.1344
L		SiO_2 wt. %	52.19	52.19	52.19	52.19	52.19	52.19	52.19
I		TiO_2 wt. %	1.62	1.62	1.62	1.62	1.62	1.62	1.62
Q		Al_2O_3 wt. %	15.28	15.28	15.28	15.28	15.28	15.28	15.28
U		FeO^T wt. %	12.68	12.68	12.68	12.68	12.68	12.68	12.68
I	C	MgO wt. %	4.86	4.86	4.86	4.86	4.86	4.86	4.86
D	O	CaO wt. %	7.63	7.63	7.63	7.63	7.63	7.63	7.63
	M	Na_2O wt. %	4.02	4.02	4.02	4.02	4.02	4.02	4.02
	P	K_2O wt. %	1.14	1.14	1.14	1.14	1.14	1.14	1.14
		Temperature (°C)	1110	1110	1110	1110	1110	1110	1110
		Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
		calc. wt. % H_2O	3.0	3.4	2.9	2.9	3.0	3.1	3.0
		Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
		Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
		calc. wt. % H_2O	2.9	3.2	2.8	2.8	2.9	2.9	2.8
		Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
		Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
		calc. wt. % H_2O	3.0	3.3	2.9	2.9	3.0	3.0	2.9

(continued on following page).

Table F.1 (continued).

		Sample	GPA.07[37]160	GPA.07[j]0	GPA.07[j]20	GPA.07[j]40	GPA.07[j]60	GPA.07[j]80	GPA.07[j]100
		X_{An}	0.6909	0.8587	0.8749	0.8182	0.8718	0.8502	0.8687
		X_{Ab}	0.3016	0.1382	0.1229	0.7810	0.1255	0.1470	0.1290
L		SiO_2 wt. %	52.19	52.19	52.19	52.19	52.19	52.19	52.19
I		TiO_2 wt. %	1.62	1.62	1.62	1.62	1.62	1.62	1.62
Q		Al_2O_3 wt. %	15.28	15.28	15.28	15.28	15.28	15.28	15.28
U		FeO^T wt. %	12.68	12.68	12.68	12.68	12.68	12.68	12.68
I	C	MgO wt. %	4.86	4.86	4.86	4.86	4.86	4.86	4.86
D	O	CaO wt. %	7.63	7.63	7.63	7.63	7.63	7.63	7.63
	M	Na_2O wt. %	4.02	4.02	4.02	4.02	4.02	4.02	4.02
	P	K_2O wt. %	1.14	1.14	1.14	1.14	1.14	1.14	1.14
		Temperature (°C)	1110	1110	1110	1110	1110	1110	1110
		Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
		calc. wt. % H_2O	1.5	2.9	3.1	0.1	3.1	2.8	3.0
		Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
		Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
		calc. wt. % H_2O	1.4	2.8	3.0	0.0	2.9	2.7	2.9
		Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
		Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
		calc. wt. % H_2O	1.4	2.9	3.1	0.0	3.0	2.8	3.0

(continued on following page).

Table F.1 (continued).

		Sample	GPA.07[j]120	GPA.07[j]140	GPA.07[k]0	GPA.07[k]20	GPA.07[k]40	GPA.07[k]60	GPA.07[k]80
		X_{An}	0.8556	0.7211	0.8982	0.8981	0.9014	0.8859	0.8696
		X_{Ab}	0.1417	0.2726	0.0991	0.0996	0.0944	0.1078	0.1267
L		SiO_2 wt. %	52.19	52.19	52.19	52.19	52.19	52.19	52.19
I		TiO_2 wt. %	1.62	1.62	1.62	1.62	1.62	1.62	1.62
Q		Al_2O_3 wt. %	15.28	15.28	15.28	15.28	15.28	15.28	15.28
U		FeO^T wt. %	12.68	12.68	12.68	12.68	12.68	12.68	12.68
I	C	MgO wt. %	4.86	4.86	4.86	4.86	4.86	4.86	4.86
D	O	CaO wt. %	7.63	7.63	7.63	7.63	7.63	7.63	7.63
	M	Na_2O wt. %	4.02	4.02	4.02	4.02	4.02	4.02	4.02
	P	K_2O wt. %	1.14	1.14	1.14	1.14	1.14	1.14	1.14
		Temperature (°C)	1110	1110	1110	1110	1110	1110	1110
		Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
		calc. wt. % H_2O	2.9	1.7	3.4	3.4	3.5	3.3	3.0
		Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
		Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
		calc. wt. % H_2O	2.7	1.6	3.3	3.3	3.3	3.1	2.9
		Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
		Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
		calc. wt. % H_2O	2.8	1.7	3.4	3.4	3.4	3.2	3.0

(continued on following page).

Table F.1 (continued).

	Sample	GP.-07[k]100	GPA.07[k]120	GPA.07[k]140	GPA.07[k]160	GPA.07[l]20	GPA.07[l]40	GPA.07[l]60
	X_{An}	0.8761	0.8875	0.9086	0.9087	0.7287	0.7170	0.7112
	X_{Ab}	0.1203	0.1078	0.0883	0.0869	0.2674	0.2744	0.2838
L	SiO_2 wt. %	52.19	52.19	52.19	52.19	52.19	52.19	52.19
I	TiO_2 wt. %	1.62	1.62	1.62	1.62	1.62	1.62	1.62
Q	Al_2O_3 wt. %	15.28	15.28	15.28	15.28	15.28	15.28	15.28
U	FeO^T wt. %	12.68	12.68	12.68	12.68	12.68	12.68	12.68
I C	MgO wt. %	4.86	4.86	4.86	4.86	4.86	4.86	4.86
D O	CaO wt. %	7.63	7.63	7.63	7.63	7.63	7.63	7.63
M	Na_2O wt. %	4.02	4.02	4.02	4.02	4.02	4.02	4.02
P	K_2O wt. %	1.14	1.14	1.14	1.14	1.14	1.14	1.14
	Temperature (°C)	1110	1110	1110	1110	1110	1110	1110
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	3.1	3.3	3.5	3.6	1.7	1.7	1.6
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	3.0	3.1	3.4	3.4	1.6	1.5	1.5
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	3.1	3.2	3.5	3.5	1.7	1.6	1.6

(continued on following page).

Table F.1 (continued).

		Sample	GPA.07[l]80	GPA.07[l]100	GPA.07[l]120	GPA.07[n]0	GPA.07[n]20	GPA.07[n]40	GPA.07[n]60
		X_{An}	0.7199	0.7205	0.7633	0.9003	0.9040	0.9034	0.8480
		X_{Ab}	0.2756	0.2747	0.2335	0.0981	0.0933	0.0957	0.1492
L		SiO_2 wt. %	52.19	52.19	52.19	52.19	52.19	52.19	52.19
I		TiO_2 wt. %	1.62	1.62	1.62	1.62	1.62	1.62	1.62
Q		Al_2O_3 wt. %	15.28	15.28	15.28	15.28	15.28	15.28	15.28
U		FeO^T wt. %	12.68	12.68	12.68	12.68	12.68	12.68	12.68
I	C	MgO wt. %	4.86	4.86	4.86	4.86	4.86	4.86	4.86
D	O	CaO wt. %	7.63	7.63	7.63	7.63	7.63	7.63	7.63
	M	Na_2O wt. %	4.02	4.02	4.02	4.02	4.02	4.02	4.02
	P	K_2O wt. %	1.14	1.14	1.14	1.14	1.14	1.14	1.14
		Temperature (°C)	1110	1110	1110	1110	1110	1110	1110
		Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
		calc. wt. % H_2O	1.7	1.7	2.0	3.4	3.5	3.4	2.8
		Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
		Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
		calc. wt. % H_2O	1.5	1.6	1.9	3.3	3.3	3.3	2.7
		Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
		Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
		calc. wt. % H_2O	1.6	1.6	2.0	3.4	3.4	3.4	2.8

(continued on following page).

Table F.1 (continued).

	Sample	GPA.07[n]80	GPA.07[o]0	GPA.07[o]20	GPA.07[o]40	GPA.07[o]60	GPA.07[o]80	GPA.07[o]100
	X_{An}	0.7322	0.8842	0.8886	0.9033	0.8965	0.8694	0.8797
	X_{Ab}	0.2646	0.1148	0.1088	0.0955	0.1019	0.1284	0.1195
L	SiO_2 wt. %	52.19	52.19	52.19	52.19	52.19	52.19	52.19
I	TiO_2 wt. %	1.62	1.62	1.62	1.62	1.62	1.62	1.62
Q	Al_2O_3 wt. %	15.28	15.28	15.28	15.28	15.28	15.28	15.28
U	FeO^T wt. %	12.68	12.68	12.68	12.68	12.68	12.68	12.68
I C	MgO wt. %	4.86	4.86	4.86	4.86	4.86	4.86	4.86
D O	CaO wt. %	7.63	7.63	7.63	7.63	7.63	7.63	7.63
M	Na_2O wt. %	4.02	4.02	4.02	4.02	4.02	4.02	4.02
P	K_2O wt. %	1.14	1.14	1.14	1.14	1.14	1.14	1.14
	Temperature (°C)	1110	1110	1110	1110	1110	1110	1110
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	1.8	3.2	3.3	3.4	3.4	3.0	3.1
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	1.6	3.1	3.1	3.3	3.2	2.9	3.0
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	1.7	3.2	3.2	3.4	3.3	3.0	3.1

(continued on following page).

Table F.1 (continued).

		Sample	GPA.07[n]80	GPA.07[o]0	GPA.07[o]20	GPA.07[o]40	GPA.07[o]60	GPA.07[o]80	GPA.07[o]100
		X_{An}	0.7322	0.8842	0.8886	0.9033	0.8965	0.8694	0.8797
		X_{Ab}	0.2646	0.1148	0.1088	0.0955	0.1019	0.1284	0.1195
L		SiO_2 wt. %	52.19	52.19	52.19	52.19	52.19	52.19	52.19
I		TiO_2 wt. %	1.62	1.62	1.62	1.62	1.62	1.62	1.62
Q		Al_2O_3 wt. %	15.28	15.28	15.28	15.28	15.28	15.28	15.28
U		FeO^T wt. %	12.68	12.68	12.68	12.68	12.68	12.68	12.68
I	C	MgO wt. %	4.86	4.86	4.86	4.86	4.86	4.86	4.86
D	O	CaO wt. %	7.63	7.63	7.63	7.63	7.63	7.63	7.63
	M	Na_2O wt. %	4.02	4.02	4.02	4.02	4.02	4.02	4.02
	P	K_2O wt. %	1.14	1.14	1.14	1.14	1.14	1.14	1.14
		Temperature (°C)	1110	1110	1110	1110	1110	1110	1110
		Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
		calc. wt. % H_2O	1.8	3.2	3.3	3.4	3.4	3.0	3.1
		Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
		Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
		calc. wt. % H_2O	1.6	3.1	3.1	3.3	3.2	2.9	3.0
		Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
		Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
		calc. wt. % H_2O	1.7	3.2	3.2	3.4	3.3	3.0	3.1

(continued on following page).

Table F.1 (continued).

	Sample	GPA.07[o]120	GPA.07[o]140	GPA.07[o]160	GPA.07[o]180	GPA.07[p]0	GPA.07[p]40	GPA.07[p]60
	X_{An}	0.8657	0.8808	0.8960	0.8848	0.7197	0.7026	0.7034
	X_{Ab}	0.1334	0.1155	0.1021	0.1126	0.2732	0.2887	0.2883
L	SiO_2 wt. %	52.19	52.19	52.19	52.19	52.19	52.19	52.19
I	TiO_2 wt. %	1.62	1.62	1.62	1.62	1.62	1.62	1.62
Q	Al_2O_3 wt. %	15.28	15.28	15.28	15.28	15.28	15.28	15.28
U	FeO^T wt. %	12.68	12.68	12.68	12.68	12.68	12.68	12.68
I C	MgO wt. %	4.86	4.86	4.86	4.86	4.86	4.86	4.86
D O	CaO wt. %	7.63	7.63	7.63	7.63	7.63	7.63	7.63
M	Na_2O wt. %	4.02	4.02	4.02	4.02	4.02	4.02	4.02
P	K_2O wt. %	1.14	1.14	1.14	1.14	1.14	1.14	1.14
	Temperature (°C)	1110	1110	1110	1110	1110	1110	1110
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	3.0	3.2	3.4	3.2	1.7	1.6	1.6
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	2.8	3.1	3.2	3.1	1.6	1.4	1.4
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	2.9	3.1	3.3	3.2	1.7	1.5	1.5

(continued on following page).

Table F.1 (continued).

		Sample	GPA.07[p]80	GPA.07[p]100	GPA.07[q]0	GPA.07[q]20	GPA.07[q]40	GPA.07[q]60	GPA.07[q]80
		X_{An}	0.7098	0.6429	0.8259	0.8850	0.8091	0.8219	0.7257
		X_{Ab}	0.2828	0.3468	0.1705	0.1129	0.1847	0.1760	0.2683
L		SiO_2 wt. %	52.19	52.19	52.19	52.19	52.19	52.19	52.19
I		TiO_2 wt. %	1.62	1.62	1.62	1.62	1.62	1.62	1.62
Q		Al_2O_3 wt. %	15.28	15.28	15.28	15.28	15.28	15.28	15.28
U		FeO^T wt. %	12.68	12.68	12.68	12.68	12.68	12.68	12.68
I	C	MgO wt. %	4.86	4.86	4.86	4.86	4.86	4.86	4.86
D	O	CaO wt. %	7.63	7.63	7.63	7.63	7.63	7.63	7.63
	M	Na_2O wt. %	4.02	4.02	4.02	4.02	4.02	4.02	4.02
	P	K_2O wt. %	1.14	1.14	1.14	1.14	1.14	1.14	1.14
		Temperature (°C)	1110	1110	1110	1110	1110	1110	1110
		Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
		calc. wt. % H_2O	1.6	1.2	2.6	3.2	2.4	2.5	1.7
		Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
		Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
		calc. wt. % H_2O	1.5	1.0	2.4	3.1	2.3	2.4	1.6
		Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
		Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
		calc. wt. % H_2O	1.6	1.1	2.5	3.2	2.4	2.5	1.7

(continued on following page).

Table F.1 (continued).

		Sample	GPA.07[r]0	GPA.07[r]20	GPA.07[r]40	GPA.07[r]60	GPA.07[r]100	GPA.07[s]0	GPA.07[s]20
		X_{An}	0.6701	0.6351	0.6769	0.7101	0.6641	0.8742	0.8640
		X_{Ab}	0.3220	0.3581	0.3179	0.2831	0.3274	0.1223	0.1237
L		SiO_2 wt. %	52.19	52.19	52.19	52.19	52.19	52.19	52.19
I		TiO_2 wt. %	1.62	1.62	1.62	1.62	1.62	1.62	1.62
Q		Al_2O_3 wt. %	15.28	15.28	15.28	15.28	15.28	15.28	15.28
U		FeO^T wt. %	12.68	12.68	12.68	12.68	12.68	12.68	12.68
I	C	MgO wt. %	4.86	4.86	4.86	4.86	4.86	4.86	4.86
D	O	CaO wt. %	7.63	7.63	7.63	7.63	7.63	7.63	7.63
	M	Na_2O wt. %	4.02	4.02	4.02	4.02	4.02	4.02	4.02
	P	K_2O wt. %	1.14	1.14	1.14	1.14	1.14	1.14	1.14
		Temperature (°C)	1110	1110	1110	1110	1110	1110	1110
		Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
		calc. wt. % H_2O	1.3	1.1	1.4	1.6	1.3	3.1	3.1
		Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
		Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
		calc. wt. % H_2O	1.2	1.0	1.2	1.5	1.2	3.0	2.9
		Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
		Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
		calc. wt. % H_2O	1.3	1.1	1.3	1.6	1.3	3.1	3.0

(continued on following page).

Table F.1 (continued).

	Sample	GPA.07[s]40	GPA.07[s]80	GPA.07[s]100	GPA.07[s]120
	X_{An}	0.8472	0.8742	0.8932	0.7059
	X_{Ab}	0.1415	0.1172	0.1027	0.2813
LIQUID COMP	SiO_2 wt. %	52.19	52.19	52.19	52.19
LIQUID COMP	TiO_2 wt. %	1.62	1.62	1.62	1.62
LIQUID COMP	Al_2O_3 wt. %	15.28	15.28	15.28	15.28
LIQUID COMP	FeO^T wt. %	12.68	12.68	12.68	12.68
LIQUID COMP	MgO wt. %	4.86	4.86	4.86	4.86
LIQUID COMP	CaO wt. %	7.63	7.63	7.63	7.63
LIQUID COMP	Na_2O wt. %	4.02	4.02	4.02	4.02
LIQUID COMP	K_2O wt. %	1.14	1.14	1.14	1.14
	Temperature (°C)	1110	1110	1110	1110
	Pressure (Bars)	1000	1000	1000	1000
	calc. wt. % H_2O	2.9	3.2	3.3	1.6
	Temperature (°C)	1120	1120	1120	1120
	Pressure (Bars)	2000	2000	2000	2000
	calc. wt. % H_2O	2.7	3.0	3.2	1.5
	Temperature (°C)	1120	1120	1120	1120
	Pressure (Bars)	3000	3000	3000	3000
	calc. wt. % H_2O	2.8	3.1	3.3	1.6

(continued on following page).

Table F.1 (continued).

		Sample	GPA.03[40]0	GPA.03[40]20	GPA.03[40]40	GPA.03[40]60	GPA.03[41]0	GPA.03[41]20	GPA.03[41]40
		X_{An}	0.8870	0.8520	0.8606	0.7869	0.5868	0.5427	0.5028
		X_{Ab}	0.1103	0.1459	0.1380	0.2084	0.4001	0.4425	0.4777
L		SiO_2 wt. %	51.83	51.83	51.83	51.83	51.83	51.83	51.83
I		TiO_2 wt. %	1.60	1.60	1.60	1.60	1.60	1.60	1.60
Q		Al_2O_3 wt. %	14.78	14.78	14.78	14.78	14.78	14.78	14.78
U		FeO^T wt. %	12.68	12.68	12.68	12.68	12.68	12.68	12.68
I	C	MgO wt. %	5.30	5.30	5.30	5.30	5.30	5.30	5.30
D	O	CaO wt. %	8.35	8.35	8.35	8.35	8.35	8.35	8.35
	M	Na_2O wt. %	3.78	3.78	3.78	3.78	3.78	3.78	3.78
	P	K_2O wt. %	1.12	1.12	1.12	1.12	1.12	1.12	1.12
		Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
		Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
		calc. wt. % H_2O	2.8	2.4	2.5	1.8	0.4	0.1	<0
		Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
		Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
		calc. wt. % H_2O	2.8	2.4	2.5	1.8	0.4	0.1	<0
		Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
		Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
		calc. wt. % H_2O	2.8	2.4	2.5	1.8	0.4	0.1	0.0

(continued on following page).

Table F.1 (continued).

		Sample	GPA.03[41]60	GPA.03[41]80	GPA.03[42]0	GPA.03[42]20	GPA.03[42]40	GPA.03[42]60	GPA.03[42]80
		X_{An}	0.5638	0.6154	0.8799	0.8804	0.8866	0.8449	0.8513
		X_{Ab}	0.4218	0.3744	0.1181	0.1184	0.1116	0.1515	0.1472
L		SiO_2 wt. %	51.83	51.83	51.83	51.83	51.83	51.83	51.83
I		TiO_2 wt. %	1.60	1.60	1.60	1.60	1.60	1.60	1.60
Q		Al_2O_3 wt. %	14.78	14.78	14.78	14.78	14.78	14.78	14.78
U		FeO^T wt. %	12.68	12.68	12.68	12.68	12.68	12.68	12.68
I	C	MgO wt. %	5.30	5.30	5.30	5.30	5.30	5.30	5.30
D	O	CaO wt. %	8.35	8.35	8.35	8.35	8.35	8.35	8.35
	M	Na_2O wt. %	3.78	3.78	3.78	3.78	3.78	3.78	3.78
	P	K_2O wt. %	1.12	1.12	1.12	1.12	1.12	1.12	1.12
		Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
		Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
		calc. wt. % H_2O	0.3	0.6	2.7	2.7	2.8	2.3	2.4
		Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
		Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
		calc. wt. % H_2O	0.2	0.5	2.7	2.7	2.8	2.3	2.4
		Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
		Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
		calc. wt. % H_2O	0.2	0.5	2.7	2.7	2.8	2.3	2.4

(continued on following page).

Table F.1 (continued).

	Sample	GPA.03[42]120	GPA.03[44]40	GPA.03[44]60	GPA.03[44]80	GPA.03[44]100	GPA.03[44]120	GPA.03[45]0
	X_{An}	0.7028	0.8211	0.7946	0.8193	0.7787	0.4869	0.8677
	X_{Ab}	0.2890	0.1753	0.2019	0.1771	0.2165	0.4872	0.1285
L	SiO_2 wt. %	51.83	51.83	51.83	51.83	51.83	51.83	51.83
I	TiO_2 wt. %	1.60	1.60	1.60	1.60	1.60	1.60	1.60
Q	Al_2O_3 wt. %	14.78	14.78	14.78	14.78	14.78	14.78	14.78
U	FeO^T wt. %	12.68	12.68	12.68	12.68	12.68	12.68	12.68
I C	MgO wt. %	5.30	5.30	5.30	5.30	5.30	5.30	5.30
D O	CaO wt. %	8.35	8.35	8.35	8.35	8.35	8.35	8.35
M	Na_2O wt. %	3.78	3.78	3.78	3.78	3.78	3.78	3.78
P	K_2O wt. %	1.12	1.12	1.12	1.12	1.12	1.12	1.12
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	1.1	2.1	1.8	2.1	1.7	<0	2.6
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	1.1	2.1	1.8	2.1	1.7	<0	2.6
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	1.1	2.1	1.8	2.0	1.7	0.0	2.6

(continued on following page).

Table F.1 (continued).

	Sample	GPA.03[45]20	GPA.03[45]40	GPA.03[45]60	GPA.03[45]80	GPA.03[45]100	GPA.03[45]120	GPA.03[46]0
	X_{An}	0.8758	0.8928	0.8922	0.8667	0.8122	0.5966	0.8073
	X_{Ab}	0.1229	0.1056	0.1070	0.1300	0.1843	0.3907	0.1872
L	SiO_2 wt. %	51.83	51.83	51.83	51.83	51.83	51.83	51.83
I	TiO_2 wt. %	1.60	1.60	1.60	1.60	1.60	1.60	1.60
Q	Al_2O_3 wt. %	14.78	14.78	14.78	14.78	14.78	14.78	14.78
U	FeO^T wt. %	12.68	12.68	12.68	12.68	12.68	12.68	12.68
I C	MgO wt. %	5.30	5.30	5.30	5.30	5.30	5.30	5.30
D O	CaO wt. %	8.35	8.35	8.35	8.35	8.35	8.35	8.35
M	Na_2O wt. %	3.78	3.78	3.78	3.78	3.78	3.78	3.78
P	K_2O wt. %	1.12	1.12	1.12	1.12	1.12	1.12	1.12
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	2.7	2.9	2.9	2.6	2.0	0.5	2.0
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	2.6	2.9	2.8	2.6	2.0	0.4	2.0
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	2.6	2.8	2.8	2.5	2.0	0.4	1.9

(continued on following page).

Table F.1 (continued).

	Sample	GPA.03[46]60	GPA.03[46]80	GPA.03[47]0	GPA.03[47]20	GPA.03[47]40	GPA.03[47]60	GPA.03[48]0
	X_{An}	0.8565	0.8124	0.8098	0.8116	0.7993	0.7939	0.9038
	X_{Ab}	0.1384	0.1849	0.1884	0.1847	0.1968	0.2021	0.0960
LIQUID COMP	SiO_2 wt. %	51.83	51.83	51.83	51.83	51.83	51.83	51.83
	TiO_2 wt. %	1.60	1.60	1.60	1.60	1.60	1.60	1.60
	Al_2O_3 wt. %	14.78	14.78	14.78	14.78	14.78	14.78	14.78
	FeO^T wt. %	12.68	12.68	12.68	12.68	12.68	12.68	12.68
	MgO wt. %	5.30	5.30	5.30	5.30	5.30	5.30	5.30
	CaO wt. %	8.35	8.35	8.35	8.35	8.35	8.35	8.35
	Na_2O wt. %	3.78	3.78	3.78	3.78	3.78	3.78	3.78
	K_2O wt. %	1.12	1.12	1.12	1.12	1.12	1.12	1.12
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	2.5	2.0	2.0	2.0	1.9	1.8	3.0
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	2.5	2.0	2.0	2.0	1.9	1.8	3.0
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	2.4	2.0	1.9	2.0	1.9	1.8	3.0

(continued on following page).

Table F.1 (continued).

	Sample	GPA.03[50]60	GPA.03[50]80	GPA.03[50]100	GPA.03[ma]0	GPA.03[ma]20	GPA.03[ma]40	GPA.03[ma]60
	X_{An}	0.8804	0.8740	0.7931	0.7926	0.7902	0.7908	0.7892
	X_{Ab}	0.1176	0.1236	0.2044	0.2033	0.2068	0.2041	0.2072
LIQUID COMP	SiO_2 wt. %	51.83	51.83	51.83	51.83	51.83	51.83	51.83
	TiO_2 wt. %	1.60	1.60	1.60	1.60	1.60	1.60	1.60
	Al_2O_3 wt. %	14.78	14.78	14.78	14.78	14.78	14.78	14.78
	FeO^T wt. %	12.68	12.68	12.68	12.68	12.68	12.68	12.68
	MgO wt. %	5.30	5.30	5.30	5.30	5.30	5.30	5.30
	CaO wt. %	8.35	8.35	8.35	8.35	8.35	8.35	8.35
	Na_2O wt. %	3.78	3.78	3.78	3.78	3.78	3.78	3.78
	K_2O wt. %	1.12	1.12	1.12	1.12	1.12	1.12	1.12
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	2.7	2.7	1.8	1.8	1.8	1.8	1.8
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	2.7	2.6	1.8	1.8	1.8	1.8	1.8
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	2.7	2.6	1.8	1.8	1.8	1.8	1.8

(continued on following page).

Table F.1 (continued).

	Sample	GPA.03[ma]80	GPA.03[na]0	GPA.03[na]20	GPA.03[na]40	GPA.03[oa]0	GPA.03[oa]40	GPA.03[pa]0
	X_{An}	0.6563	0.7247	0.7105	0.5131	0.5556	0.4308	0.6274
	X_{Ab}	0.3355	0.2675	0.2835	0.4598	0.5263	0.4586	0.3633
LIQUID COMP	SiO_2 wt. %	51.83	51.83	51.83	51.83	51.83	51.83	51.83
	TiO_2 wt. %	1.60	1.60	1.60	1.60	1.60	1.60	1.60
	Al_2O_3 wt. %	14.78	14.78	14.78	14.78	14.78	14.78	14.78
	FeO^T wt. %	12.68	12.68	12.68	12.68	12.68	12.68	12.68
	MgO wt. %	5.30	5.30	5.30	5.30	5.30	5.30	5.30
	CaO wt. %	8.35	8.35	8.35	8.35	8.35	8.35	8.35
	Na_2O wt. %	3.78	3.78	3.78	3.78	3.78	3.78	3.78
	K_2O wt. %	1.12	1.12	1.12	1.12	1.12	1.12	1.12
	Temperature (°C)	1120	1120	1120	1120	1120	1120	1120
	Pressure (Bars)	1000	1000	1000	1000	1000	1000	1000
	calc. wt. % H_2O	0.8	1.3	1.2	0.0	<0	<0	0.6
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	2000	2000	2000	2000	2000	2000	2000
	calc. wt. % H_2O	0.8	1.3	1.2	0.0	<0	0.0	0.6
	Temperature (°C)	1130	1130	1130	1130	1130	1130	1130
	Pressure (Bars)	3000	3000	3000	3000	3000	3000	3000
	calc. wt. % H_2O	0.8	1.3	1.2	0.0	0.0	0.0	0.6

(continued on following page).

Table F.1 (continued).

	Sample	GPA.03[pa]20	GPA.03[pa]40	GPA.03[qa]0	GPA.03[qa]20
	X_{An}	0.6174	0.5859	0.8038	0.7804
	X_{Ab}	0.3745	0.4015	0.1928	0.2180
LIQUID COMP	SiO_2 wt. %	51.83	51.83	51.83	51.83
	TiO_2 wt. %	1.60	1.60	1.60	1.60
	Al_2O_3 wt. %	14.78	14.78	14.78	14.78
	FeO^T wt. %	12.68	12.68	12.68	12.68
	MgO wt. %	5.30	5.30	5.30	5.30
	CaO wt. %	8.35	8.35	8.35	8.35
	Na_2O wt. %	3.78	3.78	3.78	3.78
	K_2O wt. %	1.12	1.12	1.12	1.12
	Temperature (°C)	1120	1120	1120	1120
	Pressure (Bars)	1000	1000	1000	1000
	calc. wt. % H_2O	0.6	0.4	1.9	1.7
	Temperature (°C)	1130	1130	1130	1130
	Pressure (Bars)	2000	2000	2000	2000
	calc. wt. % H_2O	0.6	0.4	1.9	1.7
	Temperature (°C)	1130	1130	1130	1130
	Pressure (Bars)	3000	3000	3000	3000
	calc. wt. % H_2O	0.5	0.4	1.9	1.7

(continued on following page).