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Chemical Analyses of pre-Mazama Silicic Volcanic Rocks, Inclusions, and Glass Separates, Crater Lake, Oregon

by

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Introduction

This report contains chemical analyses of dacite and rhyodacite lava flows that are older than the volcanic edifice of Mount Mazama (Bacon, 1983). Analyses of groundmass glass separated from rhyodacite vitrophyres and of bulk samples of magmatic inclusions in rhyodacites and dacites (Bacon, 1986) are also given. All analyzed samples were collected by C. R. Bacon and co-workers, including M.H. Moench [1982], C.A. Michelsen [1983], M.M. Hirschmann [1985], A.E. Gartner [1986, 1987], M.H. Price [1987], S.R. Young [1987], S. Nakada [1990], and S. B. McKnight [1992]; one sample (CD212-2) was collected by M. Buktenica with the submersible, Deep Rover [1989]. The analytical data are intended to supplement a paper by Nakada and others (in press) on the geology and petrology of these rocks.

Analytical methods

The major- and trace-element (Rb, Sr, Y, Zr, and Ba) contents of 108 samples have been analyzed by x-ray fluorescence. Of these, 47 (including all 8 glass separates and their host rocks, and most of the 16 inclusions) have been analyzed for Nb and additional trace elements. Chemical analyses are given in Table 1; sample number prefixes give the year of collection. Sample localities are shown in Figure 1 and coordinates are given in Table 1. Table 1 also gives map units used by Nakada and others (in press) and materials analyzed (see below). After breaking into centimeter-sized fragments with a hammer and discarding weathered or texturally anomalous fragments, rock samples were crushed in a jaw crusher equipped with alumina plates. The crushed samples generally were ground in an alumina shatterbox, except that some samples not used for INAA were ground in a tungsten carbide shatterbox. Glass separates were prepared from crushed vitrophyres using conventional heavy liquid and magnetic separation methods, and were checked for purity by observing grains mounted in oil with a petrographic microscope and hand picked

if necessary. Glass separates were ground in an agate mortar. All chemical analyses were made in USGS laboratories.

Major elements were determined by wavelength-dispersive X-ray fluorescence spectrometry (WDXRF) in Lakewood, Colorado (Taggart and others, 1987). Na_2O and K_2O were measured by flame photometry (Jackson and others, 1987) in a subset of the samples (indicated in Table 1). Rb, Sr, Y, Zr, and Ba were determined by energy-dispersive X-ray fluorescence spectrometry (Johnson and King, 1987). Nb analyses for most samples collected before 1987 were made by spectrophotometry; other Nb analyses were made by inductively coupled-plasma atomic emission spectrometry (ICP) following chemical separation. Emission spectrographic methods (Golightly and others, 1987) were used to determine Cu, Ga, Ni, and V in a few samples. Instrumental neutron activation analysis (INAA) was used to obtain concentrations of Co, Cr, Cs, Hf, Sb, Ta, Th, U, Zn, Sc, La, Ce, Nd, Sm, Eu, Tb, Yb, and Lu (Baedecker and McKown, 1987).

Precision and accuracy

Precision was measured by repeated analysis of internal standards. Means and standard deviations for repeated determinations of concentrations in representative rock standards are given by Bacon and Druitt (1988) and in Table 2 of Bruggman and others (1987). Precision of wet chemical and ICP Nb determinations was not monitored by this method; for these techniques data are reported to a number of significant figures justified by experience with the particular technique employed and concentration range encountered.

Accuracy was addressed by Bruggman and others (1987). Trace element concentrations determined for USGS standards generally agree with accepted values to within limits of measured precision. Major element data compare favorably with analyses by other laboratories of the same rock powders or of samples collected from the same outcrops, suggesting that the analyses are probably accurate to within the measured precision. Na_2O is an exception in that the WDXRF values prior to 1987 were consistently

about 5% low relative to flame photometric values and some more recent WDXRF values are low by 2-3%. To correct for this bias we have used flame photometric Na_2O and K_2O values where available and have multiplied remaining (WDXRF) Na_2O values by an appropriate factor to bring them into agreement with flame photometric data.

Map units

The map unit indicated for each sample in Table 1 is that used by Nakada and others (in press). There are three main units composed of rhyodacitic lava flows: rhyodacite of Pothole Butte (rpb), rhyodacite south of Crater Peak (rscp), and rhyodacite of Scott Creek (rsc). Division of pre-Mazama rhyodacites into these units is based on chemical composition. A fourth unit, the rhyodacite west of Cavern Creek (rcc), is represented by only one rock sample (82C-768) and glass separated from it. Dacite units are: dacite of Dry Butte (ddb), dacite of Sand Creek (dsc), and dacite west of The Pinnacles (dwp). Andesite or basaltic andesite inclusions have been found in silicic lavas of many of the map units. Such inclusions are abundant in the dacite west of The Pinnacles. Andesite lava (92C-1751) is believed to be representative of the mafic end member in mingled rhyodacite and andesite south of Bear Bluff (west of the area of Figure 1); samples 92C-1749 and 1750 are representative of the silicic end member, which is compositionally similar to rhyodacite of Scott Creek; 92C-1748 is a hybrid(?) pumice.

Analyzed samples

Figure 1 is a generalized geologic and sample locality map of the eastern and southern parts of the Crater Lake area (after Nakada and others, in press). The andesite and dacite composite volcano of Mount Mazama is the most prominent edifice. Pre-Mazama dacite and rhyodacite flows and domes occur within ~15 km of the caldera on the east and about ~10 km on the south. Constructional landforms of steep-sided domes and thick lava flows generally are preserved but original pumiceous carapaces have been

removed by erosion. Many landforms have been glacially modified but, with few exceptions, glaciation did not alter morphology so greatly as to obscure primary forms.

Except in glaciated canyon walls, pre-Mazama silicic lavas are poorly exposed, forming isolated weathered outcrops protruding from a thick Holocene pyroclastic blanket on forested slopes and, especially, on summits. Lava flows from Mount Mazama, and various Holocene pyroclastic deposits, overlie the dacites and rhyodacites. The pre-Mazama rhyodacites lie on basaltic andesite flows and monogenetic cones in the southwest and northeast parts of Figure 1, and are locally overlain by andesite and basaltic andesite of monogenetic cones (Bacon, 1990). The rhyodacites overlie and abut the earlier dacites of Dry Butte and dacites west of The Pinnacles. Further information on field relations may be found in Nakada and others (in press).

Table 1 designates the material analyzed for each analysis. The term "vitrophyre" has been used for dense, glassy porphyritic rhyodacite. Glass separates were made from many of the vitrophyre samples so that the glass compositions could be used to approximate those of the silicate liquid phase at the time of eruption. A second use of the glass data would be for correlation with tephra deposits because glass shards found in ashfall deposits should have the same composition as the groundmass glass separated from vitrophyre erupted in the same event. The rest of the silicic rock samples, with the exception of one pumice block, have been labeled "felsite". In actuality, these samples include a variety of materials: dense rocks with microlitic groundmasses containing small amounts of residual glass; holocrystalline, true felsites; and porous, commonly somewhat oxidized, devitrified rocks that experienced "vapor phase" crystallization. Weathering has affected some rock samples, particularly those that are porous.

The analyzed inclusions are all believed to be examples of undercooled magmas which were incompletely mixed with their cooler, host silicic lavas shortly before or during transport to the surface. Most have few phenocrysts, and are thus representative of basaltic andesitic and andesitic liquids that coexisted with the silicic magmas. With the exception of

the dacite west of The Pinnacles, such inclusions are generally rare in the silicic lavas of this study.

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Sample#	81C-534	82C-676	82C-677	82C-678	82C-679	82C-681	82C-682	82C-682G	82C-683	82C-686
Unit	rpb	rsc	rsc	rsc	rsc	rsc	rsc	rsc	rsc	rsc
Rock type	vitrophyre	felsite	felsite	felsite	felsite	felsite	vitrophyre	glass sep.	felsite	felsite
Latitude	42° 51.08'	42° 53.53'	42° 53.56'	42° 53.72'	42° 54.05'	42° 53.56'	42° 53.69'	42° 53.69'	42° 54.21'	42° 54.21'
Longitude	122° 04.60'	121° 55.79'	121° 55.83'	121° 56.12'	121° 56.62'	121° 56.89'	121° 56.45'	121° 56.45'	121° 57.40'	121° 57.79'
flame Ph								N		
					Major Elements					
weight %										
SiO_2	71.3	67.7	66.9	66.9	68.9	68.5	67.3	73.0	68.0	68.0
Al_2O_3	14.4	15.5	15.2	15.2	15.0	15.5	15.7	13.3	15.2	15.6
Fe_2O_3*	2.45	3.25	3.2	3.21	2.98	3.28	3.30	1.36	3.14	3.15
MgO	0.62	1.03	1.03	1.04	0.84	0.90	1.09	0.23	1.07	0.89
CaO	1.81	2.75	2.80	2.76	2.62	2.42	2.84	0.96	2.66	2.53
Na_2O	5.04	4.66	4.43	4.42	4.66	5.46	4.85	3.48	4.77	4.66
K_2O	2.80	2.43	2.67	2.70	2.59	2.37	2.49	4.81	2.52	2.49
TiO_2	0.45	0.50	0.50	0.49	0.47	0.50	0.50	0.24	0.49	0.49
P_2O_5	0.09	0.13	0.13	0.13	0.14	0.13	0.13	0.05	0.13	0.13
MnO	0.05	0.06	0.06	0.06	0.05	0.07	0.06	0.02	0.06	0.06
LOI	0.70	0.66	1.70	1.69	0.35	0.45	0.86	1.85	0.46	0.75
Total	99.71	98.67	98.62	98.60	98.60	99.58	99.12	99.30	98.50	98.75
					Trace Elements					
ppm										
Ba	837	799	780	763	777	807	832	970	768	874
Co	3.2	--	--	--	--	4.4	--	1.5	--	--
Cr	1.1	--	--	--	--	2.2	--	--	--	--
Cs	3.3	--	--	--	--	1.1	--	4.3	--	--
Cu	12	--	--	--	--	10	--	--	--	--
Ga	18	--	--	--	--	19	--	--	--	--
Hf	6.1	--	--	--	--	5.1	--	6.9	--	--
Nb	5.7	--	--	--	--	5.5	--	8.2	--	--
Ni	3.9	--	--	--	--	5.4	--	--	--	--
Rb	57	42	55	55	56	35	43	131	53	37
Sb	1.5	--	--	--	--	0.4	--	0.8	--	--
Sc	6.63	--	--	--	--	7.84	--	4.33	--	--
Sr	243	338	336	323	324	295	332	123	325	320
Ta	0.57	--	--	--	--	0.51	--	0.68	--	--
Th	5.7	--	--	--	--	4.9	--	8.5	--	--
U	2.3	--	--	--	--	1.8	--	3.1	--	--
V	29	--	--	--	--	38	--	--	--	--
Y	27	21	23	26	25	24	27	29	26	23
Zn	43	--	--	--	--	51	--	40	--	--
Zr	237	205	202	207	206	207	214	234	204	215
La	21	--	--	--	--	18	--	24	--	--
Ce	42	--	--	--	--	38	--	49	--	--
Nd	18	--	--	--	--	16	--	21	--	--
Sm	3.9	--	--	--	--	3.8	--	4.7	--	--
Eu	0.83	--	--	--	--	0.96	--	0.68	--	--
Tb	0.55	--	--	--	--	0.56	--	0.68	--	--
Yb	2.3	--	--	--	--	2.1	--	3.2	--	--
Lu	0.36	--	--	--	--	0.32	--	0.48	--	--

NOTE: N or NK means Na_2O contents or Na_2O and K_2O contents determined by flame photometer.

Sample#	82C-687	82C-688	82C-690	82C-691	82C-692	82C-693	82C-704	82C-707	82C-708	82C-709
Unit	rsc	rsc	rsc	rsc	rsc	rpb	rpb	rpb	rsc	rpb
Rock type	felsite	felsite	felsite	inclusion	felsite	felsite	felsite	felsite	felsite	felsite
Latitude	42° 54.41'	42° 54.73'	42° 53.37'	42° 53.37'	42° 53.08'	42° 52.76'	42° 58.53'	42° 56.65'	42° 56.53'	42° 57.03'
Longitude	121° 58.02'	121° 58.19'	121° 59.30'	121° 59.30'	121° 58.79'	121° 56.78'	121° 56.00'	121° 54.28'	121° 54.20'	121° 56.45'
flame Ph										
					Major Elements					
weight %										
SiO_2	69.0	69.2	68.7	55.3	67.9	70.6	70.2	71.1	67.6	69.7
Al_2O_3	15.3	14.9	15.1	17.8	15.1	14.6	14.7	14.2	15.5	13.9
Fe_2O_3*	2.97	3.09	3.39	8.09	3.31	2.46	2.64	2.55	3.43	2.45
MgO	0.82	0.68	1.02	3.73	0.92	0.44	0.54	0.55	1.10	0.63
CaO	2.33	2.25	2.59	7.26	2.63	1.78	1.70	1.81	2.90	1.81
Na_2O	4.75	4.68	4.67	3.78	4.53	4.69	4.60	4.67	4.55	4.48
K_2O	2.50	2.57	2.49	1.04	2.51	2.84	2.86	2.80	2.48	2.85
TiO_2	0.47	0.45	0.52	1.04	0.49	0.39	0.46	0.43	0.52	0.42
P_2O_5	0.14	0.12	0.16	0.30	0.12	0.08	0.08	0.10	0.12	0.09
MnO	0.07	0.06	0.06	0.13	0.06	0.03	0.05	0.05	0.06	0.05
LOI	0.64	0.75	0.59	0.63	1.29	0.66	1.12	0.59	0.86	2.01
Total	98.99	98.75	99.29	99.10	98.86	98.57	98.95	98.85	99.12	98.39
					Trace Elements					
ppm										
Ba	833	792	754	407	773	839	884	833	788	807
Co	--	5.1	6.7	22.2	--	3.2	--	--	--	--
Cr	--	2.8	5.5	38.6	--	1.4	--	--	--	--
Cs	--	1.5	1.3	0.9	--	1.3	--	--	--	--
Cu	--	15	16	51	--	16	--	--	--	--
Ga	--	16	17	23	--	15	--	--	--	--
Hf	--	5.1	4.8	2.6	--	5.8	--	--	--	--
Nb	--	5.5	4.9	3.1	--	6.2	--	--	--	--
Ni	--	5.4	7.1	22.0	--	4.4	--	--	--	--
Rb	38	55	50	18	58	57	59	62	42	59
Sb	--	0.5	0.5	--	--	0.4	--	--	--	--
Sc	--	7.40	8.10	21.3	--	5.67	--	--	--	--
Sr	293	321	314	618	339	244	242	257	356	254
Ta	--	0.51	0.46	0.27	--	0.53	--	--	--	--
Th	--	4.8	4.6	1.2	--	5.5	--	--	--	--
U	--	1.9	1.8	0.6	--	2.2	--	--	--	--
V	--	42	54	230	--	23	--	--	--	--
Y	24	24	21	19	23	30	29	26	23	24
Zn	--	45	46	85	--	34	--	--	--	--
Zr	210	211	192	116	194	237	233	238	197	234
La	--	25	16	14	--	24	--	--	--	--
Ce	--	37	30	28	--	31	--	--	--	--
Nd	--	20	13	16	--	21	--	--	--	--
Sm	--	4.3	3.2	4.1	--	4.6	--	--	--	--
Eu	--	0.99	0.84	1.23	--	0.84	--	--	--	--
Tb	--	0.61	0.48	0.38	--	0.67	--	--	--	--
Yb	--	2.0	1.9	2.1	--	2.5	--	--	--	--
Lu	--	0.31	0.29	0.29	--	0.38	--	--	--	--

Sample#	82C-710	82C-711	82C-712	82C-713	82C-731	82C-732	82C-733	82C-734	82C-735	82C-737
Unit	rpb	rpb	rpb	rpb	rpb	rpb	rpb	rpb	rpb	rsc
Rock type	felsite	felsite	felsite	inclusion	felsite	felsite	inclusion	felsite	felsite	felsite
Latitude	42° 56.27'	42° 56.76'	42° 57.74'	42° 57.74'	42° 58.97'	42° 59.02'	42° 59.02'	42° 59.38'	42° 58.12'	42° 54.44'
Longitude	121° 56.93'	121° 57.52'	121° 57.92'	121° 57.92'	121° 56.42'	121° 59.73'	121° 59.73'	121° 59.50'	121° 58.30'	121° 56.58'
flame Ph										
					Major Elements					
weight %										
SiO_2	71.5	70.4	71.6	58.5	69.8	70.0	55.8	69.1	69.7	69.3
Al_2O_3	14.0	14.5	13.6	17.2	14.0	13.9	18.2	14.2	14.0	15.1
Fe_2O_3*	2.37	2.75	2.53	5.96	2.46	2.46	6.40	2.57	2.44	2.84
MgO	0.49	0.40	0.52	3.35	0.61	0.62	3.86	0.72	0.61	0.55
CaO	1.69	1.67	1.62	6.70	1.83	1.83	7.07	2.06	1.88	2.31
Na_2O	4.80	5.19	4.65	4.34	4.46	4.59	3.94	4.36	4.55	4.90
K_2O	2.89	2.72	2.83	1.05	2.94	2.92	1.16	2.88	2.90	2.50
TiO_2	0.42	0.40	0.43	0.81	0.43	0.43	0.82	0.42	0.42	0.43
P_2O_5	0.11	0.10	0.21	0.27	0.10	0.09	0.28	0.11	0.10	0.13
MnO	0.04	0.07	0.03	0.12	0.05	0.05	0.09	0.05	0.05	0.06
LOI	0.29	0.60	0.62	0.65	2.17	1.81	1.09	2.22	1.83	0.51
Total	98.60	98.80	98.64	98.95	98.85	98.70	98.71	98.69	98.48	98.63
					Trace Elements					
ppm										
Ba	843	859	822	495	810	826	488	810	821	797
Co	--	2.2	--	15.8	--	3.4	21.0	--	--	--
Cr	--	--	--	48.8	--	--	75.1	--	--	--
Cs	--	1.5	--	0.7	--	3.2	0.7	--	--	--
Cu	--	7	--	--	--	11	21	--	--	--
Ga	--	15	--	--	--	13	20	--	--	--
Hf	--	5.8	--	3.0	--	6.0	2.7	--	--	--
Nb	--	6.6	--	6.3	--	5.7	2.6	--	--	--
Ni	--	2.7	--	--	--	3.4	42	--	--	--
Rb	63	58	57	36	57	59	28	62	58	54
Sb	--	0.5	--	0.1	--	0.5	--	--	--	--
Sc	--	7.71	--	13.6	--	6.72	15.9	--	--	--
Sr	235	226	233	929	262	242	1040	299	247	295
Ta	--	0.54	--	0.29	--	0.56	0.22	--	--	--
Th	--	5.3	--	2.1	--	5.6	2.0	--	--	--
U	--	2.1	--	0.7	--	2.1	0.5	--	--	--
V	--	--	--	--	--	23	150	--	--	--
Y	23	32	23	28	26	24	16	25	22	23
Zn	--	51	--	70	--	43	74	--	--	--
Zr	247	232	230	146	227	231	124	220	227	196
La	--	29	--	22	--	21	17	--	--	--
Ce	--	45	--	40	--	41	33	--	--	--
Nd	--	25	--	20	--	17	17	--	--	--
Sm	--	5.7	--	4.5	--	4.1	3.6	--	--	--
Eu	--	1.09	--	1.09	--	0.82	1.11	--	--	--
Tb	--	0.93	--	0.53	--	0.57	0.45	--	--	--
Yb	--	3.2	--	1.7	--	2.4	1.4	--	--	--
Lu	--	0.45	--	0.24	--	0.36	0.20	--	--	--

Sample#	82C-747	82C-755	82C-756	82C-758	82C-759	82C-760	82C-766	82C-768	82C-768G	82C-792
Unit	rsc	rsc	rsc	ddb	rsc	rsc	rsc	rcc	rcc	rsc
Rock type	felsite	felsite	felsite	felsite	felsite	felsite	alt. felsite	vitrophyre	glass sep.	felsite
Latitude	42° 57.22'	42° 56.07'	42° 56.02'	42° 51.29'	42° 52.92'	42° 52.78'	42° 54.36'	42° 53.18'	42° 51.29'	42° 58.78'
Longitude	121° 58.80'	121° 57.02'	121° 56.51'	121° 56.47'	121° 58.59'	121° 58.12'	122° 01.15'	122° 00.82'	121° 00.82'	122° 00.84'
flame Ph							N	NK	N	NK
					Major Elements					
weight %										
SiO_2	68.6	67.6	67.6	61.7	67.9	68.6	70.4	71.2	72.6	70.1
Al_2O_3	15.5	15.5	15.0	16.8	15.4	15.3	16.0	14.0	14.1	14.3
Fe_2O_3*	2.94	3.44	3.04	5.09	3.43	2.99	0.82	2.12	2.07	2.79
MgO	0.79	1.04	0.81	2.64	1.10	0.84	0.14	0.51	0.45	0.75
CaO	2.46	2.66	2.45	5.45	2.81	2.30	1.67	1.72	1.63	2.17
Na_2O	4.87	4.62	4.69	4.07	4.70	4.63	5.13	5.05	5.02	5.00
K_2O	2.33	2.35	2.58	1.53	2.37	2.44	2.32	2.78	2.86	2.72
TiO_2	0.45	0.52	0.46	0.64	0.53	0.48	0.45	0.34	0.33	0.45
P_2O_5	0.13	0.12	0.13	0.21	0.13	0.09	0.05	0.07	0.06	0.10
MnO	0.06	0.06	0.06	0.08	0.06	0.06	<0.02	0.04	0.04	0.05
LOI	0.69	0.85	2.08	0.95	0.31	0.94	1.60	1.09	0.71	0.35
Total	98.82	98.76	98.90	99.16	98.74	98.67	98.58	98.92	99.87	98.78
					Trace Elements					
ppm										
Ba	808	786	751	557	727	848	793	851	877	832
Co	4.8	6.6	--	16.2	--	--	0.6	2.4	2.4	--
Cr	--	6.9	--	43.8	--	--	--	--	--	--
Cs	1.0	1.8	--	0.3	--	--	1.1	3.4	3.6	--
Cu	11	11	--	35	--	--	--	14	--	--
Ga	14	14	--	18	--	--	19	18	--	--
Hf	5.3	5.0	--	2.8	--	--	4.9	5.2	5.4	--
Nb	5.5	5.5	--	3.1	--	--	5.9	4.6	7.0	--
Ni	4.0	4.0	--	31.0	--	--	2.6	5.6	--	--
Rb	36	40	54	30	47	42	46	61	55	53
Sb	0.4	0.4	--	--	--	--	0.3	0.8	0.7	--
Sc	7.87	8.40	--	12.3	--	--	4.98	4.9	4.95	--
Sr	318	308	296	773	320	310	283	236	225	280
Ta	0.53	0.48	--	0.27	--	--	0.46	0.47	0.48	--
Th	5.1	4.9	--	3.0	--	--	4.3	5.1	5.5	--
U	1.7	1.9	--	1.0	--	--	1.9	2.3	2.2	--
V	30	30	--	110	--	--	11	48	--	--
Y	25	22	25	19	22	23	25	23	24	25
Zn	51	43	--	56	--	--	20	38	42	--
Zr	213	206	197	128	183	221	201	212	214	207
La	18	20	--	15	--	--	16	17	19	--
Ce	39	35	--	28	--	--	29	33	35	--
Nd	18	17	--	14	--	--	19	17	14	--
Sm	4.1	3.8	--	3.1	--	--	3.8	3.4	3.5	--
Eu	0.97	0.86	--	0.92	--	--	0.97	0.65	0.69	--
Tb	0.59	0.53	--	0.43	--	--	0.62	0.45	0.47	--
Yb	2.0	2.0	--	1.2	--	--	2.5	1.7	2.1	--
Lu	0.34	0.30	--	0.20	--	--	0.38	0.29	0.31	--

Sample#	83C-1027	83C-1053	83C-1055	83C-1057	85C-1203	85C-1203G	85C-1204	85C-1204G	85C-1206	85C-1212
Unit	rsc	dsc	dsc	dsc	rscp	rscp	rsc	rsc	rsc	rsc
Rock type	felsite	felsite	felsite	felsite	vitrophyre	glass sep.	vitrophyre	glass sep.	inclusion	felsite
Latitude	42° 51.93'	42° 50.58'	42° 50.41'	42° 50.03'	42° 48.92'	42° 48.92'	42° 48.74'	42° 48.74'	42° 48.74'	42° 49.16'
Longitude	121° 57.02'	121° 56.44'	121° 56.62'	121° 56.76'	122° 05.36'	122° 05.36'	122° 04.42'	122° 04.42'	122° 04.42'	122° 03.28'
flame Ph					N	N	N	N	N	N
					Major Elements					
weight %										
SiO_2	69.7	67.4	64.7	67.3	70.4	75.2	68.4	73.2	58.1	68.9
Al_2O_3	15.1	15.9	16.5	15.7	14.9	12.9	15.4	13.7	18.2	14.8
Fe_2O_3*	2.89	3.75	4.67	3.91	2.74	1.46	3.52	1.96	6.53	3.12
MgO	0.75	1.00	1.74	1.08	0.77	0.27	1.21	0.41	3.67	0.81
CaO	2.26	3.32	4.31	3.38	2.13	0.98	3.04	1.40	7.07	2.35
Na_2O	4.95	4.71	4.54	4.70	4.83	4.58	5.06	5.11	4.19	4.85
K_2O	2.62	2.20	1.91	2.19	2.63	3.38	2.27	2.97	1.13	2.58
TiO_2	0.45	0.54	0.61	0.56	0.43	0.27	0.54	0.36	0.74	0.51
P_2O_5	0.10	0.16	0.16	0.16	0.08	0.00	0.12	0.09	0.18	0.11
MnO	0.05	0.09	0.08	0.08	0.05	0.02	0.06	0.04	0.10	0.06
LOI	0.60	0.81	0.93	0.74	1.35	0.72	0.85	0.64	0.67	2.38
Total	99.47	99.84	100.15	99.80	100.31	99.78	100.47	99.88	100.58	100.47
					Trace Elements					
ppm										
Ba	823	774	659	741	844	907	705	845	387	777
Co	--	8.4	11.7	--	4.3	1.8	6.6	2.9	19.5	--
Cr	--	4.7	19.3	--	3.3	--	6.4	--	55.5	--
Cs	--	1.3	1.3	--	3.2	4.3	2.9	3.8	1.0	--
Cu	--	14	22	--	7	--	18	--	17	--
Ga	--	16	16	--	16	--	17	--	21	--
Hf	--	3.5	3.2	--	5.8	6.5	5.2	6.5	2.1	--
Nb	--	4.0	3.6	--	5.5	8.1	5.0	8.3	2.2	--
Ni	--	5.3	12.0	--	3.3	--	6.1	--	22	--
Rb	56	46	40	46	56	73	49	57	26	50
Sb	--	0.4	0.4	--	0.5	0.7	0.4	0.5	--	--
Sc	--	9.16	12.0	--	6.72	4.64	9.07	6.48	17.3	--
Sr	294	419	478	420	268	132	354	179	654	273
Ta	--	0.46	0.36	--	0.55	0.63	0.46	0.56	0.2	--
Th	--	4.2	3.6	--	5.9	7.3	4.5	5.9	1.35	--
U	--	1.8	1.6	--	2.3	2.9	1.9	2.4	0.69	--
V	--	58	83	--	30	--	51	--	150	--
Y	19	27	20	20	24	26	25	28	14	27
Zn	--	59	57	--	44	33	53	42	73	--
Zr	213	150	131	148	218	227	202	257	94	222
La	--	26	16	--	21	23	18	23	9.3	--
Ce	--	37	30	--	41	44	37	44	18	--
Nd	--	21	16	--	18	18	17	21	10	--
Sm	--	5.2	3.6	--	4.1	4.2	4.4	5.0	2.7	--
Eu	--	1.04	0.93	--	0.78	0.58	0.95	0.83	0.87	--
Tb	--	0.72	0.54	--	0.64	0.56	0.72	0.71	0.39	--
Yb	--	2.1	1.9	--	2.2	2.7	2.2	2.6	1.2	--
Lu	--	0.35	0.28	--	0.37	0.40	0.33	0.40	0.19	--

Sample#	85C-1213	85C-1214	85C-1220	85C-1220G	85C-1221	85C-1221G	85C-1223	85C-1224	85C-1225	85C-1226
Unit	rsc	rsc	rscp	rscp	rpb	rpb	rsc	rscp	rpb	rpb
Rock type	felsite	felsite	vitrophyre	glass sep.	vitrophyre	glass sep.	felsite	felsite	felsite	felsite
Latitude	42° 49.60'	42° 48.77'	42° 50.42'	42° 50.42'	42° 50.42'	42° 50.42'	42° 50.83'	42° 50.19'	42° 48.83'	42° 49.18
Longitude	122° 04.03'	122° 04.64'	122° 04.24'	122° 04.24'	122° 04.24'	122° 04.24'	122° 01.56'	122° 05.12'	122° 00.89'	122° 01.40'
flame Ph	NK	NK	N	N	N	N	NK	NK	NK	NK
					Major Elements					
weight %										
SiO_2	69.0	68.3	70.6	75.3	69.6	72.7	69.2	71.8	71.4	71.3
Al_2O_3	15.3	15.1	14.5	12.6	14.8	13.4	15.2	14.4	14.5	14.8
Fe_2O_3*	3.32	3.15	2.72	1.42	2.70	1.70	3.33	2.66	2.70	2.62
MgO	0.92	0.92	0.77	0.24	0.71	0.32	0.69	0.71	0.63	0.37
CaO	2.48	2.63	2.12	0.94	2.06	1.17	2.42	1.84	1.81	1.73
Na_2O	5.06	4.71	4.86	4.63	4.78	4.65	5.12	4.80	4.92	5.17
K_2O	2.38	2.55	2.68	3.41	2.60	3.11	2.48	2.81	2.70	2.77
TiO_2	0.54	0.47	0.42	0.27	0.45	0.33	0.55	0.42	0.45	0.42
P_2O_5	0.12	0.11	0.09	<0.05	0.09	0.05	0.13	0.08	0.08	0.10
MnO	0.06	0.05	0.05	0.02	0.05	0.03	0.07	0.04	0.05	0.06
LOI	0.98	2.60	1.71	1.03	2.58	2.31	0.71	0.75	0.69	0.66
Total	100.16	100.59	100.52	99.86	100.42	99.77	99.90	100.31	99.93	100.00
					Trace Elements					
ppm										
Ba	787	808	834	891	874	914	798	851	930	864
Co	--	--	3.9	1.8	3.8	4.5	--	--	--	--
Cr	--	--	1.9	--	2.8	--	--	--	--	--
Cs	--	--	3.1	4.5	2.9	3.7	--	--	--	--
Cu	--	--	--	--	--	--	--	--	--	--
Ga	--	--	--	--	--	--	--	--	--	--
Hf	--	--	5.1	6.5	5.6	7.0	--	--	--	--
Nb	--	--	7.4	8.1	7.9	8.4	--	--	--	--
Ni	--	--	--	--	--	--	--	--	--	--
Rb	41	50	62	70	51	63	46	58	43	53
Sb	--	--	0.4	0.7	0.4	0.6	--	--	--	--
Sc	--	--	5.81	4.65	6.74	5.68	--	--	--	--
Sr	303	320	266	119	278	165	292	240	254	237
Ta	--	--	0.48	0.65	0.53	0.65	--	--	--	--
Th	--	--	5.2	7.4	5.3	6.8	--	--	--	--
U	--	--	2.1	3.0	2.0	2.5	--	--	--	--
V	--	--	--	--	--	--	--	--	--	--
Y	23	21	24	23	25	28	29	22	24	27
Zn	--	--	36	34	42	41	--	--	--	--
Zr	218	195	208	218	236	271	212	220	243	230
La	--	--	18	23	19	23	--	--	--	--
Ce	--	--	35	44	38	45	--	--	--	--
Nd	--	--	14	18	16	20	--	--	--	--
Sm	--	--	3.4	4.2	3.8	4.4	--	--	--	--
Eu	--	--	0.71	0.58	0.79	0.69	--	--	--	--
Tb	--	--	0.51	0.60	0.57	0.63	--	--	--	--
Yb	--	--	2.1	2.8	2.3	2.9	--	--	--	--
Lu	--	--	0.3	0.40	0.32	0.40	--	--	--	--

Sample#	85C-1227	85C-1228	85C-1232	85C-1233	85C-1235	86C-1291	86C-1292	86C-1372	86C-1374	86C-1374G
Unit	rsc	rpb	rpb	rpb	rpb	rpb	rpb	dwp	rpb	rpb
Rock type	felsite	felsite	felsite	felsite	felsite	felsite	felsite	inclusion	vitrophyre	glass sep.
Latitude	42° 49.74'	42° 48.94'	42° 50.39'	42° 00.00'	42° 48.39'	42° 51.77'	42° 52.28'	42° 51.55'	42° 51.55'	42° 51.55'
Longitude	122° 01.97'	122° 00.51'	122° 01.66'	122° 00.51'	122° 00.09'	122° 06.57'	122° 06.56'	122° 03.71'	122° 03.67'	122° 03.67'
flame Ph	NK	NK	NK	NK	NK	N	N		N	N
					Major Elements					
weight %										
SiO_2	67.2	71.6	71.4	70.6	71.6	71.3	71.6	54.8	71.1	72.4
Al_2O_3	15.2	14.4	14.7	14.9	14.3	14.3	14.2	17.3	14.5	13.6
Fe_2O_3*	3.26	2.59	2.64	2.75	2.70	2.61	2.38	7.15	2.49	2.05
MgO	0.91	0.68	0.36	0.70	0.67	0.69	0.37	4.45	0.57	0.38
CaO	2.61	1.89	1.60	2.10	1.81	1.83	1.44	7.38	1.77	1.27
Na_2O	4.84	4.97	5.06	4.97	4.89	4.90	5.02	4.52	5.13	5.15
K_2O	2.53	2.75	2.76	2.53	2.77	2.83	2.93	1.68	2.79	3.07
TiO_2	0.54	0.43	0.43	0.45	0.44	0.43	0.38	1.11	0.41	0.35
P_2O_5	0.13	0.10	0.06	0.09	0.07	0.10	0.09	0.51	0.09	0.07
MnO	0.07	0.05	0.05	0.05	0.05	0.05	0.05	0.09	0.05	0.04
LOI	1.99	0.21	1.10	0.96	0.83	0.43	0.56	0.69	0.46	0.74
Total	99.28	99.67	100.16	100.10	100.13	99.47	99.02	99.68	99.36	99.12
					Trace Elements					
ppm										
Ba	813	855	834	872	883	863	854	685	846	855
Co	--	--	--	--	--	--	2.8	24.7	2.61	2.1
Cr	--	--	--	--	--	--	--	78	--	--
Cs	--	--	--	--	--	--	2.4	0.6	3.1	3.5
Cu	--	--	--	--	--	--	--	38	11	--
Ga	--	--	--	--	--	--	--	56	4	--
Hf	--	--	--	--	--	--	5.8	4.3	6.0	6.6
Nb	--	--	--	--	--	--	7.7	12	6.4	7.3
Ni	--	--	--	--	--	--	--	32	20	--
Rb	48	54	56	33	56	58	58	41	58	63
Sb	--	--	--	--	--	--	0.4	--	0.5	0.6
Sc	--	--	--	--	--	--	5.34	17.4	5.81	5.81
Sr	310	262	232	290	264	264	194	1600	226	162
Ta	--	--	--	--	--	--	0.53	0.59	0.53	0.59
Th	--	--	--	--	--	--	5.4	5.1	5.6	5.9
U	--	--	--	--	--	--	2.1	1.2	2.2	2.3
V	--	--	--	--	--	--	--	195	27	--
Y	27	22	26	24	26	23	33	19	27	33
Zn	--	--	--	--	--	--	40	100	46	39
Zr	218	233	236	236	237	239	247	201	245	253
La	--	--	--	--	--	--	26	36	19	21
Ce	--	--	--	--	--	--	47	71	38	42
Nd	--	--	--	--	--	--	24	34	18	19
Sm	--	--	--	--	--	--	5.1	6.0	4.0	4.1
Eu	--	--	--	--	--	--	0.83	1.54	0.81	0.77
Tb	--	--	--	--	--	--	0.82	0.57	0.58	0.65
Yb	--	--	--	--	--	--	3.0	1.3	2.5	2.7
Lu	--	--	--	--	--	--	0.43	0.19	0.37	0.39

Sample#	87C-1383	87C-1389	87C-1394	87C-1397	87C-1398	87C-1399	87C-1400	87C-1401	87C-1403	87C-1404
Unit	dsc	rsc	rsc	rsc	rsc	rsc	rsc	rpb	rsc	rsc
Rock type	inclusion	felsite	felsite	felsite	inclusion	inclusion	inclusion	felsite	felsite	inclusion
Latitude	42° 50.39'	42° 51.78'	42° 51.37'	42° 52.83'	42° 52.83'	42° 52.83'	42° 52.83'	42° 51.87'	42° 54.42'	42° 54.42'
Longitude	121° 56.54'	121° 58.24'	121° 58.29'	121° 58.67'	121° 58.67'	121° 58.67'	121° 58.67'	122° 00.45'	121° 57.10'	121° 57.10'
flame Ph	N					N	N			N
					Major Elements					
weight %										
SiO_2	55.0	70.5	69.7	66.5	55.6	57.4	56.0	70.8	69.7	55.1
Al_2O_3	18.7	15.0	15.2	16.4	18.1	17.9	16.7	15.2	15.2	19.0
Fe_2O_3*	7.45	2.95	3.01	3.64	8.57	7.15	6.85	2.58	3.09	7.58
MgO	3.57	0.71	0.72	1.15	3.32	2.89	3.17	0.61	0.73	3.30
CaO	6.65	2.23	2.24	2.94	7.38	5.47	7.03	1.99	2.20	5.87
Na_2O	3.61	4.71	4.67	4.81	4.06	4.15	3.91	4.94	5.00	3.68
K_2O	0.96	2.71	2.63	2.05	1.03	1.56	1.44	2.76	2.53	1.26
TiO_2	0.79	0.47	0.46	0.56	1.19	1.01	0.92	0.41	0.46	0.95
P_2O_5	0.16	0.10	0.10	0.12	0.28	0.28	0.26	0.08	0.11	0.23
MnO	0.12	0.06	0.06	0.06	0.13	0.12	0.11	0.06	0.07	0.15
LOI	3.14	0.67	0.85	1.24	0.64	2.25	3.40	0.65	0.71	2.72
Total	100.15	100.11	99.64	99.47	100.30	100.18	99.79	100.08	99.80	99.84
					Trace Elements					
ppm										
Ba	384	803	823	878	415	598	552	867	882	492
Co	26.0	--	--	--	20.3	17.4	18.3	--	--	21.6
Cr	73	--	--	--	36.0	27.0	31.7	--	--	12.3
Cs	0.3	--	--	--	30.0	1.7	1.2	--	--	0.6
Cu	46	--	--	--	70	48	48	--	--	38
Ga	26	--	--	--	22	28	24	--	--	24
Hf	2.0	--	--	--	2.7	3.4	3.1	--	--	2.5
Nb	3.4	--	--	--	5.2	5.5	4.1	--	--	3.8
Ni	47	--	--	--	--	30	36	--	--	17
Rb	15	54	56	20	20	35	35	48	49	26
Sb	0.3	--	--	--	--	0.2	--	--	--	0.3
Sc	20.1	--	--	--	23.8	16.8	15.9	--	--	21.1
Sr	574	294	296	345	619	512	545	254	285	584
Ta	0.20	--	--	--	0.26	0.30	0.31	--	--	0.21
Th	1.3	--	--	--	1.2	1.9	1.9	--	--	1.9
U	0.6	--	--	--	0.5	0.8	0.7	--	--	0.8
V	200	--	--	--	190	160	150	--	--	220
Y	25	20	29	26	25	28	22	25	30	31
Zn	93	--	--	--	97	88	84	--	--	110
Zr	100	216	213	209	122	148	133	234	202	123
La	14	--	--	--	15	16	13	--	--	14
Ce	21	--	--	--	30	30	25	--	--	33
Nd	15	--	--	--	20	17	14	--	--	16.3
Sm	3.65	--	--	--	4.8	4.8	3.7	--	--	4.24
Eu	0.97	--	--	--	1.30	1.22	1.03	--	--	1.10
Tb	0.55	--	--	--	0.69	0.71	0.55	--	--	0.68
Yb	2.3	--	--	--	2.3	2.4	2.0	--	--	2.8
Lu	0.36	--	--	--	0.33	0.36	0.31	--	--	0.41

Sample#	87C-1406	87C-1406G	87C-1409	87C-1410	87C-1415	87C-1416	87C-1433	87C-1449	87C-1461	87C-1462
Unit	rpb	rpb	rsc	rsc	rpb	rpb	rpb	rpb	dwp	dwp
Rock type	vitrophyre	glass sep.	felsite	felsite	felsite	vitrophyre	felsite	felsite	felsite	inclusion
Latitude	42° 57.09'	42° 57.09'	42° 55.66'	42° 54.97'	42° 53.18'	42° 57.50'	42° 55.83'	42° 52.94'	42° 51.15'	42° 51.15'
Longitude	121° 57.69'	121° 57.69'	121° 54.37'	121° 56.23'	121° 57.84'	121° 56.84'	121° 57.31'	122° 02.73'	122° 01.93'	122° 01.93'
flame Ph	N	N								
					Major Elements					
weight %										
SiO_2	71.2	74.7	69.1	69.5	70.4	70.8	71.0	71.7	60.3	54.7
Al_2O_3	14.5	12.9	15.7	15.3	15.3	14.5	14.6	14.8	17.4	18.0
Fe_2O_3*	2.41	1.58	3.30	3.07	2.65	2.59	2.70	2.51	6.14	7.36
MgO	0.56	0.25	0.83	0.75	0.52	0.69	0.49	0.48	2.90	5.05
CaO	1.76	0.91	2.44	2.32	1.99	2.05	1.84	1.76	5.91	6.78
Na_2O	4.94	4.80	5.08	4.80	4.76	4.88	5.21	5.06	4.47	4.12
K_2O	2.76	3.30	2.31	2.54	2.73	2.68	2.73	2.82	1.49	1.09
TiO_2	0.42	0.27	0.50	0.47	0.41	0.43	0.46	0.41	0.85	1.00
P_2O_5	0.08	<0.05	0.13	0.10	0.07	0.08	0.10	0.08	0.24	0.41
MnO	0.04	0.03	0.09	0.06	0.05	0.05	0.06	0.05	0.10	0.13
LOI	1.04	0.87	0.53	0.65	0.70	0.89	0.36	0.29	0.44	1.42
Total	99.71	99.61	100.01	99.56	99.58	99.64	99.55	99.96	100.24	100.06
					Trace Elements					
ppm										
Ba	875	905	855	808	876	838	826	867	551	560
Co	3.2	1.5	--	--	--	--	--	--	--	--
Cr	--	--	--	--	--	--	--	--	--	--
Cs	3.2	3.7	--	--	--	--	--	--	--	--
Cu	7	--	--	--	--	--	--	--	--	--
Ga	16	--	--	--	--	--	--	--	--	--
Hf	6.1	6.4	--	--	--	--	--	--	--	--
Nb	7.4	7.1	--	--	--	--	--	--	--	--
Ni	5.1	--	--	--	--	--	--	--	--	--
Rb	56	72	35	54	64	55	53	56	33	30
Sb	0.5	0.6	--	--	--	--	--	--	--	--
Sc	6.33	5.08	--	--	--	--	--	--	--	--
Sr	237	122	298	295	263	273	267	231	732	1250
Ta	0.57	0.59	--	--	--	--	--	--	--	--
Th	5.8	6.5	--	--	--	--	--	--	--	--
U	2.4	2.5	--	--	--	--	--	--	--	--
V	32	--	--	--	--	--	--	--	--	--
Y	26	35	29	27	26	26	27	27	23	24
Zn	39	36	--	--	--	--	--	--	--	--
Zr	248	260	197	203	236	227	231	237	159	174
La	20	22	--	--	--	--	--	--	--	--
Ce	39	42	--	--	--	--	--	--	--	--
Nd	18	18	--	--	--	--	--	--	--	--
Sm	4.1	4.1	--	--	--	--	--	--	--	--
Eu	0.81	0.63	--	--	--	--	--	--	--	--
Tb	0.60	0.64	--	--	--	--	--	--	--	--
Yb	2.5	2.6	--	--	--	--	--	--	--	--
Lu	0.36	0.38	--	--	--	--	--	--	--	--

Sample#	87C-1463	87C-1464	87C-1465	87C-1467	87C-1470	87C-1472	87C-1473	90C-1616	90C-1632	90C-1633
Unit	dwp	dwp	dwp	dwp	rpb	rpb	rpb	dwp	rscp	rpb
Rock type	felsite	inclusion	inclusion	inclusion	felsite	felsite	vitrophyre	felsite	felsite	felsite
Latitude	42° 51.01'	42° 51.01'	42° 51.01'	42° 51.32'	42° 51.12'	42° 50.24'	42° 50.24'	42° 51.63'	42° 50.28'	42° 50.33'
Longitude	122° 02.13'	122° 02.13'	122° 02.13'	122° 02.15'	122° 03.33'	122° 03.03'	122° 03.03'	122° 03.77'	122° 05.92'	122° 06.22'
flame Ph								N	N	N
					Major Elements					
weight %										
SiO_2	63.3	55.7	55.4	54.7	71.4	71.5	71.6	64.7	71.0	69.1
Al_2O_3	16.6	19.0	17.5	17.7	14.6	14.6	14.5	16.2	14.5	15.2
Fe_2O_3*	5.07	7.74	7.08	7.25	2.54	2.52	2.47	4.51	2.64	3.26
MgO	2.23	3.05	4.83	4.17	0.51	0.45	0.55	2.00	0.74	0.95
CaO	4.24	7.19	7.15	7.19	1.75	1.64	1.74	4.20	2.04	2.38
Na_2O	4.57	3.95	4.27	4.42	5.14	5.07	5.06	4.88	4.90	4.83
K_2O	1.95	0.90	1.35	1.63	2.83	2.83	2.84	2.17	2.75	2.64
TiO_2	0.74	1.07	1.00	1.14	0.41	0.41	0.41	0.67	0.42	0.49
P_2O_5	0.21	0.25	0.42	0.54	0.08	0.08	0.08	0.22	0.09	0.10
MnO	0.09	0.12	0.11	0.11	0.06	0.04	0.05	0.07	0.05	0.06
LOI	0.73	1.25	1.00	1.13	0.31	0.45	0.50	0.13	0.49	0.64
Total	99.73	100.22	100.11	99.98	99.63	99.59	99.80	99.77	99.62	99.65
					Trace Elements					
ppm										
Ba	680	474	623	692	871	863	842	705	848	783
Co	--	--	--	--	--	--	--	11.5	--	--
Cr	--	--	--	--	--	--	--	21.0	--	--
Cs	--	--	--	--	--	--	--	0.9	--	--
Cu	--	--	--	--	--	--	--	--	--	--
Ga	--	--	--	--	--	--	--	--	--	--
Hf	--	--	--	--	--	--	--	4.7	--	--
Nb	--	--	--	--	--	--	--	7.1	--	--
Ni	--	--	--	--	--	--	--	--	--	--
Rb	37	21	35	44	52	54	57	47	52	51
Sb	--	--	--	--	--	--	--	0.3	--	--
Sc	--	--	--	--	--	--	--	10.74	--	--
Sr	569	638	1400	1510	234	226	227	639	263	292
Ta	--	--	--	--	--	--	--	0.48	--	--
Th	--	--	--	--	--	--	--	4.5	--	--
U	--	--	--	--	--	--	--	1.6	--	--
V	--	--	--	--	--	--	--	--	--	--
Y	26	25	22	24	26	25	29	25	21	25
Zn	--	--	--	--	--	--	--	51	--	--
Zr	183	135	183	217	245	239	245	186	200	201
La	--	--	--	--	--	--	--	22	--	--
Ce	--	--	--	--	--	--	--	44	--	--
Nd	--	--	--	--	--	--	--	19	--	--
Sm	--	--	--	--	--	--	--	4.3	--	--
Eu	--	--	--	--	--	--	--	1.1	--	--
Tb	--	--	--	--	--	--	--	0.57	--	--
Yb	--	--	--	--	--	--	--	1.9	--	--
Lu	--	--	--	--	--	--	--	0.28	--	--

Sample#	90C-1634	90C-1635	90C-1638	CD212-2	92C-1748	92C-1749	92C-1750	92C-1751
Unit	rpb	rpb	rpb	rsc	rsc	rsc	rsc	rsc
Rock type	inclusion	felsite	inclusion	vitrophyre	pumice	felsite	vitrophyre	lava
Latitude	42° 50.45'	42° 50.58'	42° 57.73'	42° 58.17'	42° 49.67'	42° 50.27'	42° 50.23'	42° 50.17'
Longitude	122° 06.23'	122° 06.28'	121° 57.92'	122° 04.82'	122° 09.42'	122° 09.53'	122° 09.43'	122° 09.47'
flame Ph	N	N	N	N	N	N	N	N
				Major Elements				
weight %								
SiO_2	52.6	69.3	58.2	67.7	66.0	69.3	68.5	59.2
Al_2O_3	17.8	15.1	18.0	14.7	15.8	15.1	15.1	17.2
Fe_2O_5*	7.85	3.23	6.24	2.99	3.52	3.28	3.33	7.06
MgO	4.06	0.94	3.52	0.96	0.99	0.88	0.92	3.04
CaO	8.01	2.51	6.52	2.64	2.68	2.55	2.65	6.07
Na_2O	4.46	4.79	3.95	4.19	4.93	5.13	5.06	4.64
K_2O	1.32	2.56	1.25	2.94	2.31	2.53	2.52	1.33
TiO_2	1.30	0.47	0.76	0.45	0.59	0.57	0.57	1.03
P_2O_5	0.72	0.10	0.19	0.11	0.07	0.15	0.15	0.27
MnO	0.11	0.06	0.10	0.05	0.07	0.07	0.07	0.12
LOI	0.67	0.46	0.99	2.90	2.78	0.19	1.09	0.01
Total	98.90	99.52	99.72	99.63	99.74	99.75	99.96	99.97
				Trace Elements				
ppm								
Ba	1510	760	546	813	690	732	717	458
Co	22.9	5.7	20.4	5.3	6.1	5.2	5.2	18.5
Cr	11.1	4.9	62	3.8	3.5	2.2	2.0	31
Cs	0.9	1.5	1.2	3.5	3.1	2.6	3.5	1.1
Cu	--	--	--	--	--	--	--	--
Ga	--	--	--	--	--	--	--	--
Hf	5.7	4.9	3.0	4.8	5.9	5.7	5.7	3.7
Nb	9.6	6.1	4.6	6.4	7.4	7.6	7.2	5.2
Ni	--	--	--	--	4	2	2	15
Rb	62	61	36	56	52	58	60	30
Sb	0.1	0.4	0.2	0.4	0.5	0.4	0.5	0.2
Sc	16.3	7.65	16.5	6.98	9.45	8.40	8.40	18.9
Sr	2050	318	761	319	369	341	355	534
Ta	0.52	0.46	0.29	0.46	0.52	0.54	0.50	0.33
Th	4.7	5.0	2.3	4.8	5.7	5.5	5.4	2.4
U	1.4	1.9	0.6	1.9	2.4	2.4	2.4	0.8
V	--	--	--	--	--	--	--	--
Y	26	27	25	23	28	27	29	26
Zn	79	40	68	43	51	47	55	62
Zr	254	189	143	197	224	220	219	153
La	44	19	16	18	17	18	20	15
Ce	95	38	34	34	38	39	41	32
Nd	50	16	16	16	18	17	21	19
Sm	9.0	3.7	3.5	3.4	4.0	4.1	4.8	4.5
Eu	2.24	0.81	1.07	0.78	1.07	1.05	1.03	1.25
Tb	0.82	0.56	0.51	0.52	0.59	0.61	0.67	0.68
Yb	1.8	2.1	1.4	1.9	2.3	2.2	2.5	2.2
Lu	0.24	0.31	0.22	0.29	0.33	0.32	0.35	0.33

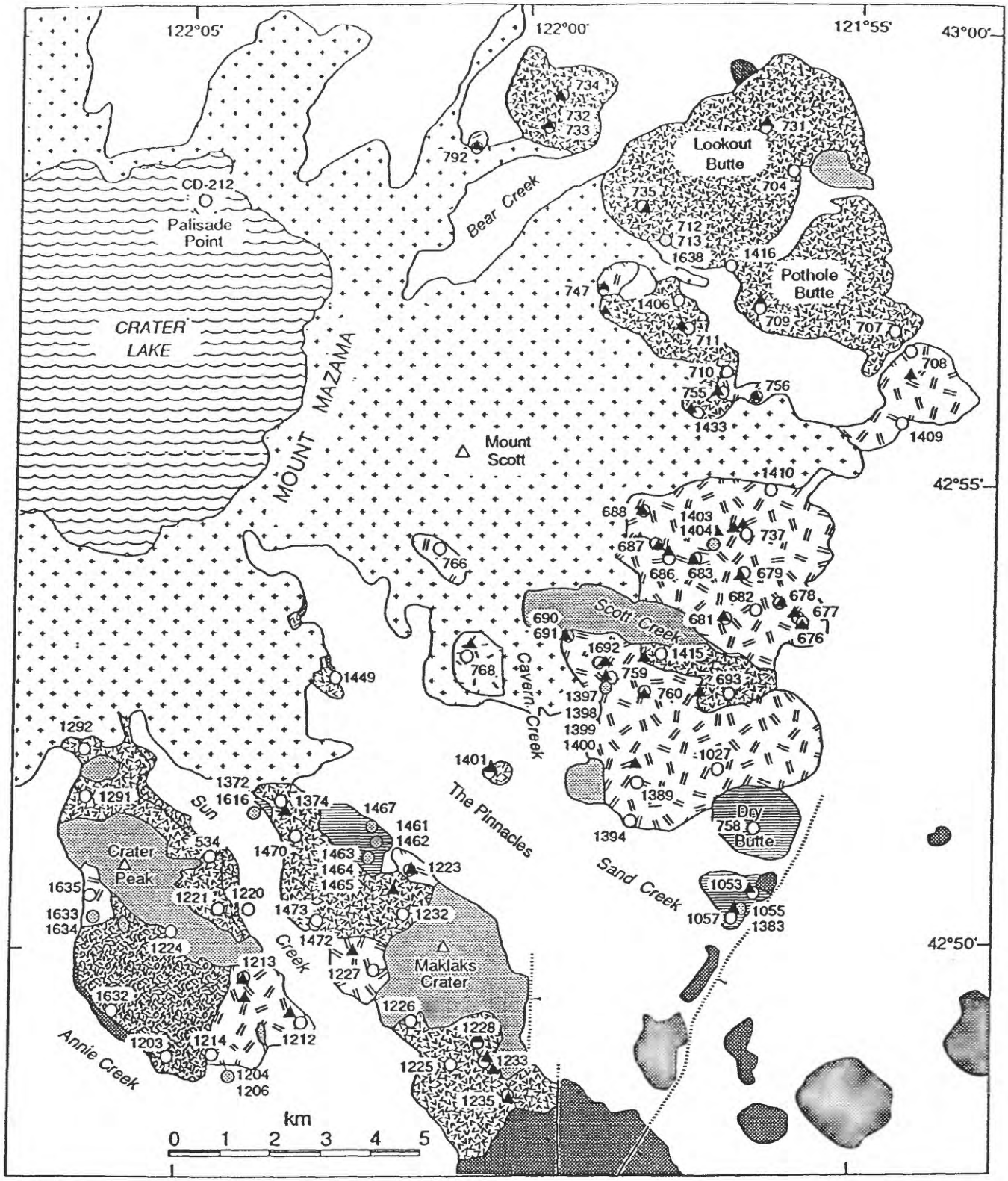
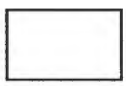
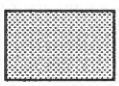
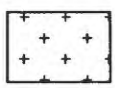


Figure 1. Interpretive bedrock geologic map of eastern half of Mount Mazama and pre-Mazama volcanic rocks based on 1:24,000-scale outcrop map by C.R. Bacon (unpublished data, 1990). Locations of vents and chemically analyzed samples indicated for pre-Mazama dacites and rhyodacites. Sample CD-212 was obtained with a manned submersible. Bear Bluff (not shown), about 5 km west of Crater Peak, is tentatively identified as pre-Mazama rhyodacite (samples 92C-1748—1751).

EXPLANATION

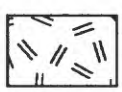

Ignimbrite of climactic eruption

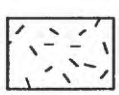

Younger monogenetic cones and lavas


Lavas of Mount Mazama


Rhyodacite of Pothole Butte


Rhyodacite south of Crater Peak


Rhyodacite of Scott Creek


Rhyodacite west of Cavern Creek


Pre-Mazama dacites


Older monogenetic cones and lavas

1632 Sample number

○ Analyzed silicic rock sample locality

◎ Analyzed andesite inclusion ± host locality

▲ Vent

△ Named Peak


Fault