

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

COMPOSITIONS OF GLASSES
FROM THE PU'U O'O--KUPAIANAHA ERUPTION
OF KILAUEA VOLCANO, HAWAII
JANUARY 1983 THROUGH DECEMBER 1994

by

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INTRODUCTION

The purpose of this report is to make available all of the glass analyses obtained through July 1995 on samples from the Pu'u O'o-Kupaianaha eruption. The samples have been collected by workers at the Hawaiian Volcano Observatory (HVO) as part of the eruption monitoring program. This long-lived eruption, which began on January 3, 1983 and continues at the present time (September 1998) had covered a large area on Kilauea's east rift by the end of 1994 (Figure 1). Various stages of the eruption have been described by Wolfe and others (1988), Heliker and Wright (1991), Mattox and others (1993), Mangan and others (1995a), and Heliker and others (1998). It is the first major eruption of Kilauea for which glass compositions have been monitored regularly throughout the eruption to determine lava eruption temperatures. The period represented in this data base extends from January 1983 through December 1994, and the data base includes 479 analyses of glasses from 346 samples.

The principal motive for monitoring glass compositions over the course of this very long eruption has been to determine how the temperature of the lava erupted has varied with time, using the geothermometry calibration developed for Kilauean glasses by Helz and Thornber (1987). The data presented here, especially the results on samples from episodes 1-20 of the eruption, are part of the data base used in comparing the results from field measurements of temperature with the results of glass geothermometry (Helz and others, 1987; Helz and others, 1995). Other reports have drawn on these data to delineate the thermal history of the entire eruption (Helz and others, 1991), to determine the thermal efficiency of lava tubes fed from the Kupaianaha pond (Helz and others, 1993) and to define the thermal characteristics of the close of the Kupaianaha period, including episode 49 (Mangan and others, 1995a). Because temperature is one of the most important intensive variables of Kilauea's magmatic system, it is also important to document carefully how the data base of glass compositions has been developed.

SAMPLE COLLECTION PROCEDURES

Procedures for collecting well-quenched, glassy samples varied, depending on field conditions and the nature of the material collected. Fragmental material, blown into the air, was collected as it fell, where it was safe to do so. Alternatively, observers put out passive containers (cans, tarps, metal sheets) where tephra and spatter could accumulate on or in them, and collected the material as soon as possible. Flow samples were retrieved from the edge of active flows, on a hammer or steel bar, or (rarely) on a thermocouple. Ponds, active channels and lava tubes were usually sampled with a hammer tied to a steel cable, either flung in or dropped from a helicopter. At the coast, where the ocean provided good, water-quenched material, observers had only to scoop up appropriate samples. For samples collected as part of the comparative-geothermometry data base (see Helz and others, 1995), the temperature was

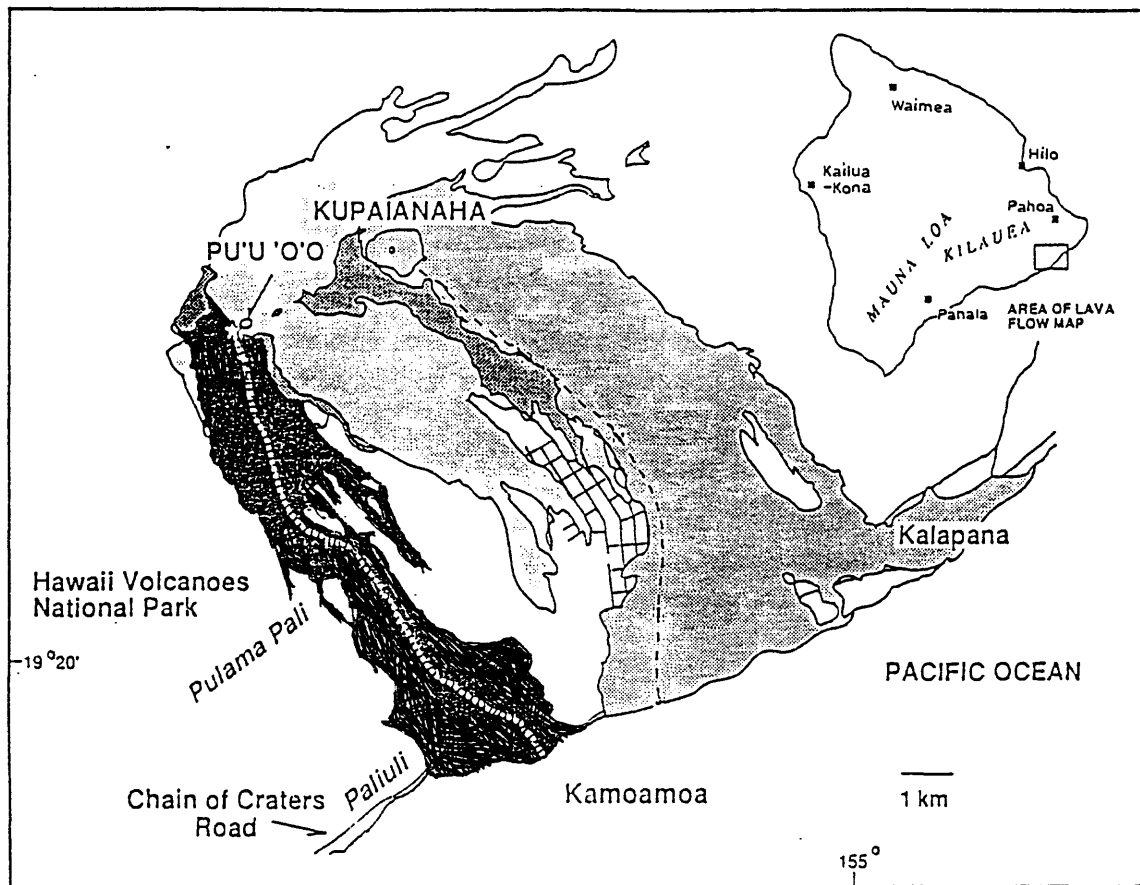


Figure 1. Index map of the ongoing eruption on Kilauea's East Rift, through December 1994. The lightest shading shows the Pu'u O'o vents and flow fields. The next darkest shows the Kupaianaha pond, shield and flows, while the slightly darker area between these two marks the extent of lavas from episode 49. The darkest area shows the vents and flows of episodes 50-53, through the end of 1994. The light dashed line indicates one of several lava tube paths active during the Kupaianaha period. The heavy dashed line in the black field shows the location of the tube system active during episode 53.

measured first, and then an appropriate sample collected, as described in Neal and others (1988). For sampling of lava in tubes, Cashman and others (1994) provide some description.

MICROPROBE ANALYTICAL METHODS

Most of the glass analyses presented here were obtained using the automated ARL-SEMQ 9-channel electron microprobe at the U.S. Geological Survey in Reston, VA. This instrument was used for all analyses made prior to January 1993, and for two sets of analyses made on 6/9/93 and 6/10/93. Operating conditions were 15 kV, with a beam current of 0.1 microamps. The beam diameter was slightly broadened from optimum focus to about 5 microns, to minimize loss of Na₂O under the beam. The raw data were corrected on-line using the empirical procedures of Bence and Albee (1968) and Albee and Ray (1970). Standards used included a very uniform basalt glass from the 1965 Makaopuhi lava lake and natural mineral standards. This glass was initially described by Wright and Okamura (1977), and subsequently reanalyzed and evaluated as a probe standard by Jarosewich and others (1979), who referred to it as sample A99.

Most analyses made after January 1993 were obtained on a 5-channel, fully automated JEOL JXA-8800, also at the US Geological Survey in Reston, VA. Operating conditions were again 15 kV, with a beam current of 0.1 microamps. The beam diameter was set at 5 μm, to minimize Na₂O loss. The data were corrected on-line using a standard ZAF correction provided by JEOL. The standardization package used was the same as that used on the SEMQ, except that sulfur was added to the list of elements analyzed. JEOL analyses can be identified in the tables by the presence of a reported value for sulfur in the analyses, as well as by date.

As mentioned above, in June 1993 two sets of samples that had been analysed on the JEOL were analyzed on the SEMQ as well, to cross-check for compatibility between the two instruments and analytical packages. Those data, plus some subsequent replicate analyses performed on the JEOL, show that the results from the two instruments are fully comparable.

The composition of Makaopuhi glass A99 was monitored repeatedly, as a "known unknown," throughout each analytical session. After all data for the unknown glasses had been corrected on-line, the resulting values of the various oxides in the unknown glasses were, *if necessary*, further adjusted for any observed deviations between the oxide values obtained for glass A99 and the reported standard analysis. These second-order corrections were made only if the observed deviations were (1) large enough to affect the last significant figure in the analysis (2) fairly constant throughout the session, and (3) not large. Maximum corrections used were in the range 0.95-1.05 for all oxides but MnO and P₂O₅; larger deviations would have triggered restandardization. In a typical session, corrections were in the range 0.98-1.02, and were large enough to be worth making for only 2-3 oxides (of eleven analyzed).

The analysis of Jarosewich and others (1979) of glass A99 was used as the reference value for all oxides except for MnO and P₂O₅. For the latter two oxides, the original analysis of the glass (given in Wright and Okamura, 1977) was used, as those values give results more compatible with other available data on Hawaiian glasses and basalts.

The purpose of this second-order adjustment was to eliminate session-to-session variations in oxide concentration, in order to maximize the internal precision of the data set. If one is to monitor the temperature variations of an eruption that continues over a period of 10 years or more, it is particularly important that analyses be consistent with each other over time. The procedure outlined has been very successful: replicate analyses on the same samples, carried out as much as 8 years apart, are virtually identical (see Tables 1-2). This type of second-order correction procedure was originally described by Byerly and others (1977), who applied it to the problem of obtaining a large, internally consistent data set for MORB glasses.

In addition to the analyses obtained as described above, the tables contain a few additional analyses collected elsewhere. Table 2 includes three analyses (for samples 961, 1003, and 1027) obtained by R. T. Helz using the energy-dispersive analysis (EDS) on the Cambridge microprobe at the University of Manchester, England. These are included to show how compositions obtained by this different technique compare with the data base. In addition, a few electron microprobe analyses by other operators have been included, again for purposes of comparison. These include two analyses by Lewis Calk (U.S.G.S., Menlo Park) for two samples from episode 49 (samples 1350F and 1354F in Table 2), and analyses for samples 1430, 1431, 1432, 1433, and 1436 in Table 3, performed by K. V. Cashman, of the University of Oregon. Neither of these sets of analyses have been subject to the second-order correction described above, so although they are very similar to the Reston analyses, they don't share the internal precision of the rest of the data set.

DESCRIPTION OF THE ANALYTICAL TABLES

Analytical data for 104 glassy samples from the Pu'u O'o stage of the eruption (episodes 1-47, from 1/83 to 7/86) are in Table 1. Information given for each sample includes the date erupted, the episode number and the sample number. Glass analyses for 167 samples from the Kupaianaha (episode 48) and episode 49 (7/86-11/91) stages of the eruption are in Table 2. Information given includes the date erupted, the sample number, and the type of sample. All samples are from episode 48, except for those explicitly identified as being from episode 49. Glass data for 75 samples from later episodes (50-53, up through 1994) are in Table 3. This table includes the date erupted, the episode and sample number for each sample.

Sample numbers usually end with a letter. The letters used are:

S = spatter sample. These samples include material thrown out of the Kupaianaha pond, or

from some other vent, or from a tube entering the ocean. The source of spatter from anywhere other than the Kupaianaha pond is always specified in the tables. The quench was usually rapid, providing a good basis for assigning a quenching temperature to the sample.

T = tephra. These are highly vesicular scoria samples, nearly all of them samples ejected from the Pu'u O'o vent. Quench was very rapid because of gas expansion during ejection. The "T" designation was also used for Pele's tears collected at Pu'u O'o during episode 53 (see Table 3). These are very dense glasses, quite different from the frothy material designated "T" in earlier stages of the eruption, although they are also well-quenched.

P = pond sample. This designation almost always implies that the sample was dipped out of the Kupaianaha pond on a hammer or cable, either thrown from the edge, or dropped from a helicopter. The quench was artificial and relatively rapid.

F = flow sample. These samples were collected from an active flow on a geologist's hammer. Some were water-quenched (fast) or air-quenched (slow enough to give problematic results for glass geothermometry). Samples hauled out through skylights are identified as such, and the elevation of the skylight given. Air temperatures within the tubes are very high, so skylight samples do not begin to cool rapidly until they are out of the tube.

The designations used here are taken from the HVO data base, which includes complete information on when, where, and how all samples were collected.

Information relating to the analyses includes the date on which the analysis was performed (where known), and the number of points averaged to produce the analysis given (where known). In Table 1 all analyses are by R.T. Helz. Table 2 includes two analyses by B.C. Hearn and two by L. Calk, as indicated, with all others being by R.T. Helz. In Table 3, the analyst (whether Helz, Hearn or Cashman) is given for all analyses. Replicate analyses are indicated by "(R)" following the number of points in the analysis. A dash indicates that *no value* was obtained for a particular element in the analysis. Parentheses around an individual oxide value in the analytical tables indicates an outlier value, which would not be expected to be duplicated in a replicate analysis. Most of these are low SiO₂ values, the effect of which can also be seen in the summations. Sulfur values are given in the line below the summation because sulfur was not determined for the glasses analyzed on the SEMQ. The summation does not include sulfur, even where it has been determined.

Temperature information given includes T_{MgO} for all samples, with T_{CaO} given where the appropriate assemblage (L + ol + augite + plagioclase) exists. The calibrations used are those of Helz and Thornber (1987), as discussed below. Where there is some doubt about the assemblage (i.e. whether plagioclase is stable or not), the temperature value is enclosed by

parentheses. Where field measurements of temperature are available for a given sample, those values are shown and the method specified (either tc for thermocouple or HS for the Hotshot infrared pyrometer). If two different kinds of field measurement are available for a single sample, the second is entered under "Comments".

Other entries under "Comments" may provide more detail on the nature of the sample, or where and when it was collected. If the sample is compound, the nature of the different parts of the sample is described. The nature of the assemblage is specified if it contains only one silicate mineral (L+ol) or two (L+ ol+cpx). The three-mineral assemblage (L+ ol+cpx + plagioclase) has not been given explicitly, to save space in the tables. It is the commonest assemblage, and samples containing it can also be identified by the presence of a value for T_{CaO} , as this is the only assemblage for which T_{CaO} is defined. Lastly, in Table 1, the distance of each sample from the Pu'u O'o vent is specified, to support the discussion in Helz and others (1995) on volatile loss with distance from the vent.

Some of the analytical data presented here is available in a computer database at HVO, and part of that data base has been issued as an open-file report (Mangan and others, 1995b). The difference between the analytical results available in these two sources and those given here are that the others give only a single glass analysis for any given sample. The single glass presented in those data bases may be an average of all analyses obtained, or be only one of several analyses; these other sources usually do not specify which. The present report gives all of the replicates, with the dates on which the analyses were obtained. In addition, where heterogeneous samples were encountered, this report gives the analytical results for each part of the sample. On the other hand, the HVO database and open-file report contain much more detail on sample collection time, location, etcetera than is reported here. Workers wanting the maximum information on a given sample or set of samples should consult both sources.

DISCUSSION OF ANALYTICAL RESULTS

The resulting glass analyses form a highly coherent data set that extends over the first eleven years of the ongoing Kilauea east rift eruption. Histograms of the summations for the data in Tables 1-3 are shown in Figures 2-4. These figures do not include analyses obtained by other techniques (EDS) or in other microprobe labs. In each case the bulk of the analyses have summations lying between 99.00 and 100.50% by weight, and the distribution is roughly Gaussian. There is a tail of low summations in the Pu'u O'o data, reflecting some problems with the silica detector on the SEMQ during the early part of this study. In a later report, we will look at the systematics of glass compositional variation on a series of MgO variation diagrams, for samples from various time intervals. Meanwhile, the consistency of the summations over time supports the idea that there is a high degree of internal coherence in this data set.

Most samples contain a homogeneous glass, the composition of which (to judge from

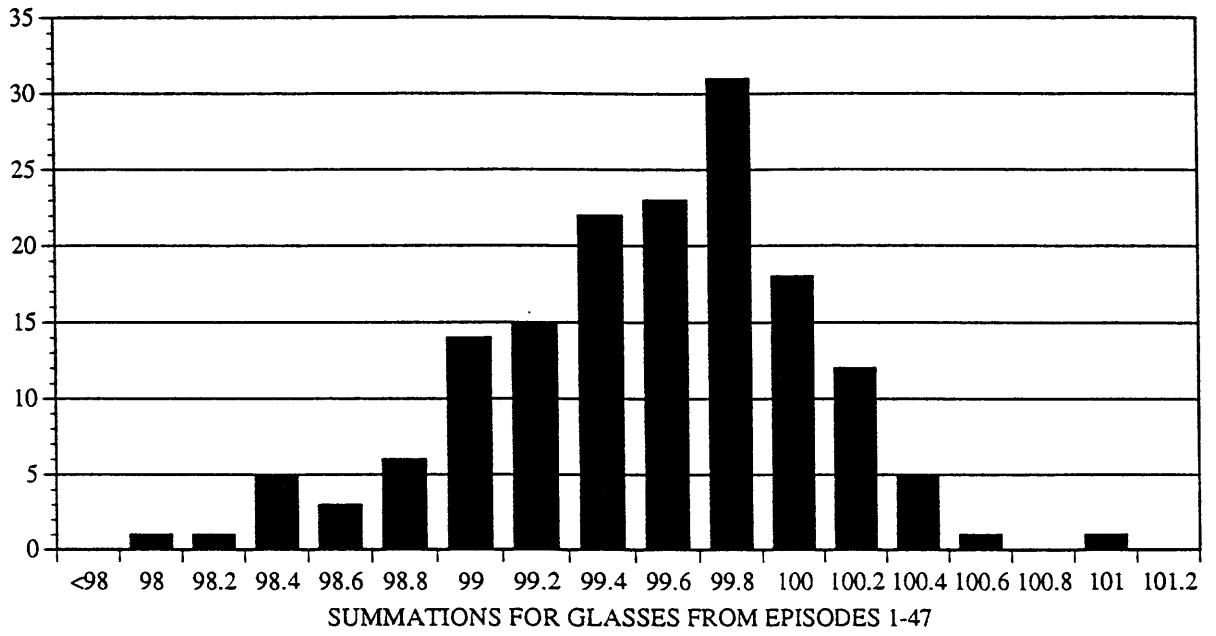


Figure 2. Frequency distribution of summations for the 158 glass analyses from samples from Pu'u O'o (episodes 1-47) as shown in Table 1.

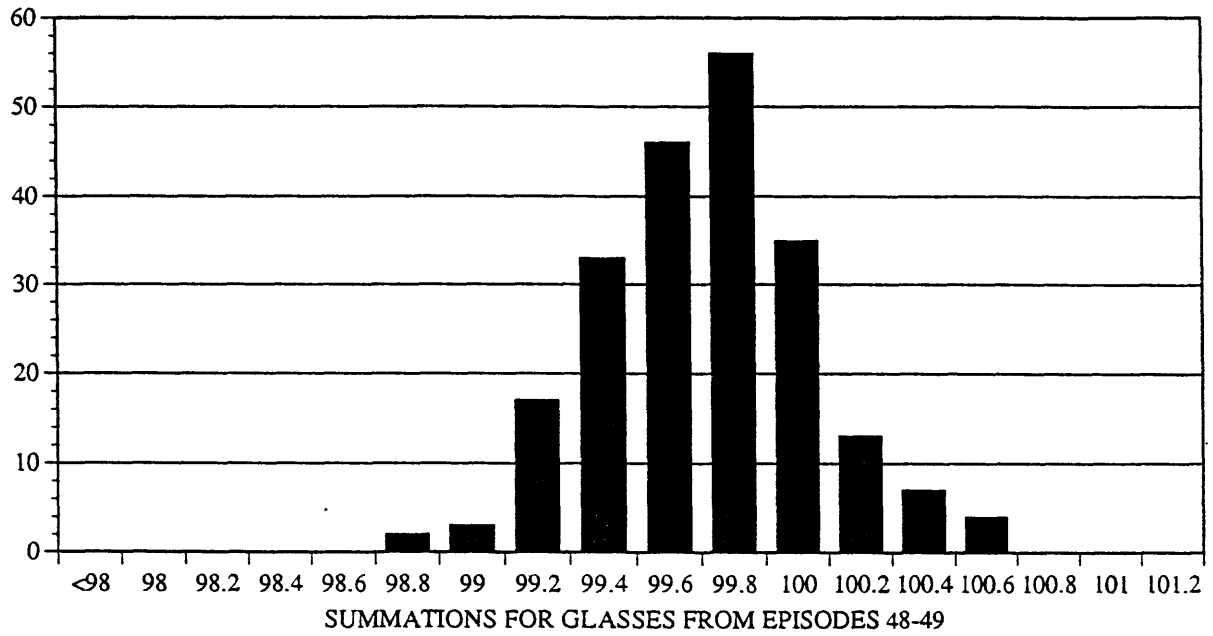


Figure 3. Frequency distribution of summations for 217 analyses of glasses from samples from the Kupaianaha vent (episodes 48 and 49) as presented in Table 2.

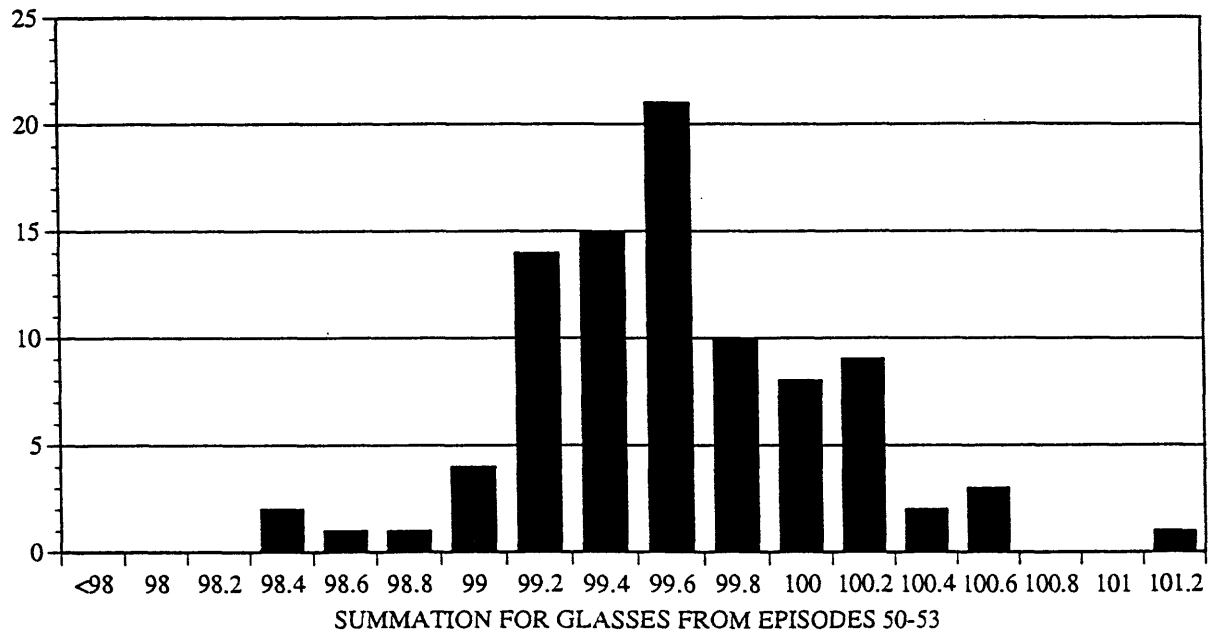


Figure 4. Frequency distribution of summations for 90 glass analyses from samples from episodes 50-53 of the current Kilauea East Rift eruption (Table 3).

the many replicate analyses performed) is adequately captured by analyzing 8-10 points per thin section. There are 90 pairs of replicate analyses in Tables 1-3. We have not analyzed these replicates fully, to determine the exact reproducibility of the analyses for each oxide, but the data would permit this and it could be a valuable exercise for the future.

A different type of replication is represented by the small number of analyses included here that were obtained by different techniques or different analysts. The three EDS analyses (samples 961P, 1003P and 1027P in Table 2) show that even using this very different technique, most oxide values are similar to those obtained with the Reston microprobe. Similarly the two Calk analyses (for samples 1350F and 1354F in Table 2) compare closely with the other microprobe analyses, except for a slight bias in CaO. The Cashman analyses (samples 1430, 1431, 1433 and 1436, in Table 3) are very similar to the others presented here, exhibiting only a slight bias in MgO: They consistently run 0.1% lower than the other analyses reported here, but that is within the expected replication range for MgO (see discussion in the next section).

In a few rare samples, the glass is heterogeneous. These need to be pointed out carefully, because one consequence of glass heterogeneity is that we cannot assign a single quenching temperature to such samples. These fall into the following categories:

(1) visibly zoned samples with obvious quenching problems. Examples of this include sample 171S (Table 1) from inside a hornito, and sample 1260F (Table 2), a skylight sample.

(2) mixed samples containing small enclaves of cooler material surrounded by hotter melt. Examples include sample 122F, which includes cooler pumice fragments that have been engulfed in a hotter pahoehoe lava. The commonest type of mixed sample contains a matrix with ol+cpx as the only silicate minerals present, surrounding a small body of material with the assemblage ol+cpx+plag. In some cases, the more differentiated melt composition, which is in equilibrium with plagioclase, has been preserved and analyzed (samples 342T, 562T, 675S, 927P, 956P, 983P, 1033P). Sample 1338S is a variant in which more differentiated glass is present next to the clusters of augite in the slide, while elsewhere the glass is in contact only with olivine. The other type of variant sample interpreted as mixed does not have the cooler melt preserved, but the rare plagioclase present is fritted and resorbed. Examples include 362S, 490T (Table 1), and 706S, 937P, and 939P (Table 2).

(3) Also, there is a class of tephra samples from Pu'u O'o that is very heterogeneous with respect to vesicularity, in both size and number of vesicles. In most cases, there is no compositional contrast between the various components, though in some cases there are minor differences in MgO content or S content. Examples of such texturally heterogeneous samples include 302T, 320T, A30, S30, 446T, 472T, 473T, and 540T (Table 1). Analyses of the different components are presented separately, and identified as being taken on either the more vesicular or the denser parts of the samples, as appropriate.

(4) There is one sample (948P) with continuously zoned glass, where the range of glass composition, though substantial, did not affect the crystalline phase assemblage present. Samples of this last type appear to be rare; however, they are intrinsically the hardest to detect, so there may be others in the collection.

Finally, there is a Pu'u O'o spatter sample (1364P) that contains enclaves of more strongly colored glass in a lighter matrix. In spite of the visible contrast, there is no compositional contrast between the two components of 1364P. The occurrence of this sample underlines the fact that in order to assess glass heterogeneity, we need actual analyses of the glasses in Kilauean eruption samples.

GLASS GEOTHERMOMETRY: METHOD AND RESULTS

Helz and Thornber (1987), in melting experiments on two samples from Kilauea Iki lava lake, demonstrated that MgO variation with temperature is essentially linear, for Kilauean melts in equilibrium with olivine. CaO in the melt is similarly linear and insensitive to bulk composition, provided that the melt is in equilibrium with the assemblage olivine + augite + plagioclase. The uncertainty of glass quenching temperatures for drill core samples is estimated to be $\pm 8-10^\circ\text{C}$ (Helz and Thornber, 1987). This includes the analytical uncertainties in the determination of MgO and CaO in the unknown glass, as well as the uncertainties in determining the temperatures of the experiments. For other, comparably uniform Kilauean glasses, the uncertainty should be the same. If the glass composition in a given sample is grossly heterogeneous, it is not possible to assign a meaningful quenching temperature to the sample.

The reproducibility of the MgO (and CaO) determinations is critical, as the precision of those determinations establishes the limit of resolution of temperature achievable by glass geothermometry. Helz and others (1995, Figure 3) show the dispersion of ΔMgO and ΔCaO , for 46 replicate analyses of glasses. A number of the replicates used in that analyses are included in the Pu'u O'o data set presented here (see data for samples from episodes 1-20, Table 1). The rest are in the Appendix to Helz and others (1995), which is available electronically from AGU as part of paper number 95JB01309. The difference between initial MgO and replicate MgO in this set never exceeds 0.15% absolute, which is 2.1% of the amount present at 7.0% MgO. This corresponds to a difference in temperature of 3°C .

For CaO, the spread in differences is somewhat larger, with a few values as high as 0.20-0.26%. At 11.0% CaO, this is 2.4% of the amount present, and corresponds to a temperature difference of 4°C . These results demonstrate that only uniform glasses that differ by more than 0.2% MgO or more than 0.3% CaO are significantly different analytically. Therefore the resulting difference in the assigned quenching temperature given in Tables 1-3 would have to exceed $3-4^\circ\text{C}$ to be significant. Thus even though temperatures are given to the nearest whole degree, they are not precise at that level.

The geothermometry results presented in Tables 1-3 as T_{MgO} and T_{CaO} have been (or will be) discussed and evaluated elsewhere. Helz and others (1987, 1995) present a comprehensive review of the comparability of glass geothermometry with other types of temperature measurements, drawing especially on data from episodes 1-20 (Table 1). Mangan and others (1995a) discuss some of the implications of the glass geothermometry results for episode 49 and the period of the eruptive pauses which occurred during 1990. Helz and others (1993) and Cashman and others (1994) deal with glass geothermometry results for samples from lava tubes. Helz and others (1991) present a preliminary overview of the thermal history of the Pu'u O'o--Kupaianaha eruption. Heliker and others (1998) discuss the later stages of the eruption covered in this data base (episodes 50-53). Additional reports on other aspects of the data base or the eruption are in preparation.

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Table 1. Microprobe analyses of Pu'u O'o glasses (episodes 1-47)

Date erupted	1/3/83	1/5/83	1/7/83	1/8/83	1/11/83	2/14/83	2/14/83	2/14/83
Episode #	1	1	1	1	1	2	2	2
Sample #	5S	11S	20S	22F	37F	63S	64F	64F
<u>Date analyzed</u>	<u>11/20/86</u>	<u>4/19/94</u>	<u>11/20/86</u>	<u>12/3/84</u>	<u>12/3/84</u>	<u>11/20/86</u>	<u>12/3/84</u>	<u>9/23/85</u>
# points	9	10	8	7	7	7	7	10 (R)
SiO ₂	50.48	51.38	50.25	50.53	51.22	50.91	51.27	(50.08)
TiO ₂	3.11	2.96	3.13	3.38	3.76	3.46	3.58	3.63
Al ₂ O ₃	13.61	13.68	13.47	12.94	12.97	13.16	13.18	13.04
Cr ₂ O ₃	.00	.01	.00	.00	.00	.00	.00	.01
FeO	11.74	11.58	11.75	12.72	13.05	12.26	12.35	12.41
MnO	.17	.18	.17	.20	.19	.16	.19	.19
MgO	6.25	6.32	6.06	5.69	5.28	5.72	5.67	5.66
CaO	10.50	10.47	10.37	10.10	9.66	10.02	10.03	10.03
Na ₂ O	2.57	2.68	2.63	2.65	2.71	2.71	2.67	2.59
K ₂ O	.61	.60	.61	.75	.77	.69	.72	.75
P ₂ O ₅	.28	.32	.31	.36	.38	.31	.37	.37
Sum	99.32	100.18	98.75	99.32	99.99	99.40	100.03	98.76
TMgO	1139	1141	1136	1128	1120	1128	1127	1127
TCaO	1143	1143	1142	1135	1128	1134	1134	1134
Tfield	--	1135	--	1124	1098	1128	1113	1113
Comments		HS S=0.019		tc	tc	HS (tc=1113)	tc	tc
Distance from vent (km)	0.0	0.0	0.0	0.03	0.40	0.0	0.03	0.03

Table 1. Microprobe analyses of Pu'u O'o glasses (continued)

Date erupted	2/16/83	2/25/83	3/1/83	3/28/83	3/28/83	3/31/83	6/14/83	6/14/83
Episode #	2	2	2	3	3	3	4	4
Sample #	66F	77F	81S	87S	88F	96F	122F	122F
Date analyzed	<u>11/20/86</u>	<u>11/4/85</u>	<u>11/20/86</u>	<u>1/7/87</u>	<u>12/3/84</u>	<u>11/4/85</u>	<u>12/3/84</u>	<u>12/3/84</u>
# points	5	9	8	6	7	11	5	6
SiO ₂	50.46	(49.98)	50.85	50.56	50.92	(49.93)	50.88	51.19
TiO ₂	3.68	3.65	3.34	(3.01)	3.48	3.58	3.13	3.01
Al ₂ O ₃	12.83	12.86	13.47	13.65	13.12	12.82	14.05	13.79
Cr ₂ O ₃	.00	.00	.00	.01	.00	.00	.00	.01
FeO	12.52	12.52	11.88	11.82	12.65	12.42	11.61	11.72
MnO	.17	.17	.19	.19	.20	.17	.17	.17
MgO	5.59	5.66	6.00	6.20	5.68	5.78	6.13	6.37
CaO	9.96	9.89	10.28	10.34	10.19	9.92	10.38	10.60
Na ₂ O	2.72	2.65	2.59	2.63	2.61	2.71	2.62	2.60
K ₂ O	.70	.74	.66	.57	.71	.73	.61	.57
P ₂ O ₅	.30	(.38)	.30	.34	.36	(.39)	.32	.32
Sum	98.93	98.50	99.56	99.32	99.92	98.45	99.90	100.35
TMgO	1125	1127	1133	1138	1128	1129	1138	1142
TCaO	1133	1132	1139	1140	1138	1133	1142	1145
Tfield	>1109	1116	1122	1126	1129	1122	1132	1132
Comments	tc	tc	HS	tc	tc	tc	tc	tc
Distance from vent (km)	0.03	0.12	0.0	0.0	0.15	0.28	0.05	0.05

Table 1. Microprobe analyses of Pu'u O'o glasses (continued)

Date erupted	6/16/83	6/17/83	6/29/83	7/22/83	7/24/83	7/25/83	8/15/83	8/17/83
Episode #	4	4	5	6	6	6	7	7
Sample #	128F	132S	136F	146P	149F	152S	160F	167F
Date analyzed	<u>11/4/85</u>	<u>1/7/87</u>	<u>8/30/85</u>	<u>11/4/85</u>	<u>12/3/84</u>	<u>1/7/87</u>	<u>8/30/85</u>	<u>12/3/84</u>
# points	10	8	10	11	7	8	10	9
SiO ₂	50.54	(49.72)	50.92	50.84	51.16	(50.16)	50.52	50.82
TiO ₂	3.11	3.07	3.19	3.03	3.01	2.83	3.04	2.98
Al ₂ O ₃	13.50	13.38	13.26	13.47	13.78	13.81	13.41	13.81
Cr ₂ O ₃	.01	.01	.02	.00	.00	.02	.02	.00
FeO	11.66	11.75	11.77	11.54	11.87	11.08	11.59	11.53
MnO	.19	.19	.22	.15	.17	.19	.21	.17
MgO	6.52	6.31	6.18	6.55	6.49	6.82	6.38	6.64
CaO	10.48	10.49	10.46	10.60	10.69	10.88	10.58	10.81
Na ₂ O	2.68	2.53	2.65	2.66	2.55	2.50	2.55	2.48
K ₂ O	.62	.59	.66	.60	.58	.52	.58	.55
P ₂ O ₅	(.40)	.35	.31	(.39)	.28	.34	.27	.31
Sum	99.71	98.39	99.64	99.83	100.58	99.15	99.15	100.10
TMgO	1144	1141	1138	1145	1144	1151	1142	1147
TCaO	1143	1143	1141	1144	1146	1149	1144	1148
Tfield	1128	--	1125	1128	1138	--	1134	1141
Comments	tc		tc	tc	tc		tc	tc
Distance from vent (km)	0.85	0.0	0.05	0.0	0.73	0.0	1.44	1.28

Table 1. Microprobe analyses of Pu'u O'o glasses (continued)

Date erupted	9/4/83	9/4/83	9/4/83	9/4/83	9/17/83	10/7/83	11/6/83	12/1/83
Episode #	8	8	8	8	9	10	11	12
Sample #	171S	171S	171S	171S	340T	187F	189F	341T
Date analyzed	<u>8/30/85</u>	<u>9/23/85</u>	<u>9/23/85</u>	<u>9/23/85</u>	<u>1/7/87</u>	<u>11/4/85</u>	<u>11/4/85</u>	<u>1/7/87</u>
# points	10	3 (R)	8	1	8	8	9	6
SiO ₂	(50.02)	(49.18)	50.40	(49.91)	50.62	50.94	(49.99)	50.70
TiO ₂	2.89	2.90	3.25	3.16	2.61	3.09	2.95	2.66
Al ₂ O ₃	13.68	13.55	13.63	13.66	13.50	13.58	13.59	13.58
Cr ₂ O ₃	.02	.02	.01	.01	.03	.00	.00	.03
FeO	11.19	11.38	12.07	12.29	10.97	(12.19)	11.43	10.91
MnO	.19	.16	.17	.17	.19	.17	.17	.20
MgO	6.53	6.58	6.16	5.76	7.34	6.63	6.86	7.14
CaO	10.98	11.01	10.63	10.37	11.33	11.06	10.96	11.21
Na ₂ O	2.54	2.54	2.57	2.63	2.47	2.42	2.47	2.48
K ₂ O	.57	.58	.61	.68	.51	.57	.56	.54
P ₂ O ₅	.30	.28	.32	.38	.27	(.38)	(.37)	.27
Sum	98.91	98.18	99.82	99.02	99.84	101.03	99.35	99.72
TMgO	1145	1146	1137	1128	1162	1147	1152	1157
TCaO	1151	1152	1146	1141	--	1153	1151	--
Tfield			1120		--	1142	1141	--
Comments			tc	sample from hornito	L+ol	tc	tc	L+ol+cpx
Distance from vent (km)			0.0	glass heterogeneous	0.0	1.56	0.76	0.0

Table 1. Microprobe analyses of Pu'u O'o glasses (continued)

Date erupted	1/20/84	1/21/84	1/21/84	1/21/84	1/21/84	1/21/84	1/21/84	1/21/84	1/21/84	1/21/84	1/21/84	1/21/84
Episode #	13	13	13	13	13	13	13	13	13	13	13	13
Sample #	209F	211F	212F	212F	212F	212F	215F	216F	216F	216F	216F	218F
<u>Date analyzed</u>	<u>8/30/85</u>	<u>8/30/85</u>	<u>8/30/85</u>	<u>8/30/85</u>	<u>8/30/85</u>	<u>8/30/85</u>	<u>8/30/85</u>	<u>1/10/86</u>	<u>4/19/94</u>	<u>8/30/85</u>		
# points	10	10	10	5 (R)	10	10	10	10	10 (R)	10	10	10
SiO ₂	51.08	51.32	(48.99)	50.07	(49.92)	50.63	51.10	50.63	51.10	51.38	51.10	51.38
TiO ₂	2.93	2.81	2.82	2.73	2.77	2.75	2.67	2.75	2.67	2.75	2.67	2.75
Al ₂ O ₃	13.44	13.85	13.56	14.00	13.85	13.54	13.65	13.54	13.65	13.47	13.65	13.47
Cr ₂ O ₃	.00	.00	.03	.00	.01	.00	.02	.00	.02	.00	.02	.00
FeO	11.69	11.31	11.67	11.49	11.29	11.08	11.10	11.08	11.10	11.35	11.10	11.35
MnO	.19	.20	.19	.19	.17	.16	.17	.16	.17	.20	.17	.20
MgO	6.45	6.58	6.50	6.45	6.67	6.91	6.90	6.91	6.90	6.50	6.90	6.50
CaO	10.69	11.00	10.71	10.69	11.06	10.95	11.09	10.95	11.09	10.79	11.09	10.79
Na ₂ O	2.58	2.60	2.50	2.50	2.48	2.59	2.53	2.59	2.53	2.59	2.53	2.59
K ₂ O	.59	.55	.60	.55	.56	.61	.51	.61	.51	.57	.51	.57
P ₂ O ₅	.29	.30	.28	.27	.28	.27	.27	.27	.27	.29	.27	.29
Sum	99.93	100.52	(97.85)	98.94	99.06	99.49	100.01	99.49	100.01	99.89	100.01	99.89
TMgO	1143	1146	1144	1143	1148	1152	1152	1152	1152	1144	1152	1144
TCaO	1146	1152	1147	1146	1153	1151	1153	1151	1153	1148	1153	1148
Tfield	1131	1131	1140	1140	1141	1147	1147	1147	1147	1130	1147	1130
Comments	tc	tc	tc	tc	tc	tc	tc	tc	tc	tc	tc	tc
Distance from vent (km)	0.28	0.28	0.25	0.25	1.08	0.92	0.92	0.92	0.92	3.71	0.92	3.71

Table 1. Microprobe analyses of Pu'u O'o glasses (continued)

Date erupted	1/21/84	1/22/84	1/22/84	1/22/84	1/31/84	1/31/84	1/31/84	1/31/84	2/15/84
Episode #	13	13	13	13	14	14	14	14	15
Sample #	220F	225F	225F	226F	231F	342T	342T	342T	343T
Date analyzed	<u>8/30/85</u>	<u>2/4/86</u>	<u>11/4/85</u>	<u>11/4/85</u>	<u>11/4/87</u>	<u>1/7/87</u>	<u>1/7/87</u>	<u>1/7/87</u>	<u>1/7/87</u>
# points	10	7 (R)	9	10	10	7	7	1	7
SiO ₂	50.03	50.55	50.31	50.79	50.63	50.47	50.36	50.18	50.18
TiO ₂	2.76	2.75	2.77	2.80	2.88	2.57	2.57	2.59	2.59
Al ₂ O ₃	13.65	13.75	13.68	13.65	13.53	13.58	13.47	13.60	13.60
Cr ₂ O ₃	.00	.00	.00	.02	.00	.01	.02	.00	.00
FeO	11.13	11.16	11.24	11.24	11.74	11.01	11.06	11.01	11.01
MnO	.19	.19	.17	.19	.17	.20	.20	.21	.21
MgO	6.57	6.77	6.81	6.86	6.61	7.43	6.89	7.34	7.34
CaO	10.72	10.78	10.89	10.96	10.61	11.36	11.29	11.63	11.63
Na ₂ O	2.57	2.57	2.51	2.51	2.47	2.42	2.47	2.43	2.43
K ₂ O	.54	.67	.54	.55	.56	.51	(.41)	.50	.50
P ₂ O ₅	.27	.37	(.40)	(.39)	(.39)	.29	.30	.30	.30
Sum	98.43	99.56	99.32	99.96	99.59	99.85	99.04	99.79	99.79
TMgO	1146	1149	1150	1152	1146	1163	1154	1162	1162
TCaO	1147	1148	1150	1151	1145	--	1157	--	--
Tffield	1140 (tc)		1144	1144	1137	--	--	--	--
Comments	1147-1150 by HS at vent		tc	tc	tc	L+ol	glass next cpx+plag	L+ol	L+ol
Distance from vent (km)	3.71		0.25	0.22	1.08		0.0	0.0	0.0

Table 1. Microprobe analyses of Pu'u O'o glasses (continued)

Date erupted	2/15/84	3/4/84	3/4/84	3/4/84	3/30/84	3/30/84	4/20/84	4/20/84
Episode #	15	16	16	16	17	17	18	18
Sample #	237F	249F	251F	344T	259F	345T	267F	267F
Date analyzed	<u>11/4/85</u>	<u>11/4/85</u>	<u>11/4/85</u>	<u>1/7/87</u>	<u>10/2/86</u>	<u>1/7/87</u>	<u>10/2/86</u>	<u>10/15/86</u>
# points	10	10	11	7	8	6	8	6 (R)
SiO ₂	50.79	51.09	50.64	50.45	50.27	50.42	50.42	50.69
TiO ₂	2.95	2.90	2.71	2.57	2.81	2.53	2.84	2.83
Al ₂ O ₃	13.60	13.45	13.87	13.36	13.56	13.44	13.35	13.54
Cr ₂ O ₃	.00	.01	.01	.03	.00	.03	.01	.00
FeO	12.23	11.93	11.16	10.98	11.54	10.96	11.65	11.55
MnO	.19	.19	.17	.22	.19	.20	.17	.20
MgO	6.22	6.40	6.85	7.36	6.58	7.44	6.43	6.46
CaO	10.39	10.80	10.93	11.37	10.71	11.39	10.84	10.79
Na ₂ O	2.52	2.51	2.55	2.34	2.62	2.49	2.64	2.48
K ₂ O	.58	.55	.52	.47	.58	.50	.55	.58
P ₂ O ₅	(.37)	(.40)	(.39)	.31	.33	.29	.33	.29
Sum	99.84	100.23	99.80	99.46	99.19	99.69	99.23	99.41
TMgO	1139	1143	1152	1162	1146	1164	1142	1143
TCaO	1141	1148	1151	--	1147	--	1148	1147
Tfield	1139	1139	1142	--	1137	--	1144	1144
Comments	tc	tc	tc	L+ol	tc	L+ol	tc	tc
Distance from vent (km)	0.98	0.70	1.81	0.0	0.28	0.0	1.44	1.44

Table 1. Microprobe analyses of Pu'u O'o glasses (continued)

Date erupted	4/19/84	5/17/84	6/8/84	6/30/84	6/30/84	7/9/84	7/9/84	7/28/84
Episode #	18	19	20	21	21	22	22	23
Sample #	346T	272F	274F	279T	279T	282T	283F	288T
Date analyzed	<u>1/7/87</u>	<u>10/15/86</u>	<u>10/2/86</u>	<u>4/16/93</u>	<u>6/10/93</u>	<u>4/16/93</u>	<u>10/2/86</u>	<u>10/2/86</u>
# points	6	8	5	4	7(R)	8	7	8
SiO ₂	50.69	50.87	50.29	51.18	49.80	50.58	(49.68)	50.50
TiO ₂	2.49	2.81	2.85	2.56	2.53	2.46	2.73	2.55
Al ₂ O ₃	13.44	13.79	13.81	13.47	13.65	13.65	13.61	13.33
Cr ₂ O ₃	.02	.01	.01	.04	.04	.03	.00	.03
FeO	11.03	11.42	11.59	11.10	11.04	10.85	11.44	11.07
MnO	.21	.20	.17	.16	.18	.16	.17	.17
MgO	7.52	6.67	6.50	7.46	7.54	7.48	6.34	7.49
CaO	11.37	11.29	10.83	11.45	11.42	11.40	10.33	11.25
Na ₂ O	2.44	2.46	2.50	2.36	2.27	2.40	2.54	2.34
K ₂ O	.49	.56	.54	.46	.47	.49	.55	.50
P ₂ O ₅	.32	.27	.36	(.20)	.23	(.22)	.33	.30
Sum	100.02	100.35	99.45	100.47	99.17	99.72	97.72	99.53
TMgO	1165	1148	1144	1164	1166	1164	1141	1165
TCaO	--	1156	1148	--	--	--	1140	--
Tfield	--	1141	1137	--	--	--	1139	--
Comments	L+ol	tc	tc	S=0.033	S=0.033	S=0.038	tc	L+ol
Distance from vent (km)	0.0	1.21	3.80	0.0		1.93	0.0	0.0

Table 1. Microprobe analyses of Pu'u O'o glasses (continued)

Date erupted	8/20/84	8/20/84	8/20/84	8/20/84	8/20/84	9/10/84	9/20/84	9/20/84	9/20/84	9/20/84
Episode #	24	24	24	24	24	pre-25	25	25	25	25
Sample #	302T	302T	302T	302T	302T	KEI-309P	320T	320T	320T	320T
Date analyzed	<u>12/11/86</u>	<u>11/1/93</u>	<u>6/9/93</u>	<u>6/9/93</u>	<u>6/9/93</u>	<u>12/11/86</u>	<u>12/11/86</u>	<u>6/9/93</u>	<u>6/9/93</u>	<u>6/9/93</u>
# points	10	6(R)	6	13	8	9	7	7	7	7
SiO ₂	50.71	50.64	50.48	51.12	50.54	50.77	50.35	50.47	51.01	
TiO ₂	2.53	2.55	2.47	2.50	2.57	2.50	2.56	2.60	2.53	
Al ₂ O ₃	13.36	13.58	13.61	13.40	13.55	13.46	13.45	13.42	13.33	
Cr ₂ O ₃	.03	.05	.05	.04	.02	.03	0.06	.05	.06	
FeO	10.69	10.61	10.84	10.88	11.06	10.74	11.10	11.12	11.10	
MnO	.20	.17	.21	.18	.17	.20	.19	.18	.19	
MgO	7.54	7.52	7.65	7.50	7.04	7.53	7.52	7.56	7.55	
CaO	11.44	11.29	11.37	11.36	11.39	11.45	11.51	11.57	11.54	
Na ₂ O	2.32	2.36	2.30	2.30	2.41	2.41	2.40	2.30	2.32	
K ₂ O	.51	.49	.46	.47	.51	.49	.48	.48	.46	
P ₂ O ₅	.28	.26	.23	.23	.31	.33	.24	.23	.21	
Sum	99.61	99.52	99.67	99.98	99.57	99.91	99.86	99.98	100.30	
TMgO	1166	1165	1168	1165	1156	1165	1165	1166	1166	
TCaO	--	--	--	--	--	--	--	--	--	
Tfield	--	--	--	--	--	--	--	--	--	
Comments	S=0.020			L+ol+cpx			L+ol			
Distance from vent (km)	0.0			0.0			0.0			

Table 1. Microprobe analyses of Pu'u O'o glasses (continued)

Date erupted	11/1/84	11/28/84	12/30/84	1/4/85	1/4/85	1/4/85	1/4/85	1/4/85
Episode #	pre-26	post-27	pre-29	29	29	29	29	29
Sample #	KEI-331F	KEI-336S	KEI-347F	354T	354T	355T	355T	355T
Date analyzed	12/11/86	12/11/86	10/2/86	4/16/93	6/10/93	10/2/86	10/2/86	10/15/86
# points	10	9	8	11	8 (R)	8	8	4 (R)
SiO ₂	50.69	50.42	50.49	51.01	50.52	50.27	50.27	50.61
TiO ₂	2.63	2.59	2.61	2.55	2.49	2.54	2.54	2.61
Al ₂ O ₃	13.70	13.64	13.62	13.66	13.69	13.44	13.44	13.49
Cr ₂ O ₃	.02	.02	.02	.03	.05	.02	.02	.01
FeO	10.80	10.71	11.05	11.02	11.06	11.14	11.14	11.47
MnO	.20	.20	.20	.17	.17	.17	.17	.17
MgO	7.01	7.01	7.02	7.49	7.56	7.38	7.38	7.51
CaO	11.61	11.62	11.38	11.34	11.31	11.28	11.28	10.85
Na ₂ O	2.39	2.40	2.40	2.33	2.31	2.39	2.39	2.32
K ₂ O	.57	.56	.50	.47	.47	.49	.49	.52
P ₂ O ₅	.29	.30	.32	(.22)	.24	.30	.30	.26
Sum	99.91	99.47	99.61	100.32	99.87	99.42	99.42	99.82
TMgO	1155	1155	1155	1165	1167	1163	1163	1165
TCaO	(1162)	--	1157	--	--	--	--	--
Tfield	1145	--	--	--	--	--	--	--
Comments	tc	L=ol+cpX		S=0.028				
Distance from vent (km)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1. Microprobe analyses of Pu'u O'o glasses (continued)

Date erupted	2/4/85	2/4/85	2/4/85	2/4/85	2/4/85	2/4/85	2/4/85
Episode #	30	30	30	30	30	30	30
Sample #	1066T A30	1066T A30 vesicular 6/9/93	1066T A30 denser 6/9/93	1067T B30	1067T B30	1068T R30	1068T R30
Date analyzed	3/12/87	6/9/93	6/9/93	1/7/87	3/12/87	1/7/87	3/12/87
# points	8	7	8	6	9 (R)	9	7 (R)
SiO ₂	50.23	51.04	50.30	50.55	50.66	50.17	50.54
TiO ₂	2.61	2.57	2.67	2.58	2.60	2.45	2.59
Al ₂ O ₃	13.48	13.43	13.43	13.50	13.63	13.25	13.39
Cr ₂ O ₃	.04	.04	.03	.02	.04	.04	.06
FeO	10.97	11.10	11.14	11.07	10.87	11.10	11.07
MnO	.18	.18	.19	.18	.17	.20	.18
MgO	7.34	7.38	7.47	7.37	7.44	7.83	7.91
CaO	11.32	11.40	11.49	11.24	11.50	11.27	11.35
Na ₂ O	2.37	2.33	2.25	2.51	2.29	2.38	2.32
K ₂ O	.44	.48	.47	.48	.48	.43	.46
P ₂ O ₅	.25	.26	.24	.26	.24	.26	.24
Sum	99.23	100.21	99.68	99.76	99.92	99.38	100.10
TMgO	1162	1163	1164	1163	1164	1172	1173
TCaO	--	--	--	--	--	--	--
Tfield	--	--	--	--	--	--	--
Comments	L+O1		L+O1		L+O1		
Distance from vent (km)	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1. Microprobe analyses of Pu'u O'o glasses (continued)

Date erupted	2/5/85	2/5/85	2/5/85	2/5/85	2/5/85	2/5/85	2/5/85	2/5/85	2/5/85	3/4/85	
Episode #	30	30	30	30	30	30	30	30	30	pre-31	
Sample #	1069T S30	1069T S30	1069T S30	1069T S30	1069T S30	1069T S30	1069T S30	362S	362S	KEI-363S	
Date analyzed	<u>3/12/87</u>	<u>4/16/93</u>	<u>6/9/93</u>	<u>4/16/93</u>	<u>6/9/93</u>	<u>4/16/93</u>	<u>6/9/93</u>	<u>10/2/86</u>	<u>3/12/87</u>	<u>10/2/86</u>	
# points	10	7	7 (R)	7	7 (R)	7	7 (R)	9	6 (R)	4 (R)	
SiO ₂	50.46	50.53	50.30	50.86	50.05	50.86	50.05	50.59	50.61	50.28	
TiO ₂	2.51	2.52	2.56	2.50	2.56	2.50	2.56	2.53	2.55	2.56	
Al ₂ O ₃	13.37	13.62	13.62	13.54	13.40	13.54	13.40	13.24	13.49	13.43	
Cr ₂ O ₃	.07	.04	.05	.03	.06	.03	.06	.02	.05	.03	
FeO	10.99	11.27	11.08	11.09	11.14	11.09	11.14	11.31	11.19	11.23	
MnO	.20	.16	.16	.18	.19	.18	.19	.18	.18	.18	
MgO	7.91	7.96	7.97	7.97	7.99	7.97	7.99	7.80	7.86	7.84	
CaO	11.38	11.24	11.29	11.31	11.37	11.31	11.37	11.24	11.32	11.21	
Na ₂ O	2.29	2.44	2.33	2.47	2.32	2.47	2.32	2.35	2.33	2.35	
K ₂ O	.46	.45	.45	.47	.46	.47	.46	.46	.48	.48	
P ₂ O ₅	.25	.27	.25	.25	.24	.25	.24	.31	.24	.24	
Sum	99.89	100.50	100.06	100.67	99.78	100.67	99.78	100.03	100.30	99.83	
TMgO	1173	1174	1174	1174	1175	1174	1175	1171	1172	1172	
TCaO	--	--	--	--	--	--	--	--	--	--	
Tfield	--	--	--	--	--	--	--	--	--	--	
Comments	L+ol+cpx			S=.043			S=.031			last spatter L+ol	
Distance from vent (km)	0.0			0.0			0.0			0.0	

Table 1. Microprobe analyses of Pu'u O'o glasses (continued)

Date erupted	4/21/85	4/22/85	4/22/85	6/12/85	6/20/85	7/1/85	7/26/85	7/26/85
Episode #	32	32	32	pre-33	pre-34	pre-34	35	35
Sample #	370F	372S	372S	KEI-378F	KEI-382S	KEI-385S	392T	392T
Date analyzed	<u>10/2/86</u>	<u>6/10/93</u>	<u>12/7/93</u>	<u>12/11/86</u>	<u>3/13/95</u>	<u>12/11/86</u>	<u>6/10/93</u>	<u>11/2/93</u>
# points	8	9	7(R)	8	9	9	4	7(R)
SiO ₂	50.77	50.17	50.91	50.41	51.18	50.15	50.96	(49.86)
TiO ₂	2.79	2.51	2.55	2.56	2.52	2.57	2.45	2.44
Al ₂ O ₃	13.64	13.61	13.43	13.46	13.58	13.52	13.34	13.21
Cr ₂ O ₃	.00	.06	.04	.03	.01	.02	.05	.04
FeO	11.77	11.06	10.98	11.08	10.76	10.98	10.80	10.81
MnO	.18	.18	.17	.20	.17	.21	.20	.17
MgO	6.50	7.74	7.79	7.19	7.13	7.08	7.56	7.48
CaO	10.83	11.26	11.28	11.50	11.52	11.42	(11.05)	11.26
Na ₂ O	2.52	2.26	2.29	2.35	2.55	2.36	2.26	2.35
K ₂ O	.55	.46	.47	.51	.45	.53	.47	.48
P ₂ O ₅	.33	.23	.23	.24	.23	.30	.25	.24
Sum	99.88	99.54	100.17	99.53	100.10	99.14	99.39	98.34
TMgO	1144	1170	1171	1158	1157	1156	1167	1164
TCaO	1148	--	--	--	--	--	--	--
Tfield	1134	--	--	1137	--	--	--	--
Comments	tc		S=0.014	tc	S=0.013			S=0.015
Distance from vent (km)	1.42	0.0	0.0	0.02	0.0	0.0		0.0

Table 1. Microprobe analyses of Pu'u O'o glasses (continued)

Date erupted	7/26/85	7/31/85	8/2/85	8/7/85	8/7/85	8/7/85	8/7/85
Episode #	35	35	35	35	35	35	35
Sample #	393T	421S	429S	438F	438F	439F	439F
Date analyzed	<u>11/1/93</u>	<u>11/1/93</u>	<u>11/2/93</u>	<u>10/15/86</u>	<u>3/12/87</u>	<u>10/15/86</u>	<u>3/12/87</u>
# points	10	10	7	9	5 (R)	7	4 (R)
SiO ₂	50.95	50.76	(50.36)	50.29	50.37	50.34	50.66
TiO ₂	2.50	2.42	2.46	2.59	2.63	2.64	2.50
Al ₂ O ₃	13.33	13.52	13.53	13.38	13.51	13.47	13.32
Cr ₂ O ₃	.05	.04	.03	.02	.03	.02	.02
FeO	10.72	10.83	10.76	10.84	11.07	11.15	11.03
MnO	.17	.18	.17	.16	.18	.13	.17
MgO	7.50	6.95	7.03	7.21	7.15	7.23	7.21
CaO	11.18	11.28	11.36	11.47	11.25	11.44	11.31
Na ₂ O	2.29	2.33	2.43	2.28	2.36	2.32	2.33
K ₂ O	.48	.49	.47	.50	.46	.46	.42
P ₂ O ₅	.24	.23	.24	.28	.25	(.37)	.24
Sum	99.41	99.03	98.84	99.02	99.26	99.57	99.21
TMgO	1165	1154	1155	1158	1157	1159	1158
TCaO	--	1156	1158	--	--	--	--
Tfield	--	--	--	1149°	1136°		
Comments	S=0.010	S=0.020	S=0.010	tc	tc	tc	tc
Distance from vent (km)	0.0	0.0	0.0	0.05	0.05	0.05	0.05

Table 1. Microprobe analyses of Pu'u O'o glasses (continued)

Date erupted	9/2/85	9/2/85	9/2/85	9/2/85	9/2/85	9/2/85	9/25/85	10/21/85
Episode #	36	36	36	36	36	36	37	38
Sample #	446T	446T	446T	446T	446T	446T	452T	459T
Date analyzed	1/24/94	1/25/94	10/15/86	1/24/94	1/25/94	1/25/94	2/2/95	11/2/93
# points	7	8 (R)	6	6 (R)	6 (R)	6 (R)	10	8
SiO ₂	50.23	50.70	50.32	50.04	50.28	50.55	50.55	50.68
TiO ₂	2.53	2.53	2.57	2.54	2.53	2.46	2.46	2.53
Al ₂ O ₃	13.21	13.20	13.41	13.27	13.35	13.39	13.39	13.34
Cr ₂ O ₃	.04	.04	.02	.04	.05	.03	.03	.03
FeO	10.85	10.98	11.43	10.97	11.02	10.78	10.78	11.03
MnO	.18	.19	.18	.18	.20	.19	.19	.17
MgO	7.69	7.70	7.66	7.63	7.60	7.64	7.64	7.47
CaO	11.26	11.26	11.46	11.15	11.23	11.35	11.35	11.19
Na ₂ O	2.42	2.37	2.30	2.38	2.34	2.41	2.41	2.37
K ₂ O	.47	.45	.53	.46	.46	.44	.44	.48
P ₂ O ₅	.28	.25	.28	.26	.25	.23	.23	.24
Sum	99.16	99.67	100.16	98.92	99.31	99.47	99.47	99.53
TMgO	1169	1169	1168	1168	1167	1168	1168	1164
TCaO	--	--	--	--	--	--	--	--
Tfield	--	--	--	--	--	--	--	--
Comments	S=0.015	S=0.018	--	S=0.040	S=0.035	S=0.020	S=0.020	S=0.015
	}		}		}		L+O1	L+O1
Distance from vent (km)	}		}		}		0.0	0.0

Table 1. Microprobe analyses of Pu'u O'o glasses (continued)

Date erupted	11/13/85	11/13/85	11/13/85	11/13/85	11/13/85	11/13/85	11/13/85	11/13/85	11/13/85	11/13/85
Episode #	pre-39	pre-39	pre-39	pre-39	pre-39	pre-39	39	39	39	39
Sample #	KEI-468P	KEI-468P	KEI-469F	KEI-469F	KEI-469F	KEI-469F	472T	472T	472T	472T
Date analyzed	1/24/94	1/25/94	1/24/94	1/25/94	1/25/94	1/25/94	11/2/93	12/6/93	11/2/93	12/6/93
# points	6	7 (R)	6	7 (R)	4	8 (R)	6	7 (R)	5 (R)	5 (R)
SiO ₂	50.63	51.13	50.52	51.42	51.03	50.54	50.64	49.76	50.23	50.23
TiO ₂	2.55	2.52	2.48	2.57	2.56	2.44	2.48	2.53	2.52	2.52
Al ₂ O ₃	13.75	13.67	13.67	13.64	13.66	13.39	13.68	13.32	13.40	13.40
Cr ₂ O ₃	.03	.03	.04	.03	.03	.03	.01	.03	.04	.04
FeO	10.72	11.05	10.80	11.07	10.88	10.72	10.85	11.01	10.92	10.92
MnO	.17	.17	.19	.19	.16	.18	.16	.18	.17	.17
MgO	7.05	7.06	6.97	7.00	7.50	7.50	7.50	7.42	7.48	7.48
CaO	11.36	11.33	11.28	11.41	11.34	11.27	11.32	11.42	11.39	11.39
Na ₂ O	2.42	2.39	2.45	2.36	2.38	2.30	2.42	2.34	2.29	2.29
K ₂ O	.47	.46	.47	.47	.46	.45	.63	.47	.45	.45
P ₂ O ₅	.27	.26	.24	.24	.23	.22	.24	.24	.24	.24
Sum	99.42	100.07	99.11	100.40	100.23	99.04	99.93	98.72	99.13	99.13
TMgO	1156	1156	1154	1154	1165	1165	1165	1163	1164	1164
TCaO	--	--	1156	1159	--	--	--	--	--	--
Tfield	1140	1130	1130	1130	--	--	--	--	--	--
Comments	S=0.013	S=0.015	S=0.018	S=0.018	S=0.015	S=0.015	S=0.015	S=0.020	S=0.016	S=0.016
Distance from vent (km)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1. Microprobe analyses of Pu'u O'o glasses (continued)

Date erupted	11/14/85	11/14/85	11/14/85	11/29/85	1/1/86	1/1/86	1/1/86	1/1/86	1/1/86
Episode #	39	39	39	39	40	40	40	40	40
Sample #	473T	473T	473T	475S	487T	490T	490T	490T	490T
Date analyzed	<u>12/30/87</u>	<u>11/1/93</u>	<u>11/1/93</u>	<u>3/13/95</u>	<u>12/6/93</u>	<u>2/10/92</u>	<u>2/19/92</u>	<u>2/19/92</u>	<u>2/19/92</u>
# points	7	5	5	10	8	8	2	2	5(R)
SiO ₂	50.89	51.32	50.97	50.93	(49.96)	50.71	50.81	50.81	50.64
TiO ₂	2.53	2.51	2.44	2.53	2.46	2.42	2.56	2.56	2.44
Al ₂ O ₃	13.33	13.45	13.32	13.42	13.36	13.56	13.64	13.57	13.57
Cr ₂ O ₃	.02	.04	.04	.02	.03	.05	.03	.03	.02
FeO	10.81	10.90	10.88	10.80	10.77	10.85	10.91	10.91	10.81
MnO	.18	.18	.18	.18	.17	.18	.19	.19	.18
MgO	7.51	7.40	7.34	7.54	7.38	7.44	7.49	7.49	7.54
CaO	11.45	11.28	11.28	11.31	11.30	11.51	11.40	11.40	11.48
Na ₂ O	2.38	2.30	2.26	2.49	2.30	2.37	2.42	2.42	2.35
K ₂ O	.47	.46	.46	.45	.48	.45	.44	.44	.43
P ₂ O ₅	.24	.22	.25	.22	.23	.24	.21	.21	.21
Sum	99.81	100.06	99.42	99.89	98.44	99.78	100.10	100.10	99.67
TMgO	1165	1163	1162	1165	1163	1163	1164	1164	1165
TCaO	--	--	--	--	--	--	--	--	--
Tfield	--	--	--	--	--	--	--	--	--
Comments	S=0.010		S=0.020	S=0.013	S=0.025	next plag		L+ol	
Distance from vent (km)	0.0		0.0	last spatter	L+ol	0.0		0.0	0.0

Table 1. Microprobe analyses of Pu'u O'o glasses (continued)

Date erupted	1/1/86	1/28/86	2/22/86	2/23/86	3/19/86	5/5/86	5/8/86
Episode #	40	41	42	42	pre-43	pre-45	45
Sample #	496T	509S	513T	517T	KEI-520S	KEI-529S	531T
Date analyzed	<u>12/30/87</u>	<u>5/26/87</u>	<u>12/30/87</u>	<u>2/10/92</u>	<u>5/26/87</u>	<u>5/26/87</u>	<u>12/30/87</u>
# points	8	6	8	7	8	7	8
SiO ₂	50.55	50.67	50.95	50.65	50.49	50.77	50.84
TiO ₂	2.51	2.46	2.58	2.42	2.64	2.66	2.57
Al ₂ O ₃	13.52	13.52	13.45	13.51	13.74	13.64	13.51
Cr ₂ O ₃	.03	.04	.02	.02	.02	.01	.02
FeO	10.89	10.90	10.84	10.91	10.93	10.98	11.08
MnO	.18	.20	.17	.18	.20	.20	.19
MgO	7.40	7.46	7.34	7.45	7.12	7.12	7.39
CaO	11.43	11.33	11.43	11.37	11.40	11.44	11.54
Na ₂ O	2.41	2.51	2.46	2.43	2.51	2.48	2.42
K ₂ O	.46	.47	.46	.44	.47	.48	.46
P ₂ O ₅	.23	.23	.22	.24	.23	.23	.23
Sum	99.61	99.79	99.92	99.62	99.75	100.01	100.25
TMgO	1163	1164	1161	1164	1157	1157	1163
TCaO	--	--	--	--	--	--	--
Tfield	--	--	--	--	--	--	--
Comments	L+ol	L+ol	L+ol	L+ol	L+ol+cpx	L+ol+cpx	L+ol
Distance from vent (km)	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1. Microprobe analyses of Pu'u O'o glasses (continued)

Date erupted	5/8/86	5/8/86	6/2/86	6/2/86	6/2/86	6/2/86	6/2/86	6/2/86
Episode #	45	45	46	46	46	46	46	46
Sample #	532T	532T	538T	540T	540T	540T	540T	545T
Date analyzed	<u>10/2/86</u>	<u>10/15/86</u>	<u>12/30/87</u>	<u>10/2/86</u>	<u>10/15/86</u>	vesicular <u>6/10/93</u>	denser <u>6/10/93</u>	<u>2/19/92</u>
# points	8	7 (R)	7	8	8 (R)	7	7	7
SiO ₂	50.38	50.93	50.81	50.46	50.80	50.58	50.18	51.20
TiO ₂	2.52	2.57	2.49	2.49	2.59	2.50	2.55	2.56
Al ₂ O ₃	13.34	13.42	13.41	13.34	13.46	13.58	13.54	13.62
Cr ₂ O ₃	.03	.01	.03	.02	.02	.04	.04	.02
FeO	11.30	11.09	10.92	11.32	11.07	11.18	11.39	10.86
MnO	.19	.16	.19	.18	.20	.16	.18	.15
MgO	7.41	7.37	7.39	7.33	7.44	7.43	7.51	7.51
CaO	11.28	11.22	11.43	11.29	11.53	11.53	11.50	11.38
Na ₂ O	2.36	2.33	2.41	2.32	2.29	2.27	2.28	2.41
K ₂ O	.49	.49	.46	.50	.48	.47	.45	.44
P ₂ O ₅	.31	.34	.23	.25	.28	.24	.24	.22
Sum	99.61	99.93	99.77	99.50	100.16	99.98	99.86	100.37
TMgO	1164	1163	1163	1161	1164	1163	1165	1165
TCaO	--	--	--	--	--	--	--	--
Tffield	--	--	--	--	--	--	--	--
Comments	L+ol		L+ol	L+ol		L+ol		L+ol
Distance from vent (km)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1. Microprobe analyses of Pu'u O'o glasses (continued)

Date erupted	6/2/86	6/2/86	6/24/86	6/24/86	6/24/86	6/24/86	6/24/86	6/25/86	6/26/86
Episode #	46	46	pre-47	pre-47	pre-47	pre-47	pre-47	pre-47	47
Sample #	547T	555T	KEI-562S	KEI-562S	KEI-562S	KEI-562S	KEI-562S	47-567F	571S
Date analyzed	11/2/93	12/30/87	5/26/87	2/3/88	2/3/88	2/3/88	2/3/88	10/2/86	11/2/93
# points	10	7	7	4 (R)	1	1	1	7	9
SiO ₂	50.22	50.57	50.65	51.10	51.09	51.29	51.29	50.46	50.15
TiO ₂	2.59	2.59	2.71	2.57	2.64	2.91	2.91	2.54	2.48
Al ₂ O ₃	13.42	13.51	13.67	13.54	13.70	13.67	13.67	13.46	13.39
Cr ₂ O ₃	.04	.04	.02	.02	.02	.00	.00	.02	.03
FeO	10.98	11.02	10.93	10.98	10.98	11.32	11.32	11.44	11.08
MnO	.18	.20	.19	.17	.19	.12	.12	.19	.17
MgO	7.39	7.40	7.17	7.22	6.95	6.32	6.32	7.01	7.35
CaO	11.43	11.42	11.48	11.53	11.52	10.95	10.95	11.32	11.49
Na ₂ O	2.40	2.38	2.50	2.48	2.57	2.51	2.51	2.38	2.39
K ₂ O	.47	.47	.47	.46	.45	.50	.50	.48	.46
P ₂ O ₅	.24	.24	.22	.22	.21	.23	.23	.31	.24
Sum	99.36	99.84	100.01	100.29	100.32	99.82	99.82	99.61	99.23
TMgO	1163	1163	1158	1158	1153	1141	1141	1155	1162
TCaO	--	--	--	--	1161	1151	1151	--	--
Tfield	--	--	--	--	--	--	--	1148	--
Comments	S=0.013	L+ol	L+ol+cpx	L+ol+cpx	glass next to	glass next to	glass next to	tc	S=0.013
Distance from vent (km)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					cpx+plag	cpx+plag	cpx+plag	L+ol+cpx	last spatter

Table 2. Microprobe analyses of glasses from episodes 48 and 49

Date erupted	7/17/86	7/18/86	7/18/86	7/19/86	7/25/86	8/10/86	8/10/86
Sample #	574S	577F	578S	579P	583F	617F	617F
Sample type	pre-48			dip on cable			
<u>Date analyzed</u>	<u>5/26/87</u>	<u>12/30/87</u>	<u>11/2/93</u>	<u>3/13/95</u>	<u>7/20/87</u>	<u>5/6/87</u>	<u>5/6/87</u>
# points	6	7	5	10	7	6	5(R)
SiO ₂	50.99	50.46	50.89	51.06	50.53	50.47	50.77
TiO ₂	2.54	2.61	2.53	2.60	2.66	2.59	2.57
Al ₂ O ₃	13.63	13.93	13.89	13.67	13.83	13.69	13.75
Cr ₂ O ₃	.02	.02	.01	.01	.01	.03	.04
FeO	10.99	10.85	11.23	10.97	11.28	11.09	11.06
MnO	.20	.21	.19	.18	.23	.20	.17
MgO	7.12	6.97	6.71	6.63	6.58	6.87	6.80
CaO	11.35	11.36	11.32	11.28	11.21	11.54	11.33
Na ₂ O	2.51	2.45	2.43	2.57	2.51	2.56	2.46
K ₂ O	.46	.46	.49	.47	.53	(.37)	.49
P ₂ O ₅	.23	.22	.24	.24	.26	(--)	.22
Sum	100.04	99.54	99.93	99.68	99.63	99.41	99.66
TMgO	1157	1153	1148	1147	1146	1152	1150
TCaO	--	--	1157	1156	1155	1161	1157
Tfield	--	1153	--	--	1141	--	--
Comments	L+ol+cpx	tc	S=0.008	S=0.012	tc		

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Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	8/30/86	8/31/86	9/10/86	9/25/86	10/8/86	11/25/86	11/29/86
Sample #	629F	633F	635F	642F	644F	663S	666F
Sample type			pond	pond	pond	pond	Littoral
Date analyzed	<u>2/2/95</u>	<u>5/26/87</u>	<u>7/20/87</u>	<u>5/26/87</u>	<u>2/2/95</u>	<u>5/6/87</u>	<u>5/6/87</u>
# points	9	9	7	5	10	8	8
SiO ₂	50.60	50.33	50.68	50.50	50.99	50.86	50.95
TiO ₂	2.62	2.59	2.54	2.74	2.49	2.54	2.85
Al ₂ O ₃	13.73	13.58	13.74	13.48	13.59	13.79	13.30
Cr ₂ O ₃	.02	.01	.02	.00	.03	.04	.02
FeO	11.01	11.13	11.04	11.76	10.91	11.01	11.99
MnO	.17	.19	.23	.23	.18	.15	.17
MgO	6.70	7.07	7.10	6.41	7.16	6.76	6.28
CaO	11.25	11.50	11.39	11.02	11.49	11.34	10.76
Na ₂ O	2.58	2.40	2.44	2.53	2.48	2.44	2.60
K ₂ O	.48	.45	.49	.54	.44	.49	.54
P ₂ O ₅	.25	.23	.23	.25	.23	.24	.26
Sum	99.41	99.48	99.90	99.46	99.99	99.66	99.72
TMgO	1148	1156	1157	1143	1158	1148	1139
TCaO	1156	1160	1158	1152	1161	1157	1147
Tfield	--	1146	1150	--	1140	--	--
Comments	S=0.014	tc	tc	S=0.014	tc	tc	

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	12/5/86	12/5/86	12/3/86	12/4/86	12/16/86	12/16/86	12/16/86	12/16/86	12/16/86	12/16/86	
Sample #	668F	668F	671F	674F	675S	675S	675S	675S	675S	675S	
Sample type	pond overflow	pond overflow	littoral								
Date analyzed	12/30/87	2/3/88	7/20/87	7/20/87	5/6/87	5/6/87	2/3/88	2/26/92	2/26/92	2/26/92	
# points	7	5 (R)	7	7	10	3 (R)	4 (R)	7 (R)	3		
SiO ₂	50.69	50.77	50.74	50.49	50.50	50.68	51.03	50.64	50.75		
TiO ₂	2.53	2.42	2.85	2.85	2.56	2.48	2.47	2.50	2.47		
Al ₂ O ₃	13.67	13.62	13.44	13.55	13.69	13.69	13.87	13.73	13.59		
Cr ₂ O ₃	.03	.02	.00	.00	.03	.07	.01	.03	.01		
FeO	10.75	11.07	12.02	11.76	11.01	10.88	11.29	10.93	10.90		
MnO	.19	.17	.17	.19	.21	.19	.17	.16	.15		
MgO	7.08	7.14	6.32	6.45	7.30	7.17	7.25	7.25	7.01		
CaO	11.38	11.63	10.76	10.99	11.55	11.38	11.54	11.47	11.37		
Na ₂ O	2.44	2.38	2.52	2.49	2.46	2.45	2.41	2.42	2.46		
K ₂ O	.46	.44	.58	.57	(.34)	.48	.48	.42	.44		
P ₂ O ₅	.23	.22	.27	.27	(--)	.25	.22	.23	.24		
Sum	99.45	99.88	99.67	99.61	99.65	99.72	100.74	99.78	99.39		
TMgO	1156	1157	1142	1143	1161	1158	1159	1159	1155		
TCaO	--	--	1147	1152	--	--	--	--	(1156)		
Tfield	1140	1140	--	--	--	--	--	--	--		
Comments	tc L+ol+cpx		L+ol+ cpx								next plag mixed sample

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Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	1/23/87	1/23/87	1/28/87	2/2/87	2/24/87	2/24/87	3/17/87	4/17-21/87	4/10/87
Sample #	1070S	1070S	691F	692F	706S	706S	712S	730S	736F
Sample type	pond spatter								
Date analyzed	3/11/88	3/29/82	7/20/87	7/20/87	7/20/87	2/3/88	12/30/87	7/20/87	7/20/87
# points	10	4 (R)	7	7	9	5 (R)	7	8	7
SiO ₂	50.66	50.95	50.64	(50.21)	(50.04)	50.77	50.56	50.69	50.23
TiO ₂	2.51	2.48	2.61	2.92	2.52	2.42	2.53	2.56	2.82
Al ₂ O ₃	13.66	13.85	13.75	13.23	13.50	13.60	13.46	13.67	13.52
Cr ₂ O ₃	.04	.04	.02	.00	.04	.02	.03	.03	.01
FeO	10.97	11.17	11.00	12.08	10.81	11.02	10.93	11.03	11.50
MnO	.17	.19	.24	.16	.20	.17	.19	.20	.24
MgO	7.15	7.12	6.96	6.21	7.23	7.24	7.12	7.07	6.53
CaO	11.45	11.50	11.37	10.69	11.43	11.40	11.38	11.55	11.06
Na ₂ O	2.46	2.35	2.47	2.52	2.39	2.40	2.44	2.47	2.50
K ₂ O	.45	.46	.50	.56	.45	.47	.45	.47	.52
P ₂ O ₅	.21	.26	.22	.27	.23	.22	.23	.23	.26
Sum	99.73	100.37	99.78	(98.85)	(98.84)	99.73	99.32	99.97	99.19
TMgO	1157	1157	1153	1138	1158	1159	1157	1156	1145
TCaO	1160	1162	1157	1146	--	--	1158	1162	1153
Tfield	--	--	1149	1133	--	--	--	--	--
Comments	collected by Helz		tc	tc	mixed sample		fritted plag only		

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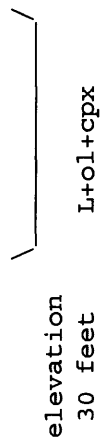
Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	4/15/87	4/15/87	5/9/87	5/12/87	5/12/87	5/19/87	6/6/87	6/11/87
Sample #	739F	739F	745F	746F	747S	748F	749S	756F
Sample type	littoral	littoral	shield vent	littoral	pond			
Date analyzed	<u>7/20/87</u>	<u>4/28/92</u>	<u>12/30/87</u>	<u>12/30/87</u>	<u>7/20/87</u>	<u>7/20/87</u>	<u>7/20/87</u>	<u>9/28/88</u>
# points	7	7 (R)	6	7	8	8	8	5
SiO ₂	(49.58)	50.70	50.72	50.74	50.76	50.17	50.55	51.36
TiO ₂	2.73	2.78	2.53	2.68	2.50	2.68	2.55	3.41
Al ₂ O ₃	13.50	13.67	13.34	13.88	13.60	13.74	13.59	12.43
Cr ₂ O ₃	.00	.00	.03	.01	.01	.01	.02	.00
FeO	11.25	11.75	11.08	11.62	11.13	11.30	11.05	13.73
MnO	.21	.19	.16	.17	.21	.17	.20	.24
MgO	6.45	6.46	6.93	6.64	7.06	6.69	7.11	5.55
CaO	10.91	11.18	11.32	11.12	11.49	11.28	11.49	10.11
Na ₂ O	2.50	2.47	2.44	2.53	2.44	2.49	2.44	2.38
K ₂ O	.52	.50	.46	.52	.48	.49	.49	.60
P ₂ O ₅	(.23)	.27	.23	.27	.22	.24	.23	.33
Sum	(97.88)	99.97	99.24	100.18	99.90	99.26	99.72	100.14
TMgO	1143	1143	1153	1147	1156	1148	1157	1126
TCaO	1150	1155	1157	1154	1160	1156	1160	1136
Tfield	--	--	1128°C	--	--	--	--	--
Comments	/		tc	350m from ocean			L+ol+cpx	

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Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	6/14/87	6/17/87	6/17/87	7/2/87	7/4/87	7/4/87	7/7/87	7/7/87	7/29/87
Sample #	759F	764S	764S	776F	770P	770P	773S	774P	781P
Sample type	littoral	spatter on overflow from pond		pond dip		pond	dip on tc	crust on pond	
Date analyzed	10/18/88	10/18/88	4/28/92	9/28/88	3/11/88	4/17/89	10/18/88	3/11/88	3/11/88
# points	6	6	7(R)	6	7	5(R)	7	7	7
SiO ₂	50.75	50.68	51.17	50.92	50.66	50.65	50.34	50.47	50.85
TiO ₂	2.88	2.62	2.58	2.77	2.61	2.54	2.62	2.56	2.61
Al ₂ O ₃	13.41	13.45	13.85	13.49	13.59	13.66	13.68	13.67	13.67
Cr ₂ O ₃	.01	.02	.03	.00	.04	.05	.02	.03	.03
FeO	11.75	11.26	11.18	11.93	11.07	11.28	11.28	11.05	11.12
MnO	.17	.17	.19	.20	.17	.17	.17	.17	.17
MgO	6.46	7.00	7.00	6.45	7.32	7.23	6.93	7.10	7.03
CaO	11.03	11.56	11.45	10.93	11.38	11.51	11.59	11.47	11.48
Na ₂ O	2.52	2.46	2.37	2.56	2.53	2.57	2.56	2.59	2.55
K ₂ O	.51	.45	.45	.51	.50	.47	.47	.49	.47
P ₂ O ₅	.25	.22	.24	.27	.23	.24	.21	.22	.20
Sum	99.74	99.89	100.51	100.03	100.10	100.37	99.87	99.82	100.18
TMgO	1144	1155	1155	1143	1161	1159	1153	1157	1155
TCaO	1151	1162	1160	1151	--	--	1162	1160	1160
Tfield	--	--	--	--	--	--	--	1145	--



Comments

tc

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	8/8/87	8/17/87	9/9/87	9/10/87	9/27/87	10/2/87	11/4/87	11/3/87	11/19/87
Sample #	784S	785F	790S	791F	802S	804F	817F	822S	845S
Sample type			Pond		Pond			Pond	
Date analyzed	<u>10/18/88</u>	<u>10/18/88</u>	<u>10/18/88</u>	<u>10/18/88</u>	<u>9/28/88</u>	<u>9/28/88</u>	<u>9/28/88</u>	<u>9/28/88</u>	<u>9/28/88</u>
# points	6	6	6	5	7	6	8	8	7
SiO ₂	50.72	50.97	50.85	50.54	50.80	50.94	50.80	50.81	51.03
TiO ₂	2.52	2.79	2.62	2.92	2.43	2.81	2.76	2.40	2.39
Al ₂ O ₃	13.64	13.46	13.70	13.46	13.71	13.54	13.48	13.49	13.69
Cr ₂ O ₃	.01	.00	.02	.00	.01	.00	.00	.00	.00
FeO	11.06	11.62	11.06	12.20	11.10	12.19	11.79	11.20	11.09
MnO	.17	.17	.17	.19	.19	.20	.20	.17	.20
MgO	6.94	6.32	6.93	6.30	6.96	6.15	6.27	6.97	6.99
CaO	11.57	11.01	11.51	10.91	11.62	10.92	10.93	11.35	11.48
Na ₂ O	2.53	2.48	2.52	2.54	2.52	2.50	2.49	2.50	2.39
K ₂ O	.47	.51	.45	.52	.45	.55	.51	.44	.44
P ₂ O ₅	.21	.25	.23	.28	.21	.29	.24	.22	.21
Sum	99.83	99.58	100.06	99.86	100.00	100.09	99.47	99.55	99.91
TMgO	1153	1141	1153	1140	1154	1137	1139	1154	1154
TCaO	1162	1151	1160	1150	1163	1151	1151	1157	1160
Tfield	--	--	--	--	--	--	--	--	--
Comments				150m from ocean			50m from ocean		

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	11/19/87	12/17/87	1/13/88	1/14/88	1/25/88	1/26/88	1/26/88	2/1/88
Sample #	852F	853P	867F	868P	873F	874P	875F	880T
Sample type	skylight at 1900'	littoral				spatter	skylight at 1980'	limu
Date analyzed	2/28/88	10/18/88	2/28/88	2/28/88	5/15/89	5/15/89	7/28/89	10/18/88
# points	7	6	6	7	7	7	7	6
SiO ₂	51.16	51.04	50.68	50.73	50.79	50.39	50.77	50.68
TiO ₂	2.66	2.51	2.81	2.46	2.63	2.50	2.67	2.65
Al ₂ O ₃	13.90	13.69	13.36	13.74	13.50	13.84	13.67	13.70
Cr ₂ O ₃	.01	.02	.00	.01	.03	.08	.05	.00
FeO	11.36	11.17	12.06	11.27	11.60	10.94	11.14	11.47
MnO	.20	.17	.19	.19	.21	.21	.17	.17
MgO	6.66	6.90	6.14	6.94	6.59	6.94	6.51	6.60
CaO	11.40	10.76	10.73	11.47	11.31	11.50	11.28	11.23
Na ₂ O	2.51	2.50	2.51	2.53	2.56	2.56	2.51	2.50
K ₂ O	.49	.46	.52	.46	.50	.46	.47	.46
P ₂ O ₅	.24	.21	.27	.22	.25	.23	.23	.23
Sum	100.59	100.07	99.27	100.02	99.97	99.65	99.47	99.69
TMgO	1147	1152	1137	1153	1146	1153	1145	1147
TCaO	1158	1158	1147	1159	1157	1160	1156	1155
Tfield	--	--	--	--	--	--	--	--
Comments			20-30m from ocean		elevation 9 feet			

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	2/2/88	2/4/88	2/8/88	2/8/88	2/11/88	2/15/88	2/14/88	2/24/88
Sample #	882S	885T	889P	889S	891S	894S	895T	897S
Sample type	littoral	Pu'u O'o	pond	pond	littoral	pond	Pu'u O'o	littoral
Date analyzed	<u>7/28/82</u>	<u>10/18/88</u>	<u>9/28/88</u>	<u>3/29/89</u>	<u>7/28/89</u>	<u>7/28/89</u>	<u>10/18/88</u>	<u>3/29/89</u>
# points	7	7	9	4 (R)	8	7	9	8
SiO ₂	51.07	50.55	50.86	50.97	51.28	50.77	50.94	50.62
TiO ₂	2.57	2.55	2.49	2.58	2.73	2.53	2.49	2.62
Al ₂ O ₃	13.98	13.64	13.85	13.79	13.34	13.58	13.57	13.62
Cr ₂ O ₃	.05	.02	.01	.03	.03	.05	.03	.03
FeO	11.06	11.06	11.19	11.30	11.58	11.00	11.09	11.16
MnO	.17	.17	.19	.19	.18	.17	.16	.17
MgO	6.64	7.08	6.89	6.98	6.38	6.86	7.11	6.74
CaO	11.43	11.44	11.51	11.48	11.12	11.38	11.40	11.45
Na ₂ O	2.54	2.48	2.51	2.39	2.59	2.48	2.43	2.37
K ₂ O	.47	.45	.45	.45	.50	.46	.44	.45
P ₂ O ₅	.25	.21	.21	.24	.26	.23	.22	.27
Sum	100.23	99.65	100.16	100.40	99.99	99.51	99.88	99.50
TMgO	1147	1156	1153	1154	1142	1152	1157	1149
TCaO	1159	1160	1161	1160	1153	1158	1159	1160
Tfield	--	--	--	--	--	--	--	--
Comments	$\frac{\text{I+ol+augite+plag}}{\text{(tr)}}$							

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	2/25/88	2/25/88	3/11/88	3/15/88	3/18/88	3/24/88	3/26/88	4/21/88
Sample #	898S	898S	901S	903P	904S	905P	906S	911P
Sample type	pond	pond	littoral on cable	spatter on cable	littoral on cable	spatter	littoral	pond
Date analyzed	2/28/88	11/8/91	7/28/89	7/28/89	7/28/89	7/28/89	7/28/89	2/14/89
# points	7	5 (R)	6	7	7	7	7	7
SiO ₂	50.94	51.10	50.67	50.99	51.05	51.11	51.39	50.70
TiO ₂	2.33	2.53	2.61	2.47	2.54	2.50	2.56	2.54
Al ₂ O ₃	13.46	13.61	13.89	13.46	13.94	13.46	13.82	13.34
Cr ₂ O ₃	.03	.05	.03	.03	.04	.04	.04	.05
FeO	11.32	11.14	11.39	10.96	11.10	11.10	11.05	11.02
MnO	.17	.18	.18	.18	.18	.18	.17	.17
MgO	7.12	7.08	6.60	7.00	6.65	7.06	6.69	7.10
CaO	11.63	11.51	11.38	11.59	11.40	11.37	11.37	11.41
Na ₂ O	2.47	2.34	2.53	2.51	2.55	2.48	2.55	2.30
K ₂ O	.44	.45	.48	.46	.48	.48	.47	.43
P ₂ O ₅	.23	.24	.26	.23	.25	.25	.25	.23
Sum	100.14	100.23	100.04	99.88	100.18	100.18	100.36	99.29
TMgO	1157	1156	1147	1154	1147	1156	1148	1157
TCaO	1162	1161	1157	1161	1159	1160	1157	1158
Tfield	--	--	--	--	--	--	--	--
Comments	L+ol+cpx+plag (tr)							

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	4/22/88	5/2/88	5/28/88	6/1/88	6/10/88	6/10/88	6/22/88
Sample #	912S	916S	925F	926S	926S	927P	935S
Sample type	littoral			pond spatter	hammer dip		littoral
Date analyzed	<u>3/29/89</u>	<u>2/14/89</u>	<u>3/29/89</u>	<u>3/29/89</u>	<u>4/17/89</u>	<u>3/29/88</u>	<u>10/7/91</u>
# points	7	7	8	7	5(R)	10	1
SiO ₂	50.91	50.42	50.97	50.71	50.92	50.55	50.59
TiO ₂	2.74	2.51	2.71	2.48	2.54	2.50	2.52
Al ₂ O ₃	13.84	14.06	13.73	13.70	13.55	13.57	13.72
Cr ₂ O ₃	.03	.05	.02	.04	.05	.04	.05
FeO	11.29	11.13	11.51	11.20	11.02	11.16	11.11
MnO	.17	.20	.17	.17	.16	.15	.17
MgO	6.67	7.03	6.55	7.23	7.21	7.12	6.99
CaO	11.44	11.47	11.16	11.43	11.58	11.39	11.65
Na ₂ O	2.41	2.36	2.42	2.36	2.55	2.36	2.30
K ₂ O	.47	.40	.48	.44	.46	.42	.45
P ₂ O ₅	.24	.21	.25	.24	.22	.25	.23
Sum	100.21	99.84	99.97	100.00	100.26	99.51	99.78
TWGO	1147	1154	1145	1159	1158	1157	1155
TCaO	1158	1159	1153	--	--	--	(1163)
Tfield	--	--	--	--	--	--	--
Comments		tr.plag			I+ol+cpx	I+ol+cpx	next plag
							mixed sample

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	6/23/88	6/23/88	7/7/88	7/8/88	7/18/88	7/22/88	7/22/88	7/22/88
Sample #	937P	937P	939P	940S	943S	948P	948P	948P
Sample type			littoral	littoral	littoral	low MgO	high MgO	low MgO
Date analyzed	3/29/89	5/15/89	4/8/91	10/24/91	10/24/91	3/29/89	10/24/91	10/24/91
# points	7	5 (R)	7	8	7	7	6	4 (R)
SiO ₂	50.71	50.72	50.75	50.80	50.96	50.58	50.91	51.28
TiO ₂	2.51	2.56	2.44	2.63	2.61	2.51	2.51	2.49
Al ₂ O ₃	13.52	13.26	13.59	13.46	13.85	13.67	13.59	13.52
Cr ₂ O ₃	.03	.07	.03	.03	.03	.04	.05	.06
FeO	11.01	11.18	11.00	11.17	11.13	11.11	11.01	11.04
MnO	.16	.17	.23	.21	.22	.17	.18	.19
MgO	7.08	7.12	7.06	6.60	6.72	7.03	7.14	7.01
CaO	11.46	11.59	11.55	11.26	11.45	11.52	11.35	11.29
Na ₂ O	2.37	2.49	2.44	2.55	2.50	2.36	2.50	2.48
K ₂ O	.44	.46	.45	.47	.46	.44	.45	.44
P ₂ O ₅	.24	.26	.21	.23	.24	.26	.23	.25
Sum	99.53	99.88	99.80	99.41	100.17	99.69	99.92	100.05
TMgO	1156	1157	1156	1147	1148	1155	1157	1155
TCaO	--	--	--	1156	1159	--	--	--
Tfield	--	--	--	--	--	--	--	--
Comments	L+ol+cpx +tr.plag (fritted only)		L+ol+cpx +tr.plag (fritted only)		hybrid sample L+ol+cpx			

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	8/5/88	8/5/88	8/24/88	8/24/88	8/24/88	8/27/88	
Sample #	954P	954P	956P	956P	956P	957S	
Sample type						littoral	
Date analyzed	<u>4/8/91</u>	<u>11/8/91</u>	<u>4/17/89</u>	<u>4/8/91</u>	<u>4/8/91</u>	<u>10/7/91</u>	
# points	7	5 (R)	8	6 (R)	2	8	
SiO ₂	50.81	51.07	50.92	50.90	51.19	51.49	
TiO ₂	2.49	2.48	2.53	2.52	2.40	2.60	
Al ₂ O ₃	13.65	13.60	13.54	13.56	13.68	14.07	
Cr ₂ O ₃	.02	.04	.04	.03	.04	.01	
FeO	10.94	11.02	10.98	11.03	10.94	11.12	
MnO	.23	.21	.17	.24	.19	.18	
MgO	7.11	7.14	7.07	7.13	6.85	6.77	
CaO	11.38	11.41	11.45	11.40	11.49	11.20	
Na ₂ O	2.41	2.36	2.53	2.36	2.45	2.32	
K ₂ O	.45	.44	.45	.44	.45	.44	
P ₂ O ₅	.23	.23	.21	.22	.19	.24	
Sum	99.72	100.00	99.89	99.83	99.87	100.44	
TMgO	1157	1157	1156	1157	1152	1149	
TCaO	--	--	--	--	1159	1155	
Tfield	--	--	--	--	--	--	
Comments	L+ol+cpx		next plag				
			mixed sample				

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	9/20/88	9/20/88	9/23/88	10/3/88	10/6/88	10/6/88	10/6/88	10/6/88	
Sample #	961P	961P	962S	982S	983P	983P	983P	983P	
Sample type	dip on cable	dip on cable	littoral	littoral	littoral	dip on cable	dip on cable		
Date analyzed	2/9/90	4/8/91	11/8/91	10/24/91	4/8/91	10/7/91	10/24/91	10/24/91	
# points	4	7	9	7	7	6 (R)	3 (R)	3	
SiO ₂	51.28	51.16	51.33	50.98	50.97	50.85	51.09	51.22	
TiO ₂	2.58	2.51	2.63	2.55	2.53	2.57	2.53	2.51	
Al ₂ O ₃	13.30	13.55	13.73	13.90	13.59	13.90	13.59	13.62	
Cr ₂ O ₃	--	.00	.04	.05	.03	.03	.02	.02	
FeO	10.86	10.90	11.00	10.99	11.10	11.09	11.14	11.10	
MnO	.17	.20	.20	.20	.19	.18	.17	.17	
MgO	7.09	7.15	6.74	6.73	7.15	7.18	7.23	7.07	
CaO	11.47	11.38	11.30	11.47	11.53	11.58	11.36	11.51	
Na ₂ O	2.43	2.36	2.36	2.53	2.42	2.23	2.39	2.45	
K ₂ O	.45	.44	.46	.44	.44	.45	.45	.44	
P ₂ O ₅	.20	.22	.23	.24	.22	.24	.20	.22	
Sum	99.83	99.87	100.02	100.08	100.17	100.30	100.19	100.33	
TMgO	1156	1157	1149	1149	1157	1158	1159	1156	
TCaO	--	--	1157	1159	--	--	--	(1161)	
Tfield	--	--	--	--	--	--	--	--	
EDS	/								
Comments	L+ol+cpx				L+ol+cpx mixed sample				next plag

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	11/17/88	11/17/88	11/17/88	11/19/88	12/2/88	12/2/88	12/4/88	12/4/88	12/4/89
Sample #	990P	990P	990P	991S	994P	994P	997T	88TLW-1	1000P
Sample type				littoral			limu	drip from collapsed tube	
Date analyzed	4/8/91	10/7/91	10/7/91	10/7/91	3/18/91	10/7/91	4/8/91	3/25/92	11/8/91
# points	7	8 (R)	5 (R)	7	8 (R)	7	9	8	
SiO ₂	50.64	50.80	51.24	51.14	51.33	51.39	51.10	51.18	51.39
TiO ₂	2.50	2.65	2.57	2.63	2.52	2.54	2.60	2.64	2.50
Al ₂ O ₃	13.63	13.90	13.77	13.92	13.67	13.92	13.67	13.75	13.60
Cr ₂ O ₃	.03	.04	.06	.01	.03	.05	.00	.00	.05
FeO	10.96	11.13	11.16	11.48	11.02	10.88	11.13	11.33	11.02
MnO	.24	.17	.17	.20	.18	.18	.20	.17	.16
MgO	7.04	7.02	7.02	6.58	6.98	7.01	6.73	6.72	7.09
CaO	11.33	11.46	11.35	11.00	11.33	11.44	11.29	11.16	11.31
Na ₂ O	2.38	2.29	2.27	2.30	2.36	2.27	2.36	2.48	2.36
K ₂ O	.44	.44	.44	.46	.44	.47	.47	.46	.44
P ₂ O ₅	.22	.25	.25	.25	.21	.24	.23	.23	.22
Sum	99.41	100.15	100.30	99.97	100.07	100.39	99.78	100.12	100.14
TMgO	1155	1155	1155	1146	1154	1155	1149	1149	1156
TCaO	1157	1158	1157	1152	1157	1159	1156	1153	1157
Tfield	--	--	--	--	--	--	--	--	--
Comments	/								

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	1/5/89	1/19/89	1/19/89	1/20/89	2/17/89	2/17/89	2/17/89	2/17/89	3/7/89	3/7/89
Sample #	1001S	1003P	1003P	1004S	1014S	1016P	1016P	1016P	1026S	1026S
Sample type	littoral	littoral	littoral	littoral	littoral	littoral	littoral	littoral	littoral	littoral
Date analyzed	11/8/91	3/18/91	2/9/90	10/24/91	11/8/91	4/8/91	11/8/91	11/8/91	10/24/91	5/28/92
# points	8	7	6	7	8	7	6 (R)	5	6 (R)	6 (R)
SiO ₂	51.14	51.15	51.18	51.25	50.83	50.67	51.12	51.15	50.80	50.80
TiO ₂	2.57	2.53	2.71	2.56	2.62	2.51	2.56	2.62	2.57	2.57
Al ₂ O ₃	13.54	13.56	13.47	13.51	13.61	13.64	13.55	13.99	13.95	13.95
Cr ₂ O ₃	.03	.01	.06	.03	.04	.02	.05	.03	.03	.03
FeO	10.91	11.00	10.96	10.99	11.00	11.09	10.95	11.08	11.05	11.05
MnO	.20	.17	.18	.18	.18	.26	.20	.18	.19	.19
MgO	6.74	7.15	7.21	6.79	6.62	7.13	7.13	6.70	6.66	6.66
CaO	11.35	11.31	(11.55)	11.39	11.30	11.43	11.44	11.50	11.25	11.25
Na ₂ O	2.35	2.38	2.46	2.41	2.43	2.38	2.42	2.55	2.49	2.49
K ₂ O	.44	.44	.44	.44	.46	.44	.44	.45	.46	.46
P ₂ O ₅	.25	.21	.23	.23	.23	.25	.22	.23	.23	.23
Sum	99.52	99.91	100.45	99.78	99.32	99.82	100.08	100.48	99.68	99.68
TMgO	1149	1157	1158	1149	1146	1157	1157	1148	1147	1147
TCaO	1157	--	--	1158	1156	1159	1159	1160	1156	1156
Tfield	--	--	--	--	--	--	--	--	--	--
Comments	L+ol+cpx			EDS			nice plag			

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	3/9/89	3/9/89	3/9/89	3/7/89	4/6/89	4/6/89	4/7/89	4/27/89	5/5/89
Sample #	1027P	1027P	1027P	1029F	1033P	1033P	1034S	1050P	1072P
Sample type							littoral		
Date analyzed	2/9/90	3/18/91	5/28/92	4/28/92	3/18/91	3/18/91	11/8/91	4/8/91	4/22/91
# points	5	8	7(R)	8	6	2	8	7	9
SiO ₂	51.12	(51.90)	51.25	50.76	51.01	51.63	51.29	50.97	50.33
TiO ₂	2.67	2.54	2.51	2.74	2.46	2.38	2.54	2.49	2.56
Al ₂ O ₃	13.30	13.65	13.84	13.66	13.65	13.64	13.55	13.58	13.67
Cr ₂ O ₃	--	.01	.04	.02	.03	.04	.06	.04	.04
FeO	11.00	11.00	11.07	11.69	10.92	11.01	11.07	11.09	10.92
MnO	.17	(.13)	.19	.20	(.11)	.18	.17	.21	.20
MgO	7.17	7.15	7.13	6.46	7.15	7.00	6.75	7.15	7.12
CaO	(11.52)	11.27	11.33	11.03	11.15	11.22	11.45	11.38	11.34
Na ₂ O	2.55	2.39	2.41	2.43	2.35	2.35	2.35	2.42	2.45
K ₂ O	.41	.43	.44	.49	.44	.41	.45	.44	.47
P ₂ O ₅	.22	.21	.22	.25	.22	.21	.24	.22	.23
Sum	100.13	100.68	100.43	99.73	99.49	100.07	99.92	99.99	99.33
TMgO	1158	1158	1157	1154	1157	1155	1149	1157	1157
TCaO	--	--	--	1152	--	1155	1160	--	1157
Tfield	--	--	--	--	--	--	--	--	--

EDS

L+ol+cpx
L+ol+cpx next plag
L+ol+cpx

mixed sample

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	5/6/89	5/11/89	5/11/89	5/16/89	5/16/89	5/19/89	5/24/89	5/24/89	5/25/89
Sample #	1073S	1074P	1075S	1076S	1076S	1077P	1078P	1078P	1079F
Sample type	Littoral	Littoral	Littoral	Littoral	Littoral	Littoral	Littoral	Littoral	floating pillow
Date analyzed	10/24/91	4/8/91	4/28/92	5/14/92	5/14/92	4/8/91	3/25/92	11/24/92	3/25/92
# points	7	8	8	10	8 (R)	7	6	11 (R)	8
SiO ₂	51.21	50.83	50.57	50.92	50.81	50.83	50.70	50.77	50.78
TiO ₂	2.58	2.45	2.64	2.75	2.71	2.53	2.51	2.51	2.72
Al ₂ O ₃	13.70	13.65	13.88	13.40	13.65	13.77	13.70	13.78	13.81
Cr ₂ O ₃	.04	.02	.03	.03	.03	.03	.01	.04	.00
FeO	10.98	11.07	11.23	11.46	11.49	10.96	11.15	11.20	11.23
MnO	.19	.24	.19	.20	.21	.22	.19	.17	.19
MgO	6.77	7.08	6.74	6.50	6.50	7.05	7.11	7.06	6.72
CaO	11.48	11.47	11.21	11.01	11.14	11.32	11.34	11.32	11.24
Na ₂ O	2.51	2.41	2.40	2.47	2.52	2.38	2.43	2.33	2.46
K ₂ O	.47	.44	.46	.49	.49	.44	.43	.43	.45
P ₂ O ₅	.26	.22	.22	.26	.26	.21	.22	.22	.23
Sum	100.19	99.88	99.57	99.49	99.81	99.74	99.79	99.83	99.83
TMgO	1149	1156	1148	1144	1144	1155	1157	1156	1148
TCaO	1160	1160	1155	1152	1153	1156	1157	1156	1155
Tfield	--	--	--	--	--	--	--	--	--
Comments									

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Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	6/27/89	8/10/89	8/12/89	9/13/89	9/13/89	9/22/89	9/22/89
Sample #	1083P	1087P	1090S	1094P	1094P	1100P	1100P
Sample type			littoral				
Date analyzed	<u>4/22/91</u>	<u>3/18/91</u>	<u>11/8/91</u>	<u>3/18/91</u>	<u>11/8/91</u>	<u>2/23/93</u>	<u>6/10/93</u>
# points	8	8	7	7	6 (R)	10	7 (R)
SiO ₂	50.75	51.13	51.16	51.14	51.04	51.30	50.63
TiO ₂	2.49	2.49	2.64	2.50	2.53	2.60	2.60
Al ₂ O ₃	13.65	13.68	13.61	13.61	13.54	13.91	13.93
Cr ₂ O ₃	.03	.02	.03	.03	.04	.03	.04
FeO	11.12	11.08	11.21	10.93	11.02	11.10	11.05
MnO	.19	.19	.17	.16	.18	.18	.18
MgO	6.98	7.01	6.72	7.05	6.99	6.99	7.01
CaO	11.42	11.21	11.17	11.18	11.29	11.45	11.43
Na ₂ O	2.40	2.34	2.44	2.35	2.38	2.38	2.31
K ₂ O	.44	.44	.45	.43	.43	.46	.44
P ₂ O ₅	.24	.23	.26	.22	.23	.22	.22
Sum	99.71	99.82	99.86	99.60	99.67	100.62	99.84
TMgO	1154	1155	1148	1155	1154	1153	1154
TCaO	1160	1155	1154	1154	1156	1160	1160
Tfield	--	--	--	--	--	--	--
Comments							S=0.017

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	10/11/89	10/11/89	10/18/89	11/12/89	11/14/89	2/7/90
Sample #	1101P	1101P	1103P	1106S	1107P	1129P
Sample type	cable dip		littoral			
Date analyzed	<u>2/22/93</u>	<u>6/10/93</u>	<u>10/7/91</u>	<u>11/8/91</u>	<u>4/22/91</u>	<u>4/22/91</u>
# points	10	5(R)	8	9	8	6
SiO ₂	50.65	50.35	51.03	51.28	51.04	51.13
TiO ₂	2.60	2.53	2.56	2.60	2.51	2.49
Al ₂ O ₃	13.63	13.83	13.73	13.77	13.73	13.73
Cr ₂ O ₃	.04	.03	.03	.04	.04	.04
FeO	11.10	11.21	10.90	10.79	10.88	10.96
MnO	.20	.19	.17	.21	.19	.18
MgO	7.03	7.01	7.04	6.80	7.12	7.00
CaO	11.30	11.49	11.34	11.42	11.30	11.42
Na ₂ O	2.32	2.33	2.29	2.35	2.41	2.37
K ₂ O	.44	.45	.45	.44	.44	.44
P ₂ O ₅	.25	.22	.23	.23	.24	.23
Sum	99.56	99.64	99.77	99.93	99.90	99.99
TMgO	1155	1154	1156	1150	1157	1155
TCaO	1157	1161	1157	1159	1157	1160
Tfield	--	--	--	--	--	--

rare coarse
plag

S=0.019

Comments

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	2/10/90	2/15/90	2/15/90	3/19/90	3/19/90	4/8/90	5/10/90	5/31/90
Sample #	1137F	1150F	1234P	1202F	1220S	1237F	1252P	1257F
Sample type	skylight at 1830'	skylight at 1420'		skylight at 1650'	littoral	skylight at 1650'		skylight at 1850'
Date analyzed	5/20/91	5/20/91	4/22/91	5/20/91	2/19/92	5/20/91	4/22/91	2/26/92
# points	6	8	7	7	8	10	7	9
SiO ₂	51.12	51.26	50.54	51.00	51.24	51.16	50.45	50.81
TiO ₂	2.39	2.70	2.47	2.66	2.75	2.47	2.47	2.63
Al ₂ O ₃	14.01	13.76	13.66	13.90	13.66	13.81	13.63	13.76
Cr ₂ O ₃	.01	.00	.05	.00	.01	.02	.04	.02
FeO	10.91	11.31	10.94	11.13	11.32	10.89	10.87	10.95
MnO	.18	.17	.18	.18	.18	.19	.19	.16
MgO	6.88	6.60	7.19	6.63	6.55	6.95	7.15	6.80
CaO	11.32	10.91	11.31	11.06	11.05	11.43	11.26	11.36
Na ₂ O	2.41	2.48	2.36	2.41	2.40	2.44	2.41	2.46
K ₂ O	.46	.49	.43	.47	.46	.46	.44	.43
P ₂ O ₅	.22	.26	.22	.26	.25	.22	.23	.26
Sum	99.91	99.94	99.35	99.70	99.87	100.04	99.14	99.64
TMgO	1152	1147	1158	1147	1145	1154	1158	1150
TCaO	1157	1150	--	1153	1152	1160	--	1157
Tfield	--	--	--	--	--	--	--	--
Comments				L+ol+cpX				L+ol+cpX

55

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	5/31/90	6/30/90	6/30/90	7/28/90	8/26/90	9/27/90	10/31/90
Sample #	1258P	1260F	1260F	1261S	1266F	1274F	1281F
Sample type		skylight at 1850'		Littoral	skylight at 1200'	skylight at 1200'	skylight at 1200'
Date analyzed	<u>4/22/91</u>	<u>5/20/91</u>	<u>5/20/91</u>	<u>11/8/91</u>	<u>5/20/91</u>	<u>4/22/91</u>	<u>2/26/92</u>
# points	7	10	1	7	7	7	9
SiO ₂	50.98	50.93	51.17	50.91	51.07	51.13	51.01
TiO ₂	2.44	2.38	2.43	2.75	2.67	2.58	2.67
Al ₂ O ₃	13.61	13.91	13.98	13.59	14.07	13.77	13.59
Cr ₂ O ₃	.03	.03	.02	.03	.03	.03	.01
FeO	10.85	10.80	10.52	11.27	10.94	10.94	11.28
MnO	.18	.19	.18	.20	.17	.18	.16
MgO	7.09	6.90	6.69	6.56	6.71	6.84	6.72
CaO	11.21	11.44	11.44	11.15	11.10	11.41	11.20
Na ₂ O	2.38	2.46	2.47	2.40	2.43	2.41	2.50
K ₂ O	.44	.46	.46	.46	.46	.44	.44
P ₂ O ₅	.24	.23	.23	.25	.26	.24	.24
Sum	99.45	99.76	99.59	99.57	99.91	99.97	99.82
TMgO	1156	1152	1148	1146	1148	1151	1148
TCaO	1155	1160	1160	1153	1153	1159	1155
Tfield	--	--	--	--	--	--	--
			lowest MgO				highest MgO

zoned sample

Comments

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	12/5/90	12/14/90	1/12/91	1/12/91	2/27/91	2/27/91	2/27/91
Sample #	1285F	1287F	1291F	1291F	1305F	1306F	1306F
Sample type	skylight at 1000'	skylight at 920'	skylight at 1845'	skylight at 1845'	skylight at 1845'	skylight at 1840'	skylight at 1840'
Date analyzed	4/22/91	11/8/91	10/7/91	3/9/92	2/3/95	9/8/94	2/22/95
# points	8	8	8	6 (R)	9	7	10 (R)
SiO ₂	51.39	51.24	51.13	50.57	51.40	50.92	51.28
TiO ₂	2.55	2.50	2.57	2.55	2.51	2.53	2.58
Al ₂ O ₃	13.71	13.65	13.87	13.73	13.72	13.75	13.72
Cr ₂ O ₃	.04	.04	.02	.02	.04	.01	.04
FeO	10.82	10.86	10.84	10.95	10.65	10.71	10.77
MnO	.19	.20	.18	.18	.18	.17	.19
MgO	6.90	6.81	6.94	6.98	6.97	7.01	7.00
CaO	11.47	11.43	11.40	11.42	11.31	11.45	11.41
Na ₂ O	2.45	2.27	2.27	2.44	2.43	2.37	2.48
K ₂ O	.46	.43	.44	.44	.42	.43	.42
P ₂ O ₅	.23	.23	.23	.25	.24	.24	.24
Sum	100.21	99.66	99.89	99.53	99.87	99.59	100.13
TMgO	1153	1151	1153	1154	1154	1155	1155
TCaO	1160	1158	1158	1158	1157	1159	1158
Tfield	--	--	--	--	--	--	--
Comments					S=0.013	S=0.017	S=0.017

Analyst

B.C. Hearn

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	3/1/91	3/1/91	3/1/91	3/1/91	4/16/91	6/13/91	6/13/91	6/13/91
Sample #	1308F	1308F	1311F	1311F	1317F	1327F	1327F	1327F
Sample type	skylight at 2080'	skylight at 2080'	littoral spatter	littoral spatter	skylight at 1880'	skylight at 2140'	skylight at 2140'	skylight at 2140'
Date analyzed	10/24/91	2/2/95	9/7/94	2/2/95	11/8/91	2/19/92	3/9/92	4/19/94
# points	9	7(R)	9	10(R)	8	10	8(R)	7(R)
SiO ₂	51.44	51.12	51.60	50.74	50.93	50.71	50.94	50.86
TiO ₂	2.52	2.52	2.54	2.47	2.54	2.57	2.54	2.51
Al ₂ O ₃	13.71	13.67	13.96	13.69	13.75	13.93	13.86	13.61
Cr ₂ O ₃	.04	.03	.00	.03	.03	.02	.00	.04
FeO	10.59	10.66	10.89	10.75	10.89	10.86	10.95	11.01
MnO	.18	.17	.18	.18	.19	.20	.16	.17
MgO	7.07	7.07	6.85	6.81	6.96	6.97	7.04	7.00
CaO	11.24	11.42	(11.53)	11.36	11.42	11.45	11.36	11.26
Na ₂ O	2.49	2.47	2.44	2.53	2.31	2.40	2.42	2.43
K ₂ O	.44	.41	.43	.43	.42	.42	.44	.43
P ₂ O ₅	.22	.25	.24	.25	.23	.21	.24	.24
Sum	99.94	99.79	100.66	99.24	99.67	99.74	99.95	99.56
TMgO	1156	1156	1152	1151	1153	1154	1155	1154
TCaO	--	--	1161	1157	1158	1159	1157	1156
Tfield	--	--	--	--	--	--	--	--

Comments S=0.014 S=0.017 S=0.015 plag rare S=0.021

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	7/16/91	7/16/91	7/29/91	7/29/91	7/29/91	8/16/91	9/4/91
Sample #	1331F	1331F	1332F	1338S	1338S	1344F	1346F
Sample type	skylight at 2140'	skylight at 2140'	skylight at 2140'	Puu O'o spatter		skylight at 2140'	skylight at 2150'
Date analyzed	2/19/92	3/9/92	12/6/93	2/10/92	2/19/92	2/10/92	2/10/92
# points	8	5 (R)	8	9	4	7 (R)	8
SiO ₂	51.21	50.81	50.79	50.83	51.05	51.04	51.07
TiO ₂	2.57	2.53	2.50	2.44	2.49	2.54	2.44
Al ₂ O ₃	13.95	13.93	13.90	13.70	13.78	13.66	13.77
Cr ₂ O ₃	.04	.02	.03	.02	.01	.01	.02
FeO	10.83	10.76	10.78	10.91	11.07	10.90	10.79
MnO	.18	.18	.18	.16	.18	.17	.16
MgO	6.95	6.90	6.86	7.23	7.07	7.19	6.93
CaO	11.41	11.32	11.30	11.37	11.32	11.44	11.33
Na ₂ O	2.40	2.50	2.34	2.47	2.26	2.38	2.42
K ₂ O	.42	.44	.45	.42	.41	.40	.43
P ₂ O ₅	.23	.23	.23	.23	.22	.21	.22
Sum	100.19	99.62	99.36	99.78	99.86	99.94	99.58
TMgO	1153	1152	1151	1160	1156	1158	1153
TCaO	1158	1157	1157	--	--	--	1157
Tfield	--	--	--	--	--	--	--
Comments	/		S=0.013	next cpx away cpx			plag rare
				heterogeneous			

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	11/8/91	11/8/91	11/14/91	10/6/91	10/6/91	10/20/91
Sample #	49/1355S	49/1356F	49/1356F	49/1356F	1359F	1360
Sample type	vent spatter		skylight at 2150'	skylight at 2150'	skylight at 2150'	skylight at 2150'
Date analyzed	<u>1/25/93</u>	<u>1/25/93</u>	<u>3/9/92</u>	<u>1/25/93</u>	<u>2/22/93</u>	<u>12/6/93</u>
# points	10	10	5	10	10 (R)	8
SiO ₂	50.74	50.96	51.05	50.70	50.61	50.97
TiO ₂	2.71	2.54	2.75	2.62	2.62	2.59
Al ₂ O ₃	13.67	13.67	13.72	13.61	13.74	13.68
Cr ₂ O ₃	.03	.02	.00	.04	.05	.03
FeO	11.09	10.76	11.11	11.04	11.14	10.80
MnO	.16	.17	.18	.16	.20	.18
MgO	6.62	6.92	6.98	6.65	6.70	6.78
CaO	11.21	11.40	10.95	11.30	11.38	11.28
Na ₂ O	2.46	2.31	2.51	2.42	2.49	2.33
K ₂ O	.47	.47	.46	.46	.43	.44
P ₂ O ₅	.23	.22	.26	.23	.25	.23
Sum	99.39	99.44	99.74	99.23	99.61	99.31
TMgO	1147	1153	1146	1147	1148	1149
TCaO	1155	1158	1151	1156	1158	1156
Tfield	--	--	--	--	--	--
Comments	S=0.018	S=0.025		S=0.019	S=0.017	S=0.010

Table 2. Microprobe analyses of glasses from episodes 48 and 49 (continued)

Date erupted	10/13/91	10/25/91	10/25/91	10/27/91	10/27/91	10/27/91	11/8/91	11/12/91
Sample #	1361S	1362P	1362P	1364P	1364P	1364P	1365F	49/1371T
Sample type	Pu'u O'O	Pu'u O'O	Pu'u O'O	Pu'u O'O	Pu'u O'O	Pu'u O'O	skylight at 2150'	
Date analyzed	<u>2/22/93</u>	<u>2/22/93</u>	<u>2/4/94</u>	<u>2/26/92</u>	<u>6/10/92</u>	<u>6/10/92</u>	<u>2/26/92</u>	<u>11/24/92</u>
# points	10	9	11(R)	13	5	3	9	10
SiO ₂	50.44	50.49	50.92	50.38	51.13	51.41	50.96	50.94
TiO ₂	2.60	2.53	2.46	2.48	2.53	2.56	2.63	2.57
Al ₂ O ₃	13.72	13.69	13.67	13.97	13.73	13.85	13.85	13.85
Cr ₂ O ₃	.04	.05	.05	.02	.02	.05	.03	.02
FeO	11.01	11.02	10.92	10.91	11.00	10.95	11.02	11.20
MnO	.17	.19	.18	.16	.16	.16	.16	.18
MgO	7.05	7.09	7.08	7.34	7.15	7.17	6.90	6.71
CaO	11.41	11.31	11.24	11.36	11.27	11.30	11.18	10.98
Na ₂ O	2.46	2.43	2.31	2.40	2.43	2.48	2.43	2.39
K ₂ O	.43	.43	.46	.41	.42	.43	.42	.43
P ₂ O ₅	.28	.24	.22	.20	.20	.20	.23	.22
Sum	99.61	99.47	99.51	99.63	100.04	100.56	99.80	99.49
TMgO	1155	1156	1156	1162	1157	1157	1152	1148
TCaO	--	--	--	--	--	--	1154	1152
Tfield	--	--	--	--	--	--	--	--
Comments	S=0.023	S=0.023	S=0.018	dark glass	light glass	L+ol+cpx		
			Analyst					
			B. C. Hearn					

Table 3. Microprobe analyses of glasses from episodes 50-53 of the Kilauea east rift eruption

Date Erupted	2/21/92	3/8/92	4/1/92	4/22/92	4/22/92	4/24/92	5/14/92
Episode #	50	51	51	Pu'u O'o	Pu'u O'o	51	51
Sample #	1378S	1380S	1384S	1385S	1385S	1386P	1387F
Sample type						pond dip	channel dip
<u>Date Analyzed</u>	<u>11/24/92</u>	<u>9/7/94</u>	<u>11/24/92</u>	<u>3/15/94</u>	<u>2/23/93</u>	<u>2/23/93</u>	<u>3/15/94</u>
Analyst	Helz	Helz	Helz	Helz	Helz	Helz	Helz
# points	10	10	10	7 (R)	10	10	6
SiO ₂	50.68	51.16	50.71	50.81	(52.29)	(51.54)	50.94
TiO ₂	2.52	2.60	2.51	2.56	2.52	2.54	2.57
Al ₂ O ₃	13.86	13.76	13.84	13.79	13.78	13.79	13.79
Cr ₂ O ₃	.02	(.01)	.03	.04	.03	.04	.03
FeO	10.97	11.18	10.92	10.99	11.11	11.13	10.81
MnO	.18	.18	.19	.17	.18	.17	.17
MgO	6.91	6.86	6.99	6.97	7.01	6.99	6.88
CaO	11.35	11.35	11.23	11.32	11.32	11.33	11.32
Na ₂ O	2.39	2.40	2.31	2.40	2.42	2.43	2.32
K ₂ O	.43	.45	.43	.42	.44	.45	.44
P ₂ O ₅	.22	.25	.21	.24	.22	.20	.23
Sum	99.53	100.20	99.37	99.71	101.32	100.61	99.50
Sulfur	--	.020	--	.018	0.027	0.017	.015
TMgO	1152	1152	1154	1154	1155	1154	1152
TCaO	1158	1158	1155	1157	1157	1157	1157
Comments							

Table 3. Glasses from episodes 50-53 of the Kilauea east rift eruption (continued)

Date Erupted	6/13/92	6/13/92	6/24/92	7/2/92	7/2/92	7/2/92	7/2/92	7/29/92
Episode #	51	51	51	51	51	51	51	51
Sample #	1391S	1391S	1393S	1394F	1395F	1395F	1396F	1397S
Sample type								
Date Analyzed	<u>2/4/94</u>	<u>6/15/94</u>	<u>2/5/94</u>	<u>2/5/94</u>	<u>11/24/92</u>	<u>2/4/94</u>	<u>2/5/94</u>	<u>11/24/92</u>
Analyst	Hearn	Helz	Hearn	Hearn	Helz	Hearn	Hearn	Helz
# points	10	8(R)	10	11	10	10(R)	10	10
SiO ₂	50.70	50.94	50.98	51.14	50.98	51.54	50.95	50.84
TiO ₂	2.55	2.57	(2.68)	2.57	2.53	2.55	2.58	2.54
Al ₂ O ₃	13.59	13.74	13.55	13.71	14.01	13.69	13.77	13.96
Cr ₂ O ₃	.02	.04	.04	.04	.03	.01	.02	.02
FeO	10.98	11.05	10.99	11.00	11.17	11.02	11.05	11.17
MnO	.17	.16	.18	.18	.17	.18	.18	.16
MgO	6.90	7.03	6.90	6.81	6.88	6.78	6.81	7.01
CaO	11.21	11.33	11.25	11.33	11.16	11.25	11.35	(11.08)
Na ₂ O	2.37	2.47	2.38	2.42	2.37	2.40	2.41	2.36
K ₂ O	.43	.45	.41	.42	.43	.44	.42	.42
P ₂ O ₅	.22	.23	.22	.22	.21	.23	.23	.20
Sum	99.14	100.01	99.58	99.84	99.94	100.09	99.77	99.76
Sulfur	.018	.019	.025	.015	--	.012	.015	--
TMgO	1152	1155	1152	1150	1152	1149	1150	1155
TCaO	1155	1157	1156	1157	1154	1156	1158	--
Comments								I+ol+cpx

Table 3. Glasses from episodes 50-53 of the Kilauea east rift eruption, cont.

Date Erupted	Episode #	Sample #	Sample type	Date Analyzed	Analyst	# points	SiO ₂	TiO ₂	Al ₂ O ₃	Cr ₂ O ₃	FeO	MnO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	Sum	Sulfur	TMgO	TCaO	Comments
9/8/92	51	1400F	tube spatter	<u>3/12/94</u>	Hearn	12	50.66	2.57	13.81	.03	11.10	.17	6.98	11.25	2.52	.44	.23	99.76	.019	1154	1156	
10/4/92	51	1404S		<u>2/23/93</u>	Helz	10	50.75	2.62	13.77	.03	11.15	.18	6.85	11.24	2.44	.44	.24	99.71	0.027	1152	1156	
10/3/92	52	1401S		<u>11/24/92</u>	Helz	10	50.57	2.51	14.02	.03	11.18	.17	6.91	11.17	2.37	.44	.20	99.57	--	1152	1155	
10/3/92	52	1402T		<u>11/24/92</u>	Helz	9	50.44	2.51	14.09	.05	11.15	.17	6.94	11.26	2.34	.44	.20	99.59	--	1153	1156	
11/12/92	51	1407F	skylight at 2350'	<u>3/12/94</u>	Hearn	12	50.52	2.58	13.70	.04	11.23	.17	6.94	11.30	2.51	.44	.23	99.66	.015	1153	1157	
11/19/92	51	1408S	Kamoamoalittoral	<u>3/12/94</u>	Hearn	12	50.96	2.64	13.75	.02	11.14	.18	6.78	11.23	2.53	.47	.23	99.93	.013	1149	1155	
12/15/92	51	1411F	skylight at 2350'	<u>6/15/94</u>	Helz	9	51.23	2.59	13.70	.04	(11.47)	.18	6.99	11.38	2.48	.44	.21	100.71	.017	1154	1158	
12/29/92	51	1413F	skylight at 2350'	<u>3/12/94</u>	Hearn	12	50.69	2.50	13.62	.02	11.01	.17	7.13	11.28	2.49	.44	.23	99.58	.015	1157	--	L+ol+cpx

Table 3. Glasses from episodes 50-53 of the Kilauea east rift eruption (continued)

Date Erupted	1/26/93	2/21/93	3/4/93	3/8/93	3/8/93	3/11/93	3/18/93	3/25/93
Episode #	51	53	53	53	53	53	53	53
Sample #	1414F	1421S	1423F	1424T	1424T	1426S	1425F	1427F
Sample type	skylight at 2350'	vent spatter	skylight at 2010'	Pu'u O'o tephra			skylight at 2010'	skylight at 2010'
Date Analyzed	<u>6/15/94</u>	<u>9/7/94</u>	<u>6/15/94</u>	<u>3/15/94</u>	<u>4/19/94</u>	<u>4/19/94</u>	<u>4/20/94</u>	<u>9/8/94</u>
Analyst	Helz	Helz	Helz	Helz	Helz	Helz	Helz	Helz
# points	10	7	10	6	8 (R)	10	10	9
SiO ₂	51.44	51.11	51.32	50.79	51.19	51.07	51.30	51.08
TiO ₂	2.38	2.50	2.55	2.53	2.49	2.45	2.56	2.59
Al ₂ O ₃	13.70	13.73	13.83	13.77	13.67	13.54	13.79	13.84
Cr ₂ O ₃	.04	(.01)	.04	.03	.04	.03	.03	(.01)
FeO	11.08	11.06	10.92	10.94	(11.28)	10.97	11.08	11.13
MnO	.18	.19	.16	.18	.17	.17	.18	.17
MgO	7.13	7.12	6.84	7.05	7.09	7.08	6.87	6.83
CaO	11.40	11.47	11.39	11.29	11.26	11.27	11.39	11.37
Na ₂ O	2.46	2.37	2.50	2.32	2.42	2.38	2.33	2.50
K ₂ O	.44	.43	.47	.47	.45	.45	.43	.44
P ₂ O ₅	.22	.23	.23	.22	.23	.22	.23	.22
Sum	100.47	100.22	100.25	99.59	100.29	99.63	100.19	100.18
Sulfur	.015	.019	.013	.018	.015	.018	.014	.005
TMgO	1157	1157	1151	1155	1156	1156	1152	1151
TCaO	--	--	1158	--	--	--	1158	1158
Comments	L+ol+cpz	L+ol+cpz	L+ol+cpz	L+ol+cpz	L+ol+cpz	L+ol+cpz	L+ol+cpz	L+ol+cpz

Table 3. Glasses from episodes 50-53 of the Kilauea east rift eruption(continued)

Date Erupted	4/9/93	4/16/93	4/16/93	4/16/93	4/16/93	4/16/93	4/16/93
Episode #	53	53	53	53	53	53	53
Sample #	1429F	1430F	1430F	1430F	1431F	1431F	1431F
Sample type	skylight	skylight at 2010'	skylight at 2010'	---	skylight at 2360'	---	---
Date Analyzed	<u>2/3/95</u>	<u>8/23/93</u>	<u>4/20/94</u>	<u>4/20/94</u>	<u>8/22/93</u>	<u>4/20/94</u>	<u>---</u>
Analyst	Helz	Helz	Hearn	Cashman	Helz	Hearn	Cashman
# points	10	10	10 (R)	?	10	10 (R)	?
SiO ₂	50.74	50.85	51.15	50.88	50.77	50.92	50.91
TiO ₂	2.53	2.56	2.51	2.51	(2.60)	2.48	2.53
Al ₂ O ₃	13.72	13.74	13.82	13.74	13.61	13.58	13.61
Cr ₂ O ₃	.03	.02	.04	---	.04	.04	---
FeO	10.98	11.04	10.93	10.96	10.92	10.87	10.60
MnO	.17	---	.17	.19	---	.17	.19
MgO	6.89	6.83	6.81	6.70	7.11	7.06	6.99
CaO	11.36	11.23	11.34	11.22	11.26	11.37	11.24
Na ₂ O	2.49	2.37	2.38	2.32	2.36	2.35	2.29
K ₂ O	.44	(.47)	.44	.44	.44	.42	.44
P ₂ O ₅	.24	(.27)	.23	.20	.20	.24	.25
Sum	99.59	99.38	99.82	99.16	99.31	99.50	99.05
Sulfur	.009	.010	0.009	---	.012	0.018	---
TMgO	1152	1151	1151	1148	1157	1156	1154
TCaO	1158	1155	1157	1155	---	---	---
Comment							L+ol+cpx

Table 3. Glasses from episodes 50-53 of the Kilauea east rift eruption (continued)

Date Erupted	4/16/93	4/16/93	4/16/93	4/16/93	4/16/93	4/16/93	4/16/93
Episode #	53	53	53	53	53	53	
Sample #	1432F	1433F	1433F	1433F	1436F	1436F	1436F
Sample type							
Date Analyzed	<u>11/17/94</u>	<u>8/22/93</u>	<u>4/20/94</u>	<u>4/20/94</u>	<u>8/22/93</u>	<u>4/20/94</u>	--
Analyst	Hearn	Helz	Hearn	Cashman	Helz	Hearn	Cashman
# points	12	10	10 (R)	--	10	10 (R)	?
SiO ₂	50.83	(50.71)	51.01	51.12	50.96	51.04	50.92
TiO ₂	2.54	2.53	2.50	2.44	2.59	2.51	2.44
Al ₂ O ₃	13.58	13.53	13.77	13.65	13.66	13.80	13.65
Cr ₂ O ₃	.04	.04	.03	--	.03	.03	--
FeO	10.91	10.99	11.01	10.69	11.09	11.09	10.78
MnO	.18	--	.18	.19	--	.17	.17
MgO	7.02	6.81	6.82	6.69	6.82	6.81	6.73
CaO	11.22	11.26	11.41	11.28	11.37	11.36	11.29
Na ₂ O	2.26	2.34	2.37	2.30	2.31	2.40	2.35
K ₂ O	.43	.44	.43	.46	.44	.43	.44
P ₂ O ₅	.23	(.28)	.22	.25	.24	.24	.23
Sum	99.24	98.93	99.75	99.07	99.51	99.88	99.00
Sulfur	.017	(.005)	.011	--	.012	.016	--
TMgO	1155	1151	1151	1147	1151	1151	1148
TCaO	1155	1156	1159	1156	1158	1158	1156
Comments							

Table 3. Glasses from episodes 50-53 of the current Kilauea east rift eruption (continued)

Date Erupted	5/6/93	5/12/93	5/27/93	6/10/93	6/17/93	6/24/93	6/24/93	7/8/93
Episode #	53	53	53	53	53	53	53	53
Sample #	1440F	1441T	1442F	1444F	1445T	1447S	1448F	1450F
Sample type	skylight at 2350'	Pu'u O'o tears	skylight at 2010'	skylight at 2010'	Pu'u O'o tears	littoral spatter	skylight at 2010'	skylight at 2010'
Date Analyzed	<u>2/3/95</u>	<u>4/20/94</u>	<u>11/18/94</u>	<u>11/18/94</u>	<u>4/19/94</u>	<u>2/3/95</u>	<u>6/16/94</u>	<u>11/17/94</u>
Analyst	Helz	Hearn	Hearn	Hearn	Helz	Helz	Helz	Hearn
# points	10	8	12	12	5	9	10	12
SiO ₂	50.94	51.34	50.90	50.93	50.81	50.80	51.66	50.94
TiO ₂	2.49	2.56	2.52	2.49	2.48	2.52	2.54	2.52
Al ₂ O ₃	13.71	13.70	13.65	13.58	13.65	13.67	13.62	13.60
Cr ₂ O ₃	.05	.04	.03	.02	.03	.03	.04	.05
FeO	10.95	10.97	11.08	(10.23)	10.96	10.94	11.12	11.06
MnO	.17	.18	.16	.18	.18	.18	.18	.18
MgO	7.08	7.11	6.68	6.85	7.23	6.79	6.98	6.89
CaO	11.31	11.31	11.37	11.30	11.33	11.39	11.43	11.27
Na ₂ O	2.48	2.31	2.22	2.25	2.40	2.48	2.46	2.20
K ₂ O	.42	.42	.44	.43	.41	.41	.44	.42
P ₂ O ₅	.23	.22	.23	.23	.23	.23	.23	.22
Sum	99.83	100.16	99.28	98.49	99.71	99.44	100.70	99.35
Sulfur	.013	0.020	.012	.016	0.014	.016	.015	.018
TMgO	1156	1157	1148	1149	1159	1149	1154	1153
TCaO	--	--	1158	1157	--	1158	1159	1156
Comment	L+ol+cpz	L+ol+cpz			L+ol+cpz			

Table 3. Glasses from episodes 50-53 of the current Kilauea east rift eruption (continued)

Date Erupted	7/14/93	8/17/93	8/31/93	9/7/93	9/15/93	10/4/93	10/11/93	10/22/93
Episode #	53	53	53	53	53	53	53	53
Sample #	1451T	1455T	1459T	1463T	1464T	1468T	1469T	1473T
Sample type	tephra Pu'u O'o	Pu'u O'o tears	Pu'u O'o tears	Pu'u O'o tears	Pu'u O'o tears	Pu'u O'o tears	Pu'u O'o tears	Pu'u O'o tears
Date Analyzed	<u>3/13/95</u>	<u>6/16/94</u>	<u>12/29/94</u>	<u>12/30/94</u>	<u>12/30/94</u>	<u>12/30/94</u>	<u>12/29/94</u>	<u>12/29/94</u>
Analyst	Helz	Helz	Hearn	Hearn	Hearn	Hearn	Hearn	Hearn
# points	10	9	10	10	10	10	9	10
SiO ₂	50.67	50.98	50.57	50.82	50.42	50.98	50.69	50.64
TiO ₂	2.51	2.58	2.46	2.47	2.44	2.46	2.46	2.45
Al ₂ O ₃	13.58	13.40	13.46	13.51	13.46	13.59	13.52	13.53
Cr ₂ O ₃	(.01)	.04	.04	.05	.04	.06	.04	.04
FeO	11.01	10.95	10.99	10.95	10.75	10.94	10.92	10.95
MnO	.18	.18	.18	.17	.17	.17	.17	.17
MgO	7.17	7.11	7.19	7.18	7.14	7.15	7.10	7.11
CaO	11.38	11.38	11.23	11.25	11.09	11.28	11.32	11.34
Na ₂ O	2.51	2.35	2.53	2.44	2.42	2.44	2.54	2.49
K ₂ O	.42	.44	.42	.42	.40	.42	.40	.42
P ₂ O ₅	.22	.22	.21	.22	.21	.23	.22	.23
Sum	99.66	99.63	99.28	99.48	98.54	99.72	99.38	99.37
Sulfur	.013	0.019	.022	.022	0.015	.019	.016	.015
TMgO	1158	1156	1158	1158	1157	1157	1156	1156
TCaO	--	--	--	--	--	--	--	--
Comment	L+ol+cpx	L+ol+cpx	L+ol+cpx	L+ol+cpx	L+ol+cpx	L+ol+cpx	L+ol+cpx	L+ol+cpx

Table 3. Glasses from episodes 50-53 of the current Kilauea east rift eruption (continued)

Date Erupted	11/10/93	11/28/93	12/18/93	1/15/94	1/15/94	1/15/94	2/1/94
Episode #	53	53	53	53	53	53	53
Sample #	1477T	1480T	1482T	1484T	1484T	1484T	1487T
Sample type	Pu'u O'o tears	Pu'u O'o tears	Pu'u O'o tears	Pu'u O'o tears	Pu'u O'o tears	Pu'u O'o tears	Pu'u O'o tears
<u>Date Analyzed</u>	<u>12/30/94</u>	<u>11/28/93</u>	<u>3/13/95</u>	<u>2/22/95</u>	<u>3/14/95</u>	<u>5/4/95</u>	<u>2/22/95</u>
Analyst	Hearn	Hearn	Helz	Hearn	Helz	Helz	Hearn
# points	10	10	9	10	6 (R)	7 (R)	10
SiO ₂	50.65	50.74	50.73	50.91	50.56	50.62	50.60
TiO ₂	2.40	2.48	2.55	2.56	2.50	2.51	2.48
Al ₂ O ₃	13.57	13.73	13.79	13.71	13.63	13.77	13.48
Cr ₂ O ₃	.04	.04	(.01)	.05	.03	.05	.04
FeO	10.98	10.96	11.04	10.99	10.93	11.02	11.00
MnO	.17	.17	.17	.17	.18	.16	.18
MgO	7.06	6.99	6.91	6.95	7.02	6.92	6.91
CaO	11.36	11.31	11.35	11.23	11.31	11.29	11.33
Na ₂ O	2.47	2.49	2.51	2.48	2.51	2.49	2.48
K ₂ O	.42	.42	.42	.43	.41	.43	.42
P ₂ O ₅	.23	.22	.21	.22	.23	.23	.23
Sum	99.35	99.55	99.69	99.70	99.31	99.49	99.15
Sulfur	0.016	0.016	0.015	(0.051)	(0.070)	0.015	.034
TMgO	1155	1154	1152	1153	1154	1152	1152
TCaO	--	1157	1158	1155	1157	1156	1157
Comment	L+ol+cpx						

Table 3. Glasses from episodes 50-53 of the current Kilauea east rift eruption (continued)

Date Erupted	2/28/94	2/28/94	2/28/94	3/16/94	4/17/94	5/4/94	6/9/94	6/30/94
Episode #	53	53	53	53	53	53	53	53
Sample #	1492T	1492T	1492T	1497T	1502T	1506T	1513T	1516T
Sample type		Pu'u O'o tears		Pu'u O'o tears	Pu'u O'o tears	Pu'u O'o tears	Pu'u O'o tears	Pu'u O'o tears
Date Analyzed	<u>2/22/95</u>	<u>3/14/95</u>	<u>5/4/95</u>	<u>3/13/95</u>	<u>2/22/95</u>	<u>2/2/95</u>	<u>2/3/95</u>	<u>3/14/95</u>
Analyst	Hearn	Helz	Helz	Helz	Hearn	Helz	Helz	Helz
# points	10	8 (R)	10 (R)	7	10	10	8	10
SiO ₂	51.12	51.09	50.54	50.61	51.13	50.61	50.69	50.94
TiO ₂	2.53	2.51	2.52	2.52	2.50	2.49	2.54	2.60
Al ₂ O ₃	13.71	13.60	13.72	13.48	13.74	13.56	13.69	13.75
Cr ₂ O ₃	.05	.03	.05	(.01)	.04	.03	.04	.02
FeO	11.00	11.06	11.04	10.96	11.04	10.97	11.00	11.08
MnO	.16	.18	.18	.19	.17	.17	.18	.17
MgO	7.05	7.16	7.06	6.92	6.96	6.80	6.73	6.76
CaO	11.41	11.38	11.36	11.35	11.40	11.21	11.21	11.25
Na ₂ O	2.54	2.54	2.46	2.54	2.51	2.48	2.49	2.50
K ₂ O	.43	.42	.43	.43	.43	.43	.45	.45
P ₂ O ₅	.23	.24	.23	.23	.23	.23	.24	.25
Sum	100.23	100.21	99.59	99.24	100.15	98.98	99.26	99.77
Sulfur	.019	0.014	.014	.013	0.020	.027	.014	.012
TMgO	1155	1158	1155	1152	1153	1150	1148	1149
TCaO	--	--	--	1158	1158	1155	1155	1156
Comment	L+ol+cpx							

Table 3. Glasses from episodes 50-53 of the current Kilauea east rift eruption (continued)

Date Erupted	7/4/94	7/11/94	8/3/94	8/1/94	8/12/94	8/18/94	10/13/94
Episode #	53	53	53	53	53	53	53
Sample #	1517T	1519F	1523F	1525T	1528T	1527F	1538F
Sample type	Pu'u O'o tears	phh toe	phh toe	Pu'u O'o tears	Pu'u O'o tears	phh toe	skylight at 2250'
<u>Date Analyzed</u>	<u>2/22/95</u>	<u>3/14/95</u>	<u>3/14/95</u>	<u>2/22/95</u>	<u>2/22/95</u>	<u>3/25/95</u>	<u>3/14/95</u>
Analyst	Hearn	Helz	Helz	Hearn	Hearn	Hearn	Helz
# points	9	10	10	10	10	10	10
SiO ₂	50.84	51.10	50.62	50.70	51.16	51.00	51.14
TiO ₂	2.53	2.63	2.68	2.55	2.52	2.68	2.54
Al ₂ O ₃	13.73	13.60	13.40	13.58	13.74	13.60	13.65
Cr ₂ O ₃	.04	.01	.01	.05	.04	.02	.04
FeO	11.00	11.21	10.94	10.99	11.04	11.15	11.06
MnO	.18	.19	.18	.17	.18	.18	.18
MgO	6.84	6.70	6.62	6.93	6.94	6.68	6.94
CaO	11.27	11.30	10.96	11.23	11.36	11.19	11.40
Na ₂ O	2.43	2.46	2.54	2.45	2.57	2.77	2.61
K ₂ O	.43	.45	.44	.42	.43	.47	.44
P ₂ O ₅	.23	.25	.25	.23	.22	.25	.25
Sum	99.52	99.90	98.64	99.30	100.20	99.99	100.25
Sulfur	.016	0.012	.011	.016	0.019	.016	.015
TMgO	1151	1148	1146	1152	1153	1148	1153
TCaO	1156	1157	1151	1155	1158	1155	1158

Comment

Table 3. Glasses from episodes 50-53 of the current Kilauea east rift eruption (continued)

Date Erupted	10/26/94	10/26/94	10/28/94	10/28/94	11/4/94	11/10/94	11/17/94	11/17/94
Episode #	53	53	53	53	53	53	53	53
Sample #	1545F	1545F	1546F	1546F	1550F	1552F	1553F	1553F
Sample type	skylight at 2250'	skylight at 2250'	skylight at 2250'	skylight at 2250'	skylight at 2250'	skylight at 2250'	skylight at 2250'	skylight at 2250'
<u>Date analyzed</u>	<u>3/23/95</u>	<u>3/24/95</u>	<u>3/23/95</u>	<u>3/24/95</u>	<u>3/23/95</u>	<u>3/14/95</u>	<u>3/23/95</u>	<u>3/24/95</u>
Analyst	Hearn	Hearn	Hearn	Hearn	Hearn	Helz	Hearn	Hearn
# points	10	10 (R)	10	10 (R)	10	10	10	10 (R)
SiO ₂	51.07	51.29	51.25	50.88	51.47	50.84	51.04	50.72
TiO ₂	2.93	2.83	2.60	2.55	2.59	2.57	2.56	2.49
Al ₂ O ₃	13.21	13.33	13.88	13.75	(14.02)	13.77	13.76	13.63
Cr ₂ O ₃	.00	.01	.04	.04	.03	.03	.03	.05
FeO	11.84	11.82	10.97	10.95	11.10	11.19	11.00	10.99
MnO	.18	.18	.18	.18	.18	.18	.17	.19
MgO	6.24	6.27	6.83	6.73	6.77	6.83	6.83	6.74
CaO	10.68	10.68	11.20	11.12	11.22	11.33	11.28	11.20
Na ₂ O	2.49	2.61	2.56	2.56	2.38	2.34	(2.63)	2.52
K ₂ O	.49	.51	.44	.46	.44	.44	.43	.45
P ₂ O ₅	.26	.29	.23	.24	.24	.24	.24	.24
Sum	99.39	99.82	100.18	99.46	100.44	99.86	99.97	99.22
Sulfur	(.006)	0.018	(.011)	.026	0.019	.015	(.014)	.027
TMgO	1139	1140	1151	1148	1149	1151	1151	1148
TCaO	1146	1146	1155	1153	1155	1157	1156	1155
Comment								

Table 3. Glasses from episodes 50-53 of the current Kilauea east rift eruption (continued)

Date Erupted	11/22/94	12/1/94	12/8/94
Episode #	53	53	53
Sample #	1554F	1557F	1558F
Sample type	skylight at 2250'	skylight at 2250'	skylight at 2250'
<u>Date Analyzed</u>	<u>3/24/95</u>	<u>3/25/95</u>	<u>3/14/95</u>

Analyst Hearn Hearn Helz

# points	10	10	10
SiO ₂	50.78	51.13	51.02
TiO ₂	2.61	2.64	2.57
Al ₂ O ₃	13.81	13.69	13.57
Cr ₂ O ₃	.03	.04	.03
FeO	10.99	11.04	11.03
MnO	.18	.17	.17
MgO	6.75	6.60	6.87
CaO	11.24	11.15	11.42
Na ₂ O	2.32	2.69	2.61
K ₂ O	.44	.46	.44
P ₂ O ₅	.25	.24	.26
Sum	99.40	99.85	99.99

Sulfur .021 0.027 .013

TMgO 1148 1146 1152

TCaO 1156 1154 1158

Comment