Appendix 1. Sample Locations and Descriptions

Location maps of volcanic ashes recovered from DSDP Leg 60 in the Mariana forearc and ODP Leg 125 in the Bonin forearc are shown in the Figures 2-1 and 2-2 on pages 17 and 18, respectively.

Location of lower crustal xenoliths in the San Francisco volcanic field (SFVF) is presented in Figure 1 on page 204, Appendix 8.

Location of dropstones (ice-rafted debris) recovered from ODP Leg 145, north Pacific Ocean is shown in the Figure 1 on page 196, Appendix 9.

Descriptions of volcanic ashes, lower crustal xenoliths, and dropstones are presented in the Tables A 1-1 and 1-2, Table A 1-3, and Table A 1-4, respectively.

Table A 1-1 The studied ash layers recovered from DSDP Leg 60 in the Mariana forearc

No.UNE	Site, Core-Section, Interval (cm)	Depth (mbsf)	Age (Ma)	Rock types
1#	459B, 1-2, 117-118	2.67	0.25	B, BA, A, D
1	458, 1-3, 88-89	3.88	0.35	BA, A
2	458, 1-3, 98-99	3.98	0.35	B, BA
3	458, 1-4, 51-52	5.01	0.40	BA, A
2#	459B, 1-4, 122-123	5.72	0.40	B, BA, A, D
4	458, 1-6, 135-136	8.85	0.45	BA
5	458, 1-6, 139-140	8.89	0.45	BA
3#	459B, 1-5, 67-68	6.67	0.46	BA, A >> D
6	458, 2-3, 89-90	13.39	1.05	BA, A
7	458, 2-4, 28-29	14.28	1.15	B, BA
8	458, 2-4, 31-32	14.31	1.15	BA, A
9	458, 2-4, 76-77	14.76	1.25	BA, A
10	458, 2-4, 118-119	15.18	1.35	B << BA, A
4#	459B, 5-1, 7-8	36.07	1.60	BA, A >> D
5#	459B, 6-3, 63-64	49.13	1.70	BA, A, D, R
6#	459B, 6-4, 51-52	50.51	1.70	BA, A, D, R
11	458, 3-1, 12-13	19.12	1.85	BA, A, D
12	458, 3-2, 113-114	21.63	2.15	BA, A
13	458, 3-2, 121-122	21.71	2.20	B, BA, A, D, R
14	458, 4-1, 140-141	29.90	2.65	BA, A
15	458, 4-2, 75-76	30.75	2.80	BA, A, D
16	458, 4-2, 96-97	30.96	2.85	BA, A, D, R
17	458, 5-3, 88-89	41.88	5.80	A, D
18	458, 5-4, 43-44	42.93	6.50	A, D
19	458, 5-4, 67-68	43.17	6.60	BA, A
20	458, 5-4, 86-87	43.36	6.90	BA, A
21	458, 6-1, 131-131	48.80	8.30	A, D
22	458, 6-2, 20-21	49.20	8.40	BA, A, D
23	458, 6-2, 33-34	49.33	8.40	A, D
24	458, 6-3, 61-62	51.11	8.50	BA, A, D
25	458, 6-3, 86-87	51.36	8.60	A, D
26	458, 7-1, 73-74	57.73	8.80	D
27	458, 7-2, 50-51	59.00	8.90	BA, A, D, R
7#	459B, 8-1, 129-130	65.79	8.90	A, D, R
8#	459B, 11-1, 63-64	93.63	9.30	BA, A, R
9#	459B, 11-2, 60-61	95.10	9.30	BA, A, D
28	458, 7-3, 10-11	60.10	9.40	A, D
10#	459B, 14-1, 80-81	122.60	9.80	BA, A, D
11#	459B, 15-1, 59-60	131.59	10.00	BA, A, D, R
29	458, 7-4, 62-63	62.12	10.50	D, R
30	458, 7-4, 81-82	62.31	10.80	BA, A, D
12#	459B, 20-1, 73-74	179.23	10.80	BA, A, D
31	458, 8-1, 3-4	66.53	11.00	A, D, R
32	458, 8-CC, 17-18	67.02	11.10	BA, A, D, R
33	458, 8-CC, 20-21	67.05	11.10	BA, A, D

See text for interpretation of ages and rock types

B basalt, BA basaltic andesite, A andesite, D dacite and R rhyolite

Samples 1-64 are from Site 458 ash layers; samples 1#-71# are from Site 459B ash layers

Table A 1-1 The studied ash layers recovered from Leg 60 in the Mariana forearc (cont)

No.UNE	Site, Core-Section, Interval (cm)	Depth (mbsf)	Age (Ma)	Rock types
34	458, 9-1, 77-78	76.77	11.50	BA, A, D
35	458, 9-2, 25-26	77.75	11.60	D
36	458, 9-2, 40-41	77.90	11.60	BA, A
37	458, 9-2, 97-98	78.47	11.70	A, D
38	458, 9-CC, 1-2	78.62	11.70	A, D
39	458, 11-1, 57-58	95.57	13.20	
40	458, 11-1, 113-114	96.13	13.20	BA, A, D, R
13#	459B, 21-CC, 18-19	189.33	13.40	BA, A, D, R
41	458, 11-1, 147-148	96.47	13.50	A
42	458, 11-2, 30-31	96.80	13.80	BA
43	458, 11-3, 17-18	98.17	14.00	BA, A
44	458, 11-CC, 4-5	98.31	14.10	BA, A
14#	459B, 22-1, 43-44	197.93	16.20	BA, A, D
45	458, 13-1, 6-7	114.06	16.90	B, BA, A, D
46	458, 13-1, 40-41	114.40	16.90	BA, A, D
15#	459B, 24-2, 49-50	218.49	17.00	B, BA, A, D
16#	459B, 25-2, 84-85	228.34	17.30	BA, A, D
17#	459B, 25-2, 119-120	228.69	17.30	BA
18#	459B, 25-3, 33-34	229.33	17.30	BA
47	458, 14-CC, 19-20	123.69	17.55	A, D, R
19#	459B, 26-1, 60-61	236.10	17.70	BA, A, D
20#	459B, 27-2, 6-7	246.56	17.80	BA, A
21#	459B, 27-2, 100-101	247.50	18.00	A, D
22#	459B, 28-2, 91-92	256.91	18.80	BA
23#	459B, 28-2, 123-124	257.23	18.80	BA, A
24#	459B, 29-1, 26-27	264.26	19.00	B, BA, A
25#	459B, 29-2, 90-91	266.40	19.20	BA, A
26#	459B, 30-1, 123-124	274.73	19.50	BA, A >> D
27#	459B, 30-3, 16-17	276.66	19.50	BA
28#	459B, 30-3, 141-142	277.91	19.60	B, BA, A, D
29#	459B, 30-4, 78-79	278.78	19.60	
30#	459B, 31-1, 38-39	283.38	20.00	BA, A, D
31#	459B, 31-2, 0-1	284.50	20.00	A, D
48	458, 16-1, 7-8	142.57	20.50	A, D
49	458, 16-1, 19-20	142.69	20.50	BA, A, D, R
50	458, 16-1, 40-41	142.90	20.50	BA, D
51	458, 16-1, 102-103	143.52	20.50	BA, A, D
52	458, 16-1, 112-113	143.62	20.50	A, D
32#	459B, 32-1, 98-99	293.48	20.50	R
33#	459B, 32-2, 8-9	294.08	20.50	BA, A
34#	459B, 32-2, 38-39	294.38	20.50	BA, A >> R
53	458, 16-2, 46-47	144.46	20.60	D, R
54	458, 16-2, 110-111	145.10	20.60	A, D, R
55	458, 16-2, 131-132	145.31	20.60	BA << D, R
35#	459B, 33-1, 107-108	303.07	20.60	D
56	458, 16-3, 14-15	145.64	20.70	A, D

See text for interpretation of ages and rock types
B basalt, BA basaltic andesite, A andesite, D dacite and R rhyolite
Samples 1-64 are from Site 458 ash layers; samples 1#-71# are from Site 459B ash layers

Table A 1-1 The studied ash layers recovered from Leg 60 in the Mariana forearc (cont)

No.UNE	Site, Core-Section, Interval (cm)	Depth (mbsf)	Age (Ma)	Rock types
36#	459B, 35-1, 9-10	321.09	21.10	D, R
37#	459B, 35-1, 112-113	322.12	21.10	D
38#	459B, 36-1, 60-61	331.10	21.20	A, D, R
39#	459B, 36-1, 75-76	331.25	21.20	A, D, R
40#	459B, 36-2, 122-123	333.22	21.20	A, D, R
41#	459B, 36-3, 8-9	333.58	21.20	A, D
42#	459B, 37-1, 32-33	340.32	21.40	D, R
43#	459B, 37-1, 98-99	340.98	21.40	A, D, R
44#	459B, 37-2, 5-6	341.55	21.40	A, D
45#	459B, 38-1, 76-77	350.26	21.60	D, R
46#	459B, 38-1, 134-135	350.84	21.60	A, D, R
47#	459B, 39-1, 114-115	360.14	21.90	D >> R
48#	459B, 39-2, 104-105	361.54	21.90	D >> R
49#	459B, 40-1, 14-15	368.54	22.00	BA, A, D
50#	459B, 40-2, 97-98	370.97	22.00	D, R
51#	459B, 40-2, 132-133	371.32	22.00	D, R
52#	459B, 40-3, 36-37	371.86	22.00	D
53#	459B, 40-3, 101-102	372.51	22.00	D >> R
54#	459B, 40-4, 102-103	374.02	22.00	D >> R
57	458, 19-1, 21-22	171.21	22.24	BA, A, D
55#	459B, 42-1, 99-100	388.49	22.30	BA, A, D, R
56#	459B, 42-1, 143-144	388.93	22.30	A, D
57#	459B, 42-2, 62-63	389.62	22.30	A, D, R
58#	459B, 42-2, 67-68	389.67	22.30	D >> A, R
58	458, 19-1, 75-76	171.75	22.40	BA, A, D
59	458, 19-1, 95-96	171.95	22.50	A
60	458, 19-2, 37-38	172.87	22.50	BA, A
59#	459B, 45-1, 40-41	416.40	22.80	BA, A
60#	459B, 45-1, 67-68	416.67	22.80	R
61#	459B, 46-2, 58-59	427.58	23.00	A >> D
62#	459B, 46-2, 80-81	427.80	23.00	D
63#	459B, 50-1, 74-75	464.24	25.70	A >> D
64#	459B, 50-2, 73-74	465.73	25.70	A, D
65#	459B, 52-2, 111-112	485.11	27.10	A, D, R
66#	459B, 53-1, 112-113	493.12	27.50	A, D, R
67#	459B, 53-2, 76-77	494.26	27.50	A >> D
61	458, 25-2, 80-81	230.30	30.90	BA, A
62	458, 27-1, 24-25	247.24	33.40	BONINITE
63	458, 27-1, 131-132	248.31	33.80	BONINITE
64	458, 27-2, 34-35	248.84	33.80	BONINITE
68#	459B, 58-1, 97-98	540.47	34.90	R
69#	459B, 58-1, 141-141	540.90	35.00	A, D
70#	459B, 58-2, 40-41	541.40	35.00	BA, A
71#	459B, 58-3, 28-29	542.78	35.00	BA, A

See text for interpretation of ages and rock types

B basalt, BA basaltic andesite, A andesite, D dacite and R rhyolite

Samples 1-64 are from Site 458 ash layers; samples 1#-71# are from Site 459B ash layers

Table A 1-2 The studied ash layers recovered from ODP Leg 125 in the Bonin forearc

No.UNE	Site, Core-Section, Interval (cm)	Depth (mbsf)	Age (Ma)	Rock types
1	782A, 1H-3, 22-24	3.2	0.25	BA, D, R
2	782A, 2H-6, 84-87	18.2	1.20	BA, A
3	782A, 6H-1, 138-140	49.2	1.80	BA, D
4	782A, 11X-3, 51-54	99.2	3.20	BA, D
5	782A, 13X-2, 104-106	117.5	3.75	A >> D
6	782A, 13X-3, 52-54	118.6	3.80	BA, A >> R
7	782A, 14X-2, 113-115	127.2	3.90	BA, A
8	782A, 14X-2, 141-143	127.5	3.90	A
10	782A, 17X-2, 123-125	156.4	5.60	BA, A >> D
11	782A, 17X-5, 140-142	161.0	5.65	BA, A
15#	782A, 19X-CC, 12-14	179.0	5.75	BA
16#	782A, 20X-CC, 9-11	184.1	6.10	BA
17#	782A, 21X-2, 83-84	194.4	6.45	BA, A
18#	782A, 23X-2, 15-16	213.2	6.80	BA
19#	782A, 23X-5, 42-43	217.9	6.90	BA
12	782A, 26X-1, 141-144	241.7	8.10	BA, A >> D
13	782A, 29X-6, 39-41	277.1	12.40	B, BA, A, D
20#	782A, 32X-2, 40-44	295.9	13.80	BA, A
21#	782A, 33X-5, 86-90	310.4	14.30	B, BA
22#	782A, 33X-7, 27-30	312.8	14.50	BA, A
14	782A, 41X-CC, 44-47	389.8	~42	R
11#	784A, 3R-3, 51-52	14.4	0.70	BA, D, R
1	784A, 8R-5, 35-37	65.2	2.75	A, D, R
2	784A, 9R-1, 69-71	69.2	3.10	R
3	784A, 10R-3, 29-31	81.4	3.45	BA << D, R
4	784A, 12R-2, 66-68	99.6	4.10	BA, A, D
5	784A, 16R-4, 103-105	141.5	6.10	B, BA, A, D
6	784A, 17R-3, 144-149	150.0	6.60	BA, A
7	784A, 17R-4, 38-40	150.5	6.60	BA, A, R
8	784A, 18R-2, 32-35	157.1	6.80	B, BA
9	784A, 18R-2, 102-104	157.8	6.80	B, BA, D, R
10	784A, 20R-3, 67-69	178.4	7.50	BA, A >> R
12#	784A, 21R-3, 77-79	188.2	8.10	A >> D
13#	784A, 24R-3, 118-120	217.4	11.00	BA, A >> R
14#	784A, 28R-1, 92-95	252.7	11.00	A << R
15#	784A, 29R-6, 77-79	269.7	13.00	BA, A
16#	784A, 31R-2, 77-78	283.1	14.00	BA
1	786A, 1H-4, 23-25	4.7	2.50	A, R
12#	786A, 2H-2, 104-106	12.3	2.90	
13#	786A, 2H-4, 84-86	15.1	3.14	BA, A, D, R
14#	786A, 2H-5, 122-124	16.9	3.18	BA, A
15#	786A, 3H-6, 104-106	27.7	4.50	BA, A, D
2	786A, 5X-1, 74-76	38.9	5.60	B, BA
3	786A, 6X-3, 126-128	51.9	10.50	BA, A >> D
4	786A, 6X-5, 7-9	53.7	10.80	BA
5	786A, 6X-5, 39-41	54.0	10.80	BA
6	786A, 7X-2, 127-129	59.9	11.50	BA
7	786A, 7X-3, 15-17	60.3	11.80	BA, A
8	786A, 7X-5, 64-66	63.7	12.50	B, BA, A, R
9	786A, 9X-3, 129-131	81.1	16.50	R
10	786A, 9X-4, 24-26	81.5	17.00	A, D, R
11	786A, 9X-5, 61-63	83.4	23.70	

See text for interpretation of ages and rock types
B basalt, BA basaltic andesite, A andesite, D dacite and R rhyolite
#Samples are new ash layers for this work; other samples are from Arculus and Bloomfield (1992)

Table A 1-3 Petrographic descirption of xenoliths from SFVF, AZ, USA

Sample	Rock type	Locality#	Pl	Cpx	Opx	Sp	Mt	Il	Ol	Am	Bi	Q	Kf	Other	Glass
AK-21a	Cumulate-Ultramafic	Flow 426, 2mi N.O'Neil, SE	***	******	***		***	*		*					
SW-2	Cumulate-Ultramafic	V 1216, SW	***	**			**			******					
C387-13	Cumulate-Ultramafic	Crater 387, W	*****	****	****	**	*		*	*				S	
AK-26e	Amphibole-Gabbro	V 149, 2mi. W. Sunset, E	*****	***	***		**			*****	*				
AK-42h	Cumulate-Mafic	1mi.N.GCTP, near C387, W		******	*****	**		*	*	*					
C160-11	Cumulate-Mafic	Crater 160, N		*******		**	*		**						
C387-29	Cumulate-Mafic	Crater 387, W	*	*******	*		*		***	*	*				*
AK-40h	Cumulate-Mafic	N side Beacon Hill,7mi.E.Williams, SW	******	****	***		**			*					
AK-35	Cumulate-Mafic	Crater160, N		*******			**			**					
C160-5	Cumulate-Mafic	Crater160, N	*	*******					***						*
C387-4	Granulite-Mafic	Crater 387, W	***	*******										Tit	
C387-11	Granulite-Mafic	Crater 387, W	****	*****	***	**	*	*	*	*				Zir	*
AK-35f	Granulite-Mafic	Crater160, N	******	***	****		**			*				S, Ap	
C160-3	Granulite-Mafic	Crater160, N	******	****	****		*	*							*
C160-8	Granulite-Mafic	Crater160, N	******	***	****		**	*			*			Ap	
C160-10	Granulite-Mafic	Crater160, N	******	****	****		*	*			*				*
AK-43c	Granulite-Intermediate	1mi.N.GCTP,near C387, W	******				**					***	***	Ap, Tit	**
SW-14	Granulite-Intermediate	V 1216, SW	******	***	**		**								**
C387-28	Granulite-Intermediate	Crater 387, W	******	***	**		*							Zir, S	*
AK-43b	Granulite-Intermediate	1mi.N.GCTP,near C387, W	*******				**					***	***	Zir	**
C387-10	Granulite-Felsic	Crater 387, W	********				*							Zir, Ap	*
SW-12	Granulite-Felsic	V 1216, SW	*******	**	***		**								*
AK-41g	Granulite-Felsic	4mi.E . C387, W	***				*	*		*	*	**	***		******
NM 87-13	Granulite-Mafic	Tule Tank (near A1 Mountain), S													
NM 87-14	Granulite-Mafic	Tule Tank (near A1 Mountain), S													
NM 87-10	Granulite-Mafic	Tule Tank (near A1 Mountain), S													
NM 87-5	Granulite-Mafic	Tule Tank (near A1 Mountain), S													
NM 87-4	Granulite-Mafic	Tule Tank (near A1 Mountain), S													
NM 87-7	Granulite-Mafic	Tule Tank (near A1 Mountain), S													
NM 87-12	Granulite-Mafic	Tule Tank (near A1 Mountain), S													
NM 87-11	Granulite-Mafic	Tule Tank (near A1 Mountain), S													
NM 87-6	Granulite-Mafic	Tule Tank (near A1 Mountain), S													

#N, S, W, SW and E are north, south, west, southwest and east direction of SFVF, respectively; samples NM 87- are from Nealey and Unruh (1993); Pl, plagioclase; Am, amphibole Cpx, clinopyroxene; Opx, orthopyroxene; Sp, spinel; Mt, magetite; Il, ilmenite; Ol, olivine; Bi, biotite; Q, quartz; Kf, alkali feldspar; Ap, apatite; S, sulfide; Tit, titanite; Zir, zircon 1*, 2*, 3*, 4*, 5*, 6*, 7*, 8* are ~ 1 %, ~ 2-10 %, ~ 10-20 %, ~ 20-30 %, ~ 30-50 %, ~ 50-70 %, ~ 70-90 %, and > 90 % of estimated relative abundances of minerals, respectively

Table A 1-3 Petrographic descirption of xenoliths from SFVF, AZ, USA (cont)

Sample	Rock type	Locality#	Pl	Cpx	Opx	Sp	Mt	Il	Ol	Am	Bi	Q	Kf	Other	Glass
SW-13	Cumulate-Ultramafic	V 1216, SW	***	**	*		**			******					
SW-4	Cumulate-Ultramafic	V 1216, SW	*	*****		**	*		*	*****					
SW-1	Cumulate-Ultramafic	V 1216, SW	***	**			**		*	******					
C160-14	Cumulate-Ultramafic	Crater 160, N	**	*****	*****	**	*			*					
SW-3	Cumulate-Ultramafic	V 1216, SW	**	******		**	*		*	*****					
C387-1	Cumulate-Ultramafic	Crater 387, W	*****	*****		**								S	
AK-25g	Cumulate-Ultramafic	V 146, 5mi.N.O'Neil, SE													
AK-37rr	Cumulate-Ultramafic	Near V 1216, SW													
AK-40k	Cumulate-Ultramafic	N side Beacon Hill,7mi.E.Williams, SW	*****	****	***		****		*						
SW-7	Cumulate-Mafic	V 1216, SW	******	***	****	**									
SW-15	Cumulate-Mafic	V 1216, SW		******	*****	**									
SW-6	Cumulate-Mafic	V 1216, SW	******	**	***	**									
C387-6	Cumulate-Mafic	Crater 387, W	*****	***	****	**	*			*				S	
SW-11	Cumulate-Mafic	V 1216, SW	**	*****	*****	**	*	*	*	*					
AK-42o	Cumulate-Mafic	1mi.N.GCTP,near C387, W		*****	*****		*			***					
Ak-42g	Cumulate-Mafic	1mi.N.GCTP,near C387, W	**	*****	*****					**					*
AK-42q	Cumulate-Mafic	1mi.N.GCTP,near C387, W		******	****		*		*						
AK-37ss	Cumulate-Mafic	Near V1216,SW.SFVF		******	****		*		*						
AK-42p	Cumulate-Mafic	1mi.N.GCTP,near C387, W		******	****		*		*						
AK-35e	Cumulate-Mafic	Crater160, N	*****	****	****		*								
C160-6	Cumulate-Mafic	Crater160, N	**	*****	****	*	*								
C160-1	Lava-Basalt	Crater160, N		****			**		***						*****
C160-12	Lava-Andesite	Crater160, N	***	***	**	*	**	*			*				****
SW-5	Granulite-Mafic	V 1216, SW	******	**	**		**			**				Zir, Ap	*
SW-10	Granulite-Mafic	V 1216, SW	******	****	***		**	*							
C387-15	Granulite-Mafic	Crater 387, W	*****	****	***		**			*					
AK-35g	Granulite-Mafic	Crater160, N	*****	****	***		*							Ap	
C160-13	Granulite-Mafic	Crater160, N	*******	**	**		*								
AK-35d	Granulite-Mafic	Crater160, N	*****	***	**		*								
AK-37v	Granulite-Felsic	Near V 1216, SW	******				*					***	***	Zir	**
RJA-3723A	Lava-Rhyolite	W 755 CW154, SFP													

#N, S, W, SW and E are north, south, west, southwest and east direction of SFVF, respectively; samples NM 87- are from Nealey and Unruh (1993); Pl, plagioclase; Am, amphibole Cpx, clinopyroxene; Opx, orthopyroxene; Sp, spinel; Mt, magetite; Il, ilmenite; Ol, olivine; Bi, biotite; Q, quartz; Kf, alkali feldspar; Ap, apatite; S, sulfide; Tit, titanite; Zir, zircon 1*, 2*, 3*, 4*, 5*, 6*, 7*, 8* are ~ 1 %, ~ 2-10 %, ~ 10-20 %, ~ 20-30 %, ~ 30-50 %, ~ 50-70 %, ~ 70-90 %, and > 90 % of estimated relative abundances of minerals, respectively

Table A 1-4 The dropstones recovered from ODP Leg 145*

No.UNE	No. Pebble	Site-core-section	Interval (cm)	W 1 (g)	W 2 (g)	W 3 (g)	W 4 (g)	W (powder)
1	152	881C-7H-1	0-20	0.1353	0.0774	0.0770	no	0.0677
2	91	881C-7H-1	0-20	0.1150	0.0873	0.0863	no	0.0846
3	104	881C-7H-1	0-20	0.1811	0.1487	0.1450	no	0.1393
4	179	881C-7H-1	0-20	0.2232	0.1673	0.1649	no	0.1611
5	148	881C-7H-1	0-20	0.3182	0.2593	0.2571	no	0.2350
6	1H-2	881A-1H-2	58-59		0.3799	0.3715	no	0.3667
7	145	881C-7H-1	0-20	0.4416	0.4030	0.4001	no	0.3746
8	2H-6	883C-2H-6	130-131		0.4006	0.3926	no	0.3884
9	25	881C-7H-1	0-20	0.7136	0.5563	0.5515	no	0.5363
10	51	881C-25X-1	0-7	0.7763	0.6436	0.6349	no	0.6282
11	11	881C-7H-1	0-20	2.6829	2.4211	2.4102	0.8426	1.4790
12	5	881C-7H-1	0-20	3.3433	2.9672	2.9364	1.2085	1.7135

*W 1 is original weight of dropstones; W 2 is weight after grinding off the sample marks
W 3 is weight after HCl-leaching; W 4 is weight left; W (powder) is weight (g) of powdered dropstones

Appendix 2. Analytical techniques

2.1 Sample preparation and treatment

2.1.1 Volcanic ashes

On the basis of sediment descriptions presented in Volume 60 of the Initial Reports of the Deep Sea Drilling Project (Hussong, Uyeda, et al., 1981) and in Volume 125 of Initial Reports of the Proceedings of the Ocean Drilling Program (Fryer, Pearce, Stokking, et al., 1990a), a total of 64 ash layers from Site 458, and 71 layers from Site 459B were examined for DSDP Leg 60, a total of 22 ash layers from Site 782A, 16 layers from Site 784A, and 15 layers from Site 786A were studied from ODP Leg 125. Ash layers selected for study either lack or have minimal evidence for bioturbation and reworking. Layers were chosen in an attempt to obtain a preliminary and temporally representative sample sequence, although we recognised that a large number of layers remain unstudied (e.g., for ODP Leg 125, 116 ash or ash-dominated layers are documented in Site 782A, 86 in Site 784A, and 58 in Site 786A), and significant time gaps have not been studied to this point.

Biostratigraphic dating and magnetostratigraphy were combined to obtain estimates for the ages of the ash layers studied (Tables A 1-1 and A 1-2, pages A 2-5). The ages assigned to sediments from DSDP Sites 458 and 459 and ODP Sites 782A, 784A and 786A are from B. Taylor.(pers. comm., 1992) and Stabell et al. (1992), respectively. The ages for ash samples from Site 458 range from about 0.35 to 34 Ma; for Site 459B, from 0.25 to 35 Ma; for Site 782A, from about 0.25 to 14.5 Ma and about 42 Ma; for Site 784A, from approximately 0.7 to 14 Ma; for Site 786A, from about 2.5 to 17 Ma and 23.7 Ma. At this point we have been unable to correlate any single layer across all five of the Sites, nor examined possible thickness variations in specific horizons in an attempt to identify source directions.

Individual shards (glasses and minerals) were handpicked from the 2- to 10- cm^3 plastic-tube cores taken on board the ship (for ODP Leg 125) and at the core repository of the DSDP Pacific and Indian Ocean Cores at the Scripps Institution of Oceanography (for DSDP Leg 60). We endeavoured to include as many different sizes (0.01 ~ 0.5 mm), shapes (most are elongated and jagged externally) and colours (almost colourless through pale yellow and varying shades of bottle green to brown) of shards as possible in any given sample. These samples were washed in deionised water in an ultrasonic bath for ~ 30 minutes, dried gently (< 105 ^{0}C), mounted in perspex, and polished and carbon-coated carefully for EMP analysis of individual glass and mineral shards, and for further PIXE PMP analysis of individual glass shards.

On the basis of 1753 major element data of glass shards in 184 bulk ash samples (1215 from 133 DSDP Leg 60 ash layers, 2 samples lacking glass; 538 from 51 ODP Leg 125 ash layers, 1 sample lacking glass, 1 sample missing from USA to Australia), a total of 24 ash layers from DSDP Leg 60 and 22 ash layers from ODP Leg 125 were selected for Sr-Nd isotopic analysis. Among 45 ash layers, 26 are relatively homogeneous and 11 are heterogeneous; 4 homogeneous and 4 heterogeneous ash layers contain 2 ~ 90 volume percent sediments (mostly nannofossil marls, chalks and clays), and 1 sample is boninite derived from Site 458 basement. These selected 45 ash layers span the arcs' explosive history from a mid-Eocene inception to the present and cover the whole rock types from basaltic andesite, andesite, to dacite and rhyolite (see Table A 3-17, pages A 53-54). In order to unravel the primary feature of Sr and Nd isotopic ratios of volcanic ash shards, an appropriate leaching strategy was determined for treatment of these ash layers for Sr and Nd isotopic analysis.

784A-13# with about 90 volume percent andesitic glass and mineral shards, 10 Ma old, weighing 5 grams, was washed in about 100 ml 18.2 M-ohm Millipore water in an ultrasonic bath for about one hour (20 ml x 1, 10 min x 1; 10 ml x 5, 5 min x 5; 5 ml x 4, 5 min x 4). The collected 100 ml pore water solution was slowly taken to dryness. The washed ash sample was then divided into five aliquots of 250 mg for no HCl-leaching, 1 N HCl-leaching, 2.5 N HCl-leaching (duplicates) and 6.0 N HCl-leaching in an ultrasonic bath for 30 to 60 minutes. The HCl-leached ash samples were washed, dried and analysed for $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ (for two samples) ratios with the dried pore water and no HCl-leaching aliquots under the same analytical condition. The Sr and Nd isotopic ratios for 784-13# leaching experiment are listed in Table A 2-1 (page A 23). Because most ash layers contain small amounts of sediments (mostly nannofossil marls, chalks and clays) and the HCl probably dissolved any remaining carbonate plus any phosphatic materials and possibly sulfide, and also attacked the clays to some degree (e.g., Carroll, 1970; DePaolo et al., 1983; and this work), 6.0 N HCl was chosen to leach all ash samples in an ultrasonic bath for one hour, which these ash samples were then rinsed with Millipore water and dried and analysed for Sr and Nd isotopic ratios following the method described in Appendix 2.6.

Based on the results of Sr-Nd isotopic ratios of 45 ash layers, 17 ash layers from DSDP Leg 60 (among them, 4 heterogeneous layers) and 12 ash layers from ODP Leg 125 (among them, 1 heterogeneous layer) were chosen for ICP-MS trace element analysis. In particular, 6 representative bulk glass shards were handpicked from their bulk ash layers for comparison. All these 29 bulk ash samples and 6 bulk glass samples were handpicked and examined under the binocular and optical microscopes to obtain pure bulk ashes (glasses + minerals) and glasses (no minerals) free of rock fragments and sediments.

2.1.2 Lower crustal xenoliths

About 150 xenoliths were sampled from basalt flows and cinder cones in different parts of the SFVF by R. J. Arculus and S. J. Keating. These samples were all thin-sectioned and examined under the microscope. 53 xenoliths were selected for detailed geochemical studies. Key selection criteria were representativeness of whole xenolith types, absence of host basalt infiltration and sufficient size (> ~ 15 cm^3) for bulk analysis by XRF spectrometry. The weathered surface and basalt rinds were removed by sawing. Most of the large samples were crushed and powdered in a tungsten-carbide (WC) ring mill. Samples AK41g, 160-8 and 387-29 however, were crushed in a steel jaw crusher, and the chips ground in an agate ring mill. Glass from AK41g was handpicked after crushing in an agate ring mill. All the xenolith chips and AK41g-glass were washed in 2 N HCl for 1 hour, rinsed in Millipore water and dried before powdering. The mineral chemistry of 40 samples of 53 xenoliths were probed at the University of Michigan and UNE. 29 xenoliths plus Ak41g-glass were chosen to measure the Sr-Nd isotopic ratios. 23 xenoliths plus Ak41g-glass were also selected for ICP-MS analysis.

2.1.3 Dropstones (Ice-rafted debris)

Twelve dropstone samples collected by B. C. McKelvey from drill cores recovered at ODP Sites 881 and 883, Leg 145 are listed in Table A 1-4 (page A 8). All dropstones are fresh, sub-rounded to rounded, less than 2 cm long, and Pliocene-Pleistocene in age (McKelvey et al. (1995). The original weights of most dropstones are less than 0.5 gram. Sample marks (resins) were ground off and samples were leached in 2.5 N HCl in an ultrasonic bath for 30 minutes, rinsed with 18.2 M-ohm Millipore water, dried, checked under the binocular microscope and powdered carefully in agate "mortar and pestle". The powdered samples were used for major element (except for Si and Al) and trace element analysis by ICP-MS. The same solutions analysed by ICP-MS were used to measure Al_2O_3 by atomic absorption spectrophotometry and determine Sr and Nd isotopic ratios.

2.2 EDS-EMP

The major element chemistry of individual glass and mineral shards within the DSDP Leg 60 and ODP Leg 125 ash layers and minerals within xenoliths was determined with a JEOL JSM-35 electron microprobe equipped with an energy dispersive attachment located in the Electron Microscope Unit at the University of New England (UNE). An accelerating voltage of 15 kV, beam current of 1 nA and a count time of 100 seconds for each point was used. Data reduction was performed using peak integration with background subtraction and corrections as outlined by Ware (1981). At present, the EDS analysis can not determine accurately low level contents of P, F and Cl. The detection limit (wt %) for the elements analysed is relatively high: - TiO_2 0.12 ~ 0.14, Al_2O_3 0.12 ~ 0.14, FeO 0.13 ~ 0.14, MnO 0.12 ~ 0.15, MgO 0.10 ~ 0.16, CaO 0.11 ~ 0.12, Na_2O 0.17 ~ 0.20, K_2O 0.07 ~ 0.08, Cr_2O_3 0.12 ~ 0.14, and V_2O_3 0.15 ~ 0.30.

In order to evaluate the accuracy and precision of major element analysis by EDS, four international basaltic and rhyolitic glass standards (USNM - 111240 VG-2, USNM - 113498/1 VG-A 99, USNM 2213 Tektite and USNM 72854 VG - 568) and our internal standards (UNE and ANU standards) were analysed. The results and recommended values from Jarosewich et al. (1980) are listed in Table A 2-2 (page A 24). There is close agreement for all elements between our averages and recommended values. The precision of our EDS analysis is better than ± 5 relative percent for all elements. The accuracy is approximately ± 3 relative percent for major element within their normal abundance levels (SiO_2 50.00 ~ 80.00, TiO_2 0.50 ~ 4.00, Al_2O_3 11.00 ~ 17.00, FeO 4.00 ~ 16.00, CaO 2.00 ~ 15.00, MgO 2.00 ~ 10.00, Na_2O 1.00 ~ 4.00, and K_2O 0.50 ~ 5.00 wt %) and about ± 20 relative percent for TiO_2 with less than 0.50, FeO < 1.00, CaO < 0.50, MgO < 1.00, K_2O < 0.20 and Na_2O < 1.00 and > 4.00 wt %.

2.3 XRF

X-ray fluorescence analyses were made on a Siemens SRS300 automated X-ray fluorescence spectrometer using standard techniques (Norrish and Chappell, 1967; Arculus and Gust, 1995) at the Department of Geology and Geophysics, UNE. Major elements were measured on glass beads, which were prepared using the conventional Norrish and Hutton (1969) technique by fusing about 0.3733 gram ignited rock powder with 2.0 gram $LiBO_2$-LiB_4O_7 (66/34) at 1000 °C in a Herzog HAG 1200 automated furnace. The accuracy of major elements, judged by running two fused discs of international standards BHVO-1 and JA-2 with every batch, was ± 2 relative percent, except for TiO_2, MnO, P_2O_5, Na_2O and K_2O, ± 2 ~ 10 relative percent. Loss on ignition (LOI) was determined by weight loss of absorbed water by heating 2 gram sample powder in a porcelain cup at 110 °C for one hour (W 1). Subsequently, the weight loss was measured of the samples (in the same porcelain cup) by heating to 1000 °C in a furnace for one hour (W 2). The reported LOI values in Appendix 5 are the difference of W 2 and W 1. LOI of duplicates indicate a precision of better than ± 5 relative percent. Ferrous iron determinations were made titrametrically using a modified Shapiro and Brannock's method (1962). Powdered samples were dissolved in a water bath in a hydrofluoric-sulphuric acid mixture, then added to a sulphuric and boric acid mixture with N-phenylanthyanilic acid indicator and titrated against ceric sulphate. The accuracy and precision were better than ± 3 relative percent judged by the standards under the same condition.

Nineteen trace elements (Nb, Zr, Y, Sr, Th, Pb, Ga, Zn, Cu, Ni, U, Rb, Cr, Ce, Sc, Nd, Ba, V, La) were determined on pressed powder pellets backed with boric acid using modifications of methods outlined by Norrish and Chappell (1967). These were made of 10 gram sample powder mixed with 2 ml elvacite solution (1: 5 = elvacite : acetone) as binding agent and pressed under 20 ton / cm^2 for 20 seconds. The accuracy of trace elements is dependent upon their abundances, which was about ± 5 ~ 10 relative percent except for Sc, Rb, Pb, Th, and U, which were ± 15 ~ 20 relative percent, and sometimes more than ± 50 %.

2.4 PIXE-PMP

Proton induced X-ray emission (PIXE) proton-microprobe (PMP) analyses were carried out at the CSIRO Heavy Ion Analytical Facility, using methods described by Griffin et al. (1988, 1989). Briefly, a beam of 3 MeV protons is focussed by the electrostatic microprobe lens (Sie and Ryan, 1986) to form a spot 20 ~ 30 µm in diameter on the carbon-coated surface of the specimen. The X-rays excited by the protons are collected by a Si (Li) energy-dispersive detector, the spectrum is collected by a LeCroy MCA, and the data processed as described by Ryan et al. (1990a). To achieve reasonable detection limits within an acceptable time, high beam currents (10 ~ 15 nA) are essential; this in turn requires that the intensity of major-element lines be reduced by selection filters, to minimise detector dead time. In this work, the major element spectra were attenuated by a 200-µm Al filter to allow use of higher beam currents (10 ~ 15 nA) and the attainment of relatively low detection levels within analysis times of approximately 5 ~ 10 minutes. Such a filter, however, limits analysed elements to those with Z > Fe. Most glass shards analysed were > 50 µm in diameter, and while the diameter of the proton beam is less than this, the depth of detectable X-ray production varies from ~ 30 µm to ~ 40 µm in the glass shards.

Quoted uncertainties are 1 standard deviation (SD), based on the counting statistics. The analytical methods employed are in principle independent of standards (Ryan et al., 1990a). However, analytical data are normalised to electron microprobe analyses for Fe to correct for bias caused by possible accumulated charge measurement problems. These corrections are usually within 10 ~ 15 %, except when beam penetration has occurred through glass shards. All samples were analysed to an accumulated charge of 3 µc.

The accuracy of the technique is estimated to be on the order of ± 5 ~ 10 relative percent at concentration levels greater than 2 ~ 3 times mean detection levels (Griffin et al., 1988; Ryan et al., 1990a,b). The precision of PIXE analyses for glass shards was judged by running three international glass standards (USNM - 113498/1 VG-A 99, USNM 2213 Tektite and USNM 72854 VG - 568) with every batch (Table A 2-3, page A 25). Because there are not any recommended trace element values for these glass standards, the average of several point analyses is used to evaluate the precision for individual point analyses of glass shards. The precision was better than ± 6 relative percent for Sr and Zr, ± 10 relative percent for Rb, Ba, Y, Nb, Cu, Zn, Ga and Pb, except for low levels of these elements: Rb < 10, Ba < 80, Sr < 10, Y < 20, Zr < 40, Nb < 15, Cu < 40, Zn < 40, Ga < 15, Pb < 20 and Ni < 15 (ppm) because their minimum detection limit (99% confidence level) of this technique is relatively high: Rb 0.8 ~ 2, Ba 20 ~ 75, Sr 0.8 ~ 2, Y 0.9 ~ 2.5, Zr 1.0 ~ 3.5, Nb 1.1 ~ 3.5, Cu 1.6 ~ 2.0, Zn 1.1 ~ 1.5, Ga 0.9 ~ 1.5, Pb 1.5 ~ 2.5, Ni 2.5 ~ 3.3, Th 3.0 ~ 3.5, Mn 8 ~ 30, La 26, Ce 35 and Fe 10 (ppm) (Ryan et al., 1990a,b).

2.5 ICP-MS

For all selected volcanic ash and glass samples, xenolith and its glass samples and dropstone samples, a complete set of 35 trace elements (Element group I: Li, Sc, V, Cr, Co, Ni, Cu, Zn, Ga, Ge, Rb, Sr, Y, Zr, Nb, Cs, Ba; Element group II: REE, Hf, Ta, Pb, Th, U) were determined by inductively coupled plasma source mass spectrometry (ICP-MS) at the VIEPS Trace Analysis Laboratory, Monash University. The major element Ti, Fe, Mn, Mg, Ca, Na, K and P of dropstone samples, was also measured by ICP-MS.

2.5.1 Sample dissolution procedures

All wet-chemistry is performed in "class 350" clean air cabinets. Powdered samples (for xenoliths and dropstones), bulk ash and glass samples, normally 0.05 ~ 0.1 grams, are dissolved for 24 to 48 hours in Savillex-type screw-top Teflon bombs on a hotplate at 100-120 $^{\circ}$C in a mixture of distilled HF (4 ml) and distilled HNO_3 (2 ml). Sample solutions are slowly taken to dryness with the aid of heatlamps, followed by conversion of fluorides to nitrates with two additions of concentrated HNO_3 (2 ml) and one addition of concentrated HCl (1 ml). Samples are then taken into solution with 2% HNO_3 (made with sub-boiled distilled concentrated HNO_3 and 18.2 M-ohm Millipore water). Aliquot's of ~ 25 grams are then taken and these are also diluted up to ~ 50 grams, giving a final dilution factor of ~2000. All samples are also made up with 100 ppb indium to serve as an internal standard to correct for instrument drift. One analytical blank and five standard solutions (based on 25 mg, 50 mg and 100 mg of digested U.S. Geological Survey standard BHVO-1 and AGV 1) are typically prepared with each run. BHVO-1 or AGV 1 are also used as a check standard to monitor accuracy during the analysis procedure.

2.5.2 Instrumentation.

Diluted rock solutions are analysed by ICP-MS using a VG PlasmaQuad PQ2+ in "peak jumping mode" for maximum sensitivity. One or two isotopes (listed below) are chosen for each element of interest based on no or minimal isobaric interferences. Five blocks of data are obtained for each sample, with each block comprising 50 mass spectrometer sweeps through the mass spectra. Total analytical blanks (comprising both chemistry and mass spectrometer components) are typically < 0.1 ppm for Element group II and < 0.5 ppm for Element group I, except for Sc, V, Cr, Ni, Cu, Zn, Sr and Ba, which are sometimes high, 0.5 ~ 5 ppm, making blank corrections < 2% for most geological samples. Measurement parameters are as follows:

Number of scan sweeps		100	
Number of peak jump sweeps:		50	
Points per peak:		3	
DAC steps between points:		5	
Dwell Time (μs)		320	
Collector type:		Pulse counting	
Element I	Isotope	Element II	Isotope

Li	7	In	115
Sc	45	Ba	137
V	51	La	139
Cr	52/53	Ce	140
Co	59	Pr	141
Ni	60/61	Nd	143/146
Cu	63	Sm	147
Zn	64/66	Eu	151
Ga	71	Gd	158
Ge	74	Tb	159
Rb	85	Dy	161/163
Sr	86	Ho	165
Y	89	Er	166
Zr	90	Tm	169
Nb	93	Yb	174
In	115	Lu	175
Cs	133	Hf	178
Ba	137	Ta	181
		Pb	204/208
		Th	232
		U	238

Each solution is run twice to obtain a complete set of trace element (Element group I and group II) data.

2.5.3 Data Reduction.

Raw counting data from the instrument are reduced using an in-house, off-line, spreadsheet-based program. The raw integrated count data are first normalised using the In internal standard count rate to suppress random variations in signal intensity. The individual run data are then scanned for outliers, then averaged for each sample. Next, calibration curves are constructed for each element using a simple, least squares linear regression of the BHVO-1 and AGV 1 standard data. In this step, the blank is used as a calibration point instead of conventional blank subtraction. This provides a stronger control on the low end and is a valid 'zero-added' standard. Using these calibration curves, the data are resolved into ppb in solution. During each analysis, a series of dummy samples are run to provide a check on instrument drift. From the ppb data, a deviation matrix is constructed for the dummy samples. If necessary, an additional drift correction is applied to the data using either a linear or polynomial approximation. In the drift correction, one dummy is not used as a control point and its deviation is presented as the accuracy assessment.

2.5.4 Estimate of Precision and Accuracy.

Precision (in-run statistics quoted as relative standard deviation = standard deviation / mean) is typically better than 5% for each analysis. As described above, determination of analytical accuracy is based on analysis of U.S. Geological Survey standard BHVO-1 and AGV1 and is typically better than 5% for most elements at the 95% confidence level. During the ICP-MS analyses of ashes, glasses, xenoliths, dropstones and island arc volcanic rocks in 1993-1994, the accuracy was judged by running six representative international geostandards (BHVO, JB-2, AGV1, JA-2, JR-2 and G-2) with every batch. The data of our analyses with recommended values from Govindaraju (1989) and representative ICP-MS data from Yoshida et al. (1992) are reported in Table A 2-4 (pages A 26-27). Clearly, our data are closer to the recommended values than Yoshida's data except for lower Cr and Ni in one standard (JA-2) and higher Ni and lower Ta in another (JB-2). All our ICP-MS analyses are single run analyses, not averages, while Yoshida's ICP-MS data are mean values of many run analyses. The accuracy was approximately ± 5 ~ 10 relative percent on trace element group I, ± 5 ~ 15 relative percent on trace element group II and no better than ± 15 ~ 20 relative percent on V, Cr, Ni, Ga, Ge, Cs, Pr, Gd, Ta, Th, U with low and very low abundances within some special samples such as those containing large percents of spinels and zircon (Table A 2-5, pages A 28-29).

2.5.5 Major element analyses of dropstones

Aliquot's of ~ 25 grams were taken from the diluted dropstone solutions and standard solutions (blank, BHVO, AGV1, JB-2 and JA-2) analysed for trace elements and diluted up to ~ 50 grams with 2 % HNO_3, yielding a final dilution factor of ~ 4000. Measurement parameters were chosen as follows:

Number of scan sweeps		100
Number of peak jump sweeps:		50
Points per peak:		3
DAC steps between points:		5
Dwell Time (μs)		320
Collector type:		Analog
Element	Isotope	Peak jump dwell
Li	7	10240
Na	23	1280
Mg	25	1280
Al	27	1280
Si	30	1280
P	31	10240
K	39	1280
Ca	42	1280
Ti	48	1280
V	51	1280

Cr	52	10240
Fe	54	1280
Mn	55	1280
Ni	60	10240
Sr	88	1280
In	115	1280
Ba	137	1280

The data reduction method is described in Appendix 2.5.3. The results are listed in Table A 2-6 (page A 30). The major element and selected trace element data are very close to the recommended values from Govindaraju (1989). The selected trace elements (Li, V, Cr, Ni, Sr and Ba) agree very well under the different running operation (diluting factor ~ 2000 running in trace element analysis condition and diluting factor ~ 4000 running in major element analysis condition). For Cr and Ni analysis, the data running in major element condition are better than those running in trace element condition. The precision and accuracy of analysis was judged by running duplicates and three representative international geostandards (JB-2, JA-2 and BHVO) under the same analytical conditions. The precision and accuracy, expressed as 100 (measured - recommended or average) / recommended or average, are better than ± 6 relative percent on major elements except for P, ± 10 relative percent on selected trace element Li, V, Sr and Ba, and ± 10 ~ 20 relative percent on P, Cr and Ni.

Clearly, it is impossible to determine accurately the content of Si and Al in such analytical conditions because of the loss of volatile silicon fluoride during $HF-HNO_3$ digestion and very high abundances of Al_2O_3 in samples and only one isotope for Al. Samples digestion with lithium metaborate ($LiBO_2$) instead of $HF-HNO_3$ might permit the determination of SiO_2 (Potts, 1987). However, the small amounts of the dropstone samples and the impurities involved in the final solutions by $LiBO_2$ digestion (pers. comm., B. Byrd, 1993) prevented us from attempting to analyse SiO_2. The same dropstone solutions were used to measure the contents of Al_2O_3 on a Varian AA 975 atomic absorption spectrophotometer at the Department of Geology and Geophysics, UNE, following the advice of Ms. J. Cook (pers. comm., 1993). The SiO_2 contents of dropstones are calculated as the difference between the original major and minor element oxide total (excluding SiO_2) and 100 %. The data for Al_2O_3 and SiO_2 of dropstone samples are listed in Table A 2-6 (page A 30) with three geostandards' values. The precision and accuracy were discussed above. The SiO_2 contents of three geostandard rocks determined in this way were in agreement with published values to within 1.0 wt %. This method for calculating SiO_2 content is reliable only to the extent of accuracy of other element data.

2.6 Sr, Nd isotopic analysis

Standard ion exchange column techniques (Zhou, 1993) were used for chemical separation of Sr and Nd at the Department of Geology and Geophysics, UNE, with thermal ionisation mass spectrometry (TIMS) (VG 354) performed at the Centre for Isotope Studies (CIS), ARC-CSIRO facility at North Ryde, Sydney.

2.6.1 Chemical separation of Sr and Nd

Technically, 1 ~ 2 x 10^{-6} grams Sr and 2 ~ 4 x 10^{-7} grams Nd are needed on the filaments for mass spectrometer (VG 354) to gain sufficient and accurate analyses (Zhou, 1993). On the basis of requirements of minimum amounts of Sr (1 ~2 μg) and Nd (0.2 ~ 0.4 μg), 0.02 ~ 0.05 grams of various types of samples (ashes, glasses and xenoliths) were weighed depending upon the abundances of Sr (8 ~ 300 ppm) and Nd (1 ~ 30 ppm) in samples and assuming a 50 % of recovery rate during the processes. However, if possible, 0.02 ~ 0.06 grams of samples were digested in order to extend the life of the ion exchange resins.

Powdered samples or bulk ash and glass samples were dissolved in 2 ml HF (distilled three times before usage, ~ 50 wt % concentration) in 30 ml open Teflon beakers for more than four hours, preferably overnight at room temperature. Then, 10 drops of $HClO_4$ were added to the beakers. Sample solutions were evaporated at about 120 °C to dryness and then all regents fumed out at 210 °C, followed with another addition of concentrated HF (2 ml) and two additions of $HClO_4$ (10 drops) to oxidise the components and get rid of fluorine in the samples. The dried samples were transformed into chlorides with one addition of 3 ml 6 N HCl, dried at 120 °C, and dissolved in 2 ml 2.5 N HCl.

The sample solutions were centrifuged to separate undissolved residues. The clear sample solutions were then loaded very carefully through resin columns to separate Sr and REE from the rest of the components with two additions of 1 ml 2.5 N HCl for careful washing, and one addition of 1 + 32 ml 2.5 N HCl for washing and flushing. Then, Sr solutions were collected by addition of 8 ml 2.5 N HCl. REE solutions were collected with one addition of 9 ml 6.0 N HCl for flushing followed by addition of 8 ml 6.0 N HCl.

In order to restore the columns back to original working condition, 20 ml 6.0 N HCl were added to the columns for stripping, followed by 25 ml 2.5 N HCl for conditioning. The REE solutions were slowly taken to dryness on a hotplate, cooled, dissolved in two drops of 0.22 N HCl and loaded with extreme care on to the top of the HDEHP resins directly. 5 ~ 10 drops of 0.22 N HCl from preserved reserve of 10 ml 0.22 N HCl were added to the resins for carefully rinsing four times after the acid run through the columns. Then, the remainder of 10 ml 0.22 N HCl was run through the columns for washing and flushing. Nd solutions were collected by addition of 5 ml 0.22 N HCl. To make the resins back to their original working condition, 10 ml 6.0 N HCl was added for stripping, 10 ml 0.22 N HCl for conditioning and another 5 ml 0.22 N HCl for reconditioning.

The separate Sr and Nd solutions in 10 ml open Teflon beakers were carefully taken to dryness on a hotplate. To the dried Sr and Nd samples was added one drop of concentrated HNO_3 to oxidise possible components from columns, slowly heated to a small spot under the beaker spout, cooled, sealed and sent to CIS, CSIRO, Sydney for TIMS determination.

The dropstone solutions previously analysed by ICP-MS were heated slowly to dryness and then processed as powdered samples described above.

2.6.2 TIMS determination

Measurements were performed on a VG-354 mass spectrometer at the CIS, CSIRO, Sydney, fitted with 16 fixed multicollectors For the TIMS, the purified sample elements are loaded on metal filaments, which is charged with strong electrical current to generate the high temperature, and firstly ionised by thermal heating. A single filament was used for Sr (zone-refined Ta filaments), and triple filaments for Nd (zone-refined Re filaments). The triple filaments were actually "double-filament" because only one side filament was loaded with samples. The special activator used in this work was phosphoric acid for Sr.

The purified dried Sr samples were dissolved in a small drop of purified water (half to a third of the normal drop depending upon the amount of samples available) and sample solutions loaded neatly onto the central part of the filaments with a small drop. Normally, a third to half of the sample is loaded. When the amount of sample is low, the loading procedure above is repeated to have half to all of the samples loaded. When all sample solutions loaded were dried, a tiny drop of 0.75 M H_3PO_5 was added on top of the samples on the filaments. The ideal amount of the acid is to just cover the sample surface. The sample filaments were then heated to fume out all the volatiles and potential organic materials and ready for machine analysis. The dried purified Nd samples were dissolved and loaded onto the zone-refined Re triple filaments as described above for Sr samples except for without using the phosphoric acid as the activator.

Reference standards throughout the course of analysis averaged values of $^{87}Sr/^{86}Sr$ = 0.71027 ± 1 (2 SD) in NBS 987, and $^{143}Nd/^{144}Nd$ = 0.511111 ± 10 (2 SD) in the O'Nions Nd standard. $^{87}Sr/^{86}Sr$ was normalised to $^{86}Sr/^{88}Sr$ = 0.1194. $^{143}Nd/^{144}Nd$ was normalised to $^{146}Nd/^{144}Nd$ =0.7219. T_{CHUR} values were calculated from the present-day "Bulk Earth", $^{143}Nd/^{144}Nd$ = 0.512638 and $^{147}Sm/^{144}Nd$ = 0.1967 (DePaolo and Wasserburg, 1976). T_{DM} values were calculated from $^{143}Nd/^{144}Nd$ = 0.513114 and $^{147}Sm/^{144}Nd$ = 0.222 (Michard et al., 1985). Epsilon Nd values were calculated using the average chondritic value of $^{143}Nd/^{144}Nd$ = 0.512638 proposed by Jacobsen and Wasserburg (1980).

2.7 Comparison of methods and data

2.7.1 EDS - WDS EMP

During this work, EDS - EMP was used to analyse major and minor elements of individual glass and mineral shards within ash layers and minerals within xenoliths as described in Appendix 2.2. The precision and accuracy of our EDS analysis is in close agreement with that of international glass standards. Approximately 2400 analyses of minerals (1034 plagioclase, 867 pyroxene and 477 Fe-Ti oxides) within ash layers show that more than 98 % are acceptable (Figure A 2-1, page A 33). The original total cations of about 1030 plagioclase analyses are between 4.98 and 5.04. If the oxidation state of iron is considered, the total cations are closer to 5.00 (4.98 ~ 5.02). For about 870 pyroxene analyses, the original total cations of more than 98 % of the data are 3.98 ~ 4.04 for clinopyroxene and pigeonite, and 4.00 ~ 4.04 for orthopyroxene. There are good relationships between iron and titanium in about 480 Fe-Ti oxide analyses (Figure A 2-1, page A 33).

The ODP Leg 125 ash samples analysed using WDS - EMP at the University of Michigan by Bloomfield and Arculus (1989) (see Arculus and Bloomfield (1992)) were remeasured using EDS - EMP at UNE for further PIXE - PMP trace element analysis. There is a good opportunity for us to compare the results of WDS and EDS at those different laboratories. Although the analysis points of glass shards within the perspex discs were not exactly the same, statistically, the sufficient number of data points yield useful information. The average values of different types of glasses are listed in Table A 2-7 (page A 31), which is derived from 288 WDS analysis data (36 ash samples) and 527 EDS data (50/53 ash samples). Also, the comparison of EDS and WDS data is illustrated in Figures A 2-2 and A 2-3 (pages A 34-35) (784A data as a representative for simplicity but a similar situation occurs in 782A and 786A data). All data (EDS and WDS) are normalised to 100 % free of volatiles (F, Cl, P and H_2O) for comparison. The total amount of P_2O_5, F and Cl for the glass shards is very low (Arculus and Bloomfield, 1992; Table A 2-7, page A 31). There is no difference for the normalised oxides within the analytical errors. Clearly, and statistically, Na_2O and MnO are consistently higher in WDS than in EDS, and CaO lower in WDS than in EDS beyond the analytical error ± 2 % for CaO, and ± 3 ~ 5 % for Na_2O. The contents of CaO + Na_2O and other oxides are almost within the same range.

It is well known that in conventional WDS analysis, certain phases, e.g., alkali and water-rich glasses and minerals, are affected by electron bombardment and liable to give incorrect results (e.g., Reed and Ware, 1975). However, other scientists have recently shown that Na and K loss during electron beam bombardment of glass is minimised when high accelerating voltage, low-bean current, short counting time, and a rastered beam are used (Neilson and Sigurdsson, 1981; Strope, 1984; Jercinovic and Keil, 1988). The EDS analysis data are in close agreement with WDS data except for Na and Ca, which indicates that the measurement techniques used are generally correct. There may be some problems with the Na and Ca calibration for WDS analysis based on our detailed comparison. However, there are no problems for specific geochemical studies using these data. From the Figure A 2-2 and Figure A 2-3 (pages A 34-35), there are no differences in the ratios and diagrams such as K_2O vs SiO_2, FeO*/MgO vs SiO_2, Al_2O_3/TiO_2, CaO/TiO_2 and

CaO/K_2O vs TiO_2, and $CaO_{6.0}$ and $Na_2O_{6.0}$ values (CaO and Na_2O values when MgO is 6.0 wt%).

2.7.2 ICP-MS and XRF

ICP-MS is a relatively new analytical technique, with the first commercial machines announced in 1983 and is also a powerful and flexible analytical technique, with the potential to be an excellent analytical tool in earth sciences (e.g., Longerich et al., 1990). The main advantages of the ICP-MS as a method for geochemical analysis are its multielement capability, sensitivity and speed. It is possible to determine 46 elements (trace element, minor and major elements), spanning the realm of geochemical behaviour, with solid detection limits ranging between 0.006 and 0.5 ppm in 0.05 ~ 0.1 gram of sample (e.g., Jenner et al., 1990 and this work). Once instrumental procedures are established, it takes only two weeks to obtain analyses on 100 samples, from sample preparation through to final data reduction (e.g., this work and unpublished data). However, one of the major disadvantages of this method is the requirement to introduce the sample in solution. In contrast, determinations by XRF and INAA (instrumental neutron activation analysis) can be obtained using solid sample preparation techniques. The need to get a sample into solution brings with it problems, including the potential for incomplete dissolution, reagent and laboratory blanks.

ICP-MS, like TIMS and SSMS (spark-source mass spectrometry), can be used to analyse small samples. Sample size needed for analysis by ICP-MS varies according to the sample introduction system and calibration technique. Using the standard pneumatic nebuliser, there is a practical need for a minimum of 8 ml of solution. The reason for this are the requirement to flush the tubing and spray chamber to allow the stabilisation of the analytical signal, and 5 minutes for the acquisition of data using a sample flow rate of ~ 1 ml / minute. The mass of sample needed to make the 8 ml of solution varies according to the elements to be determined and their concentration. During this work, the usual sample weight is 0.02 ~ 0.1 grams (0.02 ~ 0.05 grams for pure glass shards handpicked by colour and shapes, Chen and Arculus, Appendix 9). Longerich et al. (1990) analysed mineral separates using only 1 mg of sample and they believed a 0.1 mg sample mass was feasible.

The analytical methods of ICP-MS and XRF used in this work are detailed in Appendix 2.3 and 2.5. The major element and trace element data measured by XRF at UNE and ANU, and trace element data determined by ICP-MS for six representative xenoliths (cumulates and granulites) from SFVF, AZ, USA are listed in Table A 2-8 (page A 32) and illustrated in Figures A 2-4 and A 2-5 (pages A 36-37). For comparison, the trace element data of six representative international geostandards measured by ICP-MS are illustrated in Figure A 2-5 (page A 37) with the recommended values from Govindaraju (1989). Clearly, the major element data measured at UNE and ANU are in very close agreement within the analytical error of ± 2 % for SiO_2, Al_2O_3, Fe_2O_3, MgO and CaO, and ± 2 ~ 10 % for TiO_2, MnO, Na_2O, K_2O and P_2O_5 (wt %). The trace element V, Cr, Ni, Cu, Zn, Ga, Sr, Y, Zr, Nb, Rb, Ba, La and Ce determined by XRF at UNE and ANU match well within the error ± 5 ~ 15 %, and are generally in agreement with ICP-MS data. However, we have no confidence in the following elements with lower level of abundances, U < 5, Th < 10, Pb < 5, Nb < 5, Rb < 2, La < 10, Ce < 20 and Ba < 20 (ppm) measured by XRF at UNE. For these elements at low abundance level, there is also a big analytical error (generally > ± 20 %) for XRF data at ANU. Only the ICP-MS data are reliable.

For the ICP-MS data, there are some problems with Ga, Ge, Cr, Ni, Zn and Zr. If samples contain acid-resistant rock-forming accessory minerals such as zircon and spinel, the contents of Zr, Hf, Cr and Ni are lower and HF-HNO_3 digestion should be replaced by bomb method with higher temperature and higher pressure or fusion with lithium metaborate (Hall and Pelchat, 1990). If samples contain much higher abundances of Sr, Ba, Rb, Cr and Ni, the standards BHVO, AGV and G2 should be used together in order to make a wider concentration range. The big error with Ga, Ge and Sc (generally > ± 20 %) is possibly due to the lack of accurate standard values for these elements at present. Other reasons of big error (> ± 15 ~ 20) for ICP-MS may be blank contamination, sample representativeness and machine operation.

On the basis of comparison between XRF and ICP-MS methods and data, XRF data alone are reported for major and minor elements and for high abundances of Ba (> 1500), Sr (> 1000), Zr (> 100), Cr (> 300) and Ni (> 150) (ppm) in the case of xenoliths. ICP-MS data are reported for all ash, glass and dropstone samples.

Table A 2-1 HCl-leaching results of Sr-Nd isotopic analysis for 784A-13# ash

No.UNE	Sample	$^{87}Sr/^{86}Sr$	error (2 SD)	$^{143}Nd/^{144}Nd$	error (2 SD)	Epsilon Nd
1	Pore water	0.707742	0.000027			
2	no-acid leached	0.703633	0.000010	0.513076	0.000011	8.5
3	1 N HCl leached	0.703584	0.000010			
4	2.5 N HCl leached	0.703573	0.000013			
5	2.5 N HCl leached	0.703574	0.000011			
6	6.0 N HCl leached	0.703555	0.000013	0.513066	0.000011	8.3
Sr Standard	NBS-987 (N=32)	0.710247	0.000015			
Nd Standard	O'Nions Nd (N=11)			0.511111	0.000010	

See Appendix 2.1.1 for sample description and treatment; see Appendix 2.6 for analytical condition

Table A 2-2 Major element compositions of four international glass standards #

Glass Standards	N0.A0	SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO	K_2O	Na_2O
B: USNM-111240 VG-2	6087	50.89	1.93	14.00	11.94	0.14	6.67	11.44	0.26	2.73
	6067	50.94	1.86	14.43	11.65		6.86	11.46	0.21	2.58
	6081	50.97	1.87	14.28	11.64		6.84	11.32	0.24	2.83
	6075	50.98	1.86	14.26	11.83		6.76	11.55	0.19	2.58
	6073	51.02	1.65	14.23	11.80		6.76	11.67	0.19	2.67
	6085	51.09	1.93	14.28	11.45		6.95	11.43	0.17	2.69
	6089	51.25	1.86	14.12	11.78		6.73	11.48	0.15	2.63
	6070	51.36	1.77	14.30	11.63		6.68	11.47	0.19	2.61
	6083	51.43	1.85	14.10	11.55		6.77	11.53	0.26	2.51
	6084	51.46	1.74	14.31	11.69		6.59	11.66	0.17	2.38
B: USNM-113498/1 VG-A99	6118	51.41	4.38	12.57	13.88		4.80	9.64	0.82	2.50
	6120	51.49	4.13	12.65	13.38		5.00	9.55	0.87	2.92
	6116	51.62	4.08	12.78	13.35		4.95	9.62	0.86	2.75
	6117	51.71	4.23	12.78	13.26		4.93	9.47	0.80	2.83
	6115	51.77	4.06	12.77	13.14		5.04	9.76	0.81	2.64
	6114	51.87	4.17	12.79	13.29		4.92	9.56	0.82	2.57
	6113	52.05	4.22	12.39	13.37		4.80	9.68	0.79	2.71
	6119	52.15	4.04	12.73	13.16		4.97	9.45	0.90	2.60
R: USNM 2213 Tektite	6109	76.58	0.48	11.18	4.98		1.20	2.76	1.96	0.86
	6102	76.66	0.54	11.26	4.71		1.24	2.63	1.87	1.10
	6110	76.70	0.42	11.25	4.84		1.24	2.68	1.87	1.01
	6111	76.71	0.43	11.25	5.02		1.16	2.69	1.85	0.90
	6103	76.91	0.50	11.11	4.84		1.15	2.70	1.82	0.97
	6104	76.97	0.35	11.31	4.79		1.23	2.69	1.84	0.82
	6112	77.06	0.37	11.16	4.97		1.14	2.60	1.87	0.83
	6105	77.11	0.45	10.98	4.83		1.22	2.67	1.80	0.94
	6107	77.11	0.36	11.20	4.77		1.12	2.75	1.84	0.87
	6106	77.14	0.43	11.05	4.84		1.16	2.67	1.81	0.90
	6108	77.23	0.42	11.21	4.69		1.13	2.68	1.86	0.77
R: USNM 72854 VG-568	6093	78.08		12.17	0.96			0.45	4.81	3.53
	6092	78.23		12.18	1.00			0.33	4.77	3.50
	6101	78.31		12.17	0.99			0.26	4.74	3.53
	6091	78.33		12.13	1.12			0.36	4.83	3.23
	6094	78.36		12.21	0.86			0.25	4.79	3.54
	6098	78.37		12.13	0.93			0.27	4.77	3.52
	6099	78.45		12.25	0.93			0.20	4.72	3.45
	6095	78.55		12.28	0.77			0.22	4.91	3.26
	6097	78.55		12.18	0.85			0.34	4.71	3.37
	6100	78.56		12.11	1.01			0.25	4.81	3.27
	6096	78.60		12.06	1.10			0.33	4.76	3.13
	6090	78.68		12.28	0.85			0.24	4.71	3.24
B: USNM-111240 VG-2	B av 25	51.16	1.80	14.19	11.69	0.14	6.80	11.49	0.21	2.65
	Re	51.11	1.86	14.14	11.91	0.22	6.75	11.19	0.19	2.64
B: USNM-113498/1 VG-A99	B av 8	51.76	4.16	12.68	13.35		4.93	9.59	0.83	2.69
	Re	51.56	4.11	12.64	13.46	0.15	5.14	9.41	0.83	2.69
R: USNM 2213 Tektite	R av 11	76.93	0.43	11.18	4.84		1.18	2.68	1.85	0.91
	Re	75.97	0.50	11.37	4.91	0.11	1.51	2.67	1.89	1.06
R: USNM 72854 VG-568	R av 12	78.42		12.18	0.95			0.29	4.78	3.38
	Re	77.18	0.12	12.13	1.24	0.03	0.10	0.50	4.92	3.77

* Total Fe reported as FeO*; blank means below detection limit, see text

Re are data from Jarosewich et al. (1980); all data are normalized to 100% free of volatiles

Table A 2-3 Trace element abundances of three representative international glass standards measured by PIXE PMP *

International glass standards	No. Point	S (E/P)	Rb	Ba	Sr	Y	Zr	Nb	Cu	Zn	Ga	Ni	Pb	Sn	Sb
B: USNM-113498/1 VG-A99	Z-1	1.02	19.4	292.0	454.0	42.1	293.0	23.7	177.0	130.0	16.9	18.6		22.5	
	Z-2	1.09	15.8	242.0	407.0	36.8	273.0	18.2	172.0	127.0	18.9	17.0			
	Z-3	0.99	18.0	229.0	444.0	38.4	294.0	22.3	178.0	127.0	20.3	13.8			
	1#-1	0.82	14.2	220.0	446.0	39.2	261.0	21.9	189.0	136.0	19.5	18.4		19.1	
	1#-2	0.94	13.0	212.0	420.0	39.3	274.0	20.1	180.0	130.0	19.9	20.7			
	1#-3	0.93	16.9	260.0	418.0	35.9	275.0	22.6	180.0	128.0	21.7	24.3			
R: USNM 2213 Tektite	Y-1	1.01			11.4		77.4			38.7	4.5		12.0		46.3
	Y-2	1.04			10.2		77.3			35.8			6.2		75.9
	Y-3	1.03			11.4		78.3			28.5			7.7		53.8
R: USNM 72854 VG-568	X-1	0.86	228.0		3.1	66.8	152.0	37.7		72.5	22.5		30.2		
	X-2	0.84	228.0	103.0		61.2	147.0	40.1		66.1	20.8		31.0		
	X-3	0.81	215.0			63.2	149.0	33.4	6.8	64.3	20.5		30.7		
	3#-1	0.83	219.0			66.5	144.0	36.0		59.6	21.6		32.8	20.7	32.7
	3#-2	0.83	221.0	81.6		61.6	145.0	32.2		62.2	19.3		31.9		
	3#-3	0.81	221.0	114.0	3.2	57.7	142.0	33.6		63.9	19.5		35.3		
	3#-4	0.82	215.0	87.4		65.4	146.0	34.0		58.3	19.6		35.0		
	3#-5	0.88	220.0			58.6	148.0	30.1	5.8	65.6	20.8		31.8	21.5	
B: USNM-113498/1 VG-A99	Z- av 3	1.03	17.7	254.3	435.0	39.1	286.7	21.4	175.7	128.0	18.7	16.5			
	1#- av 3	0.90	14.7	230.7	428.0	38.1	270.0	21.5	183.0	131.3	20.4	21.1			
	Z+1# av 6	**0.96**	**16.2**	**242.5**	**431.5**	**38.6**	**278.3**	**21.5**	**179.3**	**129.7**	**19.5**	**18.8**		**20.8**	
R: USNM 72854 VG-568	X- av 3	0.83	223.7	103.0	3.1	63.7	149.3	37.1	6.8	67.6	21.3		30.6		
	3#- av 5	0.84	219.2	94.3	3.2	62.0	145.0	33.2	5.8	61.9	20.2		33.4	21.5	
	X+3#- av 8	**0.83**	**220.9**	**96.5**	**3.2**	**62.6**	**146.6**	**34.6**	**6.3**	**64.1**	**20.6**		**32.3**	**21.1**	**32.7**
R: USNM 2213 Tektite	**Y- av 3**	**1.03**			**11.0**		**77.7**			**34.3**	**4.5**		**8.6**		**58.7**

S (E/P) means ratio of FeO (total Fe reported as FeO*) measured by EMP and by PIXE PMP, acceptable S (E/P) ratios range 0.80 ~ 1.40

All analyses are individual point analyses, the number X-, Y- and Z- are first batch analyses, the number 1#- and 3#- are second batch analyses half year later

Table A 2-4 Trace element comparison of eight rock types for our ICP-MS analyses*

Sample	BLK1	BLK2	AGV1	AGV1 re	AGV 92	BHVO	BHVO re	BHVO 92	JB-2	JB-2 re	JB-2 92
Li	-0.4	-0.1	11.9	12.0	12.1	4.8	4.6	6.5	8.1	8.0	9.2
Sc	-1.1	-0.8	12.2	12.2	12.1	31.5	31.8	28.8	53.7	54.0	53.3
V	4.3	0.7	120.9	121.0	147.9	326.7	317.0	302.1	577.0	578.0	546.9
Cr	2.1	0.1	10.1	10.1	10.9	292.1	289.0	280.9	25.7	27.4	24.1
Co	0.4	0.0	15.2	15.3	15.3	45.2	45.0	44.7	36.6	39.8	35.3
Ni	3.7	1.1	15.9	16.0	14.8	123.9	121.0	120.8	46.9	14.2	9.5
Cu	3.2	-0.3	59.8	60.0	57.1	143.3	136.0	133.1	220.1	227.0	243.9
Zn	1.7	0.3	87.6	88.0	88.3	114.3	105.0	109.3	98.9	110.0	105.9
Ga		0.0	21.2	20.0	21.8	21.4	21.0	12.4	14.1	17.0	11.2
Ge		-0.01	1.23	1.25	1.33	1.71	1.64	1.65	1.40	1.20	1.84
Rb	0.4	0.5	67.3	67.3	64.3	10.6	11.0	9.7	7.3	6.2	6.6
Sr	-4.7	2.5	662.2	662.0	622.6	393.5	403.0	397.0	176.9	178.0	176.8
Y	0.1	0.1	20.0	20.0	19.2	27.3	27.6	27.7	24.5	26.0	24.5
Zr	-0.7	1.1	227.3	227.0	222.9	171.4	179.0	174.9	47.0	52.0	44.8
Nb	0.5	0.2	14.9	15.0	12.9	18.8	19.0	17.3	0.9	0.8	0.8
Mo	-0.06	0.03	2.68	2.70	1.84		1.02	0.94	0.84	1.10	0.44
Cs	0.02	0.01	1.28	1.28	1.38	0.13	0.13	0.05	1.28	0.90	0.78
Ba	-0.2	14.4	1245.0	1226.0	1175.0	139.5	139.0	140.6	231.9	208.0	211.9
La	-0.33	0.87	38.33	38.00	36.74	14.78	15.80	15.08	2.02	2.40	2.41
Ce	-0.13	1.33	67.25	67.00	65.62	36.19	39.00	36.86	6.44	6.50	6.60
Pr	0.10	0.11	7.61	7.60	7.93	5.04	5.70	5.22	1.26	1.20	1.11
Nd	-0.13	0.24	32.97	33.00	30.33	24.77	25.20	24.21	6.18	6.50	6.74
Sm	0.00	0.02	5.99	5.90	5.95	6.11	6.20	6.11	2.28	2.30	2.38
Eu	-0.05	-0.01	1.71	1.64	1.67	1.87	2.06	1.98	0.83	0.85	0.85
Gd	-0.14	-0.06	4.93	5.00	4.65	5.93	6.40	6.18	2.97	3.30	3.01
Tb	0.00	0.00	0.70	0.70	0.66	0.94	0.96	0.95	0.57	0.62	0.60
Dy	0.05	-0.01	3.59	3.60	3.51	5.24	5.20	5.24	3.68	3.85	3.85
Ho	-0.01	0.00	0.67	0.67	0.66	0.99	0.99	1.01	0.83	0.83	0.86
Er	-0.04	-0.01	1.69	1.70	1.78	2.34	2.40	2.54	2.29	2.40	2.50
Tm	0.00	0.00	0.26	0.26	0.28	0.34	0.33	0.38	0.37	0.50	0.42
Yb	0.04	-0.01	1.71	1.72	1.58	2.08	2.02	1.97	2.37	2.50	2.63
Lu	0.00	0.00	0.27	0.27	0.25	0.30	0.29	0.30	0.37	0.40	0.39
Hf	-0.05	0.03	5.12	5.10	5.02	4.42	4.38	4.98	1.40	1.40	1.40
Ta	0.02	0.01	0.90	0.90	1.35	1.23	1.23	1.24	0.05	0.20	0.19
Pb	0.00	-0.28	35.95	36.00	33.52	2.48	2.60	2.51	6.95	5.40	4.95
Th	-0.32	0.06	6.59	6.50	6.36	0.97	1.08	1.50	0.22	0.33	0.25
U	-0.08	0.01	1.98	1.92	2.02	0.37	0.42	0.47	0.12	0.16	0.10

* re means recommended values from Govindaraju (1989)

92 means ICP-MS data from Yoshida et al. (1992)

AGV1, BHVO, JB-2, JA-2, JR-2 and G-2 are international geostandards

Ak41g is a felsic xenolith from SFVF, AZ, USA; Ak41gl is a rhyolitic glass handpicked from Ak41g

All analyses are single run analyses, not an average; Ak41g* and Ak41gl* are the average of two single runs

Table A 2-4 Trace element comparison of eight rock types for our ICP-MS analyses* (cont)

Sample	JA-2	JA-2 re	JA-2 92	JR-2	JR-2 re	JR-2 92	G-2	G-2 re	G-2 92	Ak41gl	Ak41gl*	Ak41g	Ak41g*
Li	31.5	28.7	31.0	92.0	83.0	71.6	38.8	35.0	30.6	203.1	203.1	164.9	192.9
Sc	19.1	19.0	23.3	5.3	5.4	3.9	11.5		3.1	1.2	1.9	1.7	2.8
V	110.3	130.0	301.3	5.1	(<8)	38.9	38.1	36.0	47.0	4.6	2.4	5.6	4.0
Cr	365.7	465.0	436.5	2.1	2.6		5.5	8.0	8.9	2.7	1.8	3.7	2.8
Co	27.8	30.0	32.8	0.5	0.4		5.8	5.0	5.2	0.5	0.4	111.4	123.6
Ni	135.2	142.0	147.8	0.8	0.8	0.7	3.3	3.5	3.4	0.6	0.6	1.3	1.3
Cu	29.7	28.6	29.7	1.7	1.4	1.8	13.2	11.0	10.2	2.8	1.4	3.0	1.7
Zn	62.0	62.7	66.7	22.4	27.2	27.3	76.2	85.0	89.6	41.0	43.5	39.3	43.6
Ga	17.3	16.4	21.2	9.7	18.2	10.1	28.6	23.0	30.6	23.6	15.9	22.9	15.5
Ge	1.12		3.34	0.53	2.40	1.13	0.87	1.00	0.80	0.31	0.31	0.50	0.50
Rb	77.5	68.0	71.8	296.0	297.0	300.6	156.4	170.0	171.6	356.8	363.2	324.6	325.2
Sr	247.4	252.0	242.5	8.9	8.0	7.8	483.9	480.0	474.8	10.3	10.3	12.1	12.1
Y	17.8	18.0	17.6	49.1	51.0	51.0	10.4	11.0	9.4	61.8	64.8	61.5	57.7
Zr	115.7	119.0	104.8	91.2	98.5	89.3	251.4	300.0	34.8	84.2	89.5	74.2	70.2
Nb	9.4	9.8	8.9	19.0	19.2	16.9	14.3	13.5	10.5	151.9	162.3	141.5	144.2
Mo	0.67	0.54		3.25	2.90	3.04	0.62	0.90	0.53		3.46		2.54
Cs	5.52	4.20	4.56	25.09	26.00	25.46	1.38	1.40	1.39	15.65	16.07	12.91	12.79
Ba	309.1	317.0	288.7	41.7	39.0	29.5	1982	1900	1875	40.0	33.2	50.4	32.5
La	15.49	16.00	15.07	16.20	17.50	14.89	85.39	90.00	87.12	10.54	13.27	13.70	13.45
Ce	32.22	33.00	31.11	38.07	38.00	36.45	157.1	160.0	160.6	24.54	28.67	29.68	28.99
Pr	3.67	5.90	3.47	4.64	5.50	4.71	14.59	19.00	15.96	3.03	3.13	3.45	3.29
Nd	14.11	14.00	14.05	20.57	24.80	18.99	53.84	58.00	51.93	11.48	13.30	13.30	13.45
Sm	2.95	3.10	3.05	5.51	6.20	5.29	7.22	7.20	7.67	3.77	3.99	4.20	3.99
Eu	0.96	0.91	0.89	0.13	0.13	0.12	1.79	1.40	1.59	0.10	0.10	0.12	0.12
Gd	3.29	3.90	3.01	5.31	7.80	5.47	5.69	5.00	4.66	3.93	3.93	4.35	4.02
Tb	0.50	0.48	0.47	1.02	1.20	1.11	0.67	0.50	0.54	0.90	0.93	0.97	0.91
Dy	2.88		2.62	7.05	7.70	6.45	2.16	2.30	2.30	6.65	6.98	7.05	6.51
Ho	0.60		0.57	1.53	1.70	1.52	0.38	0.40	0.35	1.50	1.55	1.58	1.42
Er	1.59		1.68	4.33	5.20	4.59	1.07	1.20	0.91	4.51	4.79	4.55	4.19
Tm	0.25		0.29	0.82	0.86	0.89	0.13	0.17	0.12	0.97	1.01	0.93	0.84
Yb	1.66	1.60	1.65	5.56	5.40	5.42	0.84	0.86	0.54	7.23	7.40	6.61	6.23
Lu	0.28	0.27	0.34	0.95	0.92	0.93	0.13	0.11	0.07	1.20	1.27	1.08	1.00
Hf	2.89	2.80	2.36	5.69	5.20	5.20	5.96	7.90	0.80	5.29	5.89	4.46	4.10
Ta	0.73	0.61	1.33	2.43	2.40	2.23	1.00	0.91	0.75	19.72	23.92	19.72	19.47
Pb	16.63	19.30	14.08	21.92	21.90	23.88	30.42	31.00	30.54	48.64	49.89	44.75	44.26
Th	4.98	4.70	3.60	37.72	32.20	36.94	27.05	25.00	24.98	39.94	42.43	44.42	40.95
U	2.35	2.40	1.73	11.79	10.50	12.73	2.05	2.10	1.76	22.36	23.33	21.29	21.21

* re means recommended values from Govindaraju (1989)

92 means ICP-MS data from Yoshida et al. (1992)

AGV1, BHVO, JB-2, JA-2, JR-2 and G-2 are international geostandards

Ak41g is a felsic xenolith from SFVF, AZ, USA; Ak41gl is a rhyolitic glass handpicked from Ak41g

All analyses are single run analyses, not an average; Ak41g* and Ak41gl* are the average of two single runs

Table A 2-5 Trace element comparison of five types of standards and the accuracy for our ICP analyses *

Sample	Li reco	Li	Sc reco	Sc	V reco	V	Cr reco	Cr	Co reco	Co	Ni reco	Ni	Cu reco	Cu	Zn reco	Zn	Ga reco	Ga
Blank	0.0	0.1	0.0	0.8	0	0.7	0.0	0.1	0.0	0.0	0.0	1.1	0.0	0.3	0.0	0.3	0.0	0.0
AGV1	12.0	11.9	12.2	12.2	121	120.9	10.1	10.1	15.3	15.2	16.0	15.9	60.0	59.8	88.0	87.6	20.0	21.2
BHVO	4.6	4.8	31.8	31.5	317	326.7	289.0	292.1	45.0	45.2	121.0	123.9	136.0	143.3	105.0	114.3	21.0	21.4
JB-2	8.0	8.1	54.0	53.7	578	577.0	27.4	25.7	39.8	36.6	14.2	46.9	227.0	220.1	110.0	98.9	17.0	14.1
JA-2	28.7	31.5	19.0	19.1	130	110.3	465.0	365.7	30.0	27.8	142.0	135.2	28.6	29.7	62.7	62.0	16.4	17.3
JR-2	83.0	92.0	5.4	5.3	8	5.1	2.6	2.1	0.4	0.5	0.8	0.8	1.4	1.7	27.2	22.4	18.2	9.7
Accuracy %																		
AGV1		-0.5		0.4		-0.1		-0.4		-0.6		-0.7		-0.4		-0.5		6.0
BHVO		5.2		-1.1		3.0		1.1		0.4		2.4		5.4		8.8		1.9
JB-2		1.4		-0.6		-0.2		-6.2		-8.1		230.6		-3.1		-10.1		-17.2
JA-2		9.9		0.7		-15.2		-21.4		-7.3		-4.8		3.8		-1.1		5.3
JR-2		10.9		-1.3		-36.9		-19.2		20.0		10.7		20.0		-17.6		-47.0

Sample	Ge reco	Ge	Rb reco	Rb	Sr reco	Sr	Y reco	Y	Zr reco	Zr	Nb reco	Nb	Mo reco	Mo	Cs reco	Cs	Ba reco	Ba
Blank	0.00	0.01	0.0	0.1	0	2.5	0.0	0.1	0.0	1.1	0.0	0.1	0.00	0.03	0.00	0.01	0	2.2
AGV1	1.25	1.23	67.3	67.3	662	662.2	20.0	20.0	227.0	227.3	15.0	14.9	2.70	2.68	1.28	1.28	1226	1245.0
BHVO	1.64	1.71	11.0	10.6	403	393.5	27.6	27.3	179.0	171.4	19.0	18.8	1.02		0.13	0.13	139	139.5
JB-2	1.20	1.40	6.2	7.3	178	176.9	26.0	24.5	52.0	47.0	0.8	0.9	1.10	0.84	0.90	1.28	208	231.9
JA-2	3.34	1.12	68.0	77.5	252	247.4	18.0	17.8	119.0	115.7	9.8	9.4	0.54	0.67	4.20	5.52	317	309.1
JR-2	2.40	0.53	297.0	296.0	8	8.9	51.0	49.1	98.5	91.2	19.2	19.0	2.90	3.25	26.00	25.09	39	41.7
Accuracy %																		
AGV1		-1.6		0.0		0.0		0.1		0.1		-0.4		-0.7		0.0		1.5
BHVO		4.3		-3.6		-2.4		-1.1		-4.2		-1.0				-3.1		0.4
JB-2		16.7		17.1		-0.6		-5.8		-9.6		16.3		-23.6		42.2		11.5
JA-2		-66.5		13.9		-1.8		-1.4		-2.8		-4.1		24.1		31.4		-2.5
JR-2		-77.9		-0.3		10.7		-3.7		-7.4		-1.0		12.1		-3.5		7.0

* reco means recommended values from Govindaraju (1989); Accuracy % = 100 x (measured - recommended) / recommended

Table A 2-5 Trace element comparison of five types of standards and the accuracy for our ICP analyses *

Sample	La reco	La	Ce reco	Ce	Pr reco	Pr	Nd reco	Nd	Sm reco	Sm	Eu reco	Eu	Gd reco	Gd	Tb reco	Tb	Dy reco	Dy	Ho reco	Ho
Blank	0.0	0.33	0.0	0.13	0.0	0.11	0.0	0.02	0.0	0.02	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AGV1	38.0	38.33	67.0	67.25	7.6	7.61	33.0	32.97	5.9	5.99	1.64	1.71	5.0	4.93	0.70	0.70	3.60	3.59	0.67	0.67
BHVO	15.8	14.78	39.0	36.19	5.7	5.04	25.2	24.77	6.2	6.11	2.06	1.87	6.4	5.93	0.96	0.94	5.20	5.24	0.99	0.99
JB-2	2.4	2.02	6.5	6.44	1.2	1.26	6.5	6.18	2.3	2.28	0.85	0.83	3.3	2.97	0.62	0.57	3.85	3.68	0.83	0.83
JA-2	16.0	15.49	33.0	32.22	5.9	3.67	14.0	14.11	3.1	2.95	0.91	0.96	3.9	3.29	0.48	0.50	2.62	2.88	0.57	0.60
JR-2	17.5	16.20	38.0	38.07	5.5	4.64	24.8	20.57	6.2	5.51	0.13	0.13	7.8	5.31	1.20	1.02	7.70	7.05	1.70	1.53
Accuracy %																				
AGV1		0.9		0.4		0.2		-0.1		1.5		4.3		-1.4		-0.7		-0.2		-0.4
BHVO		-6.4		-7.2		-11.6		-1.7		-1.4		-9.1		-7.4		-1.7		0.8		0.2
JB-2		-15.8		-0.9		5.0		-4.9		-0.9		-2.4		-10.0		-8.1		-4.4		0.0
JA-2		-3.2		-2.4		-37.8		0.8		-4.8		5.4		-15.6		3.3		10.0		4.9
JR-2		-7.4		0.2		15.6		17.1		-11.1		0.0		-31.9		-15.0		-8.4		-10.0

Sample	Er reco	Er	Tm reco	Tm	Yb reco	Yb	Lu reco	Lu	Hf reco	Hf	Ta reco	Ta	Pb reco	Pb	Th reco	Th	U reco	U
Blank	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.03	0.00	0.01	0.0	0.60	0.00	0.06	0.00	0.01
AGV1	1.70	1.69	0.26	0.26	1.72	1.71	0.27	0.27	5.10	5.12	0.90	0.90	36.0	35.95	6.50	6.59	1.92	1.98
BHVO	2.40	2.34	0.33	0.34	2.02	2.08	0.29	0.30	4.38	4.42	1.23	1.23	2.6	2.48	1.08	0.97	0.42	0.37
JB-2	2.40	2.29	0.50	0.37	2.50	2.37	0.40	0.37	1.40	1.40	0.20	0.05	5.4	6.95	0.33	0.22	0.16	0.12
JA-2	1.68	1.59	0.29	0.25	1.60	1.66	0.27	0.28	2.80	2.89	0.61	0.73	19.3	16.63	4.70	4.98	2.40	2.35
JR-2	5.20	4.33	0.86	0.82	5.40	5.56	0.92	0.95	5.20	5.69	2.40	2.43	21.9	21.92	32.20	37.72	10.50	11.79
Accuracy %																		
AGV1		-0.7		-1.0		-0.4		0.0		0.4		0.3		-0.1		1.3		3.1
BHVO		-2.7		3.5		2.9		3.4		1.0		-0.2		-4.6		-10.1		-11.4
JB-2		-4.6		-26.0		-5.2		-7.5		0.0		-75.0		28.7		-33.3		-25.0
JA-2		-5.1		-13.4		3.7		1.9		3.1		19.2		-13.8		5.9		-2.2
JR-2		-16.7		-4.7		3.0		3.3		9.4		1.3		0.1		17.1		12.3

* reco means recommended values from Govindaraju (1989); Accuracy % = 100 x (measured - recommended) / recommended

Table A 2-6 Major element composition of dropstones compared with standards and some trace elements measured by ICP-MS

Sample	W (g)	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	MnO	Na_2O	K_2O	P_2O_5	Li	Li*	V	V*	Cr	Cr*	Ni	Ni*	Sr	Sr*	Ba	Ba*
1	0.0351	54.94	1.03	17.52	9.68	7.93	3.12	0.18	3.81	1.50	0.29	8.2		221	215	6.7	10.2	4.0	7.4	411	418	368	359
2	0.0430	65.83	0.80	16.55	5.18	4.40	1.00	0.15	4.33	1.63	0.14	3.3	3.0	34	37	3.8	5.1	2.9	2.2	246	236	434	416
3	0.0756	65.84	0.56	17.31	4.65	5.27	1.36	0.10	3.34	1.45	0.10	13.5		82	78	8.5	7.0	6.4	8.4	245	236	381	373
4	0.0829	47.86	0.68	13.06	11.39	11.68	11.32	0.19	1.80	1.75	0.26	17.6	16.7	335	318	304.2	284.7	165.2	143.2	373	355	632	609
5	0.1104	52.97	1.08	17.37	10.09	9.94	5.25	0.17	2.36	0.60	0.18	9.9		291	288	58.2	36.7	31.5	39.6	261	254	120	116
6	0.1083	56.24	0.72	16.30	8.26	9.09	5.36	0.15	2.20	1.46	0.23	7.8	7.4	269	261	81.3	75.6	21.7	40.2	621	598	495	468
7	0.1111	55.38	2.05	15.11	12.63	7.69	3.04	0.20	2.24	1.27	0.41	15.2	14.8	336	327	1.7	6.6	285.8	214.0	266	259	292	273
8	0.1079	59.96	1.22	16.72	7.18	6.22	3.63	0.13	2.68	2.09	0.17	17.4	15.7	155	145	47.4	42.4	30.5	30.9	449	418	706	651
9	0.1122	58.78	0.72	16.39	7.75	8.12	4.31	0.13	2.23	1.33	0.23	7.4	7.2	230	227	78.3	73.2	22.3	37.8	589	568	919	851
10	0.1091	60.12	0.61	18.10	5.71	7.79	3.49	0.12	2.35	1.52	0.18	5.3	5.7	204	212	13.9	14.9	104.5	100.9	459	463	415	401
11	0.1046	59.31	0.64	17.22	7.16	8.38	3.34	0.14	2.50	1.19	0.13	6.8	6.6	217	218	40.8	39.2	22.3	39.2	303	292	201	187
12	0.1062	60.88	0.74	16.77	6.34	7.86	3.99	0.10	2.36	0.77	0.21	4.9		168	171	105.4	59.9	47.1	35.3	535	535	300	286
JB-2 m	0.0981	52.59	1.14	14.77	14.08	9.67	4.86	0.21	2.16	0.40	0.12	8.4	8.1	570	577	26.1	25.7	13.2	46.9	181	177	236	215
JB-2 re		52.49#	1.19	14.67	14.34	9.89	4.67	0.20	2.03	0.42	0.10	8.0	8.0	578	578	27.4	27.4	14.2	14.2	178	178	208	208
JB-2 re		53.20																					
JA-2 m	0.1036	59.41	0.66	15.23	6.09	6.21	7.48	0.14	2.94	1.68	0.17	31.1	28.6	116	116	360.1	342.9	124.7	97.3	253	257	338	319
JA-2 re		58.53#	0.67	15.32	6.14	6.48	7.68	0.15	3.08	1.80	0.15	28.7	28.7	130	130	465.0	465.0	142.0	142.0	252	252	317	317
JA-2 re		56.18																					
BHVO m	0.1000	49.83	2.70	13.60	12.23	11.24	7.19	0.17	2.26	0.51	0.27	4.6		316		288.8		121.8		398		136	
BHVO re		49.31#	2.69	13.85	12.23	11.33	7.31	0.17	2.29	0.54	0.28	4.0		320		300.0		120.0		420		135	
BHVO re		49.90																					

W (g) is weight of powdered samples for ICP-MS analyses of all major, minor and trace elements except for Si and following Sr-Nd isotopic ratio analyses

Samples 1-12 are dropstones; JB-2, JA-2 and BHVO are international standards; re means recommended values from Govindaraju (1989); m means measured values in this work

Total Fe as Fe_2O_3; Al_2O_3 was determined by atomic absorption spectrophotometry; #SiO_2 of standards and all dropstones are the difference of 100 and all other original oxide total

*trace elements are measured in solutions of diluting factor ~ 2000; other trace elements, minor & major elements excluding Si and Al are determined in solutions of factor ~ 4000

Table A 2-7 Comparison between EDS and WDS averages of major element abundances of glasses from ODP Leg 125 ash layers #

EMP	Types	Sites	SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	Cl	F
WDS-UM, 288	B av 9	784A	51.38	1.37	14.09	14.13	0.21	5.74	10.62	2.12	0.34	0.10	0.07	0.38
	B av 1	786A	47.70	1.59	16.95	10.01	0.15	8.85	11.83	2.48	0.43	0.02	0.12	0.09
	BA av 43	782A	55.43	1.10	14.63	12.29	0.24	4.53	9.07	2.39	0.33	0.09	0.11	0.14
	BA av 14	784A	54.73	1.14	15.09	12.17	0.20	4.37	9.20	2.77	0.33	0.10	0.13	0.22
	BA av 50	786A	54.11	1.08	14.46	13.40	0.24	4.66	9.33	2.45	0.27	0.08	0.10	0.11
	A av 47	782A	58.81	1.04	15.13	10.48	0.22	3.07	7.65	3.23	0.39	0.09	0.13	0.11
	A av 22	784A	59.42	0.94	14.65	10.44	0.24	3.03	7.38	3.49	0.41	0.09	0.17	0.14
	A av 4	786A	58.02	1.12	14.11	13.22	0.23	2.81	7.19	2.85	0.46	0.07	0.03	0.11
	A av 4	786A	62.90	1.10	13.23	9.63	0.27	2.32	6.38	3.56	0.60	0.19	0.21	0.15
	D av 18	782A	67.94	0.75	14.40	5.78	0.15	1.10	3.92	4.57	1.41	0.18	0.16	0.12
	D av 20	784A	67.17	0.94	14.00	6.45	0.21	1.40	4.89	4.26	0.69	0.25	0.18	0.12
	D av 10	786A	65.32	0.69	14.08	8.13	0.21	1.68	5.35	3.69	0.85	0.05	0.16	0.22
	R av 12	782A	77.14	0.89	12.28	1.52	0.04	0.25	1.79	4.77	1.31	0.05	0.08	0.12
	R av 25	784A	76.37	0.31	12.73	1.60	0.07	0.28	1.47	4.61	2.56	0.03	0.16	0.15
	R av 9	786A	76.59	0.41	11.57	3.30	0.10	0.42	2.40	4.06	1.15	0.08	0.09	0.25
EDS-UNE, 527	B I av 3	782A	51.64	1.02	16.18	12.75	0.23	4.78	10.91	2.06	0.42			
	B I av 7	784A	51.43	1.19	14.15	13.90	0.16	5.95	11.22	1.67	0.33			
	B I av 2	786A	51.81	1.02	13.31	15.06	0.16	6.31	9.94	2.11	0.27			
	B II av 12	782A	53.44	1.10	14.21	13.63	0.18	5.09	9.91	2.07	0.37			
	B II av 22	784A	52.85	1.17	13.98	13.94	0.16	5.13	10.39	2.05	0.34			
	B II av 23	786A	53.26	0.98	13.23	13.95	0.08	6.22	10.02	1.92	0.34			
	BA av 85	782A	55.30	1.03	14.63	12.83	0.16	3.95	9.40	2.34	0.36			
	BA av 43	784A	55.12	1.07	14.84	12.85	0.18	3.76	9.33	2.44	0.41			
	BA av 37	786A	54.90	1.15	14.26	13.54	0.18	3.98	9.34	2.26	0.39			
	A av 79	782A	58.88	1.00	14.87	10.90	0.17	2.80	8.07	2.85	0.47			
	A av 73	784A	59.46	0.97	14.74	10.82	0.16	2.77	7.83	2.84	0.42			
	A av 16	786A	58.87	1.16	14.44	11.72	0.18	2.53	7.52	2.82	0.76			
	D av 13	782A	68.11	0.83	13.58	7.06	0.00	1.10	4.91	3.52	0.89			
	D av 31	784A	67.70	0.86	13.76	7.55	0.14	1.19	5.38	2.77	0.65			
	D av 11	786A	66.46	0.87	14.31	7.69		0.81	5.24	3.47	1.15			
	R av 5	782A	74.42	0.48	13.15	3.39		0.31	3.09	3.89	1.28			
	R av 39	784A	76.66	0.34	12.80	3.00		0.18	2.30	2.85	1.87			
	R av 21	786A	76.92	0.30	12.23	3.48		0.21	2.70	2.90	1.28			
	R av 5 42Ma	782A	77.79	0.15	13.02	0.82		0.10	2.52	5.35	0.24			

Classification of types (B, BA, A, D and R) is based on the method from LeBas et al. (1986), free of volatiles, normalized to 100%; *Total Fe reported as FeO*

Table A 2-8 Major and trace element comparison of six representative xenoliths from SFVF, AZ, USA

Sample	SW-2	SW-2*	SW-2#	SW-14	SW-14*	SW-14#	160-3	160-3*	160-3#	160-11	160-11*	160-11#	387-13	387-13*	387-13#	AK-35f	AK-35f*	AK-35f#
SiO2	38.68	39.11		58.36	59.09		52.09	51.75		46.55	46.57		44.44	44.45		51.10	51.77	
TiO2	3.49	3.45		0.93	0.89		1.82	1.77		0.66	0.65		0.68	0.67		0.69	0.63	
Al2O3	20.60	20.52		17.42	17.43		16.80	16.61		5.30	5.28		22.03	21.89		16.78	16.55	
Fe2O3	18.22	17.85		6.53	6.43		10.95	10.67		10.41	10.17		10.21	9.94		9.83	9.70	
MnO	0.14	0.13		0.11	0.09		0.16	0.15		0.15	0.13		0.11	0.09		0.17	0.16	
MgO	5.09	4.95		4.01	4.03		4.52	4.49		22.71	22.72		9.40	9.28		5.82	5.73	
CaO	10.46	10.33		5.41	5.41		7.27	7.30		14.04	14.31		11.88	12.04		9.50	9.51	
Na2O	2.68	2.70		3.22	3.29		4.07	4.21		0.30	0.44		1.65	1.76		4.27	4.16	
K2O	0.35	0.37		2.40	2.47		1.31	1.39		0.07	0.07		0.05	0.07		0.55	0.58	
P2O5	0.04	0.05		0.29	0.30		0.87	0.88		0.03	0.05		0.03	0.04		0.64	0.66	
S	0.02	0.02		0.03	0.02		0.00	0.00		0.00	0.00		0.03	0.04		0.01	0.01	
Total	99.77	99.48		98.71	99.45		99.86	99.22		100.22	100.39		100.51	100.27		99.36	99.46	
Sc	21		19.7	13		17.6	17		23.5	65		47.2	32		25.3	20		29.1
V	456	450	481	115	109	115	140	142	162	222	210	238	351	318	358	157	143	163
Cr	13	37	23	142	132	145	112	99	110	1589	1400	1359	31	42	43	147	135	147
Co		82	85		77	62.4		55	46.1		132	110		129	120		66	53.3
Ni	29	27	31.5	52	52	57.5	63	57	80.3	568	565	358	72	66	124.3	63	62	93.9
Cu	94	98	95.5	28	20	26.1	51	45	55.8	101	95	96	56	49	51.7	100	89	72
Zn	86	79	121	74	75	54.9	116	113	74.3	63	64	57	134	131	125.9	90	89	32.3
Ga	23	21	32.1	18	19.4	25.4	21	21.5	37.9	7	7.2	7	28	27	27.6	18	18	33
Rb	2	1.5	0.91	33	32	39.09	15	14	17.98	1	<0.5	0.76	1	<0.5	0.1	3	1	1.25
Sr	1196	1110	1293	851	830	950	846	810	974	73	71	66	743	710	738	1759	1700	1670
Ba	379	290	386	1798	1650	1880	769	730	893	47	10	21	31	35	55	732	660	686
Y	11	10	11	10	9	10	26	24	31	9	8	10	3	5	4	14	14	17
Zr	28	18	31	167	149	15	268	239	289	24	20	22	12	5	11	21	14	32
Nb	15	10.8	13.74	5	3.6	5	34	29	34.6	3	<1	0.94	2	<1	0.46	2	<1	1.42
La	7	6	8.53	21	20	21.38	40	38	48.70	10	3	3.11	4	<1	1.29	34	31	33.82
Ce	27	16	20.12	52	35	42.96	79	94	107.40	20	<2	9.30	5	<2	3.19	76	73	77.12
Pb	6	<1	1.27	11	9	11.80	9	7	8.10	3	<1	0.79	1	<1	0.66	5	4	5.29
Th	8	<1	0.14	2	<1	0.13	9	3.2	1.46	6	<1	0.35	2	<1	0.22	2	<1	1.22
U	3	<1	0.04	3	<1	0.03	3	<1	0.99		<1	0.03	2	<1	0.01	5	<1	0.06

* ANU XRF data analysed by Prof. Chappell, 1994; # ICP-MS trace element data analysed by author,1993; other are UNE XRF data analysed by Mr. J. Bedford,1993

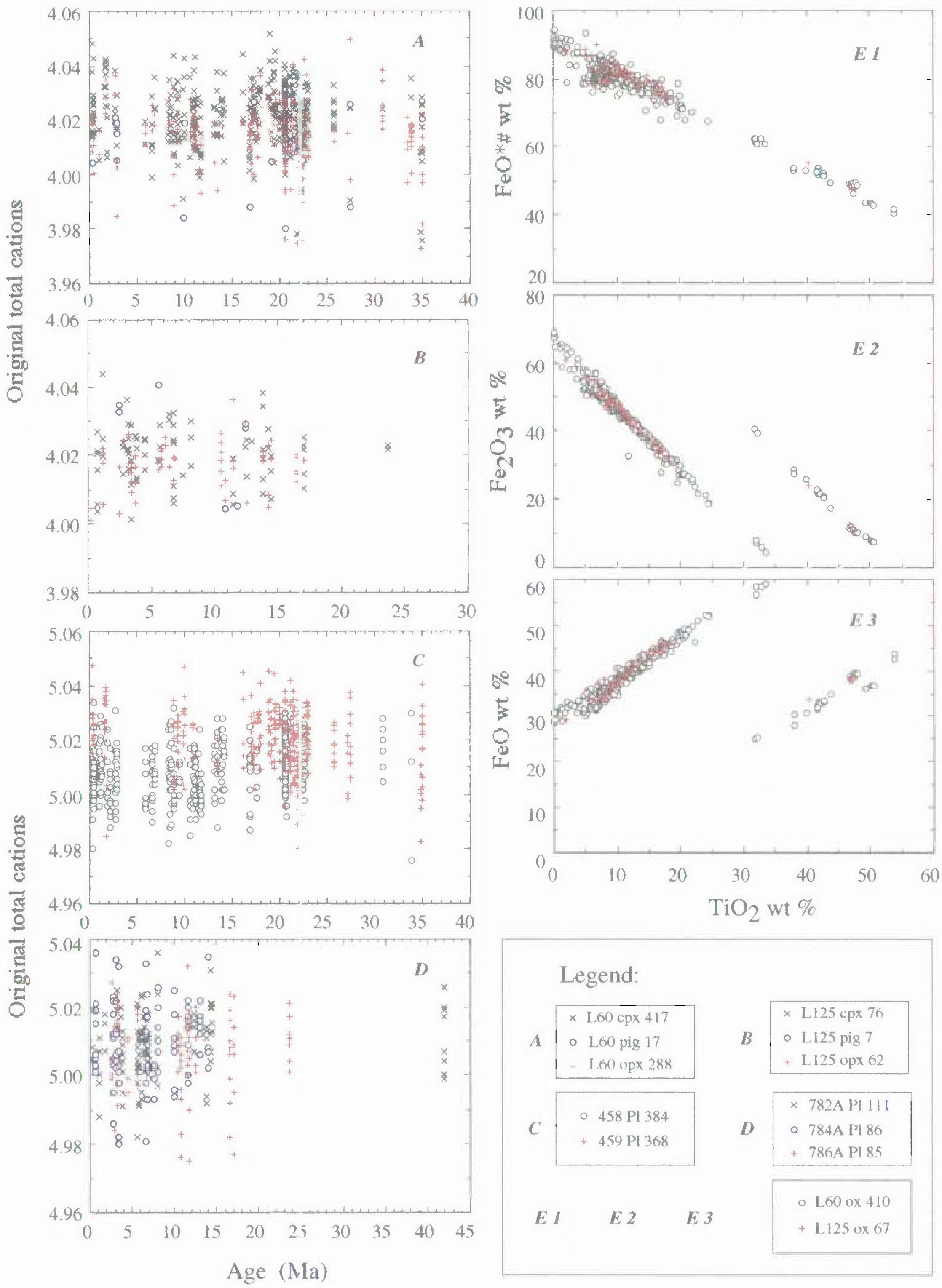

Figure A 2-1 Comparison of original total cations vs. ages of pyroxene and plagioclase within DSDP Leg 60 and ODP Leg 125 ash layers (A, B, C, and D) and relationship between iron and titanium contents in Fe-Ti oxides within the same ash layers (E). FeO*# is original total Fe measured by EDS-EMP; Fe_2O_3 and FeO are calculated on the basis of AB_2O_4 stoichiometry (spinels) and ABO_3 stoichiometry (ilmenites). See text for discussion.

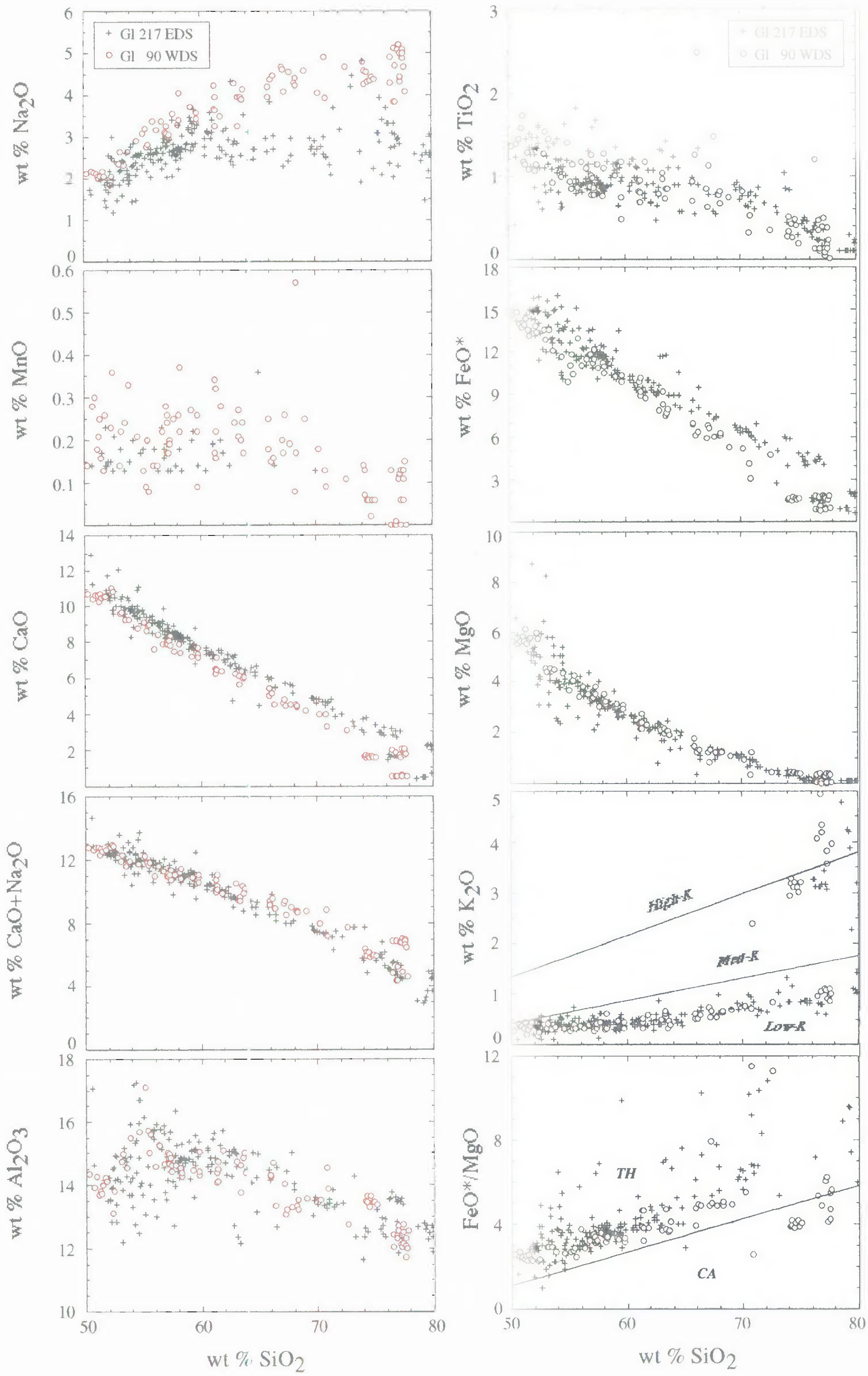

Figure A 2-2 Comparison of major element compositions determined for a representative set of glass shards (ODP Leg 125 Site 784) by wavelength- (WDS) (measured at the University of Michigan by Bloomfield and Arculus, 1989, 90 point analyses) and energy dispersive (EDS) (measured at UNE by author, 1992, 217 point analyses) electron microprobe analysis. See text for discussion.

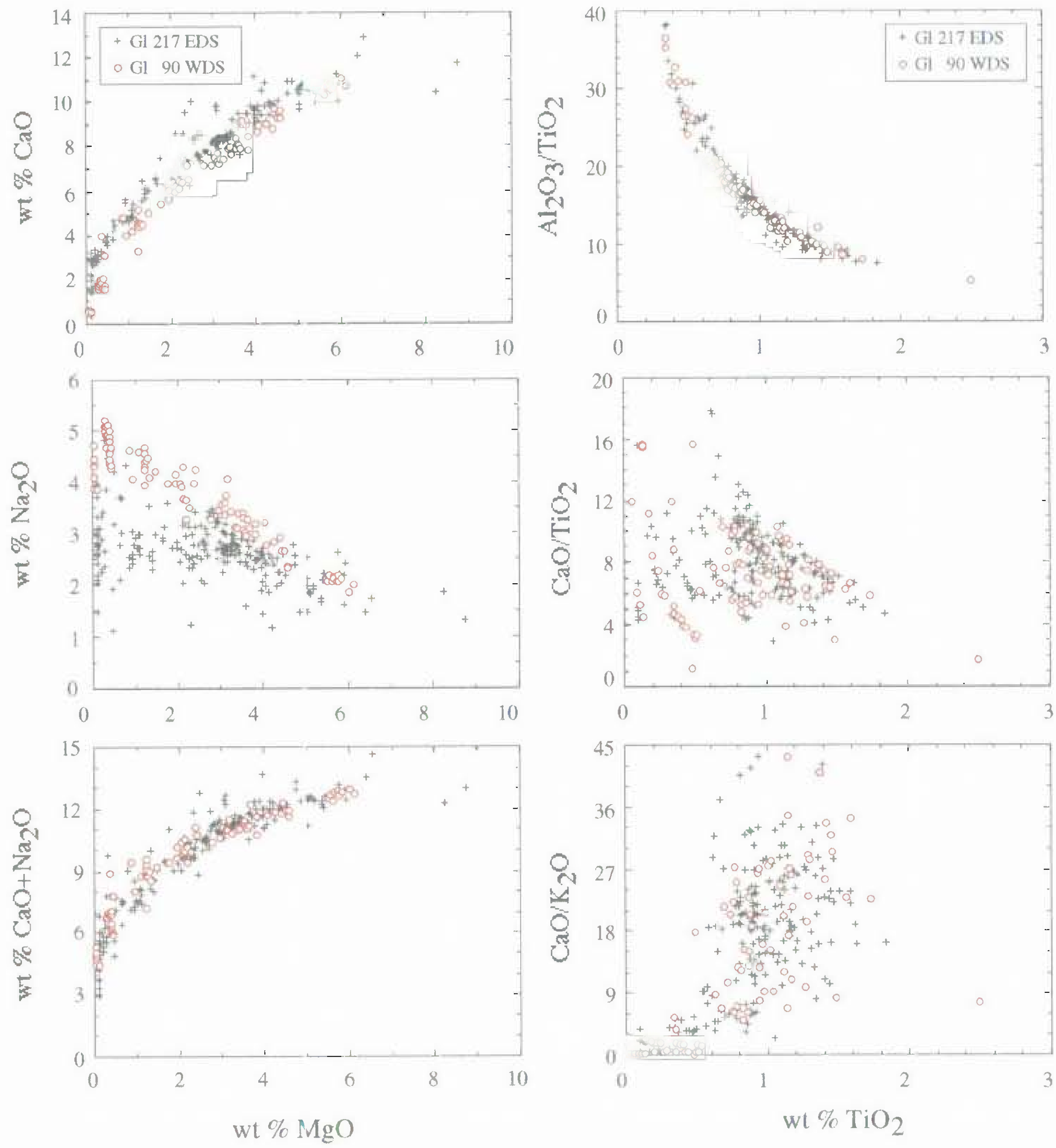

Figure A 2-3 Comparison of major element compositions determined for a representative set of glass shards (ODP Leg 125 Site 784) by wavelength- (WDS) (measured at the University of Michigan by Bloomfield and Arculus, 1989, 90 point analyses) and energy dispersive (EDS) (measured at UNE by author, 1992, 217 point analyses) electron microprobe analysis. See text for discussion.

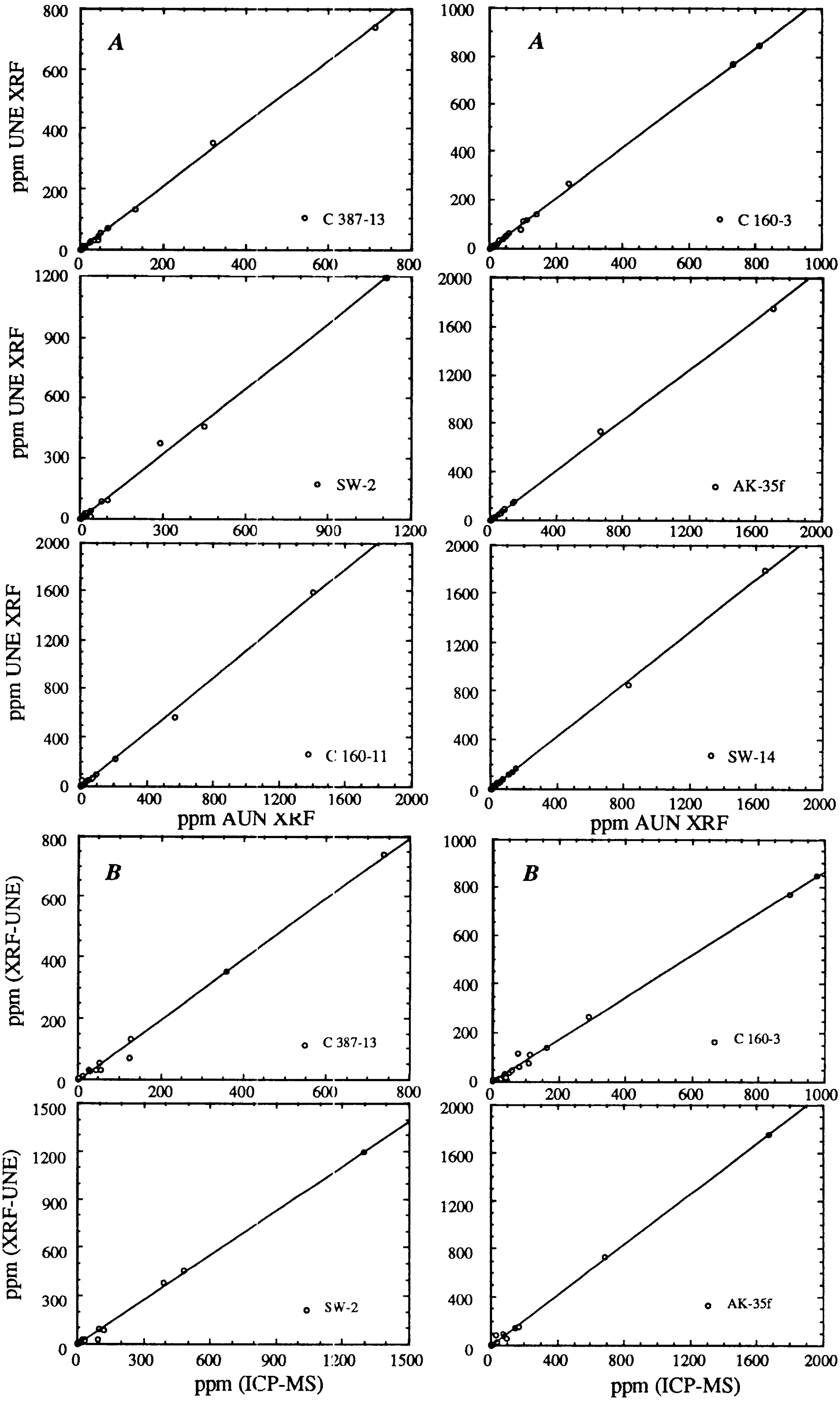

Figure A 2-4 Comparison of XRF analyses at ANU and UNE (A) and ICP-MS with XRF at UNE (B) for trace enements of six representative xenoliths from SFVF, AZ, USA. See text for discussion.

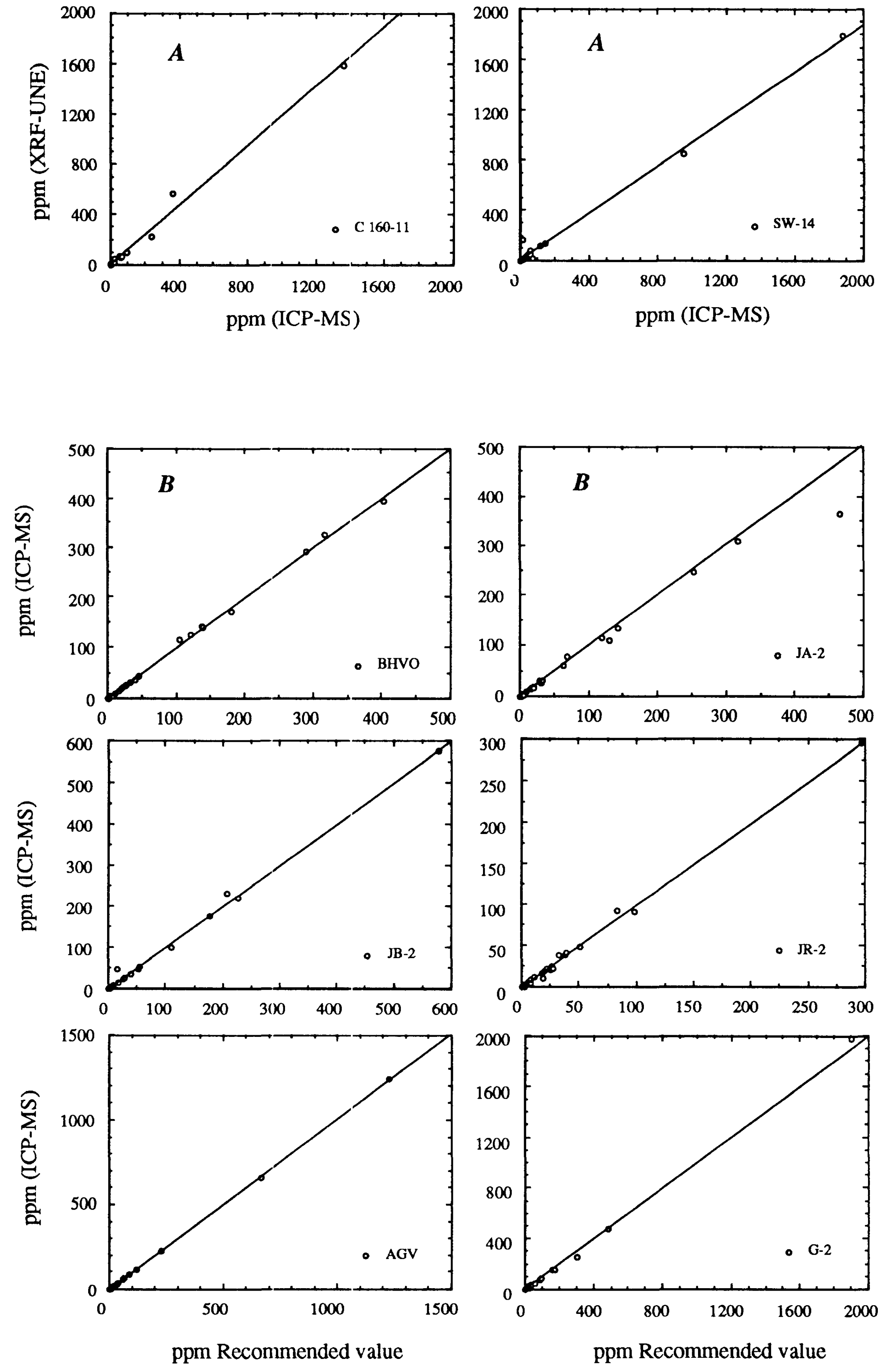

Figure A 2-5 Comparison of XRF at UNE with ICP-MS analyses of two representative xenoliths from SFVF, AZ, USA (A) and comparison of recommended trace element values with our ICP-MS analyses of six representative international geostandards (basalts, andesites, rhyolite and granite) (B). See text for discussion.

Appendix 3. Data base of volcanic ashes

The large data set (Table A 3-1 to Table A 3-8) of major element analyses of individual glass shards and mineral crystal fragments are on the enclosed CD; all other data (Table A 3-9 to Table A 3-17) of volcanic ashes are present in this Appendix.

Table A 3-9 Chemical compositions of olivine within DSDP Leg 60 ash layers

Sites	No.UNE	No.A0	Depth(mbsf)	age(Ma)	Fo	Fe/Mg	FeO/MgO	SiO_2	FeO	MnO	NiO	MgO	Total#	Si	Fe	Mn	Ni	Mg	Total
458	3	C 5975	5.01	0.40	70.46	0.42	0.75	37.49	26.62	0.27	<.18	35.62	99.45	1.00	0.59	0.01	0.00	1.41	3.00
458	3	C 6001	5.01	0.40	71.51	0.40	0.71	37.58	25.80	0.30	<.18	36.33	101.01	0.99	0.57	0.01	0.00	1.43	3.01
458	3	R 6002	5.01	0.40	71.70	0.39	0.70	37.82	25.53	0.35	<.18	36.30	101.25	1.00	0.56	0.01	0.00	1.43	3.00
458	4	C 6014	8.85	0.45	66.92	0.49	0.88	37.08	29.31	0.34	<.19	33.27	99.10	1.00	0.66	0.01	0.00	1.34	3.00
458	4	C 6018	8.85	0.45	67.89	0.47	0.84	36.96	28.63	0.43	<.18	33.97	100.46	0.99	0.64	0.01	0.00	1.36	3.01
458	4	C 6028	8.85	0.45	66.89	0.49	0.88	37.44	29.16	0.34	<.18	33.06	99.08	1.01	0.66	0.01	0.00	1.32	2.99
458	4	C 6034	8.85	0.45	68.18	0.47	0.83	37.09	28.40	0.37	<.18	34.14	100.52	0.99	0.64	0.01	0.00	1.37	3.01
458	4	R 6035	8.85	0.45	68.05	0.47	0.84	37.01	28.51	0.41	<.18	34.07	99.36	0.99	0.64	0.01	0.00	1.36	3.01
458	5	C 6052	8.89	0.45	66.27	0.51	0.91	36.55	29.98	0.41	<.18	33.06	100.07	0.99	0.68	0.01	0.00	1.33	3.01
458	5	C 6058	8.89	0.45	68.90	0.45	0.80	37.32	27.75	0.44	<.18	34.49	99.08	1.00	0.62	0.01	0.00	1.37	3.00
458	5	R 6059	8.89	0.45	68.20	0.47	0.83	37.13	28.33	0.47	<.18	34.08	99.38	1.00	0.64	0.01	0.00	1.36	3.00
458	5	C 6061	8.89	0.45	41.31	1.42	2.53	33.39	47.17	0.81	<.19	18.63	98.73	0.99	1.17	0.02	0.00	0.82	3.01
458	5	R 6062	8.89	0.45	41.53	1.41	2.51	33.80	46.80	0.75	<.19	18.65	99.36	1.00	1.16	0.02	0.00	0.82	3.00
459B	3	C 8775	6.67	0.46	11.85	7.43	13.25	29.99	62.81	2.46	<.0.20	4.74	99.75	0.99	1.73	0.07		0.23	3.01
459B	3	R 8776	6.67	0.46	10.68	8.35	14.90	31.44	61.84	2.33	0.24	4.15	96.13	1.02	1.68	0.06	0.01	0.20	2.98
459B	3	C 8779	6.67	0.46	66.32	0.51	0.91	36.84	29.76	0.52	<0.18	32.88	99.84	1.00	0.67	0.01		1.32	3.00
459B	3	R 8780	6.67	0.46	63.03	0.59	1.05	38.42	31.32	0.31	<0.18	29.96	92.59	1.04	0.71	0.01		1.21	2.96
458	14	C1 6369	29.90	2.65	71.50	0.40	0.71	37.55	25.86	0.19	<.18	36.40	98.50	0.99	0.57	0.00	0.00	1.44	3.01
458	14	C2 6370	29.90	2.65	71.90	0.39	0.70	37.80	25.40	0.35	<.18	36.46	99.24	1.00	0.56	0.01	0.00	1.44	3.00
458	14	R 6371	29.90	2.65	71.62	0.40	0.71	37.89	25.71	<.13	<.19	36.40	98.07	1.00	0.57	0.00	0.00	1.43	3.00
458	14	C 6385	29.90	2.65	68.11	0.47	0.83	37.14	28.46	0.29	<.18	34.10	99.39	1.00	0.64	0.01	0.00	1.36	3.00
458	14	R 6386	29.90	2.65	66.67	0.50	0.89	36.95	29.54	0.35	<.18	33.15	98.94	1.00	0.67	0.01	0.00	1.33	3.00
458	15	C 6414	30.75	2.80	71.06	0.41	0.73	37.84	26.01	0.31	<.18	35.84	98.69	1.00	0.58	0.01	0.00	1.41	3.00
458	38	C 7040	78.62	11.70	72.29	0.38	0.68	37.96	25.12	0.14	<.18	36.78	103.01	1.00	0.55	0.00	0.00	1.44	3.00
458	38	R 7042	78.62	11.70	72.86	0.37	0.66	38.14	24.57	0.27	<.18	37.01	101.38	1.00	0.54	0.01	0.00	1.45	3.00

Total# is original total wt %, C means core, R rim of the olivine shard

Table A 3-10 Amphibole and Garnet compositions within DSDP Leg 60 ash layers

Garnet

Site-No.UNE	458-25	458-25	458-25	459B-23	459B-23	459B-49	459B-49
No.A0	C 6688	R1 6689	R2 6690	C 9232	R 9233	C 9771	R 9772
Depth (mbsf)	51.36	51.36	51.36	257.23	257.23	368.64	368.64
age (Ma)	8.60	8.60	8.60	18.80	18.80	22.00	22.00
SiO_2	37.85	37.96	38.10	37.70	38.16	34.53	35.04
TiO_2	0.22	<.13	0.24	3.47	<.13	<.14	<.14
Al_2O_3	21.34	21.85	22.05	23.02	24.66	<.14	<.14
Fe_2O_3	2.39	2.02	0.84	0.00	0.00	31.56	30.67
FeO	13.17	13.28	13.84	10.64	12.59	0.00	0.00
MnO	<.13	<.13	<.13	<.13	<.13	0.85	0.71
MgO	<.14	<.14	<.14	<.14	<.14	<.14	<.14
CaO	24.93	24.77	24.92	25.10	24.58	33.07	33.58
K_2O	0.12	0.12	<.07	0.07	<.07	<.07	<.07
Na_2O	<.19	<.19	<.19	<.18	<.18	<.21	<.21
Total	100.00	100.00	100.00	97.89	98.40	100.52	100.51
Si	2.94	2.95	2.95	2.88	2.92	2.94	2.98
Ti	0.01	0.00	0.01	0.20	0.00	0.00	0.00
Al	1.96	2.00	2.01	2.07	2.22	0.00	0.00
Fe^{3+}	0.14	0.12	0.05	0.00	0.00	2.02	1.96
Fe^{2+}	0.86	0.86	0.90	0.68	0.81	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.06	0.05
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.08	2.06	2.07	2.05	2.02	3.02	3.06
K	0.01	0.01	0.00	0.01	0.00	0.00	0.00
Na	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	8.00	8.00	8.00	7.89	7.97	8.05	8.04
O				12.00	12.00	12.00	12.00

Amphibole

Site-No.UNE	459B-27	459B-27	459B-50
No.A0	C 9338	R 9339	C 9805
Depth (mbsf)	276.66	276.66	370.97
age (Ma)	19.5	19.5	22
SiO_2	43.51	42.81	45.04
TiO_2	3.29	3.41	2.33
Al_2O_3	13.36	13.40	13.14
Cr_2O_3	<.13	<.13	<.13
FeO*	11.80	11.66	12.16
MnO	<.13	<.13	<.13
MgO	15.00	14.93	15.62
CaO	12.79	12.78	12.49
Na_2O	2.33	2.20	2.06
K_2O	0.78	0.77	0.48
Total#	102.86	101.96	103.32
Si	6.09	6.05	6.24
Ti	0.35	0.36	0.24
Al	2.20	2.23	2.15
Cr	0.00	0.00	0.00
Fe*	1.38	1.38	1.41
Mn	0.00	0.00	0.00
Mg	3.13	3.15	3.23
Ca	1.92	1.93	1.85
Na	0.63	0.60	0.55
K	0.14	0.14	0.09
Total	15.84	15.84	15.76
Mg#*	69.38	69.54	69.60

#Total is original total wt %, total Fe reported as FeO*, Mg#* = 100 Mg/(Mg+Fe), C and R means core and rim of the mineral shard

Table A 3-11 K-feldspar, Titanite and Apatite within DSDP Leg 60 ash layers

K-feldspar

Site-No.UNE	459B-5	459B-5	459B-5
No.A0	C1 8817	C2 8819	R 8818
Depth (mbsf)	49.13	49.13	49.13
age (Ma)	1.7	1.7	1.7
SiO_2	64.48	64.69	64.74
Al_2O_3	18.62	18.45	18.29
FeO*	<.14	<.13	<.14
CaO	<.11	<.12	<.12
BaO	<.28	0.42	<.29
K_2O	16.90	16.44	16.97
Na_2O	<.17	<.17	<.17
Total#	97.81	97.36	95.52
Si	2.99	3.00	3.00
Al	1.02	1.01	1.00
Fe	0.00	0.00	0.00
Ca	0.00	0.00	0.00
Ba	0.00	0.01	0.00
K	1.00	0.97	1.00
Na	0.00	0.00	0.00
Total	5.00	4.98	5.00
An	0.00	0.00	0.00
Ab	0.00	0.00	0.00
Or	100.00	100.00	100.00
Al-(1+Ca)	0.02	0.01	0.00
Ca+Na+K	1.00	0.97	1.00

Titanite

Site-No.UNE	459B-5	459B-5
No.A0	C 8828	R 8829
Depth (mbsf)	49.13	49.13
age (Ma)	1.7	1.7
SiO_2	31.01	31.32
TiO_2	36.12	32.87
Al_2O_3	1.87	4.60
Fe_2O_3	0.34	0.73
FeO	0.00	0.00
MnO	<.14	<.14
MgO	<.14	<.13
CaO	30.59	30.39
K_2O	0.07	0.10
Na_2O	<.20	<.19
Total	100.00	100.00
Si	1.01	1.02
Ti	0.89	0.80
Al	0.07	0.18
Fe^{3+}	0.01	0.02
Fe^{2+}	0.00	0.00
Mn	0.00	0.00
Mg	0.00	0.00
Ca	1.07	1.06
K	0.00	0.00
Na	0.00	0.00
Total	3.06	3.08

Apatite

Site-No.UNE	459B-71
No.A0	C 10214
Depth (mbsf)	542.78
age (Ma)	35
SiO_2	3.17
Al_2O_3	0.71
FeO*	0.52
MgO	0.38
CaO	49.82
P_2O_5	37.82
Cl	2.09
SO_3	0.18
K_2O	0.53
Total#	95.22

Total# is original total wt %, *total Fe reported as FeO*

Table A 3-12 124 major element (EMP) and trace element (PIXE PMP) analyses of individual glass shards from DSDP Leg 60 ash layers

Sites	No.UNE	Age (Ma)	No.A0	SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO	K_2O	Na_2O	S (E/P)	Rb	Ba	Sr	Zr	Y	Mn %	Cu	Zn	Ga
458	3	0.4	5986r	53.33	0.99	13.73	13.40	0.14	5.62	9.38	0.98	2.44	0.80	25.4	318	247	103.0	34.5	0.16	22	113	12.3
458	3	0.4	6003c1	53.67	1.23	15.33	12.40		4.03	9.19	0.81	3.34	0.98	14.4	256	350	80.0	22.1	0.20	257	131	17.6
459B	3	0.46	C 8767	54.57	1.32	13.86	13.79		3.66	8.85	0.76	3.19	1.09	17.6	300	217	85.0	33.2		66	100	13.8
459B	3	0.46	C 8757	54.86	1.09	16.00	11.26		3.83	9.00	0.63	3.32	1.03	11.9	277	315	67.7	27.6		135	94	16.9
459B	3	0.46	C 8758	55.27	1.11	15.43	12.11		3.62	8.52	0.69	3.25	1.26	22.1	527	307	156.0	50.7		139	136	20.0
459B	3	0.46	C 8773	58.16	1.05	15.13	10.68		2.98	7.27	0.77	3.95	1.12	10.2	183	262	72.5	29.5		145	100	14.8
459B	3	0.46	C 8755	60.17	1.44	11.40	14.09	0.20	3.19	5.87	1.32	2.30	0.99	8.6	81	113	86.2	28.5		53	73	14.8
459B	3	0.46	C 8763	61.02	1.10	14.66	10.01		2.18	6.37	1.04	3.63	0.85	11.1	322	257	70.2	29.4		148	103	15.5
458	6	1.05	6145c	53.76	1.32	14.95	12.41		4.64	9.22	0.85	2.86	2.72	15.3	273	241	79.8	26.3	0.20	133	100	12.2
458	6	1.05	6129c	55.66	1.30	14.81	12.11		3.18	8.94	0.85	3.14	0.96	12.1	286	268	67.5	23.9	0.19	153	109	12.0
458	6	1.05	6122c	56.08	0.83	15.38	11.91		3.39	8.16	0.88	3.38	0.83	18.5	280	263	110.0	39.1	0.18	260	122	14.0
458	6	1.05	6147c	57.62	1.24	16.11	10.75		2.20	7.56	0.77	3.73	1.26	17.2	330	257	102.0	32.2	0.17	274	211	15.7
459B	4	1.6	C 8799	55.63	1.16	15.50	11.59		3.64	8.59	0.84	3.05	0.90	17.5	299	269	85.2	26.4		173	107	14.5
459B	4	1.6	C 8798	55.97	1.25	15.76	11.55	0.21	3.21	8.18	1.00	2.87	1.03	15.0	360	270	57.9	25.1		187	105	13.9
459B	4	1.6	C 8796	57.50	1.02	15.84	10.72		2.50	7.81	0.92	3.68	1.00	16.6	213	232	147.0	7.2		200	128	13.2
459B	4	1.6	C 8787	58.23	1.04	17.07	8.99		1.33	8.04	1.20	4.10	1.40	21.5	405	371	102.0	44.6		169	152	20.3
459B	5	1.7	C 8831	62.80	1.18	13.00	12.12		0.88	4.93	2.19	2.90	0.95	32.7	531	306	89.8	27.8		28	71	14.1
459B	5	1.7	C 8813	71.87	0.42	14.80	4.22		0.58	3.16	2.25	2.70	1.43	36.2	699	628	118.0	37.9		195	120	20.3
459B	5	1.7	C 8822	76.52	0.40	12.11	3.51		0.10	1.35	3.36	2.74	0.82	31.3	619	346	91.7	35.2		20	93	14.8
458	12	2.15	6321c	62.80	1.20	13.84	11.21		1.16	5.51	1.49	2.79	0.93	12.1	281	264	88.9	30.1	0.17	59	110	13.3
458	17	5.8	6489c	59.94	0.90	16.47	8.94		2.76	7.11	1.29	2.59	1.36	31.0	399	351	92.7	28.8	0.15	102	85	12.6
458	17	5.8	6469c	61.10	0.93	15.66	8.78		3.64	6.67	1.31	1.92	1.10	34.8	527	295	112.0	35.6	0.13	142	93	12.1
458	17	5.8	6470r	61.52	0.71	16.21	8.73		2.28	7.09	1.39	2.08	0.89	29.6	492	348	99.2	30.5	0.11	111	93	13.4
458	17	5.8	6472c	63.90	0.86	15.08	8.29		1.60	5.52	1.60	3.14	0.91	30.1	452	365	104.0	36.5	0.13	115	97	15.1
458	19	6.6	6545c	55.88	1.21	10.09	15.76	0.21	5.66	7.94	1.32	1.92	0.99	41.3	782	492	104.0	34.1	0.17	175	109	13.9
458	19	6.6	6525c	58.73	0.85	16.55	9.69		2.04	7.35	1.55	3.24	0.91	29.8	466	405	79.2	23.7	0.15	197	90	12.7
458	20	6.9	6565r	58.01	1.06	10.57	14.78	0.22	5.52	5.88	1.68	2.28	0.96	27.0	496	421	72.4	28.7	0.15	134	99	12.0
458	20	6.9	6574c	59.36	1.05	13.69	11.08		3.01	7.36	1.63	2.83	0.63	28.8	464	268	76.0	27.2	0.12	50	79	9.0
458	20	6.9	6560c	59.63	0.51	16.15	9.39		3.32	5.95	1.66	3.39	1.21	41.5	460	432	78.6	26.7	0.16	174	140	13.1
458	20	6.9	6575c	61.43	0.85	16.51	8.11		1.45	6.11	1.69	3.86	1.09	25.5	502	439	79.7	31.8	0.18	185	113	13.6
458	21	8.3	6586r	59.15	0.63	19.17	6.92		1.46	7.66	1.18	3.83	0.81	74.9	734	199	159.0	28.4	0.06	9	64	10.2

See Appendix 2 for detailed information about EMP and PIXE PMP and samples; Major element data are in wt %, trace element data in ppm except for Mn, wt %

Table A 3-12 124 major element (EMP) and trace element (PIXE PMP) analyses of individual glass shards from DSDP Leg 60 ash layers

Sites	No.UNE	Age (Ma)	No.A0	SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO	K_2O	Na_2O	S (E/P)	Rb	Ba	Sr	Zr	Y	Mn %	Cu	Zn	Ga
458	21	8.3	6601c	59.62	0.96	15.76	9.61		2.51	6.57	1.51	3.46	1.05	29.1	669	472	90.5	36.5	0.16	43	117	14.9
458	21	8.3	6597c	62.70	0.55	18.92	5.08		1.11	6.63	1.42	3.58	1.26	17.5	484	386	67.7	23.0	0.10	11	76	8.6
458	21	8.3	6603r	65.13	0.74	14.24	8.19		1.31	5.24	2.04	3.12	1.30	31.0	1120	317	120.0	46.0	0.12	20	107	13.4
458	22	8.4	6611c	61.58	0.72	16.31	8.27		2.20	6.58	1.59	2.75	1.61	31.8	619	474	93.3	29.3	0.16	28	100	17.5
458	22	8.4	6609c	62.33	0.80	16.27	7.75		1.91	6.50	1.60	2.87	1.23	25.9	703	472	90.8	33.1	0.15	24	106	13.5
458	24	8.5	6679c	58.95	0.75	16.55	8.74		3.33	6.94	2.05	2.72	1.28	39.1	611	616	90.1	26.5	0.14	77	97	19.3
458	24	8.5	6672c	59.42	0.92	17.14	9.07		2.41	6.55	1.97	2.51	1.49	81.0	1050	566	179.0	44.9	0.17	48	131	17.7
458	24	8.5	6675c	59.42	1.05	15.45	10.09		2.38	6.31	2.28	3.02	0.75	41.2	515	342	89.7	25.7	0.11	227	78	8.7
458	24	8.5	6681c	59.71	0.94	16.78	8.29		2.50	6.46	2.08	3.23	0.99	39.1	731	537	96.4	31.2	0.13	99	91	13.3
458	26	8.8	6718c	66.27	0.56	15.78	6.12		1.01	4.18	2.42	3.65	1.00	42.3	933	445	116.0	36.5	0.49	45	97	13.6
459B	7	8.9	8876c	61.56	1.08	15.08	9.62		1.76	5.96	1.75	3.20	1.14	32.6	850	433	107.0	27.3		106	111	15.1
459B	7	8.9	8877c	63.71	1.15	14.20	9.09		2.03	5.93	1.14	2.76	1.40	19.9	370	569	61.0	26.0		138	108	17.6
459B	7	8.9	8885c	64.12	0.57	15.66	6.67		1.77	5.28	2.08	3.85	1.37	24.9	717	400	79.8	31.0		68	102	14.7
459B	7	8.9	8871c	65.09	0.70	11.67	7.92		3.67	6.73	1.86	2.37	1.12	12.4	611	306	74.0	28.5		47	96	12.0
459B	7	8.9	8886c	67.23	0.54	15.59	5.75		1.29	4.71	1.25	3.64	1.07	19.1	669	416	62.2	25.6		34	89	13.9
459B	7	8.9	8868c	70.13	0.46	16.14	3.04		0.10	3.65	0.75	5.84	1.20	31.2	536	327	67.9	21.6		37	82	13.3
459B	7	8.9	8873c	75.30	0.48	12.94	2.82		0.10	1.32	4.39	2.74	0.82	18.2	725	309	75.0	37.1		10	80	12.5
458	35	11.6	6966c	69.54	0.65	15.88	4.42		0.80	3.35	2.16	3.20	0.76	41.4	572	231	148.0	40.7			82	14.2
458	35	11.6	6963c	70.54	0.66	15.94	3.87		0.48	3.20	2.21	3.11	1.25	61.1	780	400	217.0	66.2			137	24.5
458	35	11.6	6962c	70.99	0.73	15.56	3.90		0.49	2.92	2.40	3.00	0.88	42.6	545	330	154.0	45.6			91	14.9
458	35	11.6	6961c	71.12	0.60	15.35	3.91		0.61	3.14	2.13	3.13	0.66	36.6	447	255	124.0	38.5			74	14.9
458	35	11.6	6953c	71.35	0.75	15.34	3.74		0.51	2.97	2.19	3.15	0.92	41.1	523	348	139.0	40.9			84	15.5
458	35	11.6	6946c	71.99	0.75	15.41	3.45		0.55	2.84	2.22	2.79	0.83	42.4	592	329	152.0	42.4			88	17.6
458	35	11.6	6965c	72.01	0.40	14.92	3.56		0.66	3.00	2.34	3.11	0.77	34.9	525	265	131.0	42.6			82	14.8
458	35	11.6	6956c	72.03	0.51	15.34	3.75		0.46	2.75	2.33	2.83	0.83	45.4	614	271	146.0	42.0			84	14.2
459B	13	13.4	9020c	55.56	0.94	16.25	11.00		4.03	8.65	0.35	3.21	0.86	6.5	324	278	49.5	21.5		147	84	15.4
459B	13	13.4	9017c	56.12	0.93	16.14	10.92	0.14	3.62	8.52	0.48	3.13	1.08	13.4	372	174	90.8	37.8		7	102	14.6
459B	13	13.4	9033c	58.00	0.78	15.99	10.29		3.20	8.02	0.44	3.29	0.82	2.9	235	292	34.3	21.3		51	85	15.0
459B	13	13.4	9021c	58.02	0.69	15.93	10.19		3.32	8.20	0.46	3.18	0.82	4.2	242	275	48.0	20.4		41	84	16.1
459B	13	13.4	9032c	58.06	0.78	16.11	9.92	0.14	3.33	8.09	0.36	3.21	0.57	4.7	272	238	45.0	25.2		3	65	9.5
459B	13	13.4	9028c	58.69	0.81	15.94	10.20		3.12	7.77	0.42	3.04	1.08	5.5	322	277	75.2	33.2		7	100	17.3

See Appendix 2 for detailed information about EMP and PIXE PMP and samples; Major element data are in wt %, trace element data in ppm except for Mn, wt %

Table A 3-12 124 major element (EMP) and trace element (PIXE PMP) analyses of individual glass shards from DSDP Leg 60 ash layers

Sites	No.UNE	Age (Ma)	No.A0	SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO	K_2O	Na_2O	S (E/P)	Rb	Ba	Sr	Zr	Y	Mn %	Cu	Zn	Ga
459B	13	13.4	9018c	75.04	0.27	13.18	4.14		0.10	2.64	0.89	3.83	0.94	6.9	307	290	55.0	26.8		31	98	15.5
458	41	13.5	8072r	55.30	0.51	20.03	7.98		1.99	10.48	0.33	3.38	0.58	6.4	245	201	38.4	19.8		109	78	11.9
458	41	13.5	8093c	57.29	0.92	15.50	11.83		3.16	8.13	0.58	2.59	0.89	7.4	351	240	53.2	33.1		130	97	13.6
458	41	13.5	8074r	57.39	0.97	15.31	11.51		3.06	8.27	0.52	2.96	0.80	7.8	322	260	56.9	25.9		165	113	15.3
458	41	13.5	8078c	57.55	0.92	15.39	11.35		3.18	8.32	0.49	2.79	1.13	6.3	337	248	49.8	23.7		132	89	14.0
458	41	13.5	8073c	57.77	0.87	15.01	11.90		3.10	7.98	0.52	2.84	1.78	10.9	393	344	49.8	25.8		118	98	18.1
458	41	13.5	8083c	58.13	0.95	15.85	10.72		2.93	7.97	0.55	2.89	0.89	6.1	289	274	49.2	23.2		136	98	13.9
458	41	13.5	8071c	58.37	0.93	15.14	11.60		3.12	8.10	0.48	2.26	0.87	11.2	366	313	54.4	24.3		150	105	15.6
459B	14	16.2	9046c	59.52	0.89	15.04	10.73	0.14	2.65	7.03	0.83	3.18	0.82	6.9	249	332	41.0	14.5		148	74	13.1
459B	14	16.2	9062c	59.69	0.88	15.20	10.53		2.71	7.12	0.87	3.01	0.89	15.3	359	398	81.1	26.5		12	82	16.5
459B	14	16.2	9043c	59.71	1.09	14.81	10.96		2.53	7.21	0.97	2.73	0.79	13.8	317	317	66.4	24.9		27	105	14.9
459B	14	16.2	9065c	59.74	0.97	15.13	10.65		2.46	6.86	1.01	3.19	1.18	17.7	372	247	89.2	30.7		80	107	14.2
459B	14	16.2	9050c	61.41	0.86	15.90	9.44		1.58	6.72	1.13	2.96	1.09	15.7	322	320	69.0	23.5		111	106	14.4
459B	14	16.2	9054c	63.47	0.74	14.37	9.88		1.49	5.64	1.14	3.27	0.79	15.8	340	338	75.3	24.5		106	105	16.1
459B	18	17.3	9148c	52.80	1.46	13.62	15.35		4.35	9.47	0.65	2.30	0.83	7.6	266	203	71.0	30.7		260	112	16.8
459B	18	17.3	9145c	54.99	1.26	15.04	12.73		3.62	8.90	0.51	2.95	0.84	5.8	158	173	59.5	21.0		206	94	11.8
459B	18	17.3	9143c	55.91	1.07	15.02	12.03		3.81	8.63	0.50	3.03	1.06	6.9	253	218	71.2	27.9		228	101	14.8
458	47	17.55	8270c*r	57.18	0.92	15.35	9.89		4.10	9.41	0.67	2.48	0.84	11.9	253	199	88.5	32.3		52	94	14.4
458	47	17.55	8254c	63.07	0.92	15.13	9.40		2.03	6.65	0.58	2.23	0.97	9.0	203	270	51.8	27.7		69	108	15.3
458	47	17.55	8255c	63.08	1.29	12.70	10.94	0.17	1.42	6.03	0.81	3.55	1.64	10.6	371	314	110.0	47.0		9	26	21.7
458	47	17.55	8242c	64.57	0.78	15.57	7.46		1.63	5.50	0.82	3.68	0.76	20.7	361	294	127.0	40.2		8	82	15.6
458	47	17.55	8263c	69.49	0.57	14.93	4.96	0.13	1.02	4.15	1.33	3.42	1.08	27.7	548	387	146.0	49.6			101	21.3
458	47	17.55	8236c	69.86	0.71	14.69	5.09		0.82	3.89	1.49	3.45	0.86	21.0	409	305	118.0	39.1		13	88	15.5
459B	30	20	9398c	53.00	1.14	15.35	10.77	0.19	4.12	12.22	0.81	2.40	0.79	22.6	174	208	48.1	12.6		45	61	9.1
459B	30	20	9400c	54.77	2.23	10.89	13.90	0.27	4.91	9.62	1.71	1.70	1.21	4.5	319	526	125.0	47.5				6.9
459B	30	20	9402c	55.79	1.10	13.31	13.10		4.04	9.63	0.62	2.40	1.14	30.0	268	556	86.0	30.7		251	194	21.2
459B	30	20	9394c	63.99	1.71	15.54	6.03		0.57	5.77	2.97	3.41	1.11	10.7	205	307	59.4	23.3		58	61	14.3
458	56	20.7	8500C	60.96	0.80	8.70	13.39	0.21	7.03	6.98	0.53	1.39	1.05	11.2	316	423	68.5	33.4		21	86	17.7
458	56	20.7	8511C	65.77	1.22	12.15	10.95		0.85	4.62	1.95	2.48	1.00	8.5	222	179	75.5	32.3		39	451	22.4
458	56	20.7	8501C	72.27	0.58	13.69	5.03		0.79	4.36	0.62	2.66	0.83	11.0	313	195	82.1	35.2		22	88	12.6
458	56	20.7	8509C	73.54	0.58	13.26	5.19		0.44	3.43	0.71	2.85	1.34	12.9	309	219	89.0	35.1		18	108	14.3

See Appendix 2 for detailed information about EMP and PIXE PMP and samples; Major element data are in wt %, trace element data in ppm except for Mn, wt %

Table A 3-12 124 major element (EMP) and trace element (PIXE PMP) analyses of individual glass shards from DSDP Leg 60 ash layers

Sites	No.UNE	Age (Ma)	No.A0	SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO	K_2O	Na_2O	S (E/P)	Rb	Ba	Sr	Zr	Y	Mn %	Cu	Zn	Ga
458	56	20.7	8507C	79.69	0.10	11.71	0.10		0.10	0.72	4.10	3.79	1.87	23.3	466	362	162.0	55.8		15	17	19.7
459B	47	21.9	9740c	62.35	0.45	14.44	9.11		3.91	6.15	0.39	3.21	1.16	8.3	309	146	67.2	31.7		19	66	9.6
459B	47	21.9	9728c	72.51	0.37	14.01	5.49		0.81	4.09	0.56	2.16	1.24	7.6	288	140	65.9	29.1		27	63	8.9
459B	47	21.9	9743c	73.04	0.45	13.56	4.87		0.84	3.87	0.74	2.63	0.99	6.7	258	154	55.7	22.8		22	65	10.4
458	60	22.5	8616C	54.64	0.96	14.95	12.53		4.26	9.68	0.38	2.59	0.85	4.2	180	216	55.1	28.4		230	103	13.1
458	60	22.5	8615C	55.30	0.97	15.04	12.20		4.11	9.58	0.33	2.47	1.10	2.9	126	197	41.3	24.9		13	13	7.4
458	60	22.5	8625C	55.45	0.88	14.49	12.65		4.47	9.30	0.34	2.42	1.67	9.3	210	340	47.3	27.1		188	108	10.5
458	60	22.5	8617C	56.07	1.25	13.80	13.32		3.73	9.34	0.44	2.04	1.14	10.4	279	229	67.4	31.4		190	110	14.6
459B	61	23	10019c	64.78	0.73	14.65	8.72		1.56	5.99	0.65	2.92	1.37	9.3	245	290	60.5	30.3		173	122	18.6
459B	63	25.7	10070c	56.03	0.74	15.54	11.46		4.15	9.23	0.40	2.45	0.85	16.5	259	208	84.0	32.5		8	76	13.1
459B	63	25.7	10069c	58.59	0.97	14.09	11.96	0.13	2.85	7.88	0.58	2.95	0.77	6.6	143	216	38.3	17.2		156	86	11.2
459B	63	25.7	10072c	60.11	0.78	14.06	11.94		2.49	7.43	0.67	2.51	0.91	15.2	182	227	62.5	27.2		160	84	13.2
459B	63	25.7	10078c	60.21	1.02	13.77	11.38		2.77	8.11	0.67	2.08	0.87	11.3	225	241	54.4	24.3		157	99	15.3
459B	63	25.7	10073c	60.51	0.86	14.98	9.31		3.11	8.00	0.73	2.50	0.76	17.3	236	186	78.5	26.0		5	67	12.1
459B	63	25.7	10075c	72.10	0.62	14.37	4.28		0.52	4.07	1.40	2.63	0.76	7.0	122	149	41.4	24.4		108	93	7.4
459B	66	27.5	10123c	57.98	0.83	15.60	10.07		3.37	8.75	0.57	2.82	2.51	22.1	229	289	54.3	20.6		185	113	13.3
459B	66	27.5	10132c	58.46	0.73	14.87	10.59		3.20	8.68	0.52	2.95	2.11	10.7	217	285	69.7	27.9		132	85	14.7
459B	66	27.5	10127c	60.19	0.81	15.14	9.81		2.62	7.89	0.65	2.89	0.69	5.1	50	112	16.7	8.6		53	32	4.1
459B	66	27.5	10129c	63.04	0.75	14.44	8.83		2.04	7.20	0.73	2.97	2.33	26.7	271	395	85.3	33.9		151	109	12.8
459B	66	27.5	10133c	63.56	0.78	13.90	9.01		1.74	6.84	0.66	3.50	2.23	11.6	255	339	71.1	30.9		126	109	19.5
459B	66	27.5	10120c	77.99	0.29	11.18	1.87		0.91	4.22	0.17	3.38	2.53	13.1	234	319	71.5	26.4		174	95	16.0
458	62	33.4	8660c	58.93	0.10	13.25	8.12		8.04	9.15	0.57	1.95	1.16	16.6	70	81	26.4	4.8		75	55	8.6
459B	68	34.9	10154c	75.24	0.16	12.93	3.37		0.15	3.25	0.56	4.34	1.73	8.8	91	95	74.5	30.6		15	61	10.1
459B	68	34.9	10147c	76.84	0.24	11.96	3.24		0.10	2.57	0.76	4.38	1.87	11.5	228	155	70.8	33.5		17	77	16.6
459B	68	34.9	10150c	76.91	0.36	11.74	3.15		0.10	2.69	0.79	4.37	1.19	7.7	71	91	60.2	29.5		17	57	9.5
459B	68	34.9	10158c	76.96	0.29	11.79	3.07		0.10	2.60	0.78	4.52	1.94	7.5	221	269	77.4	38.2		27	73	26.3
459B	68	34.9	10166c	77.06	0.31	11.89	2.88		0.10	2.68	0.73	4.45	1.38	6.7	163	163	49.0	27.7		14	57	14.0
459B	70	35	10197c	55.19	1.18	16.03	11.99		3.29	10.04	0.22	2.05	0.88	3.5		127	23.6	24.8		72	98	13.9
459B	70	35	10196c	56.68	1.07	15.31	12.44		3.42	8.73	0.27	2.07	0.85	4.4	94	120	23.9	20.5		38	87	14.9
459B	70	35	10225c	56.71	1.25	15.76	11.58		3.14	9.66	0.25	1.64	0.96			130	27.6	25.2		28	97	15.4
459B	70	35	10227c	58.86	1.01	15.81	10.60		2.53	9.16	0.35	1.68	0.80	3.0	78	114	24.2	19.3		22	89	11.7

See Appendix 2 for detailed information about EMP and PIXE PMP and samples; Major element data are in wt %, trace element data in ppm except for Mn, wt %

Table A 3-13 93 major element (EMP) and trace element (PIXE PMP) analyses of individual glass shards from ODP Leg 125 ash layers

Sites	No.UNE	Age (Ma)	No.A0	SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO	K_2O	Na_2O	S (E/P)	Rb	Ba	Sr	Zr	Y	Mn %	Cu	Zn	Ga
786A	2	5.6	5079c	51.85	0.94	12.96	13.72	0.16	7.31	10.69	0.16	2.20	1.36	11.8	234	207	44.8	23.4	0.18	89	108	10.1
782A	1	0.25	5279c	55.17	1.25	11.08	14.61	0.25	7.08	8.18	0.30	2.09	1.12		171	231	27.2	15.2	0.18	64	94	14.0
782A	1	0.25	5269c	70.29	0.53	15.23	4.09		0.48	4.74	0.46	4.19	0.87	6.4	106	122	46.1	19.7	0.05	14	46	6.5
782A	1	0.25	5267c	78.31	0.41	12.16	1.43		0.10	1.39	2.84	3.47	2.26	52.6	355	65	148.0	26.8	0.04		33	7.0
784A	11	0.7	5606c	54.60	0.63	16.72	10.06		3.94	11.13	0.35	2.57	1.20	3.2	132	127	28.1	13.1	0.16	154	68	6.8
784A	11	0.7	5592c	70.68	0.63	13.25	6.35		0.69	4.46	0.93	3.01	1.45	6.9	149	68	56.5	24.8	0.14	27	52	6.1
784A	11	0.7	5611c	67.88	0.78	13.84	7.28		1.09	5.18	0.99	2.97	1.13	8.4	164	131	72.7	27.4	0.10	105	70	11.5
784A	11	0.7	5609c	79.62	0.10	12.47	1.90		0.10	2.29	1.10	2.63	1.01	15.9	276	96	152.0	44.8	0.04	10	45	10.4
784A	11	0.7	5613c	79.85	0.23	12.34	1.77		0.10	2.21	1.04	2.57	0.36	2.9	77	34	25.6	6.7	0.02	51	18	2.6
782A	2	1.2	5292c	54.95	0.89	14.26	11.27		5.01	10.37	0.47	2.28	1.05	8.2	128	181	33.8	18.7	0.15	162	81	8.8
782A	2	1.2	5303c	54.37	1.05	13.39	12.79	0.19	5.21	10.41	0.46	2.12	0.73	3.8	62	55	17.7	15.7	0.19	55	125	3.4
782A	2	1.2	5302c	58.04	0.97	15.91	9.46		3.31	8.48	0.53	2.71	1.03	7.5	97	158	41.2	14.6	0.11	145	92	8.7
782A	2	1.2	5298c	57.42	0.95	13.51	12.13		4.38	9.09	0.51	2.01	2.03	16.5	127	270	72.5	18.0	0.14	198	120	12.9
786A	1	2.5	5067c	77.71	0.10	13.32	1.05		0.10	1.65	2.82	3.46	0.37	23.2	143	77	19.6	6.1	0.13	16	18	3.3
784A	1	2.75	4506c	62.52	0.91	15.07	9.06		2.18	6.73	0.59	2.94	0.90	8.4	148	174	82.6	36.7	0.16	23	109	15.1
784A	1	2.75	4507c	60.52	0.88	15.10	10.27		2.70	7.55	0.42	2.56	1.02	5.4	94	256	61.1	30.2	0.15	41	110	18.7
784A	1	2.75	4501c	57.78	0.95	15.27	11.58		2.92	8.20	0.62	2.69	1.28	5.9	193	286	64.9	31.2	0.16	81	99	18.1
784A	1	2.75	4499c	64.65	1.10	13.15	10.52		1.39	6.10	0.60	2.48	1.44	8.9	197		75.0	28.7	0.17	30	43	40.0
784A	1	2.75	4504c	67.29	0.78	14.42	7.56		1.41	5.71	0.53	2.29	1.00	7.3	113	185	66.6	32.0	0.14	18	108	13.6
784A	1	2.75	4498c	64.39	0.90	15.01	8.20		2.06	6.59	0.41	2.44	1.40	6.1	213	169	45.2	26.2	0.17	22	95	12.5
784A	1	2.75	4494c	76.47	0.39	12.42	4.28		0.30	3.16	0.62	2.35	0.75	6.5	184	120	64.9	36.8	0.10	9	85	10.3
786A	13	3.14	5525c	55.53	1.41	13.66	14.42		3.23	8.35	0.45	2.94	1.28		185	231	84.4	32.2	0.21	119	133	17.0
786A	13	3.14	5535c	63.33	1.14	14.97	8.64		0.81	6.86	0.56	3.69	1.36		145	144	53.1	29.2	0.13	70	100	11.3
786A	13	3.14	5521c	64.74	1.28	13.60	9.26		1.03	6.01	0.49	3.59	1.24	9.0	92	187	66.0	37.9	0.15	67	102	14.8
786A	13	3.14	5520c	74.88	0.10	12.57	4.65		0.10	2.93	0.88	4.10	0.91	5.8	134	107	39.1	15.9	0.07	22	57	8.1
786A	13	3.14	5527c	75.51	0.27	12.72	3.46		0.10	1.78	1.21	5.06	0.70	2.9	102	69	20.6	9.3	0.07	14	33	4.3
784A	3	3.45	4905c	52.92	0.60	14.13	12.15		6.40	12.08	0.25	1.48	1.19	5.5	161	185	31.5	17.6	0.18	168	79	12.9
784A	3	3.45	4895c	69.72	0.92	13.62	6.41		0.97	4.77	0.78	2.77	0.97	6.3	164	218	111.0	40.4	0.13		95	17.1
784A	3	3.45	4881c	73.90	1.05	11.65	6.01		0.30	3.12	1.32	2.66	0.89	10.6	171	152	105.0	36.6	0.12	12	138	13.7
784A	3	3.45	4891c	74.01	0.85	12.35	5.86		0.48	3.70	0.84	1.91	1.23	8.3	172	192	122.0	44.8	0.10	39	87	14.7
782A	5	3.75	5360c	59.88	0.83	15.29	10.06		2.79	7.60	0.42	3.13	0.99	4.4	134	205	49.8	27.1	0.14	64	106	13.8

See Appendix 2 for detailed information about EMP and PIXE PMP and samples; Major element data are in wt %, trace element data in ppm except for Mn, wt %

Table A 3-13 93 major element (EMP) and trace element (PIXE PMP) analyses of individual glass shards from ODP Leg 125 ash layers

Sites	No.UNE	Age (Ma)	No.A0	SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO	K_2O	Na_2O	S (E/P)	Rb	Ba	Sr	Zr	Y	Mn %	Cu	Zn	Ga
782A	5	3.75	5361c	58.60	0.99	15.50	10.36	0.14	2.74	8.05	0.41	3.21	0.95	5.9		200	48.1	24.6	0.15	61	102	12.9
782A	5	3.75	5365c	58.37	0.79	15.54	10.70	0.20	2.96	8.08	0.39	2.97	1.14	7.9	168	247	53.5	27.1	0.15	69	109	14.4
782A	5	3.75	5362c	58.80	0.89	15.74	10.09		2.78	7.92	0.46	3.31	0.93	4.4	64	198	43.8	21.0	0.14	64	92	11.3
784A	4	4.1	4921c	56.94	1.14	14.98	11.66	0.18	3.49	8.44	0.31	2.88	2.15	14.6	185	172	72.4	32.0	0.22	56	123	13.0
784A	4	4.1	4922c	53.72	0.84	13.69	12.87		5.76	10.52	0.10	2.61	3.05	19.8	192	190	79.8	35.4	0.21	68	151	14.9
784A	4	4.1	4918c2	58.96	1.01	14.18	11.43		3.63	7.62	0.30	2.86	2.27	37.3	302	182	82.0	28.7	0.17	103	127	13.9
784A	4	4.1	4901c	71.60	0.87	13.36	5.30		0.64	3.85	0.66	3.71	1.40	8.7	107	104	46.8	21.6	0.10	19	70	8.2
784A	4	4.1	4914c	65.83	0.98	14.17	8.59		1.40	5.88	0.50	2.65	1.89	9.3	123	123	47.6	19.3	0.15	40	89	10.0
786A	15	4.5	5578c	56.02	1.15	15.46	11.24	0.16	3.77	8.21	0.66	3.34	1.58	44.7	393	456	196.0	46.9	0.19	102	137	26.8
786A	15	4.5	5579c	67.84	0.37	16.22	4.78		0.20	3.91	2.06	4.63	0.70	21.1	197	205	93.7	22.3	0.08	45	62	9.7
786A	2	5.6	5097c1	55.08	1.32	12.49	14.43	0.14	4.80	9.08	0.23	2.44	1.18	5.5	140	193	44.8	21.4	0.20	128	115	15.2
786A	2	5.6	5093c	56.78	1.24	14.02	13.05		3.21	8.38	0.38	2.94	0.97	4.2		144	55.3	24.3	0.16	143	110	14.9
786A	2	5.6	5077c	53.20	1.38	13.53	14.73	0.14	4.59	9.77	0.29	2.37	1.05	6.4	144	174	45.6	23.0	0.19	131	129	9.7
786A	2	5.6	5076c	54.85	1.35	12.81	14.65		5.01	8.76	0.29	2.28	1.15	8.3	121	188	50.6	24.5	0.19	134	123	15.0
786A	2	5.6	5098c	55.28	1.33	13.95	13.78	0.21	3.67	8.62	0.28	2.90	1.01	6.9	138	155	52.8	31.4	0.19	111	114	11.7
782A	15	5.75	5736c	54.87	0.97	14.62	12.73	0.19	4.29	9.59	0.34	2.41	1.15	4.1	202	412	32.0	15.3	0.14	189	102	14.3
782A	15	5.75	5733c	53.92	0.90	13.18	13.28	0.18	6.59	9.57	0.32	2.07	0.99	3.5	139	214	39.6	25.4	0.14	190	102	12.4
782A	15	5.75	5742c	53.83	0.83	13.00	14.10	0.21	7.36	9.30	0.32	1.05	1.55	5.6	177	231	42.6	22.1	0.19	66	110	15.0
784A	9	6.8	5021c	53.38	1.43	14.85	14.59		3.08	9.80	0.43	2.44	1.00	6.4	125	202	49.2	29.7	0.17	331	119	15.6
784A	9	6.8	5025c	55.78	1.83	13.54	15.12		2.62	8.54	0.52	2.04	1.00	7.3	160	175	43.3	27.5	0.19	156	122	11.8
784A	9	6.8	5041c	53.88	1.39	13.69	14.94	0.15	3.95	9.75	0.36	1.88	1.76	10.2		176	40.6	20.4	0.19	258	111	9.6
784A	9	6.8	5042c	52.65	1.11	14.18	13.36		5.95	10.05	0.30	2.40	1.69	10.9		126	37.6	19.9	0.17	247	95	9.7
784A	9	6.8	5014c	62.93	0.87	14.57	9.59		1.97	6.77	0.49	2.82	1.20	17.5	379	167	91.8	46.8	0.16	36	127	14.3
784A	9	6.8	5018c	75.01	0.30	13.20	4.84		0.21	3.36	0.84	2.25	0.80	7.0	196	121	71.0	32.5	0.09	28	79	11.2
782A	12	8.1	5468c	54.79	1.28	12.62	15.41		3.52	9.93	0.29	2.16	1.32	16.6	243	441	37.2	28.6	0.21	171	133	16.8
782A	12	8.1	5458c	60.55	1.04	14.94	10.95		1.90	7.43	0.34	2.86	1.17	7.7	273	300	56.4	31.4	0.19	50	124	16.1
784A	12	8.1	5626c	63.07	1.33	12.35	11.62		1.67	6.54	0.51	2.92	1.07	9.8	132	220	52.4	34.3	0.17	119	118	16.8
784A	12	8.1	5622c	59.25	1.36	13.62	12.09	0.20	2.61	7.71	0.48	2.68	1.04		153	236	45.5	29.4	0.18	72	115	13.1
784A	12	8.1	5632c	59.84	0.98	15.00	10.02	0.14	2.72	7.66	0.36	3.28	0.84	4.1	116	217	43.2	27.0	0.16	45	114	15.1
784A	12	8.1	5630c	59.62	1.10	14.91	10.22		2.96	7.63	0.35	3.22	1.04	5.8	156	223	41.9	26.3	0.16	42	115	13.6
784A	12	8.1	5631c	61.16	0.98	14.85	9.76	0.19	2.28	7.25	0.42	3.11	0.87	4.3	154	245	42.8	27.3	0.16	34	110	18.1

See Appendix 2 for detailed information about EMP and PIXE PMP and samples; Major element data are in wt %, trace element data in ppm except for Mn, wt %

Table A 3-13 93 major element (EMP) and trace element (PIXE PMP) analyses of individual glass shards from ODP Leg 125 ash layers (cont)

Sites	No.UNE	Age (Ma)	No.A0	SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO	K_2O	Na_2O	S (E/P)	Rb	Ba	Sr	Zr	Y	Mn %	Cu	Zn	Ga
782A	12	8.1	5472c	63.66	1.13	11.76	11.74		1.84	6.11	0.45	3.30	1.42	18.1			65.6	33.4	0.19	66	152	24.2
784A	12	8.1	5637c	63.55	1.43	11.43	11.73		2.45	6.24	0.60	2.57	1.19	6.2	206	275	57.8	40.9	0.18	67	139	17.7
784A	12	8.1	5619c	63.82	1.11	14.51	8.87		1.33	6.44	0.39	3.53	1.06	5.9	121	243	52.1	32.1	0.15	38	123	18.4
782A	12	8.1	5469c	73.55	0.69	12.72	4.18		0.65	3.73	0.54	3.93	0.98	7.5	185	194	87.5	40.3	0.11	8	86	13.2
786A	4	10.8	5130c	54.37	1.04	13.99	13.58	0.19	4.43	9.65	0.33	2.42	0.99	3.7	132	176	50.5	26.5	0.16	223	114	11.2
786A	4	10.8	5126c	54.11	1.18	14.23	13.46		4.56	9.75	0.34	2.37	1.02	5.3	91	176	49.6	25.5	0.16	257	108	10.2
786A	4	10.8	5128c	54.75	1.19	14.10	14.30		3.27	9.78	0.30	2.30	1.31	11.8	132	202	53.2	25.2	0.17	251	105	9.6
784A	14	11	5666c	76.86	0.48	11.84	4.43		0.13	2.71	0.79	2.76	1.06	13.4	242	167	106.0	55.5	0.12		106	14.8
784A	14	11	5683c	73.18	0.56	12.35	5.02		0.36	3.28	0.77	4.48	1.01	13.8	293	173	127.0	51.8	0.10		107	17.2
784A	14	11	5681c	75.35	0.42	12.58	4.58		0.17	2.97	0.85	3.08	1.00	12.7	299	169	107.0	49.2	0.10		109	15.3
784A	14	11	5668c	75.80	0.46	12.34	4.08		0.25	2.82	0.85	3.40	0.82	11.4	185	158	95.6	45.5	0.11		95	11.9
784A	14	11	5686c	75.59	0.50	12.72	4.34		0.21	2.96	0.80	2.88	1.07	12.6	171	168	106.0	46.9	0.12	7	106	15.2
786A	7	11.8	5184c	55.33	1.28	11.41	16.67		3.96	8.89	0.63	1.83	1.84	13.8	397	386	61.2	34.6	0.22	59	148	17.1
786A	7	11.8	5177c	56.39	0.96	13.18	13.61		3.53	10.23	0.30	1.80	1.21	11.7	192	322	35.5	23.8	0.18			12.1
786A	7	11.8	5185c	54.40	0.99	14.30	13.40		5.09	9.76	0.35	1.60	1.27	14.1	125	341	37.3	20.7	0.17	215	112	10.7
786A	7	11.8	5187c	53.79	0.74	14.33	13.64		5.18	10.22	0.26	1.84	1.04		114	202	28.7	21.1	0.16	212	104	10.1
782A	20	13.8	5855c	56.91	0.74	14.15	12.22		3.88	9.54	0.59	1.97	1.45	8.3		218	43.3	22.9	0.15	238	102	11.9
782A	20	13.8	5865c	61.09	0.72	15.52	8.34		3.94	8.73	0.32	1.34	0.87	8.6	112	143	36.3	20.1	0.10	60	61	7.2
782A	20	13.8	5867c	62.37	1.41	12.50	11.90	0.12	2.19	6.82	0.16	2.52	1.44	14.0	199	202	64.0	26.3	0.16	245	111	14.4
782A	20	13.8	5863c	58.01	0.71	14.32	11.68		3.63	8.86	0.68	2.11	1.05	8.3	221	189	49.8	23.5	0.14	160	96	11.3
784A	16	14	5716c	53.36	1.25	14.59	15.66		3.59	9.47	0.48	1.60	1.02	4.4	161	195	52.4	29.6	0.20	168	123	13.9
784A	16	14	5713c	54.30	1.19	14.39	13.52		3.76	9.47	0.51	2.86	1.20	4.0	146	167	46.2	23.8	0.16	263	107	10.6
784A	16	14	5724c	52.45	1.47	14.16	14.85	0.13	4.22	9.79	0.44	2.49	0.91	5.5	200	191	46.2	29.2	0.17	305	120	14.9
784A	16	14	5721c	52.45	1.34	14.96	15.14		3.11	9.63	0.37	2.99	1.06	7.0	178	194	52.4	32.4	0.18	258	120	16.3
784A	16	14	5719c	52.12	1.12	13.88	14.86		4.76	10.36	0.34	2.56	1.05		177	176	43.8	29.5	0.19	300	110	10.5
786A	9	16.5	5231c	78.69	0.33	11.56	3.26		0.15	2.51	1.14	2.37	1.75	20.7	270	98	142.0	42.3	0.06	33	59	12.3
786A	9	16.5	5223c	78.62	0.26	11.52	3.28		0.10	2.36	1.15	2.81	0.97	19.2	281	102	149.0	43.2	0.04	39	55	10.2
786A	9	16.5	5216c	78.21	0.39	11.63	3.34		0.10	2.44	1.15	2.84	1.33	15.2	303	96	125.0	35.6	0.06	43	48	8.0
786A	9	16.5	5217c	78.54	0.19	11.75	3.43		0.23	2.64	1.10	2.12	1.42	20.0	393	258	138.0	40.0	0.06	43	56	18.7
782A	14	42	5499c	77.81	0.17	13.08	0.85		0.10	2.41	0.28	5.39	0.67	1.7	34	52	37.7	8.4	0.00	6	25	4.0
782A	14	42	5507c	78.55	0.12	12.55	0.75		0.10	2.51	0.23	5.29	0.48	1.8	60	42	45.7	7.4	0.01	5	24	4.9

See Appendix 2 for detailed information about EMP and PIXE PMP and samples; Major element data are in wt %, trace element data in ppm except for Mn, wt %

Table A 3-14 Comparison of 6 representative glasses with ashes from Leg 60 and Leg 125

Sample	Glass 1	Ash-1	Glass 2	Ash-2	Glass 3	Ash-3	Glass 4	Ash-4	Glass 5	Ash-5	Glass 6	Ash-6
SiO_2	57.00	57.00	60.84	60.84	54.28	54.28	71.35	71.35	57.44	57.44	71.21	71.21
TiO_2	0.85	0.85	1.00	1.00	1.02	1.02	0.62	0.62	0.89	0.89	0.73	0.73
Al_2O_3	14.81	14.81	14.58	14.58	14.24	14.24	15.50	15.50	15.95	15.95	13.13	13.13
FeO*	12.04	12.04	9.87	9.87	13.25	13.25	3.77	3.77	11.06	11.06	6.03	6.03
MnO			0.18	0.18	0.18	0.18			0.14	0.14	0.15	0.15
MgO	3.37	3.37	2.70	2.70	4.71	4.71	0.55	0.55	2.94	2.94	0.73	0.73
CaO	8.89	8.89	7.48	7.48	9.92	9.92	2.94	2.94	8.33	8.33	4.28	4.28
Na_2O	2.69	2.69	3.11	3.11	2.23	2.23	3.00	3.00	2.85	2.85	3.23	3.23
K_2O	0.35	0.35	0.41	0.41	0.30	0.30	2.26	2.26	0.53	0.53	0.63	0.63
Cs	0.39	0.28	0.54	0.73	0.69	0.92	0.77	0.82	0.36	0.45	0.49	0.34
Rb	3.79	2.62	4.13	5.71	4.36	4.88	41.69	31.95	6.98	6.91	8.12	5.23
Li		6.75		7.37		5.04		6.75		7.21		6.46
Ba	52.1	32.1	73.2	87.1	77.4	71.6	552.1	472.5	294.8	278.1	285.8	212.3
Sr	168.7	141.2	191.2	164.0	150.0	112.9	280.2	345.2	219.9	219.9	211.7	222.2
Pb	2.06	1.93	2.91	3.46	3.57	3.24	7.33	5.29	3.76	2.98	5.03	3.41
Th	0.14	0.06	0.07	0.11	0.54	0.13	2.39	2.10	0.67	0.17	0.78	0.12
U	0.08	0.03	0.08	0.09	0.04	0.01	0.89	0.89	0.10	0.14	0.15	0.12
La	1.33	1.23	1.45	1.73	1.08	0.87	19.87	14.15	2.74	2.72	3.59	2.64
Ce	4.12	3.06	5.53	6.45	4.39	3.97	37.87	28.16	7.43	7.59	10.56	7.36
Pr	0.83	0.59	1.10	1.41	0.87	0.86	5.63	3.89	1.33	1.35	2.04	1.30
Nd	4.73	3.92	6.65	7.92	5.08	4.80	24.15	17.59	6.92	7.22	11.02	7.52
Sm	1.88	1.56	2.78	2.99	2.09	2.05	6.17	4.48	2.46	2.29	4.08	2.75
Eu	0.71	0.63	1.08	1.11	0.79	0.62	2.05	1.54	1.07	0.85	1.52	1.01
Gd	2.34	2.42	3.18	4.36	2.74	2.59	7.19	4.97	3.15	2.84	4.97	3.50
Tb	0.48	0.44	0.68	0.87	0.57	0.51	1.20	0.83	0.61	0.52	0.99	0.65
Dy	3.39	3.15	5.00	5.98	4.11	3.47	7.75	5.29	4.25	3.55	6.90	4.69
Ho	0.77	0.70	1.12	1.34	0.94	0.79	1.73	1.20	0.96	0.82	1.57	1.04
Er	2.10	1.87	2.91	3.72	2.57	2.18	4.68	3.30	2.56	2.22	4.28	2.85
Tm	0.34	0.33	0.48	0.58	0.42	0.36	0.75	0.55	0.42	0.35	0.70	0.48
Yb	2.27	2.27	3.26	3.92	2.84	2.45	4.93	3.73	2.63	2.34	4.66	3.30
Lu	0.37	0.37	0.51	0.61	0.45	0.39	0.78	0.57	0.41	0.35	0.76	0.54
Y	23.63	20.16	33.71	36.94	27.54	26.09	50.58	35.55	27.12	23.04	49.61	30.06
Zr	33.9	30.9	42.7	56.6	49.5	47.9	151.6	118.8	51.5	51.7	83.8	58.4
Nb	0.22	0.41	0.18	0.81	0.12	0.70	3.64	3.60	0.36	0.94	1.04	0.90
Hf	1.21	1.18	1.64	2.22	1.74	1.66	4.11	3.19	1.57	1.59	2.66	1.85
Ta	0.03	0.04	0.04	0.05	0.01	0.04	0.21	0.22	0.01	0.06	0.12	0.08
Sc	41.8	50.8	28.6	35.3	40.0	43.8	22.3	20.8	32.8	35.4	32.0	26.3
V	267.6	353.4	255.2	166.6	403.2	347.0	16.8	72.7	324.2	283.2	51.2	44.9
Cr	20.2	15.9	13.7	7.6	37.8	22.6	30.1	7.3	21.6	14.1	22.6	12.9
Co	30.5	30.1	23.6	15.1	36.6	34.1	9.1	9.1	27.5	27.8	11.1	10.3
Ni	62.4	24.6	68.4	17.6	56.7	35.9	21.5	16.5	37.8	29.3	29.8	19.6
Cu	126.6	121.5	63.3	48.4	188.2	121.9	13.9	28.8	121.3	121.0	22.7	16.8
Zn	76.3	83.9	74.2	87.1	82.0	75.9	65.8	69.1	77.2	87.0	90.6	80.5
Ga	13.74	4.22	15.75	4.07	13.97	2.86	28.70	12.15	20.60	9.59	19.99	6.99
$^{87}Sr/^{86}Sr$		0.70358		0.70356		0.70354		0.70389		0.70393		0.70397
$^{143}Nd/^{144}Nd$		0.513103		0.513066		0.513125		0.512924		0.513025		0.513041
epsilon Nd		9.07		8.35		9.50		5.58		7.55		7.86

See text for sample interpretation; these samples cover twe types of epsilon Nd and REE patterns
Ash samples 1: 782A-7A3.9; 2: 784A-13A10.5; 3: 786A-4BA10.8; 4: 458-35D11.6; 5: 458-41A11.5
6: 459B-52D22; glass samples 1-6 are handpicked from ash samples 1-6, respectively; total Fe reported as FeO*
All major element data are averages of EMP point analyses in wt %, trace element data are ICP-MS data in ppm

Table A 3-15 Chemical compositions of 17 representative DSDP Leg 60 bulk ash layers

Sample	1	2	3	4	5	6	7	8	9
SiO_2	53.78	55.75	57.44	57.54	61.37	64.46	65.22	71.35	55.13
TiO_2	1.23	1.10	0.89	1.04	0.94	0.82	0.75	0.62	1.19
Al_2O_3	15.38	15.28	15.95	14.42	15.26	14.17	14.90	15.50	14.55
FeO*	12.96	12.08	11.06	11.52	9.27	8.59	7.36	3.77	13.10
MnO	0.19	0.15	0.14	0.20	0.16	0.16			0.18
MgO	3.64	3.40	2.94	3.73	2.32	1.84	1.27	0.55	3.85
CaO	9.04	8.49	8.33	7.82	6.15	5.73	4.95	2.94	8.86
Na_2O	2.82	3.13	2.85	3.13	2.96	3.32	3.12	3.00	2.79
K_2O	1.10	0.77	0.53	0.73	1.68	1.06	2.49	2.26	0.52
Cs	0.56	0.45	0.45	0.57	0.53	0.66	0.69	0.82	0.38
Rb	12.90	9.10	6.91	13.30	21.75	16.18	24.06	31.95	6.61
Li	5.59	6.38	7.21	7.71	6.00	13.67	7.09	6.75	7.70
Ba	212.4	183.5	278.1	245.5	392.8	338.9	407.4	472.5	165.9
Sr	210.9	166.6	219.9	176.8	317.9	192.9	335.7	345.2	182.3
Pb	1.76	2.52	2.98	2.17	4.33	3.33	3.62	5.29	2.02
Th	0.74	0.40	0.17	0.79	1.65	0.89	1.23	2.10	0.24
U	0.29	0.22	0.14	0.36	0.63	0.47	0.49	0.89	0.12
La	6.40	3.86	2.72	5.76	11.11	7.97	7.31	14.15	3.23
Ce	12.57	9.89	7.59	11.88	21.23	18.70	14.04	28.16	7.62
Pr	1.74	1.74	1.35	1.64	2.86	2.74	1.86	3.89	1.16
Nd	8.66	8.74	7.22	8.94	14.41	14.87	9.71	17.59	6.97
Sm	2.53	2.47	2.29	2.57	3.76	4.57	2.64	4.48	2.25
Eu	0.85	0.84	0.85	0.79	1.00	1.37	0.80	1.54	0.79
Gd	2.90	2.89	2.84	2.87	3.58	4.96	2.85	4.97	2.87
Tb	0.48	0.54	0.52	0.52	0.61	0.92	0.51	0.83	0.53
Dy	3.26	3.76	3.55	3.61	4.36	6.60	3.64	5.29	4.11
Ho	0.67	0.83	0.82	0.78	0.99	1.41	0.79	1.20	0.90
Er	1.84	2.30	2.22	2.24	2.54	3.87	2.12	3.30	2.42
Tm	0.30	0.38	0.35	0.35	0.44	0.66	0.37	0.55	0.41
Yb	1.96	2.44	2.34	2.25	2.82	4.35	2.39	3.73	2.66
Lu	0.32	0.37	0.35	0.37	0.46	0.70	0.38	0.57	0.44
Y	20.37	24.48	23.04	23.18	30.10	43.16	23.75	35.55	27.35
Zr	73.6	82.6	51.7	92.2	95.9	126.1	67.9	118.8	65.4
Nb	1.90	1.96	0.94	4.33	2.39	2.35	1.72	3.60	0.90
Hf	2.25	2.54	1.59	2.74	2.94	3.62	1.94	3.19	1.95
Ta	0.13	0.14	0.06	0.31	0.18	0.17	0.11	0.22	0.08
Sc	25.7	26.2	35.4	19.2	20.5	14.4	19.7	20.8	26.3
V	217.8	230.4	283.2	152.3	218.0	72.6	142.8	72.7	316.1
Cr	11.8	13.2	14.1	17.5	10.7	7.9	7.2	7.3	12.8
Co	21.6	21.2	27.8	16.4	18.8	11.2	15.9	9.1	25.7
Ni	21.1	15.3	29.3	17.2	18.6	14.0	17.3	16.5	22.4
Cu	108.3	113.7	121.0	60.5	91.6	30.3	59.7	28.8	139.5
Zn	69.0	79.8	87.0	61.8	78.0	73.6	61.2	69.1	78.1
Ga	6.63	7.21	9.59	8.30	11.99	12.00	12.28	12.15	9.13
$^{87}Sr/^{86}Sr$	0.70351	0.70352	0.70393	0.70373	0.70396	0.70352	0.70385	0.70389	0.70381
$^{143}Nd/^{144}Nd$	0.513008	0.513034	0.513025	0.513005	0.512928	0.512926	0.512937	0.512924	0.513063
epsilon Nd	7.22	7.72	7.55	7.16	5.66	5.62	5.83	5.58	8.29

See text for sample interpretation; samples 1-9 are within 0-17 Ma
Samples 1: 458-4BA0.45; 2: 458-12BAA2.15; 3: 458-41A13.5; 4: 459B-3BAA0.46; 5: 459B-12BAD10.8
6: 458-13BAADR2.2; 7: 458-27BADAR8.9; 8: 458-35D11.6; 9: 459B-17BA17.3; total Fe reported as FeO*
All major element data are averages of EMP point analyses in wt %, trace element data are ICP-MS data in ppm

Table A 3-15 Chemical compositions of 17 representative DSDP Leg 60 bulk ash layers

Sample	10	11	12	13	14	15	16	17
SiO_2	55.37	56.46	56.67	59.96	67.46	71.21	72.24	76.49
TiO_2	0.94	1.05	1.07	0.91	0.75	0.73	0.50	0.26
Al_2O_3	14.55	14.20	15.66	15.11	14.09	13.13	13.87	12.03
FeO*	12.76	12.31	12.00	9.68	7.26	6.03	5.38	3.28
MnO	0.20	0.16	0.19		0.19	0.15		0.14
MgO	4.41	4.08	3.20	2.79	1.61	0.73	0.64	0.13
CaO	9.43	8.34	9.11	7.71	5.31	4.28	4.13	2.79
Na_2O	2.18	2.78	1.94	3.06	2.87	3.23	2.60	4.35
K_2O	0.36	0.73	0.28	0.74	0.65	0.63	0.63	0.72
Cs	0.29	0.47	0.21	0.59	0.50	0.34	0.52	0.38
Rb	5.58	11.87	4.55	9.71	9.25	5.23	7.65	7.43
Li	6.76	9.22	4.56	8.22	6.81	6.46	5.04	2.68
Ba	106.1	195.2	52.1	141.8	225.0	212.3	216.5	90.7
Sr	172.5	218.3	101.1	172.0	186.5	222.2	172.7	124.5
Pb	1.71	3.08	1.00	3.07	3.01	3.41	3.05	1.55
Th	0.19	0.52	0.19	0.31	0.38	0.12	0.15	0.46
U	0.09	0.23	0.08	0.21	0.21	0.12	0.16	0.21
La	2.86	5.20	2.05	3.40	4.34	2.64	2.44	3.73
Ce	6.70	11.22	4.52	8.32	10.48	7.36	7.35	8.52
Pr	1.10	1.60	0.72	1.49	1.59	1.30	1.40	1.26
Nd	6.15	8.76	4.71	7.46	9.42	7.52	6.74	7.32
Sm	2.01	2.68	1.85	2.54	3.16	2.75	2.50	2.48
Eu	0.72	0.77	0.74	0.79	1.17	1.01	0.87	0.88
Gd	2.70	2.84	2.85	3.22	4.11	3.50	3.04	3.06
Tb	0.51	0.53	0.52	0.59	0.72	0.65	0.58	0.61
Dy	3.85	4.19	3.86	4.19	5.26	4.69	4.08	4.25
Ho	0.84	0.92	0.84	0.96	1.15	1.04	0.98	0.95
Er	2.30	2.40	2.14	2.75	2.94	2.85	2.72	2.69
Tm	0.39	0.42	0.39	0.44	0.52	0.48	0.46	0.44
Yb	2.64	2.64	2.47	2.88	3.42	3.30	2.93	2.86
Lu	0.42	0.45	0.41	0.44	0.56	0.54	0.46	0.48
Y	25.13	27.53	25.44	26.86	35.07	30.06	27.30	27.92
Zr	50.9	69.2	37.3	59.3	78.8	58.4	61.5	66.0
Nb	0.76	1.53	0.59	1.16	1.09	0.90	1.13	1.42
Hf	1.64	2.05	1.51	1.88	2.45	1.85	1.91	2.26
Ta	0.07	0.10	0.06	0.08	0.11	0.08	0.09	0.11
Sc	33.8	28.1	28.8	30.5	22.9	26.3	31.7	16.4
V	386.2	328.6	317.4	298.1	158.7	44.9	95.2	14.1
Cr	17.1	16.5	12.2	14.3	9.6	12.9	16.5	5.1
Co	31.1	32.5	25.6	22.0	15.3	10.3	15.5	6.0
Ni	32.4	32.3	22.2	21.8	17.7	19.6	23.1	12.2
Cu	126.8	131.7	41.2	125.3	58.0	16.8	34.2	9.8
Zn	84.0	95.5	77.5	79.5	79.3	80.5	73.1	51.6
Ga	6.82	9.21	8.88	6.86	10.69	6.99	7.71	7.79
$^{87}Sr/^{86}Sr$	0.70375	0.70363	0.70364	0.70374	0.70388	0.70397	0.70385	0.70385
$^{143}Nd/^{144}Nd$	0.513059	0.513021	0.513081	0.513004	0.513046	0.513041	0.513041	0.513045
epsilon Nd	8.21	7.47	8.64	7.14	7.96	7.86	7.86	7.94

See text for sample interpretation; samples 10-17 are within 18-35 Ma
Samples 10: 458-60BAA22.5; 11: 459B-27BA19.5; 12: 459B-70BAA35; 13: 459B-67A27.5
14: 459B-58DAR; 15: 459B-52D22; 16: 459B-54D22; 17: 459B-68R34.9; total Fe reported as FeO*
All major element data are averages of EMP point analyses in wt %, trace element data are ICP-MS data in ppm

Table A 3-16 Chemical compositions of 12 representative ODP Leg 125 bulk ash layers

Sample	1	2	3	4	5	6	7	8	9	10	11	12
SiO_2	54.28	54.43	56.09	57.00	57.77	57.77	58.80	60.84	61.40	64.05	75.15	78.51
TiO_2	1.02	1.17	0.98	0.85	0.93	0.88	0.89	1.00	1.18	0.79	0.48	0.31
Al_2O_3	14.24	13.91	14.21	14.81	14.70	14.60	15.01	14.58	13.54	14.85	12.65	11.64
FeO*	13.25	13.80	13.52	12.04	11.67	11.74	10.78	9.87	10.89	8.64	4.16	3.26
MnO	0.18	0.17	0.13		0.15	0.15	0.13	0.18	0.17	0.15		
MgO	4.71	4.55	3.49	3.37	3.11	3.28	3.30	2.70	2.42	1.90	0.22	0.14
CaO	9.92	9.38	9.18	8.89	8.37	8.44	8.11	7.48	7.03	6.60	2.99	2.52
Na_2O	2.23	2.43	2.18	2.69	2.99	2.69	2.55	3.11	3.05	2.66	3.54	2.54
K_2O	0.30	0.28	0.35	0.35	0.42	0.43	0.55	0.41	0.43	0.50	0.84	1.14
Cs	0.92	0.68	0.44	0.28	0.68	0.78	1.01	0.73	0.60	0.52	0.50	0.84
Rb	4.88	7.06	3.29	2.62	5.44	9.76	9.07	5.71	4.56	6.21	5.94	7.37
Li	5.04	5.17	5.16	6.75	8.92	8.16	6.70	7.37	6.98	6.61	5.12	6.52
Ba	71.6	122.0	46.1	32.1	67.4	79.5	142.4	87.1	84.9	104.4	90.7	138.6
Sr	112.9	110.6	155.8	141.2	166.9	151.8	167.1	164.0	183.6	136.6	187.7	151.1
Pb	3.24	2.09	2.96	1.93	3.08	3.11	4.74	3.46	3.60	2.67	2.85	3.96
Th	0.13	0.08	0.06	0.06	0.03	0.05	0.23	0.11	0.18	0.02	0.05	0.08
U	0.01	0.10	0.02	0.03	0.11	0.14	0.13	0.09	0.06	0.14	0.11	0.12
La	0.87	1.39	1.36	1.23	1.60	1.89	2.58	1.73	1.26	2.04	1.39	2.03
Ce	3.97	4.68	3.33	3.06	5.46	5.95	7.60	6.45	4.99	6.73	4.74	6.15
Pr	0.86	0.97	0.63	0.59	1.03	1.15	1.26	1.41	0.98	1.38	0.91	1.22
Nd	4.80	4.85	4.27	3.92	5.81	5.91	7.04	7.92	6.13	7.40	4.71	6.08
Sm	2.05	1.79	1.75	1.56	2.25	2.17	2.57	2.99	2.50	2.74	1.76	2.13
Eu	0.62	0.65	0.67	0.63	0.75	0.79	0.88	1.11	1.01	1.03	0.89	0.83
Gd	2.59	2.31	2.77	2.42	2.84	2.92	3.10	4.36	3.70	3.76	2.48	2.74
Tb	0.51	0.46	0.50	0.44	0.58	0.57	0.61	0.87	0.72	0.72	0.47	0.57
Dy	3.47	2.99	3.66	3.15	3.95	4.13	4.03	5.98	4.87	4.89	3.27	3.90
Ho	0.79	0.68	0.81	0.70	0.88	0.91	0.95	1.34	1.11	1.07	0.76	0.88
Er	2.18	1.93	2.15	1.87	2.52	2.54	2.55	3.72	3.11	2.97	2.26	2.58
Tm	0.36	0.33	0.38	0.33	0.42	0.41	0.42	0.58	0.49	0.46	0.35	0.41
Yb	2.45	2.07	2.54	2.27	2.76	2.74	2.79	3.92	3.16	3.01	2.43	2.88
Lu	0.39	0.33	0.42	0.37	0.43	0.42	0.45	0.61	0.50	0.47	0.36	0.46
Y	26.09	21.25	22.6	20.16	25.95	23.97	28.54	36.94	28.11	24.55	21.2	28.33
Zr	47.9	48.2	33.1	30.9	44.4	45.0	49.1	56.6	38.3	47.0	43.7	55.6
Nb	0.70	1.34	0.50	0.41	0.86	1.25	0.85	0.81	0.73	1.00	0.95	0.94
Hf	1.66	1.78	1.33	1.18	1.48	1.54	1.71	2.22	1.44	1.61	1.40	1.91
Ta	0.04	0.09	0.05	0.04	0.05	0.09	0.06	0.05	0.05	0.07	0.06	0.06
Sc	43.8	51.0	56.3	50.8	45.1	34.4	41.4	35.3	32.0	29.1	23.4	40.5
V	347.0	331.9	361.8	353.4	413.1	337.1	211.2	166.6	174.4	151.6	56.3	34.4
Cr	22.6	26.6	13.1	15.9	14.4	7.6	10.1	7.6	3.7	6.8	10.1	13.3
Co	34.1	27.5	33.3	30.1	31.3	26.1	24.1	15.1	17.4	16.5	7.4	16.4
Ni	35.9	30.3	23.4	24.6	33.5	28.8	25.9	17.6	19.5	17.3	13.9	18.7
Cu	121.9	71.7	100.0	121.5	166.0	135.9	67.2	48.4	39.2	31.7	22.8	17.7
Zn	75.9	74.0	82.9	83.9	94.2	80.9	88.6	87.1	89.6	76.0	46.0	59.2
Ga	2.86	2.92	4.17	4.22	5.24		4.38	4.07				3.53
$^{87}Sr/^{86}Sr$	0.70354	0.70389	0.70358	0.70358	0.70355	0.70391	0.70368	0.70356	0.70355	0.70366	0.70371	0.70375
$^{143}Nd/^{144}Nd$	0.513125	0.513058	0.513084	0.513103	0.513098	0.513067	0.513085	0.513066	0.513099	0.513084	0.513079	0.513081
epsilon Nd	9.50	8.19	8.70	9.07	8.97	8.37	8.72	8.35	8.99	8.70	8.60	8.64

All major element data are averages of EMP point analyses in wt %, trace element data are ICP-MS data in ppm
Samples 1: 786A-4BA10.8; 2: 786A-2 BAA5.6; 3: 782A-16BA6.1; 4: 782A-7BAA3.9; 5: 782A-8A3.9
6: 784A-6BAA6.6; 7: 782A-22BAA14.5; 8: 784A-13BAA11; 9: 784A-12A8.1; 10: 784A-1ADR2.75
11: 784A-14R12; 12: 786A-9R16.5; see text for sample interpretation; total Fe reported as FeO*

Table A 3-17 Sr and Nd isotopic compositions of the bulk ashes derived from DSDP Leg 60 and ODP Leg 125

No. Sr-Nd	No. CSIRO	Site, Core-Section, Internal (cm)	No.Ash layer	Rock type	Age (Ma)	Glass %	$^{87}Sr/^{86}Sr$	$^{143}Nd/^{144}Nd$	epsilon Nd	error Nd (2SD)
60-1	CB455	458,1-6,135-136	4	BA	0.45	80	0.70350	0.513008	7.2	0.1
60-20	CB474	459B,1-5, 67-68	3	BA, A	0.46	70	0.70373	0.513005	7.2	0.2
60-2	CB456	458, 2-3, 89-90	6	BA, A	1.05	70	0.70351	0.513031	7.7	0.1
60-3	CB457	458, 3-2, 113-114	12	BA, A	2.15	85	0.70352	0.513034	7.7	0.1
60-5	CB459	458, 11-1, 147-148	41	A	13.50	90	0.70393	0.513025	7.5	0.1
60-12	CB466	459B, 25-2, 119-120	17	BA	17.30	95	0.70381	0.513063	8.3	0.2
60-10	CB464	458, 14-CC, 19-20	47	A, D, R	17.55	80	0.70371			
L60B av 7							**0.70367**	**0.513028**	**7.6**	**0.2**
60-13	CB467	459B, 30-3, 16-17	27	BA	19.50	80	0.70363	0.513020	7.4	0.2
60-15	CB469	459B, 32-2, 8-9	33	BA, A	20.50	10+80white	0.70384	0.513078	8.6	0.1
60-11	CB465	458, 16-2, 110-111	54	A, D, R	20.60	85	0.70390	0.513041	7.9	0.2
60-16	CB470	459B, 40-3, 36-37	52	D	22.00	80	0.70397	0.513041	7.9	0.2
60-17	CB471	459B, 40-4, 102-103	54	D >> R	22.00	75	0.70385	0.513041	7.9	0.3
60-23	CB477	459B, 42-2, 67-68	58	D >> A, R	22.30	75	0.70388	0.513046	8.0	0.2
60-6	CB460	458, 19-2, 37-38	60	BA, A	22.50	85	0.70375	0.513059	8.2	0.2
60-18	CB472	459B, 53-2, 76-77	67	A	27.50	95	0.70374	0.513004	7.1	0.5
60-19	CB473	459B, 58-1, 97-98	68	R	34.90	5-10+80White	0.70385	0.513045	7.9	0.2
60-24	CB478	459B, 58-2, 40-41	70	BA, A	35.00	75+20white	0.70364	0.513081	8.6	0.2
L60A av10							**0.70380**	**0.513046**	**8.0**	**0.2**
60-21	CB475	459B, 6-3, 63-64	5	BA, A, D, R	1.70	40+50white	0.70393	0.512910	5.3	0.2
60-8	CB462	458, 3-2, 121-122	13	A>>B, D, R	2.20	95	0.70352	0.512926	5.6	0.3
60-9	CB463	458, 7-2, 50-51	27	A >> D, R	8.90	80	0.70385	0.512937	5.8	0.2
60-22	CB476	459B, 20-1, 73-74	12	BA, A, D	10.80	80	0.70396	0.512928	5.7	0.3
60-4	CB458	458, 9-2, 25-26	35	D	11.60	80	0.70389	0.512924	5.6	0.1
125-18	CB496	784A, 31-2, 77-78	16	BA, A	14.00	70	0.70379	0.512939	5.9	0.3
Low Nd av 6							**0.70382**	**0.512927**	**5.6**	**0.2**

No. Ash layer is No.UNE in Table A 1-1 and Table A 1-2 described in Appendix 1
Low Nd av 6 is average of 6 ash samples from DSDP Leg 60 and ODP Leg 125 , 0-17 Ma
L60B av 7 means average value of 7 ash samples from Leg 60, 0-17 Ma; L60A av 10 is average of 10 ash samples from Leg 60, 18-35 Ma
See text for interpretation of ages, rock types and glass % (by volume) of the ash samples; methods for Sr and Nd isotopic analysis are described and disscussed in Appendix 2

Table A 3-17 Sr and Nd isotopic compositions of the bulk ashes derived from DSDP Leg 60 and ODP Leg 125 (cont)

No. Sr-Nd	No. CSIRO	Site, Core-Section, Internal (cm)	No.Ash layer	Rock type	Age (Ma)	Glass %	$^{87}Sr/^{86}Sr$	$^{143}Nd/^{144}Nd$	epsilon Nd	error Nd (2SD)
125-19	CB497	784A, 3-3, 51-52	11	BA, D, R	0.70	50	0.70379	0.513054	8.1	0.2
125-20	CB498	784A, 8-5, 35-37	1	A, D, R	2.75	70	0.70366	0.513084	8.7	0.2
125-12	CB490	786A, 2-4, 84-86	13	BA, A, D, R	3.14	55+35white?	0.70352	0.513083	8.7	0.2
125-1	CB479	782A, 14-2, 113-115	7	BA, A	3.90	90	0.70358	0.513103	9.1	0.2
125-2	CB480	782A, 14-2, 141-143	8	A	3.90	90	0.70355	0.513098	9.0	0.2
125-3	CB481	782A, 20-CC, 9-11	16	BA	6.10	85	0.70358	0.513084	8.7	0.2
125-16	CB494	784A, 21-3, 77-79	12	A >> D	8.10	70	0.70355	0.513099	9.0	0.2
784A-13	CB403	784A, 24-3, 118-120	13	BA, A	10.00	90	0.70356	0.513076	8.5	0.2
125-10	CB488	786A, 6-5, 7-9	4	BA	10.80	65+	0.70354	0.513125	9.5	0.2
125-17	CB495	784A, 28-1, 92-95	14	R >> A	11.00	60	0.70370	0.513079	8.6	0.2
125-4	CB482	782A, 33-7, 27-30	22	BA, A	14.50	50	0.70368	0.513085	8.7	0.2
125-11	CB489	786A, 9-3, 129-131	9	R	16.50	30+50white?	0.70375	0.513080	8.6	0.2
125-13	CB491	786A, 9-4, 24-26	10	A, D, R	17.00	45+20white	0.70376	0.513092	8.9	0.2
L125 av 13							**0.70363**	**0.513088**	**8.8**	**0.2**
125-5	CB483	782A, 41-CC, 44-47	14	R	~ 42	3-5+white?	0.70339			
125-15	CB493	784A, 17-3, 144-149	6	BA, A >> R	6.60	80+2-5clay?	0.70390	0.513067	8.4	0.2
125-21	CB499	784A, 10-3, 29-31	3	D, R >> BA	3.45	60+25clay	0.70397	0.513069	8.4	0.2
125-9	CB487	786A, 5-1, 74-76	2	BA	5.60	60+30clay?	0.70407	0.513058	8.2	0.2
125-8	CB486	782A, 26-1, 141-144	12	BA, A >> D	8.10	35-40+55clay?	0.70429	0.513020	7.5	0.2
125-6	CB484	782A, 1-3, 22-24	1	BA, D, R	0.25	40+40white?	0.70467	0.512972	6.5	0.1
125-14	CB492	784A, 9-1, 69-71	2	R	3.10	2-4+70clay?	0.70487	0.512716	1.5	0.2
60-14	CB468	459B, 32-1, 98-99	32	R	20.50	3-5+90clay?	0.70561	0.512868	4.5	0.3
125-7	CB485	782A, 6-1, 138-140	3	BA, D	1.80	3-5+90clay?	0.71108	0.512658	0.4	0.1
60-7	CB461	458, 27-1, 24-25	62	Boninite	34.00	40+55white	0.70468	0.512858	4.3	0.3

L125 av 13 is average of 13 ash samples from Leg 125, 1-17 Ma
No. Ash layer is No.UNE in Table A 1-1 and Table A 1-2 described in Appendix 1
See text for interpretation of ages, rock types and glass % (by volume) of the ash samples; methods for Sr and Nd isotopic analysis are described and disscussed in Appendix 2

Appendix 4. Data base of the SFVF xenoliths

The large data set (Table A 4-2 to Table A 4-9) of major element analyses of mineral crystals are included in CD; all other data (Tables A 4-1, 4-10, 4-11, 4-12, and representative mineral analyses, 4-2a to 4-9a) of xenoliths are present in this Appendix.

Table A 4-1a Major element compositions of 53 xenoliths derived from SFVF, AZ, USA

Sample	No.UNE	SiO_2	TiO_2	Al_2O_3	Fe_2O_3*	FeO	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	S	LOI	Total#	Mg#*	Mg#
AK-21a	67525	33.59	4.46	12.95	28.02	9.07	17.94	0.18	7.83	11.95	1.15	0.07	0.03	0.02	-0.10	100.18	35.63	60.61
SW-2	67484	38.68	3.49	20.60	18.22	3.94	13.84	0.14	5.09	10.46	2.68	0.35	0.04	0.02	0.15	99.93	35.62	69.72
C387-13	67864	44.44	0.68	22.03	10.22	4.85	4.83	0.11	9.40	11.88	1.65	0.05	0.03	0.03	-0.23	100.27	64.56	77.55
AK-26e	67523	45.28	1.99	18.44	12.73	4.46	7.77	0.16	6.78	9.17	3.03	0.77	0.29	0.05	0.67	99.36	51.34	73.04
AK-42h	67511	46.13	1.36	9.68	12.01	8.18	2.92	0.20	15.67	14.44	0.93	0.03	0.02	0.02	-0.20	100.30	72.10	77.35
C160-11	67875	46.55	0.66	5.30	10.41	6.87	2.78	0.15	22.71	14.04	0.30	0.07	0.03	0.00	-0.16	100.07	81.21	85.49
C387-29	67868	46.99	0.43	3.46	10.15	7.49	1.83	0.16	26.95	12.53	0.28	0.04	0.02	0.01	-0.43	100.54	84.02	86.51
AK-40h	67510	47.91	0.24	22.11	6.83	1.36	5.32	0.09	9.53	9.95	2.98	0.23	0.03	0.02	0.20	100.13	73.43	92.59
AK-35	67522	48.22	0.68	7.12	8.04	4.96	2.53	0.15	18.73	16.05	0.79	0.01	0.02	0.01	0.05	99.88	82.19	87.06
C160-5	67871	49.33	0.40	4.82	6.43	3.75	2.26	0.13	20.36	17.57	0.16	0.04	0.02	0.00	0.11	99.34	86.25	90.63
C387-4	67860	49.93	0.69	12.94	8.96	5.34	3.03	0.18	6.12	17.79	2.35	0.15	0.12	0.04	0.06	99.31	57.50	67.14
C387-11	67863	50.50	0.63	25.29	6.17	3.73	2.03	0.06	3.34	8.51	4.75	0.37	0.06	0.02	-0.12	99.55	51.75	61.48
AK-35f	67515	51.10	0.69	16.78	9.83	4.61	4.71	0.17	5.82	9.50	4.27	0.55	0.64	0.01	0.25	99.61	53.98	69.23
C160-3	67870	52.09	1.82	16.80	10.95	7.07	3.09	0.16	4.52	7.27	4.07	1.31	0.87	0.00	-0.11	99.74	44.99	53.26
C160-8	67873	52.16	0.85	14.62	10.37	6.01	3.69	0.19	6.81	9.49	3.61	0.81	0.84	0.00	0.08	99.81	56.54	66.88
C160-10	67874	54.26	0.59	16.70	7.46	3.53	3.54	0.14	5.47	8.41	4.12	0.95	0.68	0.01	1.20	99.97	59.23	73.42
AK-43c	67497	56.21	0.53	20.69	4.69	2.20	2.25	0.09	1.80	3.12	6.07	3.67	0.20	0.02	1.27	98.36	43.19	59.32
SW-14	67494	58.36	0.93	17.42	6.53	4.75	1.25	0.11	4.01	5.41	3.22	2.40	0.29	0.03	0.05	98.75	54.88	60.08
C387-28	67867	60.96	0.15	21.95	2.44	1.26	1.04	0.05	0.87	4.64	7.73	0.83	0.05	0.01	0.12	99.78	41.39	55.17
AK-43b	67496	61.22	0.71	18.46	5.18	2.26	2.67	0.11	2.04	3.16	5.15	2.75	0.28	0.02	0.88	99.96	43.82	61.67
C387-10	67862	64.87	0.94	17.83	4.96	1.11	3.73	0.03	0.15	4.69	5.05	0.48	0.02	0.00	0.37	99.38	5.65	19.41
SW-12	67492	68.21	0.34	14.44	4.46	2.55	1.63	0.14	1.62	3.20	3.47	1.47	0.06	0.02	1.70	99.13	41.84	53.10
AK-41g	67512	73.01	0.06	12.87	0.94	0.39	0.51	0.10	0.09	0.45	4.13	4.60	0.02	0.00	2.41	98.69	15.94	29.14

See Appendix 1 and 2 for samples, methods and data discussion
Total# is original total; Mg# = 100 x Mg/(Mg+Fe(II)); Mg#* = 100 x Mg/(Mg+Fe(total as Fe(II)))
All data are XRF data in wt %, except for FeO, which is determined by titration; total Fe reported as Fe_2O_3* ; Fe_2O_3 is the difference between Fe_2O_3*(XRF) and FeO (titration)

Table A 4-1a Major element compositions of 53 xenoliths derived from SFVF, AZ, USA (cont)

Sample	No.UNE	SiO_2	TiO_2	Al_2O_3	Fe_2O_3*	FeO	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	S	LOI	Total#	Mg#*	Mg#
AK-25g	67518	41.44	1.84	13.41	19.19	6.42	12.06	0.19	10.39	12.79	1.22	0.06	0.04	0.01	-0.06	100.52	51.75	74.26
AK-37rr	67521	43.96	2.59	18.60	12.78	0.91	11.77	0.14	6.54	10.61	3.32	0.43	0.06	0.02	0.44	99.51	50.34	92.76
AK-40k	67516	44.51	1.28	5.97	10.93	4.89	5.50	0.17	25.62	11.18	0.83	0.13	0.04	0.01	-0.36	100.30	82.29	90.33
C160-14	67878	40.95	1.05	17.52	13.00	4.02	8.53	0.18	12.90	13.43	0.86	0.03	0.02	0.02	0.01	99.94	66.28	85.12
C387-1	67859	42.24	0.94	20.67	8.92	3.90	4.59	0.12	10.88	15.49	1.06	0.03	0.02	0.02	-0.19	100.19	70.72	83.26
SW-1	67483	40.43	3.38	17.55	12.59	3.93	8.22	0.13	9.17	12.96	2.02	0.46	0.05	0.05	0.52	99.30	59.06	80.62
SW-13	67493	37.98	3.73	17.00	19.00	1.13	17.74	0.21	5.81	8.17	1.83	0.43	0.14	0.02	5.30	99.61	37.72	90.16
SW-3	67485	41.57	2.17	12.48	13.56	4.39	8.68	0.18	11.18	16.49	1.25	0.28	0.05	0.05	1.30	100.55	62.03	81.95
SW-4	67486	40.33	2.06	16.70	12.86	4.42	7.95	0.14	12.03	14.05	1.10	0.15	0.04	0.01	0.92	100.40	64.95	82.91
AK-35e	67499	48.28	0.82	15.18	9.12	5.95	2.51	0.14	11.95	12.45	1.89	0.12	0.04	0.02	0.28	100.30	72.18	78.17
AK-37ss	67519	48.23	0.91	6.91	8.13	1.66	6.29	0.12	14.17	18.57	0.71	0.15	0.10	0.02	1.35	99.37	77.53	93.83
AK-42g	67514	47.78	1.29	7.32	7.84	5.32	1.93	0.15	17.45	16.84	1.09	0.09	0.07	0.01	0.07	100.01	81.52	85.39
AK-42o	67517	47.58	1.07	7.87	10.65	6.97	2.91	0.18	17.14	14.57	0.96	0.07	0.06	0.11	0.07	100.32	76.13	81.42
AK-42p	67520	49.94	0.53	5.24	5.97	3.81	1.74	0.14	16.76	19.95	0.61	0.01	0.04	0.02	0.40	99.60	84.76	88.69
AK-42q	67524	47.97	1.31	7.45	7.26	4.67	2.07	0.15	15.34	18.61	1.14	0.08	0.06	0.01	0.13	99.52	80.72	85.41
C160-1	67869	46.04	1.97	11.08	10.86	7.38	2.66	0.17	13.53	12.17	2.04	1.03	0.54	0.01	0.17	99.58	71.17	76.57
C160-6	67872	51.37	0.51	13.27	10.79	6.20	3.90	0.20	10.82	11.09	2.02	0.11	0.12	0.01	-0.19	100.10	66.51	75.67
C387-6	67861	49.11	0.41	20.01	6.84	4.07	2.32	0.11	10.55	10.86	1.61	0.09	0.02	0.02	-0.11	99.49	75.36	82.21
SW-11	67491	47.15	0.96	13.59	12.01	8.85	2.18	0.18	12.24	11.07	1.77	0.10	0.05	0.04	-0.13	99.03	66.87	71.14
SW-15	67495	48.16	0.51	21.35	7.08	4.70	1.86	0.11	9.20	10.99	2.22	0.09	0.02	0.04	0.04	99.81	72.02	77.72
SW-6	67488	48.65	0.20	23.94	5.49	3.55	1.55	0.07	8.06	10.94	2.73	0.10	0.02	0.00	-0.09	100.12	74.41	80.19
SW-7	67489	46.27	0.77	18.96	8.17	5.70	1.84	0.12	10.38	13.11	1.92	0.08	0.03	0.02	0.19	100.02	71.57	76.45
C387-15	67865	49.67	1.58	21.55	10.57	5.89	4.03	0.08	3.54	8.59	4.59	0.23	0.06	0.03	-0.37	100.11	39.89	51.72
AK-35g	67498	52.24	0.67	16.36	8.93	4.78	3.62	0.16	5.74	9.41	4.08	0.82	0.61	0.02	0.20	99.24	56.00	68.16
C160-13	67877	52.49	1.81	16.76	9.58	6.08	2.82	0.14	5.17	7.94	3.98	1.57	0.58	0.01	-0.16	99.84	51.67	60.25
AK-35d	67526	53.13	0.74	17.92	7.73	3.71	3.61	0.13	4.18	7.81	4.74	1.27	0.57	0.01	0.93	99.17	51.70	66.76
C160-12	67876	53.63	0.60	17.80	7.49	4.11	2.92	0.15	5.01	9.58	4.17	0.49	0.27	0.00	0.84	100.01	56.99	68.48
SW-5	67847	54.40	0.68	17.49	9.32	4.24	4.61	0.19	3.94	7.25	4.75	0.87	0.38	0.01	0.60	99.86	45.56	62.35
SW-10	67490	54.60	0.79	17.40	7.93	4.89	2.50	0.15	4.52	7.20	5.27	0.82	0.31	0.03	0.38	99.41	53.02	62.23
AK-37v	67513	72.21	0.14	14.02	1.23	0.14	1.07	0.03	0.28	1.41	4.35	3.29	0.04	0.00	1.56	98.58	31.02	78.09

All data are XRF data in wt %, except for FeO, which is determined by titration; total Fe reported as Fe_2O_3*; Fe_2O_3 is the difference between Fe_2O_3*(XRF) and FeO (titration)

Table A 4-1b Trace element compositions of 53 xenoliths derived from SFVF, AZ, USA

Sample	Sc	V	Cr	Ni	Cu	Zn	Ga	Rb	Sr	Y	Zr	Nb	Ba	La	Ce	Nd	Pb	Th	U
AK-21a	58	1348	32	221	188	152	27	1	349	13	30	3	73	11	9	10	4	4	3
SW-2	21	456	13	29	94	86	23	2	1196	11	28	15	379	7	27	14	6	8	3
C387-13	32	351	31	72	56	134	28	1	743	3	12	2	31	4	5	5		2	2
AK-26e	24	268	9	34	40	76	18	6	953	24	76	23	646	30	55	32	7	4	4
AK-42h	66	329	766	314	48	74	16	1	74	19	49	2	113	5	8	10	2	2	2
C160-11	65	222	1589	568	101	63	7	1	73	9	24	3	47	10	20	20	3	6	
C387-29	55	180	1868	811	79	62	5	1	56	8	20	3	27	3	9	11	5	6	1
AK-40h	6	44	78	180	31	50	13	2	1257			2	192	3	9	1	2	3	1
AK-35	68	273	2942	573	72	40	9	1	52	14	23	1	51	7	8	7	2	3	2
C160-5	69	222	3101	539	55	33	5	1	157	8	14	3	30	9	19	18	3	5	2
C387-4	58	211	577	65	13	80	15	1	405	19	57	17	156	12	20	17	10	8	3
C387-11	10	122	49	104	22	110	22	2	1495	2	20	5	120	8	4	5	3	5	4
AK-35f	20	157	147	63	100	90	18	3	1759	14	21	2	732	34	76	51	5	2	5
C160-3	17	140	112	63	51	116	21	15	846	26	268	34	769	40	79	56	9	9	3
C160-8	24	212	172	88	19	119	17	6	1318	18	34	7	713	41	82	60	6	3	2
C160-10	12	136	114	64	32	85	19	5	1548	12	37	5	926	35	62	44	6	5	3
AK-43c	6	42	27	15	25	90	21	97	952	7	161	5	1761	35	83	32	20	11	2
SW-14	13	115	142	52	28	74	18	33	851	10	167	5	1798	21	52	24	11	2	3
C387-28		24	22	12	15	24	18	1	1565	1	670	4	560	15	21	9	7	5	2
AK-43b	6	65	33	17	26	101	20	91	745	10	167	10	1081	72	155	60	22	13	4
C387-10	3	72	16	9	13	9	16	4	944	0	56	13	190	7	8	2	19	5	3
SW-12	4	41	7	8	31	66	15	37	311	6	145	7	716	19	44	15	10	6	1
AK-41g		1	4	1	3	54	21	314	10	61	107	153	91	11	29	13	49	47	23

See Appendix 1 and 2 for samples, methods and data discussion
All data are XRF data in ppm determined by Mr. John Bedford at UNE

Table A 4-1b Trace element compositions of 53 xenoliths derived from SFVF, AZ, USA (cont)

Sample	Sc	V	Cr	Ni	Cu	Zn	Ga	Rb	Sr	Y	Zr	Nb	Ba	La	Ce	Nd	Pb	Th	U
AK-25g	49	744	32	60	120	113	21	1	428	12	28	1	53	3	8	7	4	5	1
AK-37rr	32	290	8	24	44	72	19	2	991	19	44	17	404	13	23	19	4	4	1
AK-40k	44	235	3449	647	53	64	9	1	111	10	22	2	37	4	2	11	2	4	2
C160-14	48	429	30	147	24	218	25	1	193	15	31	1	10	5	11	12	5	6	2
C387-1	57	378	77	124	39	125	25	1	336	11	25	2	41	2	11	9	3	5	2
SW-1	40	461	62	71	143	52	17	2	894	18	37	15	578	11	28	20	3	1	2
SW-13	40	407	13	100	68	138	22	7	663	24	77	27	1279	24	42	30	4	4	4
SW-3	68	449	420	62	56	77	18	2	339	22	64	11	384	9	29	25	2	2	1
SW-4	66	501	261	150	101	107	21	2	462	14	31	6	361	11	28	16	3	2	1
AK-35e	48	260	529	179	66	65	15	1	367	10	21	1	38	5	8	7	1	2	3
AK-37ss	100	250	2765	276	87	38	10	3	183	10	36	10	229	9	17	11	3	4	1
AK-42g	70	310	3563	410	63	42	9	1	119	14	42	4	138	6	15	14	4	5	3
AK-42o	63	313	1226	407	93	55	11		115	14	36	3	46	6	7	8	3	4	2
AK-42p	97	263	4470	247	39	24	6	1	65	11	18		68	3	10	6	6	3	0
AK-42q	81	319	3847	361	58	34	10	1	117	16	49	3	45	7	13	10	1	4	2
C160-1	40	275	1288	331	106	82	14	16	661	17	161	47	715	37	67	40	7	9	3
C160-6	38	166	416	157	38	100	14	1	467	11	22	2	102	10	12	11	3	5	1
C387-6	28	143	59	65	21	40	13	1	808	2	10	3	70	6	4	6	3	5	3
SW-11	37	268	346	234	46	97	16	2	231	16	43	2	34	3	10	7	3	3	1
SW-15	23	180	68	76	36	70	19		815	2	4	2	75	0	8	2	1	1	3
SW-6	7	52	151	64	19	36	14	1	1086		0	2	91	4	5	5	2	2	2
SW-7	37	246	93	89	41	74	18	2	671	6	14	2	64	3	6	3	5	4	1
C387-15	9	150	48	91	34	68	20	1	2019	3	19	4	184	7	8	5	1	4	3
AK-35g	21	177	145	68	38	105	18	4	1376	15	16	3	628	37	94	50	8	4	3
C160-13	12	188	148	60	58	95	20	17	943	19	204	42	919	43	70	43	10	9	4
AK-35d	18	135	68	41	33	92	19	4	1668	17	64	5	1300	58	121	61	8	3	2
C160-12	21	108	146	50	14	80	19	3	1020	12	32	5	408	16	32	25	6	5	1
SW-5	27	187	58	23	24	109	19	5	554	40	67	8	571	55	40	38	12	4	2
SW-10	19	99	132	61	28	111	23	3	1184	22	104	13	816	40	96	46	7	3	2
AK-37v	0	11	4	4	16	30	18	49	244	3	100	6	592	9	17	6	22	14	3

All data are XRF data in ppm determined by Mr. John Bedford at UNE; see Appendix 1 and 2 for samples, methods and data discussion

Table A 4-2a Representative analyses of plagioclase from 15 SFVF cumulates and 1 amphibole-gabbro

Sample	Types	No.point	No.A0		SiO_2	Al_2O_3	FeO*	CaO	BaO	K_2O	Na_2O	Total#	**An**	Ab	Or	T. Cation
AK-26e	Amphibole-Gabbro	1	C7531		52.42	30.26	0.43	12.17	<.27	0.35	4.36	101.17	**59.4**	38.6	2.1	5.01
AK-26e	Amphibole-Gabbro	1	C* 7533		53.82	29.22	0.57	11.03	<.28	0.53	4.82	100.20	**54.1**	42.8	3.1	5.01
AK-26e	Amphibole-Gabbro	1	R 7532		55.75	27.82	0.54	9.47	<.27	0.78	5.65	100.48	**45.9**	49.6	4.5	5.01
AK-26e	Amphibole-Gabbro	2	C1 7539		49.00	32.90	0.21	14.99	<.27	0.14	2.76	100.86	**74.4**	24.8	0.8	5.00
AK-26e	Amphibole-Gabbro	2	C2 7540		49.32	32.73	0.20	14.55	<.27	0.19	3.00	101.06	**72.0**	26.9	1.1	5.01
AK-26e	Amphibole-Gabbro	2	R 7541		50.12	32.08	0.30	13.73	<.27	0.26	3.51	102.05	**67.3**	31.2	1.5	5.02
AK-26e	Amphibole-Gabbro	4	C 7564		47.54	33.89	0.17	15.97	<.27	0.19	2.24	101.86	**78.9**	20.0	1.1	5.01
AK-26e	Amphibole-Gabbro	7	C 7576		52.96	30.26	<.13	11.78	<.27	0.40	4.60	100.80	**57.2**	40.5	2.3	5.01
AK-26e	Amphibole-Gabbro	7	R 7577		49.42	32.62	0.22	14.28	<.27	0.16	3.30	101.32	**69.9**	29.2	1.0	5.02
AK-26e	Amphibole-Gabbro	8	C 7582	incl by amp	47.01	34.38	0.35	15.97	<.27	0.20	2.08	101.61	**79.9**	18.9	1.2	5.01
AK-26e	Amphibole-Gabbro	11	C1 7586		53.75	29.90	<.13	11.01	<.27	0.44	4.89	101.19	**54.0**	43.4	2.6	5.00
AK-26e	Amphibole-Gabbro	11	C2 7587		51.99	30.92	<.13	12.37	<.26	0.40	4.33	101.20	**59.8**	37.9	2.3	5.02
AK-26e	Amphibole-Gabbro	12	C 7591	incl by amp	49.94	31.90	0.54	14.08	<.27	0.29	3.24	100.79	**69.4**	28.9	1.7	5.01
AK-26e	Amphibole-Gabbro	15	C 7598		49.73	32.60	0.17	14.08	<.27	0.16	3.27	101.46	**69.8**	29.3	1.0	5.01
AK-26e	Amphibole-Gabbro	15	R 7599		48.77	32.67	0.26	14.67	0.26	0.31	3.05	102.61	**71.4**	26.9	1.8	5.03
AK-26e	Amphibole-Gabbro	16	C 7602	incl by amp	50.88	31.55	0.40	13.91	<.27	0.33	2.92	99.99	**71.0**	27.0	2.0	4.98
AK-26e	Amphibole-Gabbro	17	C 7607	incl by amp	52.85	30.37	0.32	11.83	<.27	0.22	4.42	100.97	**58.9**	39.8	1.3	5.00
AK-26e	Amphibole-Gabbro	18	C 7608	incl by amp	49.28	32.28	0.52	14.45	<.27	0.31	3.17	101.75	**70.3**	27.9	1.8	5.02
AK-26e	Amphibole-Gabbro	19	R 7615	incl by amp	49.98	32.27	0.29	13.96	<.27	0.23	3.27	100.75	**69.3**	29.4	1.4	5.01
AK-26e	Amphibole-Gabbro	19	C 7614	incl by amp	49.30	32.49	0.25	14.44	<.27	0.25	3.28	101.78	**69.9**	28.7	1.4	5.02
AK-26e	Amphibole-Gabbro	21	C 7633	incl by amp	51.17	31.33	0.33	13.06	<.27	0.27	3.84	100.79	**64.2**	34.2	1.6	5.01
AK-26e	Amphibole-Gabbro	23	C 7650		59.34	24.38	0.57	5.89	0.35	3.38	6.09	101.53	**28.1**	52.7	19.2	5.03
AK-21a	Cumulate Ultra	1	C 3517		49.22	32.91	0.21	14.84	<.28	0.13	2.70	100.91	**74.7**	24.6	0.8	4.99
AK-21a	Cumulate Ultra	1	R 3518		48.86	32.53	0.57	14.92	<.27	0.33	2.80	102.12	**73.2**	24.9	1.9	5.02
AK-21a	Cumulate Ultra	6	C 3565		48.91	32.60	0.19	14.94	<.27	0.24	3.13	101.26	**71.5**	27.1	1.4	5.03
AK-21a	Cumulate Ultra	6	R 3566		49.08	32.61	0.34	14.75	<.27	0.27	2.96	101.05	**72.2**	26.2	1.6	5.02
AK-21a	Cumulate Ultra	7	C 3574		49.56	32.51	0.21	14.51	<.27	0.21	3.01	101.24	**71.8**	27.0	1.2	5.00
AK-21a	Cumulate Ultra	7	R 3575		48.94	32.70	0.18	14.90	<.27	0.20	3.10	101.39	**71.8**	27.0	1.1	5.02
AK-21a	Cumulate Ultra	8	C 3576		51.10	30.93	0.38	12.73	0.53	0.24	4.10	101.27	**62.3**	36.3	1.4	5.02
AK-21a	Cumulate Ultra	15	C 3605		49.18	32.67	0.36	14.75	<.27	0.23	2.82	101.05	**73.3**	25.4	1.3	5.00
AK-21a	Cumulate Ultra	17	C 3632		49.08	32.39	0.40	14.71	<.27	0.29	3.14	101.69	**70.9**	27.4	1.6	5.03

See Appendix 1 and 2 for samples and analytical method
Total Fe reported as FeO*; Total# is original total (wt %); T.Cation is total cation based on 8 oxygens

Table A 4-2a Representative analyses of plagioclase from 15 SFVF cumulates and 1 amphibole-gabbro (cont)

Sample	Types	No.point	No.A0		SiO_2	Al_2O_3	FeO*	CaO	BaO	K_2O	Na_2O	Total#	**An**	Ab	Or	T. Cation
C387-13	Cumulate Ultra	1	C 7889		49.00	33.27	<.13	14.67	<.28	0.13	2.93	99.29	**72.9**	26.3	0.7	5.01
C387-13	Cumulate Ultra	1	R 7890		51.10	31.62	0.16	13.23	<.27	0.15	3.73	100.13	**65.6**	33.5	0.9	5.00
C387-13	Cumulate Ultra	2	C 7891		53.28	30.35	<.13	11.39	<.28	0.12	4.85	99.19	**56.1**	43.2	0.7	5.00
C387-13	Cumulate Ultra	3	C 7906		48.56	33.11	<.13	15.29	<.27	0.16	2.88	100.53	**73.9**	25.2	0.9	5.02
C387-13	Cumulate Ultra	3	R 7907		48.36	33.51	<.13	15.50	<.27	0.15	2.48	99.95	**76.9**	22.3	0.9	5.00
C387-13	Cumulate Ultra	9	C 7946		48.09	33.87	<.13	15.64	<.28	<.07	2.40	101.24	**78.2**	21.8	0.0	5.00
C387-13	Cumulate Ultra	9	R 7947		52.36	30.56	0.45	12.30	<.28	0.17	4.17	98.27	**61.4**	37.6	1.0	5.00
C387-13	Cumulate Ultra	11	C 7954		50.69	31.80	<.13	13.26	<.27	0.15	4.11	102.35	**63.5**	35.6	0.9	5.03
C387-13	Cumulate Ultra	11	R 7955		51.01	31.69	<.13	13.24	<.27	0.16	3.91	102.29	**64.6**	34.5	0.9	5.01
C387-13	Cumulate Ultra	13	C 7920	in lava	49.37	31.38	0.82	13.97	0.64	0.38	3.43	101.77	**67.7**	30.1	2.2	5.04
C387-13	Cumulate Ultra	15	C 7960	in lava	50.69	30.85	0.87	13.58	<.27	0.37	3.63	102.20	**65.9**	31.9	2.1	5.02
C387-13	Cumulate Ultra	16	C 7961	in lava	49.94	31.68	0.77	14.09	<.27	0.25	3.29	100.80	**69.3**	29.3	1.5	5.02
C387-13	Cumulate Ultra	16	R 7962	in lava	49.27	31.52	1.17	14.08	0.55	0.21	3.18	100.47	**70.1**	28.7	1.3	5.02
C387-13	Cumulate Ultra	17	C 7963	in lava	50.14	30.93	1.00	13.96	0.35	0.31	3.32	101.21	**68.7**	29.5	1.8	5.02
C160-5	Cumulate	6	3888C		50.47	31.49	0.46	13.98	<.28	0.71	2.90	98.46	**69.6**	26.2	4.2	5.00
C160-5	Cumulate	6	3889R		49.70	32.07	0.43	14.76	<.27	0.22	2.82	101.39	**73.4**	25.4	1.3	5.00
C160-5	Cumulate	7	3890C1		50.10	30.93	0.75	14.03	0.42	0.47	3.30	100.83	**68.3**	29.0	2.7	5.02
C160-5	Cumulate	7	3891C2		49.69	31.59	0.68	14.75	<.28	0.26	3.01	100.76	**71.9**	26.6	1.5	5.01
C160-5	Cumulate	7	3892R		50.41	31.33	0.84	13.64	<.28	1.17	2.61	99.17	**69.1**	23.9	7.0	5.00
C160-5	Cumulate	8	3898C		50.52	31.13	0.81	13.83	0.27	0.34	3.10	101.18	**69.7**	28.3	2.0	5.00
C160-5	Cumulate	8	3899R		48.94	32.56	0.52	14.80	<.27	0.22	2.96	101.69	**72.5**	26.3	1.3	5.02
SW-6	Cumulate	1	C1 3931		48.59	32.88	0.13	14.84		0.09	2.73	99.26	**74.6**	24.9	0.5	5.00
SW-6	Cumulate	1	C2 3932		48.01	32.35	<.13	14.47		0.10	2.99	97.92	**72.4**	27.0	0.6	5.01
SW-6	Cumulate	1	R 3933		48.21	32.68	<.13	15.17		0.13	2.85	99.03	**74.1**	25.2	0.8	5.02
SW-6	Cumulate	2	C 3934		48.12	33.43	<.13	15.37		0.12	2.63	99.67	**75.8**	23.5	0.7	5.01
SW-6	Cumulate	3	C 3940		50.98	31.22	0.20	13.02		0.12	4.09	99.64	**63.3**	36.0	0.7	5.02
SW-6	Cumulate	3	R 3941		49.53	32.31	<.13	14.26		0.15	3.35	99.59	**69.6**	29.5	0.9	5.01
SW-6	Cumulate	4	R 3948		48.83	32.80	<.13	14.75		0.10	2.89	99.37	**73.4**	26.0	0.6	5.00
SW-6	Cumulate	4	C 3947		48.21	32.98	<.13	15.30		0.17	2.73	99.39	**74.8**	24.2	1.0	5.01

See Appendix 1 and 2 for samples and analytical method

Total Fe reported as FeO*; Total# is original total (wt %); T.Cation is total cation based on 8 oxygens

Table A 4-3a Representative analyses of plagioclase from 17 SFVF granulites and 1 cumulate melt?

Sample	Types	No.point	No.A0	SiO_2	Al_2O_3	FeO*	CaO	BaO	K_2O	Na_2O	Total#	**An**	Ab	Or	T.Cation
AK-42g	Cumulate ?	1	C 7720	56.93	27.55	<.13	8.63	<.27	0.37	6.51	100.81	**41.4**	56.5	2.1	5.01
AK-42g	Cumulate ?	1	R 7721	56.78	27.58	0.17	8.60	<.27	0.32	6.57	102.31	**41.2**	57.0	1.8	5.02
AK-42g	Cumulate ?	4	C 7738	56.47	27.84	<.13	8.86	<.27	0.27	6.55	101.43	**42.1**	56.3	1.6	5.02
AK-42g	Cumulate ?	4	R 7739	56.70	27.71	<.13	8.92	<.27	0.36	6.31	101.58	**42.9**	55.0	2.1	5.01
AK-42g	Cumulate ?	8	C 7749	56.78	27.50	<.13	8.63	<.27	0.37	6.71	101.44	**40.7**	57.3	2.1	5.03
AK-42g	Cumulate ?	9	C 7767	56.66	28.02	<.13	8.73	<.27	0.31	6.28	101.40	**42.7**	55.5	1.8	5.00
AK-42g	Cumulate ?	9	R 7768	56.38	27.74	0.28	8.73	<.27	0.35	6.52	101.08	**41.7**	56.3	2.0	5.02
C160-3	Mafic	1	C 7449	58.49	25.94	0.36	7.36	<.26	0.93	6.92	102.69	**35.1**	59.7	5.3	5.02
C160-3	Mafic	1	R 7450	58.50	26.42	0.19	7.90	<.27	0.87	6.12	102.62	**39.5**	55.3	5.2	4.98
C160-3	Mafic	6	C 7481	58.36	26.64	<.13	7.52	<.27	0.92	6.56	102.09	**36.7**	57.9	5.3	5.00
C160-3	Mafic	6	R 7482	57.35	26.97	0.18	8.20	<.26	0.87	6.44	102.43	**39.2**	55.8	5.0	5.02
C160-3	Mafic	7	C 7488	58.73	26.25	0.34	7.46	<.27	0.88	6.36	101.25	**37.3**	57.5	5.2	4.98
C160-3	Mafic	10	C 7508	58.42	26.40	0.16	7.33	<.27	0.91	6.77	102.63	**35.5**	59.3	5.3	5.01
C160-3	Mafic	10	R 7509	56.93	27.16	0.21	8.79	<.26	0.75	6.16	102.67	**42.2**	53.5	4.3	5.01
C160-3	Mafic	12	C 7517	56.72	27.44	0.26	8.61	<.26	0.76	6.20	103.47	**41.5**	54.1	4.4	5.01
C387-11	Mafic	1	C7305	51.54	29.97	0.79	12.62	0.36	0.33	4.38	99.40	**60.3**	37.9	1.9	5.04
C387-11	Mafic	3	C1 7312	56.30	28.08	<.13	9.26	<.27	0.41	5.95	100.39	**45.1**	52.5	2.4	5.00
C387-11	Mafic	3	C2 7313	54.83	29.11	<.13	10.13	<.27	0.32	5.60	100.69	**49.0**	49.1	1.9	5.01
C387-11	Mafic	3	R 7314	55.01	28.73	0.14	9.74	<.27	0.34	6.05	101.09	**46.2**	51.9	1.9	5.03
C387-11	Mafic	4	C 7320	56.50	27.82	<.13	8.74	<.27	0.50	6.44	101.29	**41.7**	55.5	2.8	5.02
C387-11	Mafic	4	R 7321	56.59	27.41	0.20	8.19	<.26	0.67	6.94	101.67	**38.0**	58.3	3.7	5.05
C387-11	Mafic	5	C 7322	57.93	26.83	0.26	7.33	<.26	0.58	7.07	100.94	**35.2**	61.5	3.3	5.02
C387-11	Mafic	5	R 7323	57.21	27.63	<.13	8.23	<.27	0.52	6.41	100.95	**40.2**	56.7	3.0	5.00
C387-11	Mafic	6	C 7325	56.68	27.77	<.13	8.69	<.27	0.47	6.40	100.95	**41.7**	55.6	2.7	5.01
C387-11	Mafic	6	R 7326	56.34	28.14	<.13	8.68	<.27	0.49	6.35	101.54	**41.8**	55.4	2.8	5.02
C387-11	Mafic	7	C 7333	58.27	26.51	<.13	7.46	<.27	0.65	7.11	102.33	**35.3**	61.0	3.7	5.02
C387-11	Mafic	20	C 7437	54.83	28.74	0.17	9.90	<.26	0.31	6.05	102.86	**46.7**	51.6	1.8	5.04

See Appendix 1 and 2 for samples and analytical method

Total Fe reported as FeO*; Total# is original total (wt %); T.Cation is total cation based on 8 oxygens

Table A 4-3a Representative analyses of plagioclase from 17 SFVF granulites and 1 cumulate melt? (cont)

Sample	Types	No.point	No.A0	SiO_2	Al_2O_3	FeO*	CaO	BaO	K_2O	Na_2O	Total#	An	Ab	Or	T.Cation
C387-4	Mafic	2	5930c	56.15	27.67	0.17	9.12		0.65	6.25	100.19	**43.0**	53.4	3.6	5.03
C387-4	Mafic	2	5931r	56.46	27.67		8.81		0.64	6.43	101.47	**41.6**	54.8	3.6	5.03
C387-4	Mafic	6	5950c	56.60	27.38	0.35	8.62		0.69	6.36	102.03	**41.2**	54.9	4.0	5.02
C387-4	Mafic	9	5957c	57.29	26.91	0.20	8.31		0.73	6.56	101.07	**39.5**	56.4	4.2	5.02
C387-4	Mafic	9	5958r	57.11	27.26		8.42		0.67	6.54	101.49	**39.9**	56.2	3.9	5.02
C387-4	Mafic	10	5960r	56.92	27.38		8.65		0.64	6.41	101.80	**41.2**	55.3	3.6	5.02
C387-4	Mafic	10	5959c	57.05	27.27		8.72		0.65	6.30	100.05	**41.8**	54.6	3.7	5.01
C387-28	Interm	2	C 4349	61.39	24.17	0.20	4.78	<.27	0.93	8.54	101.36	**22.4**	72.4	5.2	5.03
C387-28	Interm	2	R 4350	61.96	24.00	<.13	4.56	<.27	0.81	8.67	101.01	**21.5**	73.9	4.6	5.02
C387-28	Interm	3	C1 4355	61.68	24.17	<.13	4.77	<.27	0.92	8.46	101.73	**22.5**	72.3	5.2	5.02
C387-28	Interm	3	C2 4354	61.73	24.26	<.13	4.72	<.26	0.97	8.32	102.03	**22.5**	72.0	5.5	5.01
C387-28	Interm	3	R 4353	61.64	24.18	<.13	4.73	<.27	0.94	8.51	101.93	**22.2**	72.5	5.3	5.02
C387-28	Interm	4	C 4363	61.85	23.94	0.19	4.50	<.27	0.96	8.56	102.14	**21.3**	73.3	5.4	5.02
C387-28	Interm	5	C 4365	62.31	24.08	<.13	4.42	<.27	0.91	8.28	101.12	**21.6**	73.2	5.3	4.99
C387-28	Interm	5	R 4366	61.81	24.03	<.13	4.82	<.27	0.86	8.48	101.59	**22.7**	72.5	4.8	5.01
C387-28	Interm	6	C 4373	61.56	24.20	0.17	4.79	<.26	0.92	8.36	103.55	**22.8**	72.0	5.2	5.01
C387-28	Interm	10	C 4406	62.18	23.63	0.17	4.23	<.26	1.01	8.78	103.39	**19.8**	74.5	5.7	5.02
C387-10	Felsic	1	C1 4444	58.95	25.92	<.13	7.10	<.26	0.57	7.46	101.84	**33.4**	63.5	3.2	5.02
C387-10	Felsic	1	C2 4445	59.18	25.97	<.13	7.13	<.27	0.50	7.22	100.97	**34.3**	62.9	2.9	5.00
C387-10	Felsic	1	R 4446	59.14	26.04	<.13	7.02	<.27	0.34	7.46	100.97	**33.5**	64.5	2.0	5.01
C387-10	Felsic	4	C 4455	59.51	25.77	<.13	6.40	<.27	0.67	7.65	101.23	**30.4**	65.8	3.8	5.02
C387-10	Felsic	4	R 4456	59.06	26.27	<.13	7.16	<.27	0.38	7.14	101.74	**34.9**	62.9	2.2	5.00
C387-10	Felsic	6	C 4461	59.79	25.68	<.13	7.10	<.28	0.46	6.97	100.09	**35.0**	62.3	2.7	4.98
C387-10	Felsic	8	C 4465	58.64	26.31	<.12	7.19	<.26	0.40	7.46	102.07	**33.9**	63.8	2.3	5.02
C387-10	Felsic	8	R 4466	59.00	26.01	<.12	6.79	<.26	0.35	7.85	102.15	**31.7**	66.3	1.9	5.03
C387-10	Felsic	11	C 4476	59.55	26.00	<.13	6.82	<.27	0.24	7.39	101.21	**33.3**	65.3	1.4	4.99
C387-10	Felsic	11	R 4477	59.14	26.20	<.13	7.05	<.27	0.30	7.31	100.49	**34.2**	64.1	1.7	5.00
C387-10	Felsic	13	C 4479	59.10	26.08	<.12	7.10	<.26	0.40	7.32	102.19	**34.1**	63.6	2.3	5.00
C387-10	Felsic	15	C 4481	59.34	25.99	<.13	6.64	<.27	0.45	7.58	100.63	**31.8**	65.7	2.6	5.01
C387-10	Felsic	15	R 4482	59.19	26.01	<.13	6.81	<.27	0.35	7.63	100.95	**32.4**	65.6	2.0	5.02

See Appendix 1 and 2 for samples and analytical method
Total Fe reported as FeO*; Total# is original total (wt %); T.Cation is total cation based on 8 oxygens

Table A 4-4a Representative analyses of pyroxene from 22 cumulate xenoliths and 1 amphibole-gabbro and 1 basalt

Sample	Types	No.point	No.A0	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO*	MnO	MgO	CaO	Na_2O	Mg#*	Wo	En	Fs	Total#	Al(4)	Al(6)
C387-13	Cumulate U	1	C 7882	51.09	<.12	5.89	<.12	16.88	0.17	25.35	0.64	<.19	72.8	1.3	74.2	24.5	4.02	0.15	0.10
C387-13	Cumulate U	1	C 7884	51.01	<.13	5.96	<.12	16.95	<.11	25.51	0.56	<.20	72.9	1.2	74.6	24.3	4.02	0.16	0.09
C387-13	Cumulate U	1	R 7883	51.10	0.15	5.81	<.12	16.71	0.18	25.50	0.55	<.19	73.1	1.2	74.4	24.4	4.02	0.15	0.09
C387-13	Cumulate U	9	C 7926	48.00	1.07	8.35	<.13	7.90	0.16	12.31	21.11	1.09	73.5	50.9	41.3	7.8	4.04	0.23	0.13
C387-13	Cumulate U	9	R 7927	47.96	1.12	8.78	<.13	7.83	<.12	11.74	21.59	0.99	72.8	51.4	38.9	9.7	4.03	0.23	0.15
C387-13	Cumulate U	14	C 7956	49.25	0.79	7.41	<.13	8.39	<.12	13.26	19.92	0.97	73.8	46.3	42.9	10.8	4.03	0.19	0.14
C387-13	Cumulate U	14	R 7957	49.43	0.70	7.62	<.13	7.80	0.16	12.68	20.61	1.00	74.4	48.1	41.1	10.8	4.02	0.18	0.15
C387-13	Cumulate U	20	C 7909	52.36	<.14	3.96	0.58	4.31	<.12	17.47	21.06	0.27	87.8	44.0	50.8	5.3	4.01	0.10	0.07
C387-13	Cumulate U	20	R 7910	51.91	0.23	3.82	1.27	3.58	0.20	17.07	21.57	0.35	89.5	45.7	50.3	4.0	4.01	0.11	0.05
C387-13	Cumulate U	23	C 7924	50.56	0.50	5.53	0.33	6.99	0.34	14.86	20.00	0.89	79.1	45.4	46.9	7.7	4.03	0.15	0.09
C387-13	Cumulate U	23	R 7925	51.73	0.36	4.36	0.81	5.48	0.13	17.74	18.75	0.64	85.2	40.7	53.5	5.8	4.02	0.12	0.06
C387-13	Cumulate U	24	C 7943	52.26	0.19	3.71	1.20	3.91	<.12	17.47	20.90	0.37	88.9	43.9	51.1	5.0	4.01	0.10	0.06
C387-13	Cumulate U	24	R 7944	51.46	0.46	4.55	0.83	4.99	0.13	16.61	20.50	0.47	85.6	44.0	49.6	6.3	4.01	0.12	0.07
AK-26e	Am-gabbro	1	C 7547	48.17	1.24	6.20	<.13	12.24	0.25	13.53	18.14	0.23	66.3	40.5	42.0	17.5	4.02	0.20	0.08
AK-26e	Am-gabbro	1	R 7548	48.13	1.13	6.39	<.13	12.13	0.21	13.70	17.86	0.46	66.8	40.7	43.4	15.9	4.03	0.21	0.08
AK-26e	Am-gabbro	9	C 7563	51.36	0.21	3.53	<.12	18.06	0.38	25.27	1.18	<.19	71.4	2.5	73.6	24.0	4.03	0.13	0.02
AK-26e	Am-gabbro	10	C 7570	51.82	<.13	1.34	<.12	24.79	0.88	20.49	0.68	<.20	59.6	1.4	59.8	38.8	4.01	0.05	0.01
AK-26e	Am-gabbro	10	R 7571	52.38	<.12	1.31	<.12	22.15	0.64	22.79	0.72	<.20	64.7	1.5	65.5	33.0	4.02	0.06	0.00
AK-26e	Am-gabbro	16	C 7611	51.73	<.13	1.46	<.13	24.58	0.92	20.81	0.51	<.21	60.2	1.1	60.9	38.1	4.01	0.05	0.01
AK-26e	Am-gabbro	19	C 7635	49.12	1.42	5.19	<.13	10.36	0.23	14.70	18.77	0.20	71.7	40.9	44.5	14.6	4.02	0.17	0.05
AK-26e	Am-gabbro	19	R 7636	49.29	1.28	5.15	<.13	10.16	0.25	14.48	19.03	0.35	71.8	41.9	44.3	13.8	4.02	0.17	0.06
AK-26e	Am-gabbro	27	C 7645	48.69	1.28	5.37	<.13	10.87	0.38	14.89	18.30	0.22	70.9	40.4	45.8	13.8	4.03	0.19	0.04
AK-26e	Am-gabbro	27	R 7646	48.97	1.39	5.89	<.13	10.09	0.17	14.63	18.32	0.53	72.1	41.1	45.6	13.3	4.03	0.19	0.07
AK-26e	Am-gabbro	31	C 7651	51.05	0.50	4.63	<.13	6.25	<.12	15.65	21.92	<.19	81.7	45.7	45.4	9.0	4.01	0.13	0.08
AK-21a	Cumulate	1	C1 3546	49.90	1.10	4.82	<.13	9.31	0.12	14.60	19.73	0.41	73.7	43.1	44.4	12.5	4.02	0.15	0.06
AK-21a	Cumulate	1	C2 3547	48.98	1.28	5.94	<.13	9.59	<.12	13.93	20.00	0.29	72.1	43.9	42.5	13.6	4.02	0.18	0.08
AK-21a	Cumulate	1	R 3548	48.76	1.19	5.75	<.13	8.79	0.31	13.81	21.04	0.35	73.7	46.9	42.9	10.2	4.03	0.19	0.06
AK-21a	Cumulate	17	R 3598	49.01	1.27	5.49	<.13	9.22	0.15	14.06	20.35	0.45	73.1	45.3	43.6	11.1	4.03	0.18	0.06
AK-21a	Cumulate	17	C 3597	48.61	1.35	6.01	<.13	9.16	0.31	14.03	20.17	0.36	73.2	45.1	43.6	11.3	4.03	0.20	0.07
AK-21a	Cumulate	20	C 3627	49.41	1.32	5.97	0.36	6.55	0.23	14.86	20.96	0.34	80.2	45.9	45.3	8.8	4.01	0.18	0.08
AK-21a	Cumulate	20	R 3631	51.03	0.51	4.87	<.13	6.98	0.17	16.32	19.90	0.22	80.6	42.3	48.2	9.5	4.01	0.13	0.08
C160-5	Cumulate	10	3902C	51.00	0.30	5.50	0.32	4.63	0.22	16.92	20.90	0.21	86.7	44.6	50.2	5.2	4.02	0.15	0.09
C160-5	Cumulate	10	3903R	51.63	0.20	5.79	0.17	4.47	<.12	16.67	20.86	0.20	86.9	43.9	48.8	7.3	4.00	0.12	0.12

See Appendix 1 and 2 for samples and analytical method; total Fe reported as FeO*; Mg#* = 100 x Mg/(Mg+Fe*); Total# is original total cations

Table A 4-4a Representative analyses of pyroxene from 22 cumulate xenoliths and 1 amphibole-gabbro and 1 basalt (cont)

Sample	Types	No.point	No.A0	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO*	MnO	MgO	CaO	Na_2O	Mg#*	Wo	En	Fs	Total#	Al(4)	Al(6)
C160-5	Cumulate	4	C1 3871	51.70	0.22	4.93	0.44	4.48	0.17	17.04	20.74	0.27	87.1	43.9	50.1	6.0	4.01	0.12	0.09
C160-5	Cumulate	4	C2 3872	51.45	0.22	5.34	0.27	4.50	0.13	16.84	20.76	0.49	87.0	44.9	50.6	4.5	4.02	0.13	0.09
C160-5	Cumulate	4	R 3873	52.22	<.13	3.93	0.32	4.07	<.12	17.71	21.74	<.19	88.6	44.6	50.6	4.9	4.01	0.10	0.06
C160-5	Cumulate	13	3920C	51.29	0.14	5.90	0.26	4.52	<.12	16.58	20.99	0.30	86.7	44.8	49.2	6.0	4.01	0.14	0.12
C160-5	Cumulate	13	3921R	52.12	<.13	4.65	0.39	4.24	0.21	17.44	20.95	<.19	88.0	43.2	50.1	6.7	4.00	0.11	0.09
C387-29	Cumulate	1	C1 7070	52.04	0.42	4.42	0.43	4.43	0.14	16.38	21.23	0.50	86.8	45.3	48.6	6.2	4.01	0.11	0.08
C387-29	Cumulate	1	C2 7071	51.83	0.41	4.43	0.31	4.49	0.21	16.25	21.57	0.49	86.6	46.2	48.4	5.4	4.01	0.11	0.08
C387-29	Cumulate	1	R 7072	51.47	0.48	4.73	0.32	4.68	0.17	16.32	21.20	0.63	86.1	46.1	49.4	4.5	4.02	0.13	0.07
C387-29	Cumulate	11	C 7104	52.32	0.24	4.49	0.19	4.43	<.12	16.23	21.68	0.42	86.7	45.7	47.6	6.8	4.00	0.10	0.10
C387-29	Cumulate	11	R 7105	51.54	0.46	4.69	0.34	4.74	<.11	16.10	21.46	0.67	85.8	46.7	48.7	4.7	4.02	0.12	0.08
C387-29	Cumulate	26	C 7145	54.00	<.12	4.18	<.12	10.12	0.20	30.83	0.68	<.19	84.5	1.4	85.4	13.3	4.02	0.11	0.06
C387-29	Cumulate	26	R 7146	54.04	<.12	4.23	0.15	9.98	0.22	30.66	0.72	<.19	84.6	1.4	84.9	13.7	4.01	0.11	0.07
C387-29	Cumulate	27	C 7147	50.82	0.51	5.10	0.31	5.29	0.12	15.85	21.39	0.61	84.2	47.0	48.5	4.5	4.03	0.15	0.07
SW-11	Cumulate	C		49.64	0.29	6.87	<.12	19.91	0.31	21.77	1.05	0.16	66.1	2.3	66.2	31.5	4.02	0.17	0.12
SW-11	Cumulate	C		48.56	0.90	8.37	0.21	10.25	0.18	13.30	17.23	1.00	69.8	40.8	43.8	15.5	4.02	0.20	0.16
SW-11	Cumulate	R		43.38	1.06	18.32	0.26	7.87	0.19	10.23	17.77	0.92	69.9	47.0	37.7	15.3	4.01	0.41	0.39
SW-11	Cumulate	C		48.95	0.87	8.05	<.12	8.81	0.17	12.07	20.05	1.03	70.9	47.2	39.5	13.3	4.02	0.19	0.16
SW-6	Cumulate	2	C1 3937	50.93	<.13	6.87	<.12	15.55	0.25	25.95	0.45	<.20	74.8	1.0	76.3	22.8	4.02	0.17	0.12
SW-6	Cumulate	2	C2 3938	50.47	<.12	6.91	<.12	15.47	0.26	26.35	0.54	<.19	75.2	1.1	78.2	20.7	4.03	0.19	0.10
SW-6	Cumulate	2	R 3939	51.67	<.13	6.41	<.13	15.06	0.21	26.09	0.57	<.20	75.5	1.2	75.5	23.3	4.01	0.15	0.13
SW-6	Cumulate	4	C 3944	51.72	<.12	5.88	<.12	15.15	0.26	26.44	0.56	<.19	75.7	1.2	76.5	22.3	4.01	0.15	0.10
SW-6	Cumulate	4	R 3945	51.51	<.12	6.16	<.12	15.17	0.33	26.32	0.51	<.19	75.6	1.1	76.6	22.4	4.01	0.15	0.11
SW-6	Cumulate	C		51.35	<.12	7.26	<.12	14.37	0.15	26.15	0.72	0.00	76.4	1.5	76.0	22.5	4.01	0.16	0.14
SW-6	Cumulate	C		49.36	0.61	8.57	<.12	6.54	0.00	12.75	21.06	1.11	77.7	49.5	41.7	8.8	4.02	0.19	0.18
SW-6	Cumulate	C		49.87	0.53	8.16	<.12	6.47	0.00	12.95	21.01	1.01	78.1	48.6	41.6	9.8	4.01	0.17	0.18
C160-1	Basalt	1	C 4407	52.36	0.54	2.76	0.58	3.91	0.22	17.35	21.90	0.39	88.8	46.0	50.6	3.4	4.02	0.10	0.02
C160-1	Basalt	1	R 4408	51.38	0.78	2.85	0.40	5.21	0.20	16.72	22.25	0.20	85.1	46.8	48.9	4.4	4.03	0.12	0.00
C160-1	Basalt	2	C 4412	51.94	0.44	2.93	1.23	3.66	0.22	16.98	22.25	0.33	89.2	46.9	49.8	3.2	4.02	0.11	0.02
C160-1	Basalt	3	C1 4416	49.86	1.05	5.23	0.29	5.33	0.24	15.80	21.69	0.51	84.1	48.0	48.6	3.4	4.03	0.18	0.05
C160-1	Basalt	3	C2 4415	49.65	1.14	5.67	0.14	5.45	0.13	15.50	21.72	0.58	83.5	48.3	48.0	3.7	4.03	0.19	0.06
C160-1	Basalt	3	C3 4414	50.15	1.09	5.37	0.34	5.30	0.12	15.76	21.45	0.42	84.1	46.7	47.7	5.6	4.02	0.17	0.07
C160-1	Basalt	3	R 4413	50.86	0.85	4.61	0.25	4.76	<.12	16.16	22.01	0.50	85.8	47.6	48.6	3.8	4.03	0.15	0.05
C160-1	Basalt	8	C 4428	52.16	0.37	2.80	1.09	3.49	<.12	17.68	22.04	0.36	90.0	46.3	51.6	2.1	4.02	0.11	0.01

See Appendix 1 and 2 for samples and analytical method; total Fe reported as FeO*; Mg#* = 100 x Mg/(Mg+Fe*); Total# is original total cations

Table A 4-5a Representative analyses of pyroxene from 12 granulite xenoliths and 1 andesite

Sample	Types	No.point	No.A0	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO*	MnO	MgO	CaO	Na_2O	$Mg^{\#*}$	Wo	En	Fs	$Total^{\#}$	Al(4)	Al(6)
AK-35f	Mafic	3	C 3434	50.24	0.41	4.57	<.13	11.63	0.34	13.43	18.35	1.04	67.3	42.5	43.3	14.2	4.04	0.13	0.07
AK-35f	Mafic	3	R 3435	50.68	0.44	4.68	<.13	11.87	0.40	13.32	17.58	1.03	66.7	40.4	42.6	17.1	4.02	0.11	0.09
AK-35f	Mafic	4	C 3442	51.72	<.13	3.20	<.13	20.19	0.53	23.09	1.27	<.20	67.1	2.7	67.1	30.2	4.02	0.10	0.04
AK-35f	Mafic	4	R 3443	51.69	<.12	3.28	<.12	20.26	0.67	22.79	1.32	<.20	66.7	2.8	66.4	30.8	4.01	0.09	0.05
AK-35f	Mafic	12a	C 3482	51.88	0.20	2.40	<.13	10.95	0.44	13.91	19.46	0.76	69.4	42.8	42.6	14.7	4.03	0.07	0.04
AK-35f	Mafic	12b	C 3480	52.45	<.13	2.42	<.12	19.91	0.62	23.18	1.43	<.20	67.5	2.9	66.5	30.5	4.01	0.07	0.04
C160-10	Mafic	1	C 7981	50.83	0.29	3.56	<.13	11.99	0.42	12.92	19.13	0.88	65.8	43.4	40.7	15.9	4.03	0.10	0.06
C160-10	Mafic	1	R 7982	51.26	0.27	3.37	<.13	11.45	0.25	13.01	19.55	0.84	67.0	43.6	40.4	16.0	4.02	0.09	0.06
C160-10	Mafic	4	C 7992	51.98	<.12	1.85	<.12	22.73	0.59	21.93	0.93	<.20	63.2	1.9	63.5	34.6	4.01	0.06	0.02
C160-10	Mafic	4	R 7993	52.16	<.12	2.23	<.12	22.52	0.50	21.66	0.93	<.20	63.2	1.9	62.4	35.7	4.00	0.06	0.04
C160-3	Mafic	1	C 7438	51.11	<.12	2.16	<.12	24.59	0.61	20.58	0.94	<.20	59.9	2.0	60.6	37.4	4.02	0.08	0.02
C160-3	Mafic	1	R 7439	50.91	<.12	2.36	<.12	24.32	0.61	20.71	1.10	<.20	60.3	2.3	61.3	36.4	4.03	0.09	0.01
C160-3	Mafic	10	C 7476	50.99	0.38	3.51	<.13	11.81	0.26	12.66	19.67	0.73	65.6	43.7	39.1	17.2	4.02	0.09	0.06
C160-3	Mafic	10	R 7474	50.49	0.42	3.34	<.13	12.87	0.42	12.81	18.86	0.78	64.0	42.6	40.3	17.1	4.03	0.11	0.04
C160-8	Mafic	3	3959R	51.29	<.13	2.59	<.13	24.37	0.59	20.11	1.04	<.20	59.5	2.2	59.0	38.8	4.01	0.07	0.04
C160-8	Mafic	3	3958C	51.41	<.13	2.13	<.13	24.15	0.70	20.64	0.96	<.21	60.4	2.0	60.6	37.4	4.01	0.07	0.03
C160-8	Mafic	16	4009C	51.71	<.14	2.40	<.13	12.19	0.49	12.55	20.01	0.65	64.7	44.0	38.3	17.7	4.02	0.06	0.05
C160-8	Mafic	16	4010R	51.37	<.14	3.22	<.14	12.05	0.31	12.61	19.90	0.53	65.1	43.5	38.3	18.2	4.01	0.07	0.07
C160-8	Mafic	21	4024C	51.11	<.13	1.96	<.13	24.61	0.64	20.86	0.81	<.21	60.2	1.7	61.5	36.8	4.03	0.08	0.01
C160-8	Mafic	28	4080C	51.24	<.14	2.71	<.13	12.20	0.24	12.76	20.25	0.60	65.1	44.5	39.0	16.4	4.03	0.08	0.04
C387-11	Mafic	1	C 7277	47.67	1.15	8.32	<.13	12.00	0.30	12.72	17.01	0.83	65.4	40.4	42.1	17.5	4.03	0.23	0.14
C387-11	Mafic	1	R 7278	48.34	1.11	8.10	<.13	10.36	0.23	11.35	19.57	0.93	66.1	46.2	37.3	16.5	4.01	0.20	0.16
C387-11	Mafic	25	C 7380	49.49	1.15	6.88	<.13	9.53	<.12	12.18	19.88	0.89	69.5	45.4	38.7	15.9	4.01	0.16	0.14
C387-11	Mafic	27	C 7429	49.83	<.13	5.68	<.13	22.07	0.30	21.44	0.68	<.20	63.4	1.5	64.5	34.1	4.02	0.15	0.09
C387-11	Mafic	27	R 7430	49.79	<.12	5.44	<.12	22.01	0.36	21.55	0.84	<.20	63.6	1.8	64.9	33.3	4.02	0.15	0.08
C387-4	Mafic	9	5942c	49.37	0.45	5.07	<.12	12.56	0.40	10.11	21.12	0.92	58.9	49.4	32.9	17.8	4.03	0.14	0.09
C387-4	Mafic	9	5943r	49.24	0.40	5.38	<.12	12.57	0.36	9.90	21.20	0.95	58.4	49.8	32.4	17.8	4.03	0.14	0.10
C387-4	Mafic	15	5963c	49.75	0.27	4.29	<.12	12.49	0.34	10.52	21.13	1.20	60.1	50.3	34.8	14.9	4.05	0.13	0.06
C387-4	Mafic	15	5964r	48.90	0.56	5.24	<.12	12.88	0.26	10.10	20.89	1.17	58.3	50.2	33.8	16.1	4.05	0.16	0.08
SW-10	Mafic	C		50.99	0.17	2.51	<.12	24.32	0.58	20.29	1.00	0.14	59.8	2.1	60.4	37.5	4.02	0.08	0.03
SW-10	Mafic	R		51.08	0.10	2.54	<.12	24.25	0.65	20.43	0.95	0.00	60.0	2.0	60.1	37.9	4.01	0.08	0.03
SW-10	Mafic	C		50.48	0.42	4.16	<.12	12.53	0.39	11.92	18.77	1.33	62.9	44.3	39.2	16.5	4.04	0.11	0.07
SW-10	Mafic	R		50.62	0.34	4.21	<.12	12.45	0.35	11.86	18.88	1.29	62.9	44.4	38.8	16.9	4.03	0.11	0.08
SW-5	Mafic	C		51.82	0.14	1.11	<.12	24.15	0.97	20.69	1.12	0.00	60.4	2.3	60.3	37.4	4.01	0.05	0.00
SW-5	Mafic	C		52.19	0.16	1.14	<.12	23.21	1.02	20.88	1.15	0.25	61.6	2.4	61.6	36.0	4.02	0.04	0.01

See Appendix 1 and 2 for samples and analytical method; total Fe reported as FeO*; Mg#* = 100 x Mg/(Mg+Fe*); Total# is original total cations based on 6 oxygens

Table A 4-5a Representative analyses of pyroxene from 12 granulite xenoliths and 1 andesite (cont)

Sample	Types	No.point	No.A0	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO*	MnO	MgO	CaO	Na_2O	Mg#*	Wo	En	Fs	Total#	Al(4)	Al(6)
SW-5	Mafic	C		51.56	0.24	1.85	<.13	11.80	0.35	13.04	20.62	0.54	66.3	44.8	39.4	15.8	4.03	0.07	0.02
SW-5	Mafic	C		51.74	0.19	1.89	<.13	11.59	0.47	13.18	20.24	0.70	67.0	44.4	40.2	15.3	4.03	0.06	0.02
AK-42g	Cumulate?	1	C 7706	50.71	0.76	6.17	0.19	7.02	0.17	14.09	19.86	1.02	78.2	45.1	44.5	10.4	4.01	0.14	0.13
AK-42g	Cumulate?	1	R 7707	51.16	0.83	5.52	<.13	6.86	<.12	14.37	20.10	1.16	78.9	45.5	45.3	9.2	4.02	0.13	0.11
AK-42g	Cumulate?	10	C1 7724	53.12	<.12	4.17	<.12	14.69	0.25	27.02	0.75	<.19	76.6	1.5	76.1	22.4	4.01	0.10	0.08
AK-42g	Cumulate?	10	C2 7725	52.88	0.15	4.18	<.12	14.71	0.31	26.97	0.80	<.19	76.6	1.6	76.2	22.1	4.01	0.10	0.07
AK-42g	Cumulate?	10	R 7726	52.59	0.15	4.29	0.13	14.84	0.30	27.01	0.70	<.19	76.4	1.4	76.8	21.8	4.01	0.11	0.07
AK-42g	Cumulate?	12	C 7730	50.74	0.65	6.07	0.32	6.59	0.17	14.26	20.17	1.03	79.4	45.9	45.1	9.0	4.02	0.14	0.12
AK-42g	Cumulate?	28	C 7765	52.82	<.13	4.32	<.13	14.86	0.29	26.95	0.75	<.20	76.4	1.5	76.4	22.1	4.01	0.11	0.08
AK-42g	Cumulate?	28	R 7766	52.87	<.12	4.07	<.12	14.93	0.33	27.06	0.75	<.19	76.4	1.5	76.7	21.8	4.01	0.10	0.07
AK-42g	Cumulate?	29	C1 7774	50.77	0.70	5.81	0.24	7.20	<.12	14.67	19.60	1.00	78.4	44.3	46.1	9.6	4.02	0.14	0.11
AK-42g	Cumulate?	29	C2 7775	52.95	0.13	3.99	<.12	15.02	0.23	26.84	0.83	<.19	76.1	1.7	75.7	22.6	4.01	0.10	0.07
AK-42g	Cumulate?	29	C3 7776	52.47	<.12	4.14	<.12	15.08	0.38	27.16	0.77	<.19	76.2	1.6	77.6	20.8	4.02	0.12	0.06
C160-12	Andesite	3	C1 4540	48.19	1.24	6.78	<.13	11.52	<.12	13.05	18.45	0.76	66.9	42.8	42.1	15.0	4.03	0.21	0.09
C160-12	Andesite	3	C2 4541	48.44	1.24	6.73	<.13	10.90	0.25	13.06	18.54	0.84	68.1	43.3	42.4	14.3	4.03	0.20	0.10
C160-12	Andesite	3	R 4542	48.42	1.11	6.36	<.13	11.15	0.23	13.23	18.58	0.93	67.9	43.8	43.4	12.8	4.04	0.20	0.08
C160-12	Andesite	5	C 4565	48.61	1.05	7.72	<.13	9.69	0.19	14.09	17.80	0.87	72.2	41.6	45.8	12.6	4.03	0.21	0.13
C160-12	Andesite	5	R 4566	48.48	1.05	7.65	<.13	9.74	0.20	14.38	17.51	0.96	72.5	41.4	47.3	11.4	4.04	0.22	0.12
C160-12	Andesite	6	C 4579	50.73	0.28	3.23	<.13	21.82	0.50	22.06	1.38	<.20	64.3	2.9	65.1	32.0	4.03	0.12	0.02
C160-12	Andesite	6	R 4580	50.76	0.17	3.54	<.13	22.45	0.48	21.33	1.28	<.20	62.9	2.7	63.0	34.3	4.02	0.11	0.05
C387-28	Interm	5	R 4378	50.78	<.13	3.51	<.13	14.21	0.59	11.38	18.09	1.44	58.8	43.4	38.0	18.6	4.05	0.09	0.06
C387-28	Interm	5	C 4377	50.94	<.13	3.48	<.13	13.88	0.54	11.51	18.16	1.49	59.6	43.5	38.4	18.1	4.04	0.09	0.07
C387-28	Interm	12	C 4404	51.12	0.21	3.11	<.13	13.96	0.52	11.73	17.94	1.40	60.0	42.3	38.5	19.2	4.04	0.08	0.06
C387-28	Interm	12	R 4405	51.10	0.21	3.03	<.13	14.28	0.57	11.54	17.83	1.44	59.0	42.3	38.1	19.7	4.04	0.08	0.06
C387-28	Interm	14	C 4359	50.36	<.12	2.05	<.12	26.75	1.15	18.44	1.02	0.23	55.1	2.3	56.7	41.1	4.03	0.08	0.01
C387-28	Interm	14	R 4360	50.40	<.12	2.02	<.12	26.79	1.04	18.39	1.12	0.25	55.0	2.5	56.5	41.1	4.03	0.08	0.01
C387-28	Interm	18	C 4397	50.60	<.12	2.24	<.12	26.26	1.17	18.69	1.04	<.20	55.9	2.2	56.1	41.6	4.02	0.08	0.03
C387-28	Interm	18	R 4398	50.77	<.12	1.94	<.12	26.52	1.03	18.79	0.94	<.20	55.8	2.0	56.1	41.9	4.02	0.07	0.02
SW-14	Interm	C	NW-4	50.95	0.14	2.79	<.13	22.59	0.39	21.88	1.02	0.24	63.3	2.2	65.4	32.4	4.04	0.11	0.01
SW-14	Interm	C	NW-4	51.37	<.12	2.57	<.13	22.64	0.35	22.13	0.94	0.00	63.5	2.0	64.6	33.5	4.02	0.09	0.02
SW-14	Interm	R	NW-4	51.47	<.12	2.72	<.13	22.34	0.34	21.91	1.01	0.21	63.6	2.1	64.8	33.1	4.03	0.09	0.03
SW-12	Felsic	C		51.83	<.12	1.60	<.13	25.89	0.88	19.26	0.54	0.00	57.0	1.1	56.4	42.5	4.00	0.03	0.04
SW-12	Felsic	C		51.72	<.12	1.56	<.13	25.52	0.85	19.80	0.55	0.00	58.0	1.1	57.8	41.1	4.01	0.04	0.03
SW-12	Felsic	C		51.98	<.12	1.60	<.13	24.55	0.76	20.52	0.59	0.00	59.8	1.2	59.5	39.2	4.01	0.04	0.03
SW-12	Felsic	C		52.23	<.12	1.34	<.13	24.49	0.89	20.52	0.54	0.00	59.9	1.1	59.3	39.5	4.00	0.03	0.03

See Appendix 1 and 2 for samples and analytical method; total Fe reported as FeO*; Mg#* = 100 x Mg/(Mg+Fe*); Total# is original total cations based on 6 oxygens

Table A 4-6a Representative analyses of Al-Ti-Fe oxides from 18 SFVF cumulate xenoliths and 1 amphibole-gabbro

Sample	Types	No.point	No.A0		TiO_2	Al_2O_3	Cr_2O_3	V_2O_3	Fe_2O_3	FeO	NiO	MnO	MgO	Total#	Ti	Al	Fe^{3+}	Fe^{2+}	Mg	T.Cation
AK-21a	Cumulate-U	1	C 3522		11.36	8.21	<.13	0.44	42.21	35.48	<.26	<.14	5.58	103.28	0.29	0.33	1.08	1.01	0.28	3.00
AK-21a	Cumulate-U	1	R 3524		11.83	10.94	<.13	0.83	38.50	35.86	<.27	0.25	5.94	103.90	0.30	0.43	0.96	0.99	0.29	3.00
AK-21a	Cumulate-U	1a	C 3528		0.13	0.13	<.13	<.15	69.30	31.18	<.27	<.14	0.19	100.93	0.00	0.01	1.99	0.99	0.01	3.00
AK-21a	Cumulate-U	1a	R 3530		0.23	0.18	<.13	<.15	69.51	31.37	<.27	<.14	0.25	101.55	0.01	0.01	1.98	0.99	0.01	3.00
AK-21a	Cumulate-U	4	C 3539		11.08	9.37	<.13	0.78	42.96	34.26	<.27	0.26	6.57	105.29	0.27	0.36	1.07	0.94	0.32	3.00
AK-21a	Cumulate-U	4	R 3541		7.53	6.51	<.13	0.68	51.21	32.59	<.27	0.33	4.81	103.67	0.19	0.26	1.33	0.94	0.25	3.00
AK-21a	Cumulate-U	7	C 3564		19.04	5.55	<.13	0.54	29.25	43.40	<.27	0.28	4.43	102.48	0.50	0.23	0.76	1.26	0.23	3.00
AK-21a	Cumulate-U	10	C 3580		20.24	9.74	<.13	0.62	21.94	43.13	<.27	0.34	5.59	101.59	0.52	0.39	0.56	1.22	0.28	3.00
AK-21a	Cumulate-U	10	R 3581		6.53	8.17	<.13	0.88	52.32	34.99	<.27	0.16	3.54	106.60	0.17	0.32	1.32	0.98	0.18	3.00
AK-21a	Cumulate-U	12	C 3592	in pl	22.67	4.69	0.13	0.67	20.42	47.70	<.26	0.39	3.11	99.78	0.61	0.20	0.55	1.43	0.17	3.00
AK-21a	Cumulate-U	1	C 3525		46.85	1.65	<.13	<.29	13.21	31.07	<.27	0.33	6.01	99.12	0.86	0.05	0.24	0.63	0.22	2.00
AK-21a	Cumulate-U	1	R 3527		43.68	1.67	<.13	<.28	19.77	27.25	<.26	0.35	6.55	99.27	0.80	0.05	0.36	0.55	0.24	2.00
AK-21a	Cumulate-U	16	C 3618		50.28	0.79	<.13	<.30	2.82	37.02	<.26	<.14	4.60	95.51	0.96	0.02	0.05	0.79	0.17	2.00
AK-21a	Cumulate-U	16	R 3623		47.97	2.24	<.13	0.44	7.52	34.02	<.26	<.13	5.12	97.31	0.89	0.07	0.14	0.70	0.19	2.00
AK-21a	Cumulate-U	4	C 3540		55.63	2.45	<.13	<.31	0.00	32.45	<.26	<.13	5.84	96.36	1.01	0.07	0.00	0.66	0.21	1.95
AK-21a	Cumulate-U	17	C 3633		53.84	3.13	<.13	<.31	0.00	34.17	<.26	<.13	5.30	96.45	0.99	0.09	0.00	0.70	0.19	1.97
C160-14	Cumulate-U	1	C 4185		0.50	62.97	<.12	<.14	2.06	19.52	0.27	<.12	14.82	100.14	0.01	1.94	0.04	0.43	0.58	3.00
C160-14	Cumulate-U	1	R 4187		0.55	58.02	<.12	<.14	7.05	19.08	<.24	0.13	14.50	99.32	0.01	1.84	0.14	0.43	0.58	3.00
C160-14	Cumulate-U	3	C1 4217		<.12	2.55	<.13	<.15	66.92	30.83	<.28	<.14	0.60	100.90	0.00	0.11	1.89	0.97	0.03	3.00
C160-14	Cumulate-U	3	C2 4218		<.12	2.47	<.13	0.40	66.48	30.27	<.27	<.14	0.88	100.50	0.00	0.11	1.88	0.95	0.05	3.00
C160-14	Cumulate-U	3	C3 4219		0.47	62.00	<.12	<.14	1.90	20.73	<.25	<.13	13.83	98.94	0.01	1.94	0.04	0.46	0.55	3.00
C160-14	Cumulate-U	3	C6 4222		0.41	62.60	<.12	<.14	5.51	16.19	<.23	<.12	17.47	102.18	0.01	1.88	0.11	0.34	0.66	3.00
C160-14	Cumulate-U	5	C 4236	in cpx	<.12	0.61	<.13	<.15	67.37	29.51	0.29	<.14	0.53	98.32	0.00	0.03	1.97	0.96	0.03	3.00
C160-14	Cumulate-U	6	C 4238	in cpx	0.35	60.12	<.12	<.14	5.54	18.32	<.24	<.12	15.24	99.58	0.01	1.88	0.11	0.41	0.60	3.00
C387-13	Cumulate-U	1	C 7885		0.27	58.07	<.12	<.14	7.52	21.15	<.24	<.13	13.26	100.26	0.01	1.84	0.15	0.47	0.53	3.00
C387-13	Cumulate-U	1	R 7886		0.22	58.47	<.12	0.29	8.07	21.23	<.24	<.12	13.54	101.82	0.00	1.82	0.16	0.47	0.53	3.00
C387-13	Cumulate-U	7	C 7932		0.16	60.39	<.12	<.14	7.37	19.55	<.24	<.13	14.93	102.40	0.00	1.85	0.14	0.42	0.58	3.00
C387-13	Cumulate-U	8	C 7948		21.44	1.95	<.13	0.57	24.76	49.36	<.27	0.29	0.95	99.31	0.60	0.09	0.69	1.54	0.05	3.00
C387-13	Cumulate-U	10	C 7950		22.13	1.71	<.13	<.23	26.66	50.12	<.27	0.27	1.46	102.35	0.60	0.07	0.72	1.51	0.08	3.00
C387-13	Cumulate-U	12	C 7979	in am	0.31	58.90	<.12	0.15	8.34	21.49	<.24	<.12	13.69	102.89	0.01	1.82	0.16	0.47	0.54	3.00
C387-13	Cumulate-U	13	C 7980	in am	0.20	58.56	<.12	<.14	8.48	21.09	<.24	<.13	13.67	102.00	0.00	1.82	0.17	0.47	0.54	3.00

See Appendix 1 and 2 for samples and analytical method; Total# is original total (wt %)

Fe_2O_3-FeO are calculated on the basis of AB_2O_4 (spinel) and ABO_3 (ilmenite) stoichiometry; T.Cation is cations based on 4 oxygens (spinel) and 3 oxygens (ilmenite)

Table A 4-6a Representative analyses of Al-Ti-Fe oxides from 18 SFVF cumulate xenoliths and 1 amphibole-gabbro (cont)

Sample	Types	No.point	No.A0		TiO_2	Al_2O_3	Cr_2O_3	V_2O_3	Fe_2O_3	FeO	NiO	MnO	MgO	Total#	Ti	Al	Fe^{3+}	Fe^{2+}	Mg	T.Cation
C387-1	Cumulate-U	1	C 4264		<.11	61.35	<.12	<.14	6.15	18.45	<.24	<.12	15.45	101.41	0.00	1.88	0.12	0.40	0.60	3.00
C387-1	Cumulate-U	10	C 4302	in cpx	<.12	61.06	<.12	<.14	5.98	17.93	<.25	<.13	15.59	100.56	0.00	1.88	0.12	0.39	0.61	3.00
C387-1	Cumulate-U	15	C 4323		<.11	62.18	<.12	<.14	5.92	18.99	<.24	<.13	15.43	102.52	0.00	1.89	0.11	0.41	0.59	3.00
C387-1	Cumulate-U	15	R 4324		0.12	62.39	<.12	<.14	5.95	19.33	<.24	<.12	15.44	103.22	0.00	1.88	0.11	0.41	0.59	3.00
SW-1	Cumulate-U		C		21.74	8.80	0.00	0.90	18.71	44.14	0.00	0.18	5.53	100.00	0.57	0.36	0.49	1.28	0.29	3.00
SW-1	Cumulate-U		C		12.17	14.22	0.00	0.58	32.15	33.25	0.00	0.24	7.39	100.00	0.31	0.56	0.81	0.93	0.37	3.00
SW-1	Cumulate-U		C		11.30	13.73	0.00	0.59	34.23	32.77	0.00	0.29	7.09	100.00	0.29	0.54	0.87	0.92	0.36	3.00
SW-2	Cumulate-U		C		16.16	9.67	0.00	0.53	28.84	38.72	0.00	0.53	5.54	99.99	0.42	0.39	0.75	1.12	0.29	3.00
SW-2	Cumulate-U		C		15.38	11.96	0.00	0.41	28.21	37.34	0.00	0.34	6.35	99.99	0.39	0.48	0.72	1.06	0.32	3.00
SW-3	Cumulate-U		C		9.87	13.17	0.34	0.58	36.46	33.83	0.00	0.27	5.49	100.01	0.25	0.53	0.94	0.97	0.28	3.00
SW-3	Cumulate-U		C		1.65	47.63	0.33	0.28	16.23	20.77	0.00	0.00	13.11	100.00	0.04	1.57	0.34	0.49	0.55	3.00
SW-3	Cumulate-U		C		0.36	0.33	3.64	0.18	64.17	30.03	0.90	0.00	0.38	99.99	0.01	0.02	1.85	0.96	0.02	3.00
SW-3	Cumulate-U		C	in ol	7.89	15.69	0.61	0.54	37.63	30.74	0.00	0.36	6.52	99.98	0.20	0.62	0.95	0.86	0.33	3.00
SW-3	Cumulate-U		C	in ol	7.97	14.97	0.56	0.44	38.31	31.07	0.00	0.50	6.19	100.01	0.20	0.60	0.97	0.88	0.31	3.00
SW-4	Cumulate-U		C		1.41	47.23	0.19	0.33	17.37	20.00	0.00	0.15	13.33	100.01	0.03	1.56	0.37	0.47	0.56	3.00
SW-4	Cumulate-U		R		1.55	47.55	0.37	0.24	16.11	21.67	0.00	0.18	12.34	100.01	0.03	1.58	0.34	0.51	0.52	3.00
SW-4	Cumulate-U		C	in ol	0.19	3.92	0.19	0.13	63.77	31.00	0.52	0.00	0.27	99.99	0.01	0.17	1.81	0.98	0.02	3.00
SW-4	Cumulate-U		C	in ol	1.76	45.59	0.33	0.28	18.46	20.19	0.00	0.18	13.20	99.99	0.04	1.52	0.39	0.48	0.56	3.00
SW-4	Cumulate-U		C		15.79	11.76	0.00	0.67	28.21	35.33	0.00	0.37	7.86	99.99	0.40	0.47	0.72	1.00	0.40	3.00
SW-13	Cumulate-U		C		14.29	1.47	0.00	0.49	40.47	40.52	0.00	0.33	2.43	100.00	0.40	0.06	1.13	1.25	0.13	3.00
SW-13	Cumulate-U		C		27.07	9.30	0.25	0.27	9.29	45.23	0.00	1.08	7.50	99.99	0.69	0.37	0.24	1.28	0.38	3.00
SW-13	Cumulate-U		C		6.92	3.68	0.00	0.65	51.82	34.54	0.00	0.16	2.23	100.00	0.19	0.16	1.44	1.06	0.12	3.00
AK-35	Cumulate	3	C 7693		<.12	1.19	<.13	<.15	67.42	31.17	<.28	<.14	<.16	99.79	0.00	0.05	1.95	1.00	0.00	3.00
AK-35	Cumulate	6	C 7696		<.12	1.29	<.13	<.15	83.46	0.06	0.27	0.52	21.10	106.71	0.00	0.05	1.95	0.00	0.98	3.00
AK-42h	Cumulate	1	C 2598		50.89	1.60	<.13	<.30	9.64	27.81	<.26	<.14	10.07	100.01	0.89	0.04	0.17	0.54	0.35	2.00
AK-42h	Cumulate	1	R 2599		52.15	0.80	<.13	<.30	10.01	27.98	<.26	0.23	10.48	101.65	0.90	0.02	0.17	0.54	0.36	2.00
AK-42h	Cumulate	8	C 2605	in am	0.27	58.13	1.21	<.14	6.85	21.32	0.30	0.16	13.09	101.32	0.01	1.83	0.14	0.48	0.52	3.00
AK-42h	Cumulate	8	R 2607	in am	0.42	57.76	1.13	<.14	8.23	19.72	<.24	0.18	14.47	101.90	0.01	1.80	0.16	0.44	0.57	3.00
AK-42h	Cumulate	11	C 2615	in am	1.31	54.68	1.01	<.14	11.41	16.77	0.47	<.13	16.43	102.07	0.03	1.70	0.23	0.37	0.65	3.00
AK-42h	Cumulate	1a	C 3417		0.38	57.42	1.05	<.14	7.63	20.71	0.32	0.18	13.40	101.10	0.01	1.81	0.15	0.46	0.53	3.00
AK-42h	Cumulate	1a	R 3420		0.87	55.27	1.05	<.14	9.09	19.42	0.50	<.13	14.13	100.31	0.02	1.76	0.18	0.44	0.57	3.00
AK-42h	Cumulate	1a	C 3413		50.28	1.74	<.13	<.30	11.49	26.66	0.26	0.25	10.13	100.80	0.88	0.05	0.20	0.52	0.35	2.00
AK-42h	Cumulate	1a	R 3416		50.36	1.18	0.14	<.30	9.48	27.46	<.26	<.13	10.00	98.62	0.90	0.03	0.17	0.54	0.35	2.00

See Appendix 1 and 2 for samples and analytical method; Total# is original total (wt %)
Fe_2O_3-FeO are calculated on the basis of AB_2O_4 (spinel) and ABO_3 (ilmenite) stoichiometry; T.Cation is cations based on 4 oxygens (spinel) and 3 oxygens (ilmenite)

Table A 4-6a Representative analyses of Al-Ti-Fe oxides from 18 SFVF cumulate xenoliths and 1 amphibole-gabbro (cont)

Sample	Types	No.point	No.A0		TiO_2	Al_2O_3	Cr_2O_3	V_2O_3	Fe_2O_3	FeO	NiO	MnO	MgO	Total#	Ti	Al	Fe^{3+}	Fe^{2+}	Mg	T.Cation
C160-11	Cumulate	1	C 4142		<.13	1.74	<.13	<.15	67.73	17.64	14.21	<.14	0.22	101.53	0.00	0.08	1.92	0.56	0.01	3.00
C160-11	Cumulate	1	R 4143		<.13	1.20	<.13	<.15	69.89	9.57	23.04	<.14	0.31	104.02	0.00	0.05	1.95	0.30	0.02	3.00
C160-11	Cumulate	2	C 4161		0.41	59.13	1.66	<.14	7.46	15.54	<.25	<.13	17.39	101.58	0.01	1.80	0.15	0.34	0.67	3.00
C160-11	Cumulate	2	R 4162		0.49	58.52	1.85	<.14	8.21	15.34	0.35	<.13	17.39	102.15	0.01	1.78	0.16	0.33	0.67	3.00
C160-5	Cumulate	4	C 3900		<.13	1.54	<.13	<.15	68.45	9.99	21.61	<.14	0.62	102.21	0.00	0.07	1.93	0.31	0.03	3.00
C387-6	Cumulate	9	C 7242		0.12	64.70	<.11	<.13	3.33	9.54	<.23	<.12	21.19	98.88	0.00	1.93	0.06	0.20	0.80	3.00
C387-6	Cumulate	11	C 7257		<.11	60.75	0.62	<.14	5.60	18.08	<.24	<.13	15.45	100.50	0.00	1.88	0.11	0.40	0.60	3.00
C387-6	Cumulate	13	C 7170	in ol	0.75	19.06	39.73	<.15	11.21	14.95	0.34	1.04	12.50	99.59	0.02	0.71	0.27	0.39	0.59	3.00
C387-6	Cumulate	14	C 7173	in ol	0.17	60.53	1.19	<.14	8.02	9.47	0.37	<.13	20.93	100.67	0.00	1.82	0.15	0.20	0.79	3.00
C387-6	Cumulate	14	R 7174	in ol	0.18	60.11	1.53	<.14	7.51	10.45	<.24	<.13	20.38	100.17	0.00	1.82	0.14	0.22	0.78	3.00
C387-29	Cumulate	1	C 7103		<.12	0.82	<.13	<.15	69.70	26.62	4.37	<.14	0.62	102.13	0.00	0.04	1.96	0.83	0.03	3.00
C387-29	Cumulate	3	C 7131		<.12	0.32	<.13	<.15	69.82	30.70	0.39	<.14	0.31	101.53	0.00	0.01	1.99	0.97	0.02	3.00
SW-6	Cumulate		C		0.00	62.53	0.11	0.00	4.08	17.06	0.00	0.00	16.22	100.00	0.00	1.92	0.08	0.37	0.63	3.00
SW-6	Cumulate	1	C 3935		0.00	60.90	<.12	<.14	5.61	18.23	<.24	<.12	15.27	100.00	0.00	1.89	0.11	0.40	0.60	3.00
SW-6	Cumulate	1	R 3936		0.00	61.12	<.12	<.14	5.39	18.16	<.24	<.13	15.33	100.00	0.00	1.89	0.11	0.40	0.60	3.00
SW-7	Cumulate		C		0.00	59.13	0.76	0.19	6.07	19.58	0.00	0.19	14.08	100.00	0.00	1.86	0.12	0.44	0.56	3.00
SW-7	Cumulate		C		0.13	59.64	0.41	0.11	5.73	19.80	0.00	0.00	14.18	100.00	0.00	1.87	0.12	0.44	0.56	3.00
SW-11	Cumulate		C		0.33	59.22	0.45	0.14	4.67	22.63	0.22	0.16	12.18	100.00	0.01	1.88	0.10	0.51	0.49	3.00
SW-11	Cumulate		C		16.35	11.71	0.16	0.44	28.88	31.32	0.00	0.24	10.90	100.00	0.41	0.46	0.72	0.86	0.54	3.00
SW-11	Cumulate		C		50.13	1.01	0.30	0.35	7.55	34.43	0.21	0.35	3.66	97.99	0.91	0.03	0.13	0.70	0.20	1.99
SW-11	Cumulate		C		49.62	0.80	0.27	0.42	8.02	34.49	0.00	0.37	5.69	100.01	0.90	0.02	0.15	0.70	0.21	2.00
SW-15	Cumulate	NW-3	C	in cpx	0.28	63.61	0.00	0.00	4.89	10.34	0.00	0.00	20.88	100.00	0.01	1.90	0.09	0.22	0.79	3.00
SW-15	Cumulate	NW-3	C	in pl	0.00	61.24	0.22	0.00	5.26	17.45	0.00	0.00	15.83	100.00	0.00	1.89	0.10	0.38	0.62	3.00
SW-15	Cumulate	NW-3	C		0.00	60.53	0.60	0.00	5.42	18.22	0.00	0.00	15.24	100.01	0.00	1.88	0.11	0.40	0.60	3.00
SW-15	Cumulate	NW-3	R		0.11	60.41	0.72	0.12	5.42	17.38	0.00	0.00	15.83	99.99	0.00	1.87	0.11	0.38	0.62	3.00
SW-15	Cumulate	NW-3	C	in opx	0.26	62.76	0.00	0.00	5.55	11.21	0.00	0.00	20.22	100.00	0.01	1.88	0.11	0.24	0.77	3.00
AK-26e	Am-grabbo	2	C 7534		9.74	6.19	<.13	0.25	47.86	36.42	<.27	0.34	3.80	104.61	0.25	0.25	1.24	1.05	0.19	3.00
AK-26e	Am-grabbo	2	R 7535		11.56	7.33	<.13	0.31	40.69	40.52	<.27	<.14	2.18	102.60	0.31	0.30	1.08	1.19	0.11	3.00
AK-26e	Am-grabbo	7	C 7596		22.60	4.80	<.13	0.43	20.49	49.26	<.27	0.43	2.11	100.12	0.61	0.20	0.56	1.49	0.11	3.00
AK-26e	Am-grabbo	8	C 7606	in am	10.47	7.31	<.13	0.47	42.89	34.63	<.27	0.16	4.88	100.81	0.28	0.30	1.13	1.02	0.26	3.00
AK-26e	Am-grabbo	9	C 7612	in am	11.04	7.84	<.13	0.26	41.10	37.44	<.27	0.22	3.55	101.46	0.29	0.32	1.09	1.10	0.19	3.00
AK-26e	Am-grabbo	12	C 7626	in pl	8.61	4.30	<.13	<.18	50.69	38.19	<.27	0.33	1.57	103.69	0.23	0.18	1.36	1.14	0.08	3.00
AK-26e	Am-grabbo	12	R 7627	in pl	8.80	4.37	<.13	0.19	50.82	38.58	<.28	0.28	1.68	104.72	0.23	0.18	1.35	1.14	0.09	3.00

See Appendix 1 and 2 for samples and analytical method; Total# is original total (wt %)
Fe_2O_3-FeO are calculated on the basis of AB_2O_4 (spinel) and ABO_3 (ilmenite) stoichiometry; T.Cation is cations based on 4 oxygens (spinel) and 3 oxygens (ilmenite)

Table A 4-7a Representative analyses of Al-Ti-Fe oxides from 14 SFVF granulite xenoliths and 1 andesite

Sample	Types	No.point	No.A0	TiO_2	Al_2O_3	Cr_2O_3	V_2O_3	Fe_2O_3	FeO	NiO	MnO	MgO	Total#	Ti	Al	Fe^{3+}	Fe^{2+}	Mg	T.Cation
C160-12	Andesite	1	C 4536	1.74	3.36	<.13	0.23	60.79	31.38	<.27	0.15	0.79	98.44	0.05	0.15	1.74	1.00	0.04	3.00
C160-12	Andesite	2	C 4537	31.33	1.47	0.41	0.31	1.97	56.93	<.27	<.14	0.94	93.36	0.93	0.07	0.06	1.87	0.06	3.00
C160-12	Andesite	5	C 4553	15.01	4.32	<.13	0.35	37.68	42.43	<.28	0.34	2.46	102.59	0.40	0.18	1.01	1.26	0.13	3.00
C160-12	Andesite	5	R 4554	15.25	4.52	<.13	0.49	36.94	42.71	<.27	0.40	2.44	102.76	0.41	0.19	0.98	1.27	0.13	3.00
C160-12	Andesite	4	C 4551	47.31	0.24	<.13	<.29	11.11	37.95	<.27	0.37	2.36	99.34	0.89	0.01	0.21	0.80	0.09	2.00
C160-12	Andesite	7	C 4559	48.41	0.15	<.13	<.30	9.87	38.67	<.27	0.39	2.50	100.00	0.91	0.00	0.18	0.80	0.09	2.00
C160-12	Andesite	7	R 4560	47.53	0.20	<.13	<.29	12.14	38.03	<.26	0.36	2.44	100.70	0.88	0.01	0.23	0.79	0.09	2.00
C160-12	Andesite	11	C 4575	49.12	<.12	<.13	<.30	8.87	37.76	<.27	0.45	3.35	99.54	0.92	0.00	0.17	0.78	0.12	2.00
C160-12	Andesite	11	R 4576	48.81	0.25	<.13	<.30	9.50	37.76	<.27	0.50	3.16	99.97	0.91	0.01	0.18	0.78	0.12	2.00
AK-42g	Cumulate?	1	C 7780	1.03	54.61	5.18	<.14	6.10	13.02	0.57	<.14	17.93	98.44	0.02	1.73	0.12	0.29	0.72	3.00
AK-42g	Cumulate?	1	C* 7781	1.06	54.58	5.53	0.17	5.57	13.01	0.67	0.14	17.83	98.57	0.02	1.72	0.11	0.29	0.71	3.00
AK-35f	Mafic	3	C 3426	10.90	7.14	0.35	0.36	41.76	37.12	<.27	0.21	3.61	101.45	0.29	0.30	1.11	1.09	0.19	3.00
AK-35f	Mafic	4	C 3427	<.12	3.58	<.12	<.14	52.53	25.09	<.27	<.14	0.60	81.80	0.00	0.19	1.81	0.96	0.04	3.00
AK-35f	Mafic	5	C 3451	10.23	7.01	0.42	0.48	43.60	36.91	<.27	0.32	3.45	102.41	0.27	0.29	1.15	1.08	0.18	3.00
AK-35f	Mafic	5	R 3454	8.81	8.19	0.43	0.38	43.53	34.64	<.27	0.26	3.74	99.99	0.24	0.34	1.16	1.03	0.20	3.00
AK-35f	Mafic	9	C 3485 in pl	10.38	4.05	0.40	0.36	46.76	36.74	<.28	0.29	3.30	102.28	0.28	0.17	1.25	1.09	0.18	3.00
AK-35f	Mafic	10	C 3491 in pl	9.59	6.95	0.44	0.51	45.17	36.27	<.27	0.32	3.55	102.80	0.25	0.29	1.19	1.06	0.18	3.00
C160-3	Mafic	1	C 7440	31.28	1.09	0.50	<.25	8.10	54.91	<.27	<.14	3.36	99.24	0.86	0.05	0.22	1.68	0.18	3.00
C160-3	Mafic	1	R 7442	31.61	1.18	0.47	0.36	7.09	55.79	<.27	<.14	3.07	99.57	0.87	0.05	0.19	1.70	0.17	3.00
C160-3	Mafic	6	C 7461	32.54	2.00	0.42	0.43	3.93	56.40	<.27	<.14	3.20	98.92	0.89	0.09	0.11	1.72	0.17	3.00
C160-3	Mafic	6	R 7462	16.55	4.66	0.71	0.38	32.61	39.73	<.27	0.16	4.69	99.47	0.45	0.20	0.88	1.19	0.25	3.00
C160-3	Mafic	12	C 7496 in cpx	7.45	4.34	3.38	0.34	47.73	35.48	<.27	0.17	2.26	101.16	0.20	0.19	1.30	1.08	0.12	3.00
C160-3	Mafic	15	C 7510 in opx	10.74	3.80	2.77	0.58	44.63	37.08	<.27	0.35	3.48	103.42	0.28	0.16	1.18	1.09	0.18	3.00
C160-3	Mafic	19	C 7522	31.27	0.98	0.41	0.38	7.19	57.08	<.26	<.14	1.94	99.25	0.87	0.04	0.20	1.76	0.11	3.00
C160-3	Mafic	19	R 7523	31.33	1.59	0.37	<.25	7.06	55.91	<.27	0.17	2.65	99.07	0.86	0.07	0.19	1.71	0.14	3.00
C160-8	Mafic	3	C 3983 in opx	28.49	0.67	0.23	0.39	11.94	54.35	<.27	<.14	1.69	97.76	0.81	0.03	0.34	1.71	0.10	3.00
C160-8	Mafic	4	C 3996	29.63	1.12	0.16	0.54	10.78	50.95	<.27	<.14	4.67	97.84	0.82	0.05	0.30	1.56	0.25	3.00
C160-8	Mafic	4	R 3997	30.01	0.96	<.13	<.25	10.69	52.62	<.27	<.14	3.84	98.13	0.83	0.04	0.30	1.62	0.21	3.00
C160-8	Mafic	13	C 4040	29.78	0.90	0.37	0.67	9.12	54.50	<.26	0.21	2.29	97.84	0.84	0.04	0.26	1.70	0.13	3.00
C160-8	Mafic	13	R 4043	6.83	3.45	0.94	0.73	53.34	32.96	<.27	<.14	3.67	101.92	0.18	0.15	1.44	0.99	0.20	3.00
C160-8	Mafic	14	C 4047 in opx	5.56	2.49	0.68	0.58	56.83	32.70	<.27	<.14	2.92	101.75	0.15	0.11	1.55	0.99	0.16	3.00
C160-8	Mafic	17	C 4050 in opx	5.29	2.75	0.49	0.82	57.37	33.23	<.28	0.18	2.51	102.65	0.14	0.12	1.56	1.00	0.14	3.00
C160-8	Mafic	23	C 4082	31.50	0.81	0.23	0.76	42.96	23.94	<.26	<.14	2.46	102.66	0.58	0.02	0.79	0.49	0.09	2.00

See Appendices 1 and 2 for samples and analytical method; Total# is original total (wt %)
Fe_2O_3-FeO are calculated on the basis of AB_2O_4 (spinel) and ABO_3 (ilmenite) stoichiometry; T.Cation is total cations based on 4 oxygens (spinel) and 3 oxygens (ilmenite)

Table A 4-7a Representative analyses of Al-Ti-Fe oxides from 14 SFVF granulite xenoliths and 1 andesite

Sample	Types	No.point	No.A0	TiO_2	Al_2O_3	Cr_2O_3	V_2O_3	Fe_2O_3	FeO	NiO	MnO	MgO	Total#	Ti	Al	Fe^{3+}	Fe^{2+}	Mg	T.Cation
C160-10	Mafic	1	C 7987	6.92	4.06	0.74	0.69	53.79	33.19	<.27	0.20	3.81	103.40	0.18	0.17	1.43	0.98	0.20	3.00
C160-10	Mafic	3	C 7996 in pl	29.47	1.42	<.13	0.55	9.87	56.48	<.27	<.14	1.25	99.03	0.82	0.06	0.28	1.75	0.07	3.00
C160-10	Mafic	7	C 8002	29.42	2.20	<.13	0.38	8.36	52.45	<.27	<.14	3.34	96.15	0.83	0.10	0.24	1.64	0.19	3.00
C160-10	Mafic	11	C 8015 in opx	27.81	4.03	<.13	0.30	9.69	53.57	<.27	<.14	2.13	97.52	0.77	0.18	0.27	1.66	0.12	3.00
C160-10	Mafic	18	C 8028 in opx	28.73	0.74	0.16	0.53	11.90	53.21	<.27	<.14	2.62	97.88	0.81	0.03	0.33	1.66	0.15	3.00
C160-10	Mafic	19	C 8030	35.66	1.09	<.13	0.55	1.18	52.09	<.26	<.13	7.63	98.19	0.95	0.05	0.03	1.55	0.40	3.00
C160-10	Mafic	25	C 8049 in opx	6.28	4.89	0.27	0.55	53.14	35.08	<.27	0.32	2.04	102.55	0.17	0.21	1.43	1.05	0.11	3.00
C160-10	Mafic	28	C 8058 in cpx	28.15	0.96	0.29	0.24	12.86	53.07	<.26	0.21	2.27	98.06	0.79	0.04	0.36	1.66	0.13	3.00
C387-11	Mafic	1	C 7269	1.47	52.93	<.12	<.15	10.72	25.93	<.25	0.18	10.47	101.69	0.03	1.72	0.22	0.60	0.43	3.00
C387-11	Mafic	5	C 7275	0.30	56.11	<.12	<.14	8.80	26.19	<.25	<.13	10.02	101.42	0.01	1.81	0.18	0.60	0.41	3.00
C387-11	Mafic	5	R 7276	0.40	56.61	<.12	<.14	8.53	26.11	<.24	<.13	10.28	101.93	0.01	1.81	0.17	0.59	0.42	3.00
C387-11	Mafic	10	C 7299	17.73	11.51	<.13	0.25	25.30	36.29	<.27	<.14	8.53	99.61	0.45	0.46	0.64	1.02	0.43	3.00
C387-11	Mafic	18	C 7340	21.57	9.44	<.13	<.22	21.34	43.77	<.27	0.42	6.10	102.64	0.54	0.37	0.54	1.23	0.30	3.00
C387-11	Mafic	18	R 7341	23.19	6.87	<.13	<.23	20.77	44.18	<.27	0.27	6.41	101.69	0.60	0.28	0.53	1.26	0.33	3.00
C387-11	Mafic	26	C 7385 in sp	49.88	1.72	<.13	<.30	8.41	36.84	<.26	0.16	4.40	101.41	0.90	0.05	0.15	0.74	0.16	2.00
C387-11	Mafic	29	C 7389 in sp	50.19	1.04	<.13	<.30	9.08	34.43	<.26	0.48	5.73	100.96	0.90	0.03	0.16	0.69	0.20	2.00
C387-11	Mafic	29	R 7390 in sp	50.35	1.12	<.13	<.30	9.17	34.34	<.26	0.50	5.86	101.33	0.90	0.03	0.16	0.68	0.21	2.00
C387-11	Mafic	32	C 7393 in sp	50.57	1.97	<.13	<.30	8.31	33.43	<.26	0.54	6.45	101.27	0.90	0.05	0.15	0.66	0.23	2.00
C387-11	Mafic	32	R 7394 in sp	50.60	1.66	<.13	<.30	9.60	33.07	<.26	0.45	6.72	102.10	0.89	0.05	0.17	0.65	0.23	2.00
C387-11	Mafic	48	C 7422	51.39	1.17	<.13	<.30	7.30	37.56	<.26	0.46	4.59	102.47	0.92	0.03	0.13	0.75	0.16	2.00
SW-5	Mafic		C	6.50	3.26	0.14	0.63	52.82	34.32	0.00	0.44	1.89	100.00	0.18	0.14	1.47	1.06	0.10	3.00
SW-5	Mafic		C	9.62	3.79	0.00	0.75	46.19	37.40	0.00	0.34	1.90	99.99	0.27	0.17	1.28	1.15	0.10	3.00
SW-10	Mafic		C	8.27	3.38	0.61	0.30	51.26	29.81	0.00	0.50	5.86	99.99	0.22	0.14	1.38	0.89	0.31	3.00
SW-10	Mafic		C	32.19	1.18	0.65	0.35	6.07	56.51	0.00	0.00	3.05	100.00	0.88	0.05	0.17	1.71	0.17	3.00
SW-10	Mafic		C	31.22	1.64	0.17	0.53	7.42	56.32	0.00	0.16	2.53	99.99	0.85	0.07	0.20	1.71	0.14	3.00
AK-43b	Interm	2	C 3312	9.17	8.92	0.15	0.21	46.40	33.03	<.27	0.70	5.67	104.25	0.23	0.35	1.17	0.93	0.28	3.00
AK-43b	Interm	2	R 3313	9.90	11.08	<.13	0.36	43.12	33.31	<.27	0.57	6.34	104.69	0.25	0.43	1.07	0.92	0.31	3.00
AK-43b	Interm	12	C 3343	1.64	12.37	<.13	0.21	54.82	29.90	<.28	0.20	3.55	102.69	0.04	0.50	1.41	0.86	0.18	3.00
AK-43b	Interm	15	C 3363	18.47	3.70	<.13	<.22	30.53	47.50	<.27	0.21	1.04	101.45	0.50	0.16	0.83	1.44	0.06	3.00
AK-43b	Interm	16	C 3368	2.68	16.06	0.24	0.20	49.71	29.03	<.27	0.44	5.18	103.54	0.07	0.62	1.23	0.80	0.25	3.00
AK-43b	Interm	21	C 3389	0.00	0.66	<.13	0.16	66.36	30.39	<.27	<.14	<.16	97.57	0.00	0.03	1.96	1.00	0.00	3.00
AK-43b	Interm	22	C 3279	13.86	13.55	<.13	<.20	30.79	36.26	0.31	0.61	6.26	101.64	0.35	0.53	0.77	1.01	0.31	3.00
AK-43b	Interm	22	R 3280	13.22	14.30	<.13	<.20	30.67	35.12	<.27	0.68	6.65	100.63	0.33	0.56	0.77	0.98	0.33	3.00

See Appendices 1 and 2 for samples and analytical method; Total# is original total (wt %)
Fe_2O_3-FeO are calculated on the basis of AB_2O_4 (spinel) and ABO_3 (ilmenite) stoichiometry; T.Cation is total cations based on 4 oxygens (spinel) and 3 oxygens (ilmenite)

Table A 4-7a Representative analyses of Al-Ti-Fe oxides from 14 SFVF granulite xenoliths and 1 andesite

Sample	Types	No.point	No.A0	TiO_2	Al_2O_3	Cr_2O_3	V_2O_3	Fe_2O_3	FeO	NiO	MnO	MgO	Total#	Ti	Al	Fe^{3+}	Fe^{2+}	Mg	T.Cation
AK-43c	Interm	2	C 7796	7.31	9.82	<.13	<.18	48.13	31.40	<.27	0.68	5.40	102.75	0.19	0.39	1.23	0.89	0.27	3.00
AK-43c	Interm	10	C 7846	<.13	0.56	0.13	<.15	71.71	31.36	<.28	<.14	0.76	104.53	0.00	0.02	1.97	0.96	0.04	3.00
AK-43c	Interm	10	R 7847	0.46	1.82	<.13	<.15	69.06	30.36	<.28	<.14	1.59	103.29	0.01	0.08	1.90	0.93	0.09	3.00
AK-43c	Interm	11	C 7852	12.24	2.42	0.22	<.20	46.70	38.15	<.28	0.60	3.41	103.74	0.33	0.10	1.24	1.13	0.18	3.00
C387-28	Interm	1	C 4344	7.43	5.11	<.13	0.26	52.95	36.20	<.28	0.25	2.50	104.71	0.20	0.21	1.39	1.06	0.13	3.00
C387-28	Interm	1	R 4346	6.99	5.34	<.13	0.31	52.16	34.87	<.28	0.23	2.72	102.61	0.19	0.22	1.39	1.04	0.14	3.00
C387-28	Interm	4	C 4369	4.86	5.76	<.13	0.30	56.82	34.58	<.28	0.19	2.09	104.59	0.13	0.24	1.50	1.01	0.11	3.00
C387-28	Interm	9	C 4403	5.91	6.06	<.13	<.18	53.95	35.96	<.28	0.22	1.68	103.77	0.16	0.25	1.43	1.06	0.09	3.00
SW-14	Interm	NW-4	C	37.55	1.31	0.52	0.85	27.53	27.56	0.00	0.22	3.71	100.01	0.70	0.04	0.51	0.57	0.14	2.00
SW-14	Interm	NW-4	R	37.97	1.26	0.44	0.67	26.80	27.97	0.00	0.14	3.79	99.99	0.70	0.04	0.50	0.58	0.14	2.00
SW-14	Interm	NW-4	C	35.02	2.40	0.42	0.62	29.52	28.37	0.00	0.21	2.25	99.98	0.65	0.07	0.55	0.59	0.08	2.00
SW-14	Interm	NW-4	C	37.83	1.68	0.45	0.63	25.00	30.81	0.00	0.28	2.23	100.00	0.71	0.05	0.47	0.64	0.08	2.00
AK-41g	Felsic	2	C 3177	7.05	1.17	<.13	<.18	55.80	36.68	<.28	1.90	<.16	102.59	0.20	0.05	1.56	1.14	0.00	3.00
AK-41g	Felsic	6	C 3268	7.37	0.97	<.13	<.18	54.89	37.05	<.27	1.24	0.18	101.69	0.21	0.04	1.54	1.16	0.01	3.00
AK-41g	Felsic	6	R 3269	7.67	0.90	<.13	<.18	55.32	36.78	<.27	2.50	<.16	103.16	0.21	0.04	1.54	1.13	0.00	3.00
AK-41g	Felsic	3	C 3220	51.07	0.22	<.13	<.30	7.76	38.75	<.28	7.08	<.15	104.88	0.93	0.01	0.14	0.78	0.00	2.00
AK-41g	Felsic	3	R 3225	46.40	0.30	<.13	<.29	8.66	35.56	<.27	5.83	0.14	96.88	0.91	0.01	0.17	0.78	0.01	2.00
AK-41g	Felsic	3a	C 3232	48.10	0.15	<.13	<.29	8.76	35.86	<.27	7.30	<.14	100.18	0.91	0.00	0.17	0.76	0.00	2.00
AK-41g	Felsic	11	C1 4123 in bi	46.79	0.23	<.13	<.29	8.18	35.39	<.27	6.60	<.14	97.19	0.92	0.01	0.16	0.77	0.00	2.00
AK-41g	Felsic	11	C2 4124 in bi	47.04	0.29	<.13	<.29	6.76	36.28	<.26	5.94	<.14	96.30	0.93	0.01	0.13	0.80	0.00	2.00
C387-10	Felsic	1	C 4437	18.19	0.40	<.13	0.23	33.26	48.06	<.27	<.14	<.15	100.13	0.52	0.02	0.94	1.52	0.00	3.00
C387-10	Felsic	1	R 4440	21.63	0.97	<.13	<.22	26.53	47.73	<.27	<.14	2.13	98.99	0.61	0.04	0.74	1.49	0.12	3.00
C387-10	Felsic	5	C 4457	14.35	1.39	0.13	<.20	42.05	44.69	0.30	0.19	0.34	103.46	0.39	0.06	1.15	1.36	0.02	3.00
C387-10	Felsic	5	R 4458	13.84	1.50	<.13	<.20	40.98	43.90	<.27	<.14	0.27	100.50	0.39	0.07	1.15	1.37	0.02	3.00
C387-10	Felsic	7	C 4467	18.16	1.03	<.13	<.21	31.57	47.14	<.27	0.18	0.15	98.24	0.52	0.05	0.91	1.51	0.01	3.00
C387-10	Felsic	7	R 4468	18.55	1.63	<.13	<.21	31.40	47.66	<.27	0.32	0.37	99.93	0.52	0.07	0.88	1.49	0.02	3.00
SW-12	Felsic		C	8.57	7.33	0.00	0.57	44.18	37.54	0.00	0.00	1.80	99.99	0.23	0.31	1.20	1.14	0.10	3.00
SW-12	Felsic		C	22.60	6.98	0.00	0.43	17.69	50.12	0.00	0.35	1.84	100.01	0.61	0.29	0.48	1.50	0.10	3.00
SW-12	Felsic		C	6.51	5.75	0.00	0.36	50.18	35.30	0.00	0.20	1.70	100.00	0.18	0.25	1.38	1.08	0.09	3.00
SW-12	Felsic		C	12.91	6.38	0.00	0.62	37.28	40.28	0.00	0.00	2.54	100.01	0.35	0.27	1.01	1.21	0.14	3.00
SW-9	Felsic ?		C	16.41	5.26	0.17	0.31	31.22	45.31	0.00	0.20	1.11	99.99	0.45	0.23	0.86	1.38	0.06	3.00
SW-9	Felsic ?		C	14.42	1.20	0.00	0.35	39.54	43.84	0.00	0.32	0.33	100.00	0.41	0.05	1.12	1.38	0.02	3.00
SW-9	Felsic ?		C	12.96	7.43	0.00	0.24	35.66	42.01	0.00	0.42	1.28	100.00	0.35	0.32	0.97	1.27	0.07	3.00

See Appendices 1 and 2 for samples and analytical method; Total# is original total (wt %)

Fe_2O_3-FeO are calculated on the basis of AB_2O_4 (spinel) and ABO_3 (ilmenite) stoichiometry; T.Cation is total cations based on 4 oxygens (spinel) and 3 oxygens (ilmenite)

Table A 4-8a Respresentative analyses of Amphibole and Biotite from 16 SFVF xenoliths and andesite and amphibole-gabbro

Sample	Types	Phase	No.Point	No.A0	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO*	MnO	MgO	CaO	Na_2O	K_2O	Mg#*	Total#	T.Cation
AK-21a	Cumulate-ultra	Am	1	C 3542	41.52	4.45	14.35	<.13	12.14	<.13	13.07	12.10	2.37	0.52	65.7	100.51	15.73
AK-21a	Cumulate-ultra	Am	1	R 3544	40.69	4.37	14.42	<.12	12.68	<.13	13.28	11.88	2.47	0.55	65.1	100.34	15.82
C160-14	Cumulate-ultra	Am	1	C 4241	40.80	4.56	16.27	<.13	11.38	<.13	13.03	11.57	2.47	0.77	67.1	100.85	15.74
C160-14	Cumulate-ultra	Am	1	R 4242	40.56	4.27	15.68	<.13	10.77	<.13	12.84	11.28	2.36	0.84	68.0	98.60	15.71
C387-13	Cumulate-ultra	Am	1	C1 7968	40.40	<.12	23.80	<.12	16.48	0.14	13.14	6.04	<.19	<.06	58.7	104.68	15.31
C387-13	Cumulate-ultra	Am	1	C2 7969	40.07	<.12	23.68	<.12	17.37	<.12	13.10	5.79	<.19	<.06	57.3	105.01	15.34
C387-13	Cumulate-ultra	Am	1	R 7970	41.02	<.12	24.78	<.12	15.04	<.12	11.41	7.75	<.19	<.06	57.5	102.87	15.19
C387-13	Cumulate-ultra	Am	2	C 7971	40.43	<.12	23.54	<.12	16.61	0.12	13.57	5.73	<.19	<.06	59.3	105.66	15.33
C387-13	Cumulate-ultra	Am	2	R 7972	41.11	<.12	24.06	<.12	15.92	0.18	12.59	6.14	<.19	<.06	58.5	103.77	15.23
C387-13	Cumulate-ultra	Am	4	C 7977	39.96	<.12	23.58	<.12	17.82	0.15	11.80	6.69	<.19	<.06	54.1	104.24	15.32
SW-1	Cumulate-ultra	Am	C		39.44	4.61	14.43	0.15	12.32	0.00	12.40	11.67	2.59	0.85	64.2	98.47	15.85
SW-1	Cumulate-ultra	Am	C		40.09	4.47	14.26	<.12	12.39	0.00	12.57	11.74	2.68	0.80	64.4	99.00	15.85
SW-1	Cumulate-ultra	Am	C		39.64	4.65	14.84	<.12	12.21	0.00	12.42	11.84	2.59	0.81	64.4	99.00	15.84
SW-2	Cumulate-ultra	Am	C		39.99	4.57	14.64	<.12	13.36	0.00	12.02	11.65	2.60	0.88	61.6	99.71	15.84
SW-2	Cumulate-ultra	Am	R		39.29	4.67	14.40	<.12	13.10	0.17	12.11	11.40	2.84	0.82	62.2	98.80	15.91
SW-2	Cumulate-ultra	Am	C		39.44	4.43	14.25	0.15	13.18	0.18	11.97	11.37	2.72	0.80	61.8	98.50	15.88
SW-3	Cumulate-ultra	Am	C		39.23	3.84	14.64	0.15	11.71	0.14	13.06	11.83	2.31	1.11	66.5	98.08	15.93
SW-3	Cumulate-ultra	Am	C		38.93	4.80	15.10	0.15	11.84	0.00	12.70	11.96	2.55	0.88	65.7	98.92	15.88
SW-3	Cumulate-ultra	Am	C		39.71	4.19	14.76	<.12	11.86	0.00	13.11	11.82	2.53	1.02	66.3	99.00	15.90
SW-4	Cumulate-ultra	Am	C		39.90	4.62	14.76	<.12	10.74	0.14	13.76	12.07	2.53	0.67	69.6	99.20	15.85
SW-4	Cumulate-ultra	Am	C		39.42	4.70	15.53	0.15	10.72	0.00	13.50	12.18	2.56	0.72	69.2	99.49	15.86
SW-4	Cumulate-ultra	Am	R		39.11	4.49	15.15	0.21	11.06	0.00	13.38	11.98	2.41	0.72	68.3	98.50	15.86
AK-26e	Am-gabbro	Am	2	C1 7542	41.83	4.44	14.53	<.13	11.70	<.13	13.97	12.07	2.56	0.42	68.0	101.52	15.78
AK-26e	Am-gabbro	Am	2	C2 7543	41.84	4.13	14.47	<.13	12.00	<.13	13.76	12.05	2.40	0.38	67.1	101.02	15.75
AK-26e	Am-gabbro	Am	2	R 7544	41.87	3.64	13.90	<.13	12.17	<.13	13.87	11.57	2.34	0.34	67.0	99.70	15.75
AK-26e	Am-gabbro	Am	7	C 7578	42.00	3.41	14.69	<.12	11.96	<.12	13.99	11.85	2.33	1.17	67.6	101.41	15.86
AK-26e	Am-gabbro	Am	7	R 7579	40.07	3.08	14.30	<.12	13.61	0.15	11.77	10.56	2.23	0.51	60.6	96.26	15.73
AK-26e	Am-gabbro	Am	12	C 7613	41.61	4.36	14.39	<.13	11.69	<.13	13.53	12.07	2.46	0.42	67.4	100.52	15.74
AK-26e	Am-gabbro	Am	16	C 7625	42.08	4.09	13.88	<.13	13.68	<.13	13.51	11.75	2.16	0.95	63.8	102.11	15.80
AK-35	Cumulate	Am	2	C1 7659	41.19	3.65	14.67	<.13	9.91	<.13	13.83	12.06	2.19	0.84	71.3	98.35	15.75
AK-35	Cumulate	Am	2	C2 7660	41.66	3.73	14.98	<.12	10.38	<.13	14.31	12.11	2.24	0.87	71.1	100.27	15.78
AK-35	Cumulate	Am	2	R 7661	41.77	4.01	15.08	<.12	10.20	<.12	14.12	11.97	2.38	0.74	71.2	100.28	15.75

See Appendix 1 and 2 for samples and analytical method

Total Fe reported as FeO*; Mg#* = 100 x Mg/(Mg + Fe), where Fe is total Fe as Fe^{2+}; Total# is original total (wt %); T.Cation is original total based 23 oxygens

Table A 4-8a Respresentative analyses of Amphibole and Biotite from 16 SFVF xenoliths and andesite and amphibole-gabbro (cont)

Sample	Types	Phase	No.Point	No.A0		SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO*	MnO	MgO	CaO	Na_2O	K_2O	Mg#*	Total#	T.Cation
AK-35	Cumulate	Am	10	C 7679	in py	41.82	4.21	15.31	0.19	9.09	<.13	13.87	12.81	1.84	1.36	73.1	100.47	15.69
AK-35	Cumulate	Am	6	C 7671		41.69	3.56	14.58	0.15	9.87	<.13	14.42	12.40	2.11	0.97	72.3	99.76	15.78
AK-35	Cumulate	Am	6	R 7672		41.82	3.92	14.71	0.17	9.82	<.13	14.09	12.10	2.05	0.83	71.9	99.53	15.69
AK-35	Cumulate	Am	12	C 7682	in py	41.57	3.93	14.92	<.13	9.90	<.13	14.30	12.48	1.90	1.04	72.0	100.05	15.74
AK-35	Cumulate	Am	13	C 7689		40.09	5.82	15.32	<.13	11.38	<.13	13.64	12.73	2.30	0.86	68.1	102.13	15.81
AK-35	Cumulate	Am	18	C 7705		40.93	4.69	15.88	<.13	8.05	<.13	14.79	12.66	2.07	0.69	76.6	99.75	15.70
AK-42h	Cumulate	Am	2	C 2551	in cpx	41.21	4.52	15.92	<.12	10.72	<.13	12.90	11.67	2.87	0.49	68.2	100.29	15.74
AK-42h	Cumulate	Am	6	L1 2562	inter	41.48	6.26	14.96	<.13	7.72	<.13	16.06	11.38	2.76	0.27	78.8	100.87	15.70
AK-42h	Cumulate	Am	6	L2 2563	inter	41.77	6.14	14.92	<.13	8.11	<.13	15.61	11.18	2.71	0.20	77.4	100.63	15.64
AK-42h	Cumulate	Am	6	R 2565	inter	44.76	4.28	14.23	<.12	8.41	<.13	8.86	17.30	1.30	0.18	65.3	99.33	15.16
AK-42h	Cumulate	Am	8	C 2570		41.51	6.00	15.70	<.12	9.99	<.12	14.38	11.57	2.94	0.47	72.0	102.56	15.74
AK-42h	Cumulate	Am	8	R 2571		41.24	4.19	15.79	<.13	11.18	<.13	12.76	11.84	2.67	0.33	67.1	100.00	15.71
AK-42h	Cumulate	Am	9	C 2572	inter	41.51	4.16	16.33	<.12	11.77	<.12	11.84	11.48	2.84	0.41	64.2	100.34	15.68
AK-42h	Cumulate	Am	9	R 2573	inter	40.85	4.59	15.89	<.13	10.99	<.13	13.00	11.73	2.56	0.36	67.8	99.98	15.70
AK-42h	Cumulate	Am	14	C 3411		40.71	4.10	16.74	0.15	10.76	<.13	13.00	11.44	3.01	<.06	68.3	99.90	15.74
AK-42h	Cumulate	Am	14	R 3412		40.57	3.74	16.22	<.12	10.70	<.12	13.15	11.50	2.94	<.06	68.7	98.82	15.76
C387-6	Cumulate	Am	1	C 7182	in opx	40.82	6.38	15.21	<.13	8.01	<.13	15.12	11.42	2.63	0.81	77.1	100.41	15.72
C387-6	Cumulate	Am	1	R 7183	in opx	41.30	5.97	14.22	<.12	8.20	<.12	15.50	11.74	2.61	0.75	77.1	100.28	15.75
C387-6	Cumulate	Am	3	C 7221	in opx	41.31	6.10	14.52	<.12	8.07	<.13	15.70	11.76	2.44	0.72	77.6	100.61	15.72
C387-6	Cumulate	Am	4	C 7222	in opx	41.18	5.81	14.40	<.12	8.64	<.13	15.31	11.58	2.55	0.64	76.0	100.12	15.73
C387-29	Cumulate	Am	1	C 7139	in cpx	42.82	2.99	15.35	0.68	6.23	<.12	16.03	12.51	2.34	1.53	82.1	100.47	15.82
C387-29	Cumulate	Am	2	C 7149	in cpx	42.86	2.80	15.09	0.50	6.37	<.13	15.95	12.35	2.20	1.41	81.7	99.53	15.78
AK-42g	Cumulate?	Am	4	C 7728		43.23	4.04	14.87	0.33	10.07	<.13	13.85	11.31	2.70	0.67	71.0	101.08	15.67
AK-42g	Cumulate?	Am	4	R 7729		43.07	4.22	14.76	0.40	9.67	<.12	14.20	11.42	2.60	0.77	72.4	101.12	15.68
AK-42g	Cumulate?	Am	6	C 7744	in py	43.12	4.09	14.86	0.41	9.54	<.12	14.24	11.21	2.64	0.88	72.7	100.98	15.68
AK-42g	Cumulate?	Am	8	C 7753	in py	43.20	3.82	14.61	0.35	9.19	<.13	14.45	11.34	2.56	0.65	73.7	100.17	15.66
AK-42g	Cumulate?	Am	12	C 7759		45.41	3.34	14.07	0.21	8.61	<.13	12.95	12.21	2.36	0.69	72.8	99.86	15.45
AK-42g	Cumulate?	Am	12	R 7760		42.88	4.06	14.46	0.26	9.30	<.13	14.44	11.32	2.60	0.59	73.5	99.92	15.67
AK-35f	Mafic	Am	1	C 3493		42.49	4.23	13.37	<.13	14.27	<.13	12.35	11.03	2.45	1.14	60.7	101.34	15.76
AK-35f	Mafic	Am	2	C 3495		41.25	4.04	13.37	<.13	14.48	<.13	11.67	10.78	2.49	1.19	59.0	99.27	15.80
AK-35f	Mafic	Am	2	R 3496		41.94	4.80	13.40	<.12	12.23	<.13	13.54	11.57	2.37	1.03	66.4	100.88	15.77
AK-35f	Mafic	Am	3	C 3497		41.60	4.34	13.23	<.12	14.38	<.13	11.73	10.92	2.51	1.27	59.3	99.98	15.79

See Appendix 1 and 2 for samples and analytical method

Total Fe reported as FeO*; Mg#* = 100 x Mg/(Mg + Fe), where Fe is total Fe as Fe^{2+}; Total# is original total (wt %); T.Cation is original total based 23 oxygens

Table A 4-8a Respresentative analyses of Amphibole and Biotite from 16 SFVF xenoliths and andesite and amphibole-gabbro (cont)

Sample	Types	Phase	No.Point	No.A0		SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO*	MnO	MgO	CaO	Na_2O	K_2O	Mg#*	Total#	T.Cation
C387-11	Mafic	Am	1	C 7304		47.75	3.34	14.51	<.12	16.23	0.15	7.00	6.61	3.70	1.87	43.5	101.17	15.34
C387-11	Mafic	Am	1	R 7307		47.83	0.81	8.41	<.13	11.31	<.13	11.69	18.90	0.85	0.10	64.8	99.90	15.44
SW-5	Mafic	Am	C			44.20	2.06	10.25	0.12	14.05	0.22	13.25	11.07	2.27	1.50	62.7	99.00	15.84
SW-5	Mafic	Am	C			42.60	2.32	9.64	0.00	15.89	0.27	13.28	11.33	2.02	1.26	59.8	98.60	15.94
SW-5	Mafic	Am	C			43.12	1.82	10.44	0.11	14.55	0.19	13.22	11.26	2.13	1.37	61.8	98.23	15.90
AK-41g	Felsic	Am	1	C1 3262		41.74	0.93	7.94	<.13	29.52	3.05	2.93	9.04	2.04	0.94	15.0	98.12	15.83
AK-41g	Felsic	Am	1	C2 3263		43.24	0.76	7.53	<.13	30.25	2.96	3.17	9.14	1.95	0.84	15.7	99.85	15.77
AK-41g	Felsic	Am	1	C3 3264		40.92	0.89	8.06	<.13	29.20	2.93	2.74	8.70	1.92	0.85	14.4	96.22	15.79
AK-41g	Felsic	Am	1	R 3265		43.30	0.96	7.91	<.13	30.38	3.06	2.95	9.38	2.14	0.90	14.8	100.98	15.80
C160-12	Andesite	Am	1	4543c		40.49	5.47	14.69		12.97		12.33	10.87	2.74	0.74	62.9	100.30	15.76
C160-12	Andesite	Am	i	4544r		40.09	5.53	14.35		11.99		13.25	11.08	2.56	0.76	66.3	99.62	15.78
SW-8		Am	C			40.80	5.00	13.34	0.00	11.83	0.00	12.96	11.46	2.72	0.97	66.1	99.20	15.80
AK-26e	Am-grabbo	Bi	1	C 7567		37.01	4.83	16.20	<.13	15.23	<.13	15.07	<.11	0.40	8.57	63.8	97.31	15.54
AK-26e	Am-grabbo	Bi	1	R 7568		36.40	5.09	16.38	<.13	14.28	<.13	15.07	<.11	0.40	8.41	65.3	96.03	15.51
C387-29	Cumulate	Bi	1	C 7140	in cpx	38.18	3.98	17.58	0.73	5.75	<.12	20.80	0.53	0.33	7.48	86.6	95.38	15.40
C160-8	Mafic	Bi	1	C 4083		36.14	5.99	14.76	<.13	16.51	<.13	12.13	<.11	<.20	8.64	56.7	94.17	15.34
C160-8	Mafic	Bi	1	R 4084		35.91	6.02	14.73	<.13	17.06	<.13	12.31	<.11	<.20	8.41	56.3	94.43	15.36
C160-10	Mafic	Bi	1	C 8036		37.69	6.07	16.29	<.13	16.20	<.13	13.08	<.11	<.20	8.95	59.0	98.28	15.32
C160-10	Mafic	Bi	1	R 8037		37.87	6.11	16.21	<.13	16.19	<.13	13.42	<.11	<.20	9.11	59.6	98.91	15.35
C160-10	Mafic	Bi	3	C 8041		36.94	5.93	14.82	<.13	15.49	<.13	12.89	0.71	<.20	8.30	59.7	95.07	15.30
C160-10	Mafic	Bi	3	R 8042		37.59	6.38	15.17	<.13	16.71	<.13	13.30	<.11	0.35	8.85	58.6	98.35	15.41
C160-10	Mafic	Bi	4	C 8043		37.56	6.18	15.30	<.13	16.00	<.13	13.77	<.11	<.21	8.98	60.5	97.79	15.38
AK-41g	Felsic	Bi	1	C 3189		35.54	4.22	13.03	<.13	31.20	1.11	3.79	<.11	<.21	8.25	17.8	97.14	15.46
AK-41g	Felsic	Bi	3	C1 3227		35.61	3.81	13.12	<.13	31.84	1.07	3.81	<.11	<.21	8.86	17.6	98.12	15.58
AK-41g	Felsic	Bi	3	C2 3229		35.03	3.48	15.57	<.13	30.93	1.25	3.82	<.11	<.21	8.60	18.0	98.68	15.55
AK-41g	Felsic	Bi	3	R 3228		35.54	4.41	13.30	<.13	32.10	1.05	3.93	<.11	<.22	8.86	17.9	99.20	15.57
AK-41g	Felsic	Bi	5	C 3241		36.14	3.03	12.81	<.13	32.37	1.19	3.88	<.11	<.22	8.70	17.6	98.11	15.60
AK-41g	Felsic	Bi	5	R 3242		38.18	3.21	13.23	<.13	28.85	1.10	3.39	<.11	0.60	8.46	17.3	97.02	15.37
AK-41g	Felsic	Bi	6	C 3256		34.48	3.15	13.88	<.13	31.81	1.11	3.55	<.11	<.22	8.35	16.6	96.33	15.60

See Appendix 1 and 2 for samples and analytical method

Total Fe reported as FeO*; Mg#* = 100 x Mg/(Mg + Fe), where Fe is total Fe as Fe^{2+}; Total# is original total (wt %); T.Cation is original total based 23 oxygens

Table A 4-9a Respresentative analyses of olivine from 11 SFVF xenoliths (10 cumulates and 1 granulite) and basalt, andesite and amphibole-gabbro

Sample	Types	No.Point	No.A0		SiO_2	FeO	MnO	MgO	NiO	Total#	Si	Fe	Mn	Mg	Ni	T.Cation	Fo
C387-13	Cumulate-ultra	1	C 7911		39.14	18.14	<.13	42.72	<.18	96.36	1.00	0.39		1.62		3.00	80.8
C387-13	Cumulate-ultra	1	R 7912		39.13	18.02	<.13	42.85	<.18	97.66	1.00	0.38		1.63		3.00	80.9
C387-13	Cumulate-ultra	2	C1 7913		40.93	10.64	<.13	48.42	<.18	96.91	1.00	0.22		1.77		3.00	89.0
C387-13	Cumulate-ultra	2	C2 7914		40.65	10.63	<.13	48.54	0.18	97.11	1.00	0.22		1.78	0.00	3.00	89.1
C387-13	Cumulate-ultra	2	R 7915		40.19	12.52	<.12	47.03	0.26	98.32	1.00	0.26		1.74	0.01	3.00	87.0
C387-13	Cumulate-ultra	6	C 7942		39.12	17.70	<.13	43.18	<.18	99.43	0.99	0.38		1.64		3.01	81.3
C387-13	Cumulate-ultra	8	C 7965		38.62	29.26	0.16	31.97	<.19	94.06	1.03	0.65	0.00	1.28		2.97	66.1
C387-13	Cumulate-ultra	8	R 7966		37.98	26.00	0.17	35.84	<.18	100.48	1.00	0.58	0.00	1.41		3.00	71.1
SW-1	Cumulate-ultra	C			37.94	23.87	0.35	37.33		99.09	1.00	0.52	0.01	1.46		3.00	73.6
SW-1	Cumulate-ultra	C			38.15	22.88	0.34	38.35		99.12	1.00	0.50	0.01	1.49		3.00	74.9
SW-3	Cumulate-ultra	C1			37.85	24.20	0.41	37.25		100.95	1.00	0.53	0.01	1.46		3.01	73.3
SW-3	Cumulate-ultra	C2			37.79	24.47	0.39	37.05		100.14	1.00	0.54	0.01	1.45		3.01	73.0
SW-3	Cumulate-ultra	R			37.69	24.45	0.47	37.09		100.42	0.99	0.54	0.01	1.46		3.01	73.0
SW-4	Cumulate-ultra	C			37.78	22.93	0.32	38.10		100.00	0.99	0.50	0.01	1.48		3.00	74.7
SW-4	Cumulate-ultra	R			38.08	22.55	0.21	38.86		100.60	0.99	0.49	0.01	1.51		3.01	75.5
AK-26e	Am-gabbro	1	C1 7603	incl by amp	38.07	24.56	0.33	37.04	<.18	99.62	1.00	0.54	0.01	1.45	0.00	3.00	72.9
AK-26e	Am-gabbro	1	C2 7604	incl by amp	37.92	25.16	0.37	36.55	<.18	99.91	1.00	0.55	0.01	1.44	0.00	3.00	72.1
AK-26e	Am-gabbro	1	C3 7605	incl by amp	37.77	25.39	0.24	36.60	<.18	100.60	1.00	0.56	0.01	1.44	0.00	3.00	72.0
AK-26e	Am-gabbro	2	C 7619	incl by amp	38.01	23.79	0.35	37.84	<.18	100.12	1.00	0.52	0.01	1.48	0.00	3.00	73.9
AK-26e	Am-gabbro	2	R 7620	incl by amp	38.02	24.13	0.26	37.58	<.18	100.05	1.00	0.53	0.01	1.47	0.00	3.00	73.5
AK-26e	Am-gabbro	3	C 7629	incl by amp	37.72	25.40	0.28	36.61	<.18	99.19	1.00	0.56	0.01	1.44	0.00	3.00	72.0
AK-42h	Cumulate	1	C 3119		38.64	18.98	<.12	42.06	0.33	100.17	0.99	0.41	0.00	1.61	0.01	3.01	79.8
C160-5	Cumulate	1	3847c		40.11	12.61		47.06	0.22	99.34	1.00	0.26		1.74	0.00	3.00	86.9
C160-5	Cumulate	1	3849r		40.33	12.88		46.79		99.91	1.00	0.27		1.73		3.00	86.6
C160-5	Cumulate	7	3885c		40.62	12.51		46.87		98.24	1.01	0.26		1.73		3.00	87.0
C160-5	Cumulate	8	3895r		40.67	12.94		46.40		99.63	1.01	0.27		1.72		2.99	86.5
C160-5	Cumulate	8	3894c		40.11	12.92		46.73	0.24	100.10	1.00	0.27		1.73	0.01	3.00	86.6
C160-5	Cumulate	9	3897c		40.51	12.55		46.74	0.20	99.15	1.00	0.26		1.73	0.00	3.00	86.9
C160-5	Cumulate	15	3922c		40.29	13.36		46.18	0.18	99.83	1.00	0.28		1.71	0.00	3.00	86.0
SW-11	Cumulate	C			37.93	24.11	0.29	37.28		99.89	1.00	0.53	0.01	1.46		3.00	73.4
SW-11	Cumulate	C			38.40	22.54	0.00	38.87		100.66	1.00	0.49	0.00	1.51		3.00	75.5

See Appendix 1 and 2 for samples and analytical method; Total# is original total (wt %); T.Cation is total cation based on 4 oxygens

Table A 4-9a Respresentative analyses of olivine from 11 SFVF xenoliths (10 cumulates and 1 granulite) and basalt, andesite and Amp-gabbro (cont)

Sample	Types	No.Point	No.A0		SiO_2	FeO	MnO	MgO	NiO	Total#	Si	Fe	Mn	Mg	Ni	T.Cation	Fo
C160-11	Cumulate	1	4144c1		39.26	18.50		42.24		99.56	1.00	0.39		1.61		3.00	80.3
C160-11	Cumulate	1	4145c2		39.23	18.31		42.46		99.25	1.00	0.39		1.61		3.00	80.5
C160-11	Cumulate	1	4146r		39.44	18.28		42.28		99.09	1.00	0.39		1.60		3.00	80.5
C160-11	Cumulate	7	4171c		39.16	18.29	0.15	42.11	0.28	99.15	1.00	0.39	0.00	1.60	0.01	3.00	80.4
C160-11	Cumulate	2	4147c	in lava	40.97	10.84		48.19		97.09	1.01	0.22		1.76		2.99	88.8
C160-11	Cumulate	2	4148r	in lava	40.56	13.07		46.38		97.56	1.01	0.27		1.72		2.99	86.4
C160-11	Cumulate	4	4151c	in lava	41.10	11.07		47.83		97.91	1.01	0.23		1.75		2.99	88.5
C160-11	Cumulate	12	4184c	in lava	40.44	13.08		46.48		98.78	1.00	0.27		1.72		3.00	86.4
C387-6	Cumulate	1	7162c		39.20	16.60		44.20		98.83	0.99	0.35		1.67		3.01	82.6
C387-6	Cumulate	1	7163r		39.53	16.90	0.13	43.44		98.33	1.00	0.36	0.00	1.64		3.00	82.1
C387-6	Cumulate	2	7164c		39.71	15.13		45.16		98.18	1.00	0.32		1.69		3.00	84.2
C387-6	Cumulate	4	7166c		40.69	10.80		48.30	0.21	98.93	1.00	0.22		1.77	0.00	3.00	88.9
C387-29	Cumulate	1	7077c1		39.53	16.54		43.93		100.48	1.00	0.35		1.65		3.00	82.6
C387-29	Cumulate	1	7076c2		39.42	16.30		44.28		99.70	1.00	0.34		1.67		3.01	82.9
C387-29	Cumulate	1	7074r		39.49	16.45		44.06		100.57	1.00	0.35		1.66		3.00	82.7
C387-29	Cumulate	12	7118c		39.59	16.34		43.78	0.29	100.10	1.00	0.35		1.65	0.01	3.00	82.7
C387-29	Cumulate	19	7134c		39.50	16.15		43.98	0.37	100.72	1.00	0.34		1.66	0.01	3.00	82.9
C387-29	Cumulate	19	7135r		39.32	16.58		44.10		99.97	0.99	0.35		1.66		3.01	82.6
C160-1	Basalt	2	4420c		40.63	10.13		48.95	0.30	98.72	1.00	0.21		1.79	0.01	3.00	89.6
C160-1	Basalt	2	4421r		40.09	14.55	0.14	45.01	0.20	100.55	1.00	0.31	0.00	1.68	0.00	3.00	84.7
C160-1	Basalt	3	4423c		39.77	15.79		44.44		100.52	1.00	0.33		1.67		3.00	83.4
C160-1	Basalt	3	4424r		39.92	14.61		45.48		100.16	1.00	0.31		1.70		3.00	84.7
C160-1	Basalt	6	4436c		39.95	13.72	0.24	46.08		100.63	1.00	0.29	0.01	1.71		3.00	85.7
C160-12	Andesite	1	4549c		34.58	40.84	0.47	24.11		98.77	0.99	0.98	0.01	1.03		3.01	51.3
C160-12	Andesite	2	4561c		36.38	32.01	0.44	31.17		99.37	0.99	0.73	0.01	1.27		3.01	63.4
C160-12	Andesite	2	4562r		36.78	30.93	0.36	31.92		98.77	1.00	0.70	0.01	1.29		3.00	64.8
C160-12	Andesite	3	4572c		34.43	41.78	0.42	23.36		99.37	0.99	1.01	0.01	1.00		3.01	49.9
C160-12	Andesite	4	4573c		35.84	39.66	0.62	23.88		98.36	1.02	0.94	0.02	1.01		2.98	51.8
C387-11	Granulite-mafic	1	C 7358		37.00	29.10	0.22	33.68	<.18	98.99	1.00	0.65	0.01	1.35		3.00	67.4
C387-11	Granulite-mafic	1	R 7359		36.32	32.05	0.20	31.43	<.19	97.12	0.99	0.73	0.00	1.28		3.01	63.6
C387-11	Granulite-mafic	2	C 7362		38.09	24.56	<.13	37.35	<.18	100.54	1.00	0.54		1.46		3.00	73.1
C387-11	Granulite-mafic	4	C 7339		38.59	27.30	0.19	33.92	<.18	97.62	1.02	0.61	0.00	1.34		2.98	68.9

See Appendix 1 and 2 for samples and analytical method; Total# is original total (wt %); T.Cation is total cation based on 4 oxygens

Table A 4-10 Representative analyses and CIPW values of glasses within 10 SFVF xenoliths

Sample	Type	No.Point	No.A0		SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO	Na_2O	K_2O	Total#	Mg#*	q	or	ab	an	c	hy	mt	di	ol	il
SW-11	Cumulate	C			48.98	4.93	13.99	14.41	0.27	3.82	9.42	2.30	1.20	100.90		5	7	19	24		12	5	17		9
SW-11	Cumulate	C			48.99	4.88	14.00	14.89	0.20	3.68	8.89	2.60	1.15	100.00		5	7	22	23		13	5	16		9
C387-11	Mafic	1	C 7282		49.08	4.20	16.06	13.74	0.13	2.44	7.37	5.02	1.96	103.27	24.0		12	42	16			4	18		8
C387-11	Mafic	1	R 7283		48.10	4.93	15.45	14.27	<.13	2.59	7.77	5.04	1.86	103.96	24.4		11	43	14			5	21		9
C387-11	Mafic	2	L1 7284		48.51	4.76	15.34	14.64	<.13	2.49	8.17	4.38	1.72	104.01	23.2		10	37	17			5	20		9
C387-11	Mafic	2	L2 7285		48.49	5.05	14.77	14.75	<.13	2.45	8.55	4.32	1.60	103.14	22.9		9	37	16			5	22		10
C387-11	Mafic	2	L3 7286		48.05	5.02	15.11	14.84	0.13	2.49	8.42	4.25	1.70	103.05	23.0		10	36	17			5	21		10
C387-11	Mafic	3	C 7288		49.34	4.50	15.34	13.71	<.13	2.26	7.84	5.04	1.98	103.33	22.7		12	43	13			4	22		9
C387-11	Mafic	4	C1 7297		48.82	2.74	18.93	12.74	<.12	4.22	7.53	4.02	1.00	104.91	37.1		6	34	31		1	4	6	13	5
C387-11	Mafic	4	C2 7298		48.30	2.90	19.05	12.60	0.16	4.23	7.80	3.88	1.07	80.58	37.5		6	33	31			4	6		6
C387-11	Mafic	5	C 7308		48.15	5.23	15.31	13.39	<.13	1.87	10.09	3.92	2.05	102.98	19.9		12	33	18			4	27		10
C387-11	Mafic	6	C 7309		46.77	6.40	14.44	13.17	0.14	2.31	10.38	4.58	1.82	102.49	23.8		11	39	13			4	32		12
C387-11	Mafic	7	C 7316	in cpx	49.28	3.88	17.70	12.76	<.13	3.75	6.70	4.18	1.75	103.78	34.4		10	35	24			4	7		7
C387-11	Mafic	8	C 7330		50.87	4.13	17.60	11.44	<.12	2.39	7.06	4.67	1.84	105.38	27.2		11	40	22			4	11		8
C387-11	Mafic	9	C 7347		49.33	3.41	15.63	14.24	<.13	1.15	9.80	5.01	1.43	104.24	12.6		8	42	16			5	28		6
C387-11	Mafic	10	C 7348		47.91	3.98	14.34	15.70	0.15	5.21	6.36	4.01	2.34	100.50	37.2		14	34	14			5	14		8
C387-11	Mafic	11	C 7356		47.30	5.33	14.09	16.34	0.28	2.74	8.51	3.77	1.64	104.28	23.0		10	32	17			5	22		10
C387-11	Mafic	12	C 7357		48.59	4.69	15.25	14.98	<.13	2.15	8.61	3.89	1.83	103.06	20.4		11	33	19			5	20		9
C387-11	Mafic	13	C 7360		47.69	5.02	14.20	16.35	<.13	2.29	8.38	4.18	1.89	103.45	20.0		11	35	14			5	23		10
C387-11	Mafic	14	C 7361		48.07	5.12	13.96	16.29	<.13	2.22	8.76	3.79	1.79	104.43	19.6		11	32	16			5	24		10
C387-11	Mafic	15	C 7366		48.80	3.56	14.05	14.08	0.13	6.59	6.79	3.95	2.07	104.92	45.5		12	33	15			5	16		7
C387-11	Mafic	16	C 7371		48.34	4.87	12.56	15.73	<.13	3.15	10.52	3.17	1.66	104.52	26.3		10	27	15			5	31		9
C387-11	Mafic	17	C 7383		49.54	3.03	16.70	14.86	0.24	1.68	8.54	3.13	2.30	103.31	16.8		14	26	25		6	5	15	3	6
C387-11	Mafic		Av 20		48.50	4.44	15.41	14.39	0.18	2.85	8.36	4.20	1.78	102.49											
C160-10	Mafic	3	C 8059		53.32	0.77	22.33	5.69	<.12	2.54	9.94	4.64	0.77	107.52	44.3		5	39	38		2	3	9	3	1
C160-10	Mafic	4	C 8063		53.32	1.81	15.81	10.77	<.13	4.79	8.02	3.98	1.51	104.53	44.2	1	9	34	21		12	5	15		3
C160-10	Mafic	5	C 8064		50.18	2.32	18.62	11.76	<.14	3.87	7.09	4.41	1.76	96.40	37.0		10	37	26			6	8		4
C160-10	Mafic	6	C 8065		53.21	1.92	18.37	8.56	<.13	3.73	8.52	4.87	0.82	102.20	43.7		5	41	26		5	4	13	3	4
C160-10	Mafic	1	C 8032	in opx	48.93	0.16	37.15	4.78	<.13	0.85	3.06	1.81	3.28	99.22	24.0	16	19	15	15	25	7	2	0		0
C160-10	Mafic	2	C 8051	in pl	58.77	1.24	20.93	3.65	<.12	3.05	0.88	5.62	5.85	103.30	59.8		35	48	4	4		2	0		2

See Appendices 1 and 2 for samples and analytical method; Total Fe reported as FeO*; Mg#* = 100 x Mg/(Mg+Fe*); Total# is original total (wt %)
Weight-based norms are calculated using $Fe^{2+}/(Fe^{2+}$ and $Fe^{3+})$ = 0.85; For CIPW values, blank and minerals not listed mean no, 0 is less than 0.5 wt %

Table A 4-10 Representative analyses and CIPW values of glasses within 10 SFVF xenoliths (cont)

Sample	Type	No.Point	No.A0		SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO	Na_2O	K_2O	Total#	Mg#*	q	or	ab	an	c	hy	mt	di	ol	il
C160-3	Mafic	2	C 7493		55.35	2.97	14.89	11.06	<.12	3.45	7.37	3.71	1.20	105.57	35.7	9	7	31	20		8	5	13		6
C160-3	Mafic	2	R 7494		55.76	2.69	15.13	9.60	<.12	3.65	8.37	3.86	0.95	105.88	40.4	8	6	33	21		6	5	17		5
C160-3	Mafic	1	R 7469	in py	60.02	1.70	15.63	9.20	<.12	2.15	5.22	4.23	1.86	105.77	29.4	13	11	36	18		9	4	6		3
C160-3	Mafic	1	C 7470	in py	59.04	2.01	15.54	9.59	<.12	2.28	5.43	4.27	1.84	106.15	29.8	11	11	36	18		8	5	8		4
AK-43c	Interm	1	L1 7786		58.84	1.17	21.42	3.80	<.13	1.09	1.11	6.70	5.87	99.31	33.9		35	57	6	2		2			2
AK-43c	Interm	1	L2 7787		59.74	1.19	20.91	3.86	<.13	1.21	0.55	6.18	6.37	98.72	35.8		38	52	3	3		2			2
AK-43c	Interm	1	L3 7788		59.75	1.05	21.22	3.71	<.13	1.09	0.56	6.34	6.28	97.93	34.3		37	54	3	3		2			2
AK-43c	Interm	3	L2 7833		61.64	1.34	18.25	4.63	<.13	0.97	1.75	5.75	5.67	102.76	27.1	0	34	49	7		4	2	1		3
AK-43c	Interm	3	L3 7834		62.18	1.08	18.64	3.96	<.12	0.73	1.69	5.89	5.82	102.85	24.8	0	34	50	7		4	2			2
AK-43c	Interm	4	L1 7835		62.19	1.38	18.54	4.23	<.13	0.73	1.43	5.69	5.81	100.46	23.5	2	34	48	7	0	4	2			3
AK-43c	Interm	4	L2 7836		62.68	0.89	18.21	4.59	<.13	0.91	1.63	5.42	5.66	101.34	26.2	3	33	46	8	0	5	2			2
AK-43c	Interm	5	L2 7838		62.06	0.96	18.38	4.52	<.13	0.87	1.63	5.94	5.63	101.05	25.6	0	33	50	7		5	2			2
AK-43c	Interm	6	L 7839		61.74	0.81	20.22	3.53	<.13	0.87	0.59	6.23	6.01	100.56	30.5		36	53	3	2	0	2		3	2
AK-43c	Interm	8	L 7857		61.16	0.82	20.65	3.45	<.12	0.54	2.71	6.77	3.90	103.91	21.9		23	57	13	0	1	2		2	2
AK-43c	Interm	9	C 7858		56.14	1.53	21.45	4.98	<.12	2.15	1.69	7.07	5.00	102.69	43.5		30	60	8	1		2			3
AK-43c	Interm	10	L1 7875		58.76	2.68	16.68	6.21	<.13	1.20	3.87	5.56	5.05	100.51	25.7		30	47	6			3	11		5
AK-43c	Interm	10	L2 7876		58.69	3.06	16.25	6.13	<.13	1.03	4.25	5.65	4.92	100.71	23.1		29	48	4			3	13		6
AK-43c	Interm	11	L1 7877		57.66	2.91	16.50	7.06	<.13	1.08	4.46	6.00	4.32	101.05	21.5		26	51	5			3	14		6
AK-43c	Interm	11	L2 7878		58.59	2.75	16.29	6.79	<.13	1.04	3.80	6.09	4.63	100.00	21.5		27	52	3			3	13		5
AK-43c	Interm		Av 15		60.12	1.57	18.91	4.76	<.13	1.03	2.11	6.09	5.40	100.92	28.7		32	52	9			2	1		3
AK-43b	Interm	1	C1 3274		59.43	1.50	20.27	5.19	<.12	1.79	1.78	4.54	5.51	105.92	38.1	4	33	38	9	4	7	3			3
AK-43b	Interm	1	C2 3275		59.87	1.32	20.12	5.18	<.12	1.72	1.63	4.61	5.55	105.07	37.1	4	33	39	8	4	7	3			3
AK-43b	Interm	1	R 3276		60.12	1.42	20.03	5.08	0.14	1.50	1.82	5.82	4.08	105.39	34.4	3	24	49	9	3	7	2			3
AK-43b	Interm	2	C 3282		61.37	1.07	19.40	4.10	<.13	1.40	1.42	5.45	5.79	102.43	37.8	1	34	46	7	2	6	2			2
AK-43b	Interm	2	R 3283		61.44	0.87	19.62	4.22	<.12	1.22	1.14	5.79	5.71	103.33	34.0	0	34	49	6	2	6	2			2
AK-43b	Interm	3	C2 3291		59.81	0.87	20.33	5.31	<.12	1.56	2.17	6.31	3.64	104.47	34.4	0	22	53	11	2	8	3			2
AK-43b	Interm	3	R1 3292		60.44	0.82	19.92	4.94	<.12	1.72	2.14	6.10	3.91	104.60	38.2	1	23	52	11	2	8	2			2
AK-43b	Interm	3	R2 3293		62.61	0.38	19.25	4.43	<.12	1.02	0.72	5.75	5.85	104.33	29.2	2	35	49	4	2	6	2			1
AK-43b	Interm	4	C 3308		61.87	1.50	20.14	4.50	<.12	1.42	1.67	3.59	5.30	103.96	36.0	14	31	30	8	5	6	2			3
AK-43b	Interm	5	C 3309		59.34	1.52	20.36	5.53	0.22	1.99	2.40	3.51	5.13	103.51	39.1	10	30	30	12	5	8	3			3

See Appendices 1 and 2 for samples and analytical method; Total Fe reported as FeO*; Mg#* = 100 x Mg/(Mg+Fe*); Total# is original total (wt %)
Weight-based norms are calculated using Fe^{2+}/(Fe^{2+} and Fe^{3+}) = 0.85; For CIPW values, blank and minerals not listed mean no, 0 is less than 0.5 wt %

Table A 4-10 Representative analyses and CIPW values of glasses within 10 SFVF xenoliths (cont)

Sample	Type	No.Point	No.A0	SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO	Na_2O	K_2O	Total#	Mg#*	q	or	ab	an	c	hy	mt	di	ol	il
AK-43b	Interm	6	C1 3310	60.25	1.18	19.98	5.04	<.13	1.77	1.79	4.61	5.37	103.08	38.5	5	32	39	9	3	8	2			2
AK-43b	Interm	6	C2 3311	58.68	1.26	20.28	5.32	0.16	2.05	1.97	4.92	5.37	102.22	40.7	1	32	42	10	3	9	3			2
AK-43b	Interm	10	C 3340	61.94	0.70	19.69	4.80	<.12	1.19	1.23	4.37	6.08	104.27	30.6	7	36	37	6	4	7	2			1
AK-43b	Interm	11	C2 3350	60.04	1.23	19.37	4.29	<.12	1.36	1.42	6.36	5.94	103.44	36.0		35	54	7	0		2			2
AK-43b	Interm	11	C3 3351	60.83	1.27	19.11	4.64	<.13	1.23	1.38	5.46	6.08	103.47	32.1		36	46	7	1	5	2		0	2
AK-43b	Interm	12	C 3366	61.36	0.97	18.84	4.95	<.13	1.28	1.48	5.59	5.52	102.72	31.6	1	33	47	7	1	7	2			2
AK-43b	Interm	13	C1 3370	61.50	0.54	19.82	4.56	<.13	1.36	1.31	5.11	5.80	103.21	34.7	3	34	43	7	3	7	2			1
AK-43b	Interm	13	C2 3372	59.62	1.17	19.28	5.47	0.13	2.26	2.00	4.67	5.41	102.24	42.4	2	32	40	10	2	9	3			2
AK-43b	Interm	13	C3 3373	61.28	1.14	19.84	4.59	<.13	1.38	1.62	4.71	5.46	102.83	34.8	6	32	40	8	3	6	2			2
AK-43b	Interm	14	C 3383	61.52	0.61	19.78	4.88	<.13	1.40	1.27	4.86	5.68	102.79	33.9	5	34	41	6	3	7	2			1
AK-43b	Interm	15	C1 3387	62.56	0.77	17.61	5.54	<.13	1.67	2.28	4.38	5.18	102.60	35.0	8	31	37	11	1	8	3			1
AK-43b	Interm	15	C2 3388	63.45	0.91	17.43	5.11	<.12	1.25	1.99	4.43	5.42	102.84	30.4	9	32	37	10	1	7	2			2
AK-43b	Interm	16	C1 3391	62.13	1.29	18.35	5.50	<.13	1.62	1.86	3.84	5.42	100.60	34.5	11	32	32	9	3	7	3			2
AK-43b	Interm	16	C2 3392	61.60	1.02	20.00	4.77	<.13	1.52	1.67	3.91	5.51	100.22	36.3	11	33	33	8	5	7	2			2
AK-43b	Interm	17	C 3393	59.91	1.33	19.04	6.17	<.13	1.92	2.29	4.09	5.25	100.35	35.7	6	31	35	11	2	9	3			3
AK-43b	Interm	18	C 3394	62.09	1.04	19.00	4.88	<.13	1.46	1.66	4.39	5.48	101.33	34.8	8	32	37	8	3	7	2			2
AK-43b	Interm	19	C 3398	62.59	1.17	18.97	4.42	<.13	1.52	1.60	4.21	5.53	100.30	38.0	10	33	36	8	3	6	2			2
AK-43b	Interm		Av 27	61.02	1.07	19.48	4.94	<.13	1.54	1.69	4.87	5.37	103.02	35.7	4	32	42	8	2	7	2			2
SW-9	Felsic?	C		74.54	1.27	12.39	4.33	0.14	2.78	0.16	0.67	3.42	96.23		53	20	6	1	7	7	3			2
SW-9	Felsic?	C		73.42	0.61	12.92	6.42	0.14	1.57	0.38	0.55	3.80	96.85		52	22	5	2	7	6	5			1
SW-12	Felsic	C		75.09	0.33	12.58	3.84	<.13	0.66	1.25	2.23	3.82	93.79		43	23	19	6	3	3	3			1
SW-12	Felsic	C		72.98	0.42	13.68	4.40	<.13	0.82	1.48	2.33	3.81	93.70		40	23	20	7	3	3	4			1
SW-12	Felsic	C		73.73	0.68	13.73	4.15	<.13	0.73	1.46	1.83	3.68	94.98		44	22	15	7	4	3	3			1
SW-12	Felsic	C		70.20	0.41	14.15	5.54	<.13	0.88	1.66	3.11	3.94	98.70		32	23	26	8	2	4	4			1
SW-12	Felsic	C		71.64	0.48	14.09	4.71	<.13	0.82	1.55	2.86	3.87	99.32		35	23	24	8	2	3	4			1
SW-12	Felsic	C		72.03	0.48	14.28	4.51	<.13	0.79	1.57	2.41	3.75	98.78		39	22	20	8	3	3	4			1
SW-12	Felsic	C		72.99	0.68	14.10	3.98	<.13	0.84	1.42	2.26	3.73	97.94		41	22	19	7	4	3	3			1
SW-17	Felsic?	C	NW-2	76.18	0.29	14.32	1.17	<.13	0.45	1.05	2.50	3.90	98.04		44	23	21	5	4	1	1			1
SW-17	Felsic?	C	NW-2	75.37	0.00	14.32	1.17	<.13	0.00	0.91	2.17	6.07	95.80		37	36	18	5	3	1	1			
SW-17	Felsic?	C	NW-2	74.50	0.24	15.41	0.98	<.13	0.29	1.25	2.87	4.25	97.23		38	25	24	6	4	1	1			0
SW-17	Felsic?	C	NW-2	73.39	0.28	16.31	0.68	<.13	0.14	0.68	2.45	6.05	93.17		34	36	21	3	5	0	1			1

See Appendices 1 and 2 for samples and analytical method; Total Fe reported as FeO*; Mg#* = 100 x Mg/(Mg+Fe*); Total# is original total (wt %)
Weight-based norms are calculated using $Fe^{2+}/(Fe^{2+}$ and $Fe^{3+}) = 0.85$; For CIPW values, blank and minerals not listed mean no, 0 is less than 0.5 wt %

Table A 4-10 Representative analyses and CIPW values of glasses within 10 SFVF xenoliths (cont)

Sample	Type	No.Point	No.A0	SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO	Na_2O	K_2O	Total#	Mg#*	q	or	ab	an	c	hy	mt	di	ol	il
AK-41g	Felsic	1	L1 3161	78.03	<.13	13.20	0.59	<.13	<.14	0.21	2.79	5.17	99.87		41	31	24	1	3	0	0			
AK-41g	Felsic	1	L2 3162	77.35	<.12	13.44	0.80	<.12	<.14	0.28	3.93	4.20	102.42		38	25	33	1	2	0	1			
AK-41g	Felsic	1	L3 3163	77.59	<.12	13.29	0.89	<.12	<.14	0.25	3.81	4.17	103.05		39	25	32	1	2	0	1			
AK-41g	Felsic	1	L4 3164	78.26	<.13	13.00	0.65	<.13	<.14	0.14	3.72	4.23	101.20		40	25	31	1	2	0	1			
AK-41g	Felsic	1	L5 3165	77.50	<.12	13.23	0.80	<.12	<.14	0.31	3.89	4.27	102.51		38	25	33	2	2	0	1			
AK-41g	Felsic	1	L9 3169	77.14	<.12	13.53	0.68	<.12	<.14	0.38	3.88	4.39	102.40		37	26	33	2	2	0	1			
AK-41g	Felsic	1	L10 3170	77.33	<.12	13.35	0.72	<.12	<.14	0.25	3.78	4.57	102.70		37	27	32	1	2	0	1			
AK-41g	Felsic	2	L1 3175	77.68	<.12	13.25	0.65	<.12	<.14	0.28	3.66	4.47	101.36		39	26	31	1	2	0	1			
AK-41g	Felsic	2	L2 3176	77.68	<.12	13.28	0.71	<.12	<.14	0.22	3.86	4.25	101.64		38	25	33	1	2	0	1			
AK-41g	Felsic	3	L1 3181	77.52	<.12	13.12	0.59	<.12	<.14	0.19	3.22	5.36	100.88		38	32	27	1	2	0	0			
AK-41g	Felsic	3	L2 3182	77.20	<.12	13.40	0.66	<.12	<.14	0.25	4.12	4.37	102.78		36	26	35	1	1	0	1			
AK-41g	Felsic	4	L1 3209	77.69	<.12	13.02	0.71	<.12	<.14	0.27	4.12	4.19	101.19		37	25	35	1	1	0	1			
AK-41g	Felsic	5	L1 3213	77.59	<.12	13.19	0.68	<.12	<.14	0.21	4.06	4.27	101.03		37	25	34	1	2	0	1			
AK-41g	Felsic	5	L2 3214	77.37	<.12	13.24	0.58	<.12	<.14	0.25	4.15	4.41	102.19		36	26	35	1	1	0	0			
AK-41g	Felsic	6	L1 3218	77.25	<.12	13.25	0.73	<.12	<.14	0.32	4.15	4.31	102.22		36	25	35	2	1	0	1			
AK-41g	Felsic	7	L1 3230	78.29	<.12	13.03	0.62	<.12	<.14	0.25	3.50	4.31	101.77		41	25	30	1	2	0	0			
AK-41g	Felsic	7	L2 3231	77.80	<.12	13.32	0.59	<.12	<.14	0.24	3.79	4.25	101.19		39	25	32	1	2	0	0			
AK-41g	Felsic	8	L2 3252	77.71	<.12	13.05	0.69	<.12	<.14	0.28	4.01	4.25	102.12		37	25	34	1	1	0	1			
AK-41g	Felsic	8	L3 3253	77.86	<.13	13.05	0.69	<.12	<.14	0.16	3.42	4.82	99.90		39	28	29	1	2	0	1			
AK-41g	Felsic	8	L4 3254	77.56	<.12	13.35	0.56	<.12	<.14	0.19	3.77	4.56	101.53		38	27	32	1	2	0	0			
AK-41g	Felsic	9	L1 3266	77.88	<.12	12.83	0.78	<.12	<.14	0.31	3.86	4.33	101.48		38	26	33	2	1	0	1			
AK-41g	Felsic	10	C3 4092	77.68	<.13	12.93	0.60	<.13	<.14	0.24	4.18	4.36	99.08		36	26	35	1	1	0	0			
AK-41g	Felsic	10	C4 4093	77.72	<.13	12.86	0.57	<.13	<.14	0.21	3.93	4.71	97.66		36	28	33	1	1	0	0			
AK-41g	Felsic	10	C5 4094	77.41	<.12	12.67	0.82	<.12	<.14	0.29	4.18	4.64	99.12		35	27	35	1	0	0	1			
AK-41g	Felsic	11	C1 4109	77.77	<.13	12.65	0.66	<.13	<.14	0.19	3.63	5.11	98.42		37	30	31	1	1	0	1			
AK-41g	Felsic	11	C2 4110	77.46	<.12	12.88	0.55	<.12	<.14	0.39	4.35	4.36	100.15		35	26	37	2	0	0	0			
AK-41g	Felsic	12	C1 4132	77.36	<.12	12.82	0.76	<.12	<.14	0.35	4.38	4.32	100.01		34	26	37	2	0	0	1			
AK-41g	Felsic	12	C2 4133	76.63	<.13	13.82	0.67	<.13	<.14	0.28	4.14	4.46	98.31		35	26	35	1	2	0	1			
AK-41g	Felsic	1	L6 3166	77.11	<.12	13.12	1.16	<.12	<.14	0.22	3.43	4.96	100.57		37	29	29	1	2	1	1			
AK-41g	Felsic	1	L8 3168	76.22	<.12	13.03	2.70	<.12	<.14	0.17	3.77	4.11	102.91		38	24	32	1	2	1	2			
AK-41g	Felsic		Av 30	77.52	<.12	13.14	0.76	<.12	<.14	0.25	3.85	4.47	101.06		37	26	33	1	1	0	1			

See Appendices 1 and 2 for samples and analytical method; Total Fe reported as FeO*; Mg#* = 100 x Mg/(Mg+Fe*); Total# is original total (wt %)
Weight-based norms are calculated using $Fe^{2+}/(Fe^{2+}$ and $Fe^{3+}) = 0.85$; For CIPW values, blank and minerals not listed mean no, 0 is less than 0.5 wt %

Table A 4-11 Major element (XRF) and trace element (ICP-MS) data of 23 SFVF xenoliths

Sample	AK-21a	SW-2	C387-13	AK-26e	AK-42h	C160-11	C387-29	AK-40h	AK-35	C160-5	AK41g-gl	3723A	JR-2
Type	Cu-U	Cu-U	Cu-U	Am-gab	Cu	Cu	Cu	Cu	Cu	Cu	R	R	R
SiO_2	33.59	38.68	44.44	45.28	46.13	46.55	46.99	47.91	48.22	49.33	77.52	75.64	75.65
TiO_2	4.46	3.49	0.68	1.99	1.36	0.66	0.43	0.24	0.68	0.40	<0.12	0.02	0.09
Al_2O_3	12.95	20.60	22.03	18.44	9.68	5.30	3.46	22.11	7.12	4.82	13.14	13.49	12.82
Fe_2O_3*	28.02	18.22	10.22	12.73	12.01	10.41	10.15	6.83	8.04	6.43	0.84	1.10	0.86
FeO#	9.07	3.94	4.85	4.46	8.18	6.87	7.49	1.36	4.96	3.75		0.75	0.43
MnO	0.18	0.14	0.11	0.16	0.20	0.15	0.16	0.09	0.15	0.13	< 0.12		0.11
MgO	7.83	5.09	9.40	6.78	15.67	22.71	26.95	9.53	18.73	20.36	< 0.14	0.06	0.05
CaO	11.95	10.46	11.88	9.17	14.44	14.04	12.53	9.95	16.05	17.57	0.26	0.57	0.45
Na_2O	1.15	2.68	1.65	3.03	0.93	0.30	0.28	2.98	0.79	0.16	3.87	4.27	4.03
K_2O	0.07	0.35	0.05	0.77	0.03	0.07	0.04	0.23	0.01	0.04	4.47	4.93	4.45
P_2O_5	0.03	0.04	0.03	0.29	0.02	0.03	0.02	0.03	0.02	0.02			0.01
S	0.02	0.02	0.03	0.05	0.02		0.01	0.02	0.01				
LOI	-0.10	0.15	-0.23	0.67	-0.20	-0.16	-0.43	0.20	0.05	0.11			
Total#	100.15	99.92	100.29	99.36	100.29	100.06	100.59	100.12	99.87	99.37	100.10	100.08	98.52
Cs	0.056	0.022	0.008	0.117	0.014	0.023	0.013	0.006	0.015	0.011	16.07	12.40	26.00
Rb	0.19	0.91	0.11	5.39	0.14	0.86	0.21	1.44	0.94	0.52	363.2	265.0	297.0
Li											203.1		83.0
Ba	78.6	383.8	54.5	631.7	15.1	26.5	5.4	87.2	2.3	14.4	33.2	4.9	39.0
Sr	347	1291	738	962	70.2	72.5	37.4	1118.8	40.9	152.4	10.3	2.4	8.0
Pb	0.86	1.27	0.66	6.14	0.36	0.79	1.37	0.89	0.49	0.47	49.89	55.30	21.90
Th	0.07	0.14	0.22	1.33	0.28	0.35	0.08	0.05	0.06	0.12	42.43	25.70	32.20
U	0.06	0.04	0.01	0.53	0.02	0.03	0.02	0.02	0.01	0.02	23.33	13.70	10.50
La	2.89	8.22	1.29	23.86	2.13	3.11	1.37	1.48	1.51	3.14	13.27	8.00	17.50
Ce	6.40	19.17	3.19	49.05	7.71	9.30	4.37	3.30	5.16	9.10	28.67	21.40	38.00
Pr	1.19	2.83	0.47	6.10	1.51	1.72	0.70	0.32	0.86	1.49	3.13	2.80	5.50
Nd	5.83	12.56	2.23	23.09	8.27	8.34	3.34	1.10	4.35	6.94	13.30	11.50	24.80
Sm	1.85	3.06	0.71	4.74	2.83	2.28	1.02	0.20	1.40	1.69	3.99	4.49	6.20
Eu	0.68	1.55	0.39	2.08	0.97	0.66	0.33	0.36	0.48	0.49	0.10	0.02	0.13
Gd	2.07	2.97	0.79	5.45	3.19	2.10	1.09	0.39	1.68	1.64	3.93	5.10	7.80
Tb	0.35	0.43	0.13	0.70	0.55	0.33	0.19	0.05	0.30	0.25	0.93	1.10	1.20
Dy	2.17	2.24	0.77	3.68	3.37	1.82	1.15	0.30	2.10	1.40	6.98	6.95	7.70
Ho	0.44	0.44	0.15	0.75	0.67	0.36	0.23	0.06	0.43	0.27	1.55	1.67	1.70
Er	1.08	1.04	0.37	1.94	1.67	0.87	0.55	0.15	1.07	0.66	4.79	5.00	5.20
Tm	0.15	0.15	0.06	0.28	0.24	0.13	0.08	0.02	0.17	0.09	1.01	0.73	0.86
Yb	0.91	0.80	0.35	1.71	1.52	0.76	0.48	0.14	1.00	0.56	7.40	5.70	5.40
Lu	0.14	0.12	0.05	0.26	0.22	0.11	0.07	0.02	0.15	0.08	1.27	1.04	0.92
Y	11.21	11.31	4.25	19.36	18.62	10.36	5.41	0.81	10.40	6.98	64.78	68.00	51.00
Zr	23.9	31.4	10.6	64.7	42.9	22.2	10.1	2.1	17.8	8.2	89.5	93.0	98.5
Nb	2.05	13.74	0.46	19.91	1.09	0.94	0.32	0.01	0.16	0.47	162.3	136.0	19.2
Hf	1.17	1.15	0.42	2.20	1.64	0.86	0.54	0.12	0.86	0.50	5.89	5.60	5.20
Ta	0.61	0.93	1.60	1.40	0.76	0.66	0.26	0.61	0.43	0.20	23.92		2.40
Sc	32.26	19.69	25.30	18.13	39.70	47.15	43.69	18.56	40.83	53.64	1.89	4.80	5.40
V	1222	479	358	258	305	238	158	35.4	242.9	218.5	2.4	1.2	5.1
Cr	45.6	23.4	42.6	19.2	669	1515	1612	71.5	2424	2889	1.8	3.0	2.6
Co	159.5	85.2	119.6	80.5	122.2	110.9	111.7	96.3	87.7	75.1	0.4		0.4
Ni	178.2	91.5	124.3	78.2	334.2	500.2	358.6	113.7	275.5	332.8	0.6	3.0	0.8
Cu	167.4	95.5	51.7	42.6	34.8	96.0	62.3	18.5	53.3	45.4	1.4	1.0	1.4
Zn	171.0	121.0	125.9	75.0	62.7	57.0	33.7	22.2	28.1	24.8	43.5	98.0	27.2
Ga	26.19	32.08	27.61	33.54	11.40	7.00	4.10	10.48	6.21	6.23	15.86	38.00	18.20
Ge	2.00	1.50	0.32	1.25	0.46	0.39	1.43	0.62	1.35	1.59	0.31		2.40
Mo	0.54	0.34	2.76	0.60	0.46	2.55	0.09	0.08	0.20	0.04	3.46		2.90
Sn	2.17	1.33	0.60	2.61	0.71	0.85	0.66	0.47	0.41	0.42		24.30	
Mg#*	35.6	35.6	64.6	51.3	72.1	81.2	84.0	73.4	82.2	86.3		9.8	10.3
Mg#	60.6	69.7	77.6	73.0	77.4	85.5	86.5	92.6	87.1	90.6		12.5	17.2

Mg#* = 100 x Mg/(Mg+Fe*); Mg# = 100 x Mg/(Mg+Fe(II)); Total# is original total (wt %)
See Appendices 1 and 2 for samples and analytical method; Total Fe as Fe2O3*; FeO# determined by titration;
JR-2 is rhyolitic geostandard from Govindaraju (1989); 3723A is SFVF rhyolite from Arculus and Gust (1995)

Table A 4-11 Major element (XRF) and trace element (ICP-MS) data of 23 SFVF xenoliths

Sample	C387-4	C387-11	AK-35f	C160-3	C160-8	C160-10	AK-43c	SW-14	C387-28	AK-43b	C387-10	SW-12	AK-41g
Type	Mafic	Mafic	Mafic	Mafic	Mafic	Mafic	Interm	Interm	Interm	Interm	Felsic	Felsic	Felsic
SiO_2	49.93	50.50	51.10	52.09	52.16	54.26	56.21	58.36	60.96	61.22	64.87	68.21	73.01
TiO_2	0.69	0.63	0.69	1.82	0.85	0.59	0.53	0.93	0.15	0.71	0.94	0.34	0.06
Al_2O_3	12.94	25.29	16.78	16.80	14.62	16.70	20.69	17.42	21.95	18.46	17.83	14.44	12.87
Fe_2O_3*	8.96	6.17	9.83	10.95	10.37	7.46	4.69	6.53	2.44	5.18	4.96	4.46	0.94
FeO#	5.34	3.73	4.61	7.07	6.01	3.53	2.20	4.75	1.26	2.26	1.11	2.55	0.39
MnO	0.18	0.06	0.17	0.16	0.19	0.14	0.09	0.11	0.05	0.11	0.03	0.14	0.10
MgO	6.12	3.34	5.82	4.52	6.81	5.47	1.80	4.01	0.87	2.04	0.15	1.62	0.09
CaO	17.79	8.51	9.50	7.27	9.49	8.41	3.12	5.41	4.64	3.16	4.69	3.20	0.45
Na_2O	2.35	4.75	4.27	4.07	3.61	4.12	6.07	3.22	7.73	5.15	5.05	3.47	4.13
K_2O	0.15	0.37	0.55	1.31	0.81	0.95	3.67	2.40	0.83	2.75	0.48	1.47	4.60
P_2O_5	0.12	0.06	0.64	0.87	0.84	0.68	0.20	0.29	0.05	0.28	0.02	0.06	0.02
S	0.04	0.02	0.01			0.01	0.02	0.03	0.01	0.02		0.02	
LOI	0.06	-0.12	0.25	-0.11	0.08	1.20	1.27	0.05	0.12	0.88	0.37	1.70	2.41
Total#	99.33	99.58	99.61	99.75	99.83	99.99	98.36	98.76	99.80	99.96	99.39	99.13	98.68
Cs	0.008	0.023	0.009	0.172	0.089	0.076	6.345	0.031	0.013	6.269	0.358	0.451	12.790
Rb	0.45	1.45	1.29	19.24	5.71	5.28	118.20	36.15	1.24	106.8	3.22	40.42	325.2
Li									6.20		16.40		192.9
Ba	125.7	126.7	697	822	754	966	2038	1880	568	1164	182	762	32.5
Sr	395	1246	1686	946	1549	1711	1051	950	1497	755	912	329	12.1
Pb	6.25	0.75	5.29	8.10	9.18	8.31	23.57	11.80	6.52	25.50	25.10	8.78	44.26
Th	1.60	0.31	1.22	1.46	1.16	0.45	2.12	0.13	1.27	2.63	1.82	3.11	40.95
U	1.41	0.04	0.06	0.99	0.25	0.19	0.98	0.03	0.06	1.40	0.24	0.13	21.21
La	9.14	3.38	33.82	48.76	47.52	37.57	46.54	21.38	10.37	85.62	4.88	22.88	13.45
Ce	19.92	6.91	77.12	107.44	110.25	81.61	92.40	42.96	13.99	167.43	8.38	42.51	28.99
Pr	2.74	0.91	10.73	14.66	16.14	10.46	11.02	5.41	1.31	18.84	0.85	4.94	3.29
Nd	11.04	3.81	43.92	57.52	66.27	42.07	37.71	20.99	4.37	62.68	2.79	16.98	13.45
Sm	2.90	1.01	9.02	12.25	13.31	8.99	10.98	3.96	0.69	10.11	0.39	3.46	3.99
Eu	0.95	0.88	3.12	4.13	4.00	3.80	4.69	3.78	1.06	3.07	0.91	1.95	0.12
Gd	3.35	1.14	8.31	9.68	9.57	7.51	6.86	4.64	0.55	7.63	0.24	3.09	4.02
Tb	0.51	0.17	0.89	1.19	1.10	0.80	0.57	0.45	0.08	0.84	0.03	0.27	0.91
Dy	2.98	0.93	4.32	6.24	5.30	3.40	2.64	1.96	0.44	3.85	0.15	1.14	6.51
Ho	0.62	0.18	0.64	1.17	0.89	0.57	0.36	0.38	0.09	0.42	0.03	0.21	1.42
Er	1.69	0.44	1.76	2.81	2.20	1.49	1.00	1.01	0.26	1.21	0.07	0.58	4.19
Tm	0.27	0.07	0.21	0.38	0.27	0.19	0.13	0.14	0.04	0.15	0.01	0.08	0.84
Yb	1.80	0.39	1.35	2.25	1.61	1.07	0.75	0.85	0.26	1.03	0.06	0.45	6.23
Lu	0.28	0.06	0.20	0.32	0.22	0.15	0.11	0.13	0.04	0.15	0.01	0.07	1.00
Y	18.74	5.15	16.97	30.82	23.11	15.45	9.55	10.15	2.66	10.89	0.86	5.69	57.75
Zr	52.2	18.7	32.5	288.9	33.2	25.1	38.5	19.6	113.1	50.6	7.8	40.3	70.2
Nb	15.19	2.14	1.42	34.59	5.64	2.95	5.44	5.01	1.30	9.24	11.61	7.01	144.24
Hf	1.49	0.56	1.10	5.75	1.05	0.76	1.02	0.65	1.98	1.26	0.21	1.03	4.10
Ta	4.05	0.80	0.39	2.06	0.52	0.21	1.62	0.54	0.39	2.07	1.88	0.84	19.47
Sc	41.51	10.87	29.08	23.49	29.14	19.52	27.75	17.60	11.62	23.46	12.69	15.81	2.75
V	196.7	121.6	163.3	162.4	215.8	136.4	47.2	115.1	26.2	66.3	74.4	37.5	4.0
Cr	506.2	48.8	146.9	110.4	164.4	111.6	39.1	144.7	23.5	37.3	20.1	11.7	2.8
Co	105.5	124.4	53.3	46.1	65.5	34.2	66.5	62.4	44.0	70.4	96.0	35.6	123.6
Ni	166.3	105.7	93.9	80.3	100.2	81.7	34.1	57.5	21.9	30.4	22.0	25.7	1.3
Cu	13.7	18.9	72.0	55.8	21.2	26.1	19.8	26.1	12.5	21.4	18.0	24.2	1.7
Zn	31.1	88.5	32.3	74.3	35.5	49.2	27.7	54.9	15.5	32.6	27.0	38.4	43.6
Ga	17.56	22.85	33.03	37.93	34.38	45.33	78.86	75.44	25.05	48.32	17.13	38.14	15.53
Ge	2.19	0.19	1.29	1.40	1.37	1.15	1.03	1.30	0.64	1.14	1.05	1.01	0.50
Mo	0.77	0.22	0.15	1.72	0.19	0.13	0.14	0.10	0.22	0.29	0.23	1.53	2.54
Sn	14.22	1.20	0.57	1.60	1.24	0.74	0.71	1.52	2.58	1.19	2.53	2.02	13.59
Mg#*	57.5	51.8	54.0	45.0	56.5	59.2	43.2	54.9	41.4	43.8	5.7	41.8	15.9
Mg#	67.1	61.5	69.2	53.3	66.9	73.4	59.3	60.1	55.2	61.7	19.4	53.1	29.1

Mg#* = 100 x Mg/(Mg+Fe*); Mg# = 100 x Mg/(Mg--Fe(II)); Total# is original total (wt %)
See Appendices 1 and 2 for samples and analytical method; Total Fe as Fe2O3*; FeO# determined by titration;
JR-2 is rhyolitic geostandard from Govindaraju (1989); 3723A is SFVF rhyolite from Arculus and Gust (1995)

Table A 4-12 Sr-Nd isotopic compositions of representative SFVF xenoliths

Sample	Type	No CSIRO	Rb (ppm)	Sr (ppm)	Nd (ppm)	Sm (ppm)	$^{87}Sr/^{86}Sr$	$^{143}Nd/^{144}Nd$	epsilon Nd	error Nd	$^{87}Rb/^{86}Sr$	$^{147}Sm/^{144}Nd$	T chur (Ga)	T DM (Ga)
AK-21a	Cumulate-U	X-6, CB515	0.19	346.8	5.83	1.85	0.703185	0.512608	-0.59	0.23	0.0018	0.1922	1.01	2.57
SW-2	Cumulate-U	X-1, CB510	0.91	1290.7	12.56	3.06	0.703642	0.512727	1.74	0.23	0.0020	0.1471		0.79
C387-13	Cumulate-U	X-21, CB530	0.11	737.8	2.23	0.71	0.703400				0.0004	0.1914		
C387-1	Cumulate-U	X-16, CB525					0.703249	0.512832	3.78	0.21				
AK-26e	Am-gabbro	X-7, CB516	5.39	962.1	23.09	4.74	0.703716	0.512613	-0.49	0.18	0.0164	0.1240	0.05	0.78
AK-42h	Cumulate	X-13, CB523	0.14	70.2	8.27	2.83	0.703336	0.512838	3.90	0.18	0.0056	0.2068	3.01	2.75
C160-11	Cumulate	X-28, CB806	0.86	72.5	8.34	2.28	0.703696	0.512603	-0.68	0.20	0.0332	0.1649	0.17	1.36
C387-29	Cumulate	X-23, CB532	0.21	37.4	3.34	1.02	0.703724	0.512646	0.16	0.21	0.0108	0.1848		1.91
AK-40h	Cumulate	X-10, CB519	1.44	1118.8	1.10	0.20	0.703327	0.512655	0.33	0.21	0.0036	0.1115		0.63
AK-35	Cumulate	X-8, CB517	0.94	40.9	4.35	1.40	0.703374	0.512785	2.87	0.21	0.0017	0.1947		1.83
C160-5	Cumulate	X-25, CB803	0.52	152.4	6.94	1.69	0.704742	0.512652	0.27	0.21	0.0099	0.1476		0.95
AK-42g	Cumulate	X-12, CB521					0.703412	0.512800	3.16	0.17				
C387-6	Cumulate	X-18, CB527					0.703262	0.512798	3.12	0.18				
SW-6	Cumulate	X-2, CB511					0.703549	0.512715	1.50	0.40				
SW-15	Cumulate	X-5, CB514					0.703352	0.512809	3.34	0.23				
C387-4	Granulite-mafic	X-17, CB526	0.45	394.8	11.04	2.90	0.703797	0.512370	-5.23	0.18	0.0033	0.1590	1.08	1.79
C387-11	Granulite-mafic	X-20, CB529	1.45	1245.8	3.81	1.01	0.703005	0.512919	5.48	0.21	0.0028	0.1602		0.48
AK-35f	Granulite-mafic	X-9, CB518	1.29	1685.8	43.92	9.02	0.703857	0.511892	-14.55	0.14	0.0022	0.1241	1.56	1.90
C160-3	Granulite-mafic	X-24, CB533	19.24	945.7	57.52	12.25	0.703194	0.512362	-5.38	0.21	0.0534	0.1287	0.62	1.23
C160-8	Granulite-mafic	X-26, CB804	5.71	1548.7	66.27	13.31	0.704083	0.511814	-16.07	0.20	0.0095	0.1214	1.66	1.96
C160-10	Granulite-mafic	X-27, CB805	5.28	1711.3	42.07	8.99	0.704164	0.511777	-16.80	0.18	0.0080	0.1291	1.94	2.19
AK-43c	Intermediate	X-15, CB524	118.20	1051.1	37.71	10.98	0.709559	0.511576	-20.72	0.20	0.3204	0.1760	1.67	1.92
SW-14	Intermediate	X-4, CB513	36.15	949.7	20.99	3.96	0.706606	0.511830	-15.76	0.23	0.1191	0.1141	1.49	1.81
C387-28	Intermediate	X-22, CB531	1.24	1496.8	4.37	0.69	0.703293	0.512448	-3.71	0.20	0.0022	0.0954	0.29	0.80
AK-43b	Intermediate	X-14, CB522	106.81	754.8	62.68	10.11	0.711069	0.511434	-23.49	0.18	0.4093	0.0975	1.84	2.05
C387-10	Felsic	X-19, CB528	3.22	911.9	2.79	0.39	0.702870	0.511541	-21.40	0.23	0.0097	0.0845	1.49	1.74
SW-12	Felsic	X-3, CB512	40.42	329.3	16.98	3.46	0.715306	0.511793	-16.48	0.21	0.3960	0.1233	1.75	2.03
AK-41g	Felsic	X-11, CB520	325.20	12.1	13.45	3.99	0.708291	0.512541	-1.89	0.18	77.9968	0.1793	0.85	2.04
AK-41g-gl	Rhyolitic glass	41GG, CC491	363.23	10.3	13.30	3.99	0.711652	0.512543	-1.85	0.20	102.51	0.1811	0.93	2.12
3723A	Rhyolite-lava		265.00	2.4	11.50	4.49	0.707170	0.512552	-1.68	0.21	319.41	0.2360		
JR-2	Rhyolite-lava		297.00	8.0	24.80	6.20					107.39	0.1511		

See Appendix 1 and 2 for samples and analytical method; error Nd is epsilon Nd based on 2 SD
JR-2 is rhyolitic geostandard from Govindaraju (1989); 3723A is SFVF rhyolite from Arculus and Gust (1995)

Appendix 5. Data base of dropstones from ODP Leg 145

This appendix includes data of major elements, trace elements and Sr-Nd isotopic ratio of 12 dropston samples (only Table A 5-1).

Table A 5-1 Element and Sr-Nd isotopic data of 12 dropstones from ODP Leg 145

No.UNE	1	2	3	4	5	6	7	8	9	10	11	12
No.Pebble	152	91	104	179	148	1H-2	145	2H-6	25	51	11	5
No.CSIRO		CC483	CC484	CC487	CC486	CC488	CC485	CC489	CC481	CC482		CC480
SiO_2	54.94	65.83	65.84	47.86	52.97	56.24	55.38	59.96	58.78	60.12	59.31	60.88
TiO_2	1.03	0.80	0.56	0.68	1.08	0.72	2.05	1.22	0.72	0.61	0.64	0.74
Al_2O_3	17.52	16.55	17.31	13.06	17.37	16.30	15.11	16.72	16.39	18.10	17.22	16.77
Fe_2O_3	9.68	5.18	4.65	11.39	10.09	8.26	12.63	7.18	7.75	5.71	7.16	6.34
CaO	7.93	4.40	5.27	11.68	9.94	9.09	7.69	6.22	8.12	7.79	8.38	7.86
MgO	3.12	1.00	1.36	11.32	5.25	5.36	3.04	3.63	4.31	3.49	3.34	3.99
MnO	0.18	0.15	0.10	0.19	0.17	0.15	0.20	0.13	0.13	0.12	0.14	0.10
Na_2O	3.81	4.33	3.34	1.80	2.36	2.20	2.24	2.68	2.23	2.35	2.50	2.36
K_2O	1.50	1.63	1.45	1.75	0.60	1.46	1.27	2.09	1.33	1.52	1.19	0.77
P_2O_5	0.29	0.14	0.10	0.26	0.18	0.23	0.41	0.17	0.23	0.18	0.13	0.21
Li	8.18	3.17	13.48	17.18	9.88	7.57	15.03	16.53	7.32	5.48	6.69	4.91
Sc	22.1	16.6	12.8	27.0	19.9	23.1	28.4	17.8	22.2	18.6	24.3	16.4
V	218.2	35.7	79.8	326.5	289.6	265.3	331.1	150.2	228.5	208.1	217.6	169.2
Cr	8.4	4.4	7.7	294.5	47.4	78.4	4.2	44.9	75.7	14.4	40.0	82.7
Co	18.8	6.5	13.2	46.9	31.7	25.8	263.9	18.8	24.7	100.5	35.8	28.2
Ni	5.7	2.6	7.4	154.2	35.5	30.9	249.9	30.7	30.0	102.7	30.7	41.2
Cu	20.2	7.6	26.9	58.3	147.3	99.0	67.8	15.1	67.0	28.2	62.0	23.8
Zn	87.0	79.7	57.4	72.8	81.4	61.8	120.2	72.2	64.1	58.0	59.4	59.7
Ga	9.28	9.79	8.18	10.23	5.87	9.79	8.36	13.02	15.34	9.39	6.37	7.80
Ge	0.89	0.09	0.15	1.09	1.44	1.22	2.45	1.11	1.53	1.15	1.18	1.03
Rb	32.6	31.1	27.4	26.4	10.3	29.6	31.0	45.4	41.0	42.1	20.6	12.7
Sr	414.2	240.7	240.1	363.8	257.8	609.4	262.3	433.5	578.5	460.9	297.2	535.3
Y	25.7	27.6	22.1	16.2	25.8	17.9	58.6	19.8	21.6	17.2	23.5	15.3
Zr	122.9	153.9	109.6	36.3	94.3	69.2	244.1	293.8	132.7	84.3	81.7	117.1
Nb	3.70	3.49	2.33	1.31	2.01	2.06	6.08	14.53	2.31	2.06	1.49	2.85
Mo	1.89	1.56	1.90	0.42	1.10	0.96	2.40	1.96	2.32	1.92	1.42	1.62
Cs	1.02	0.95	1.91	0.42	0.34	1.43	1.62	1.52	1.85	2.45	1.28	0.29
Ba	363.4	425.2	377.1	620.5	118.1	481.5	282.7	678.5	885.3	407.7	193.9	293.2
La	10.46	4.33	7.20	3.75	5.12	11.01	16.37	11.06	16.09	12.45	6.46	7.66
Ce	20.33	9.90	16.30	9.65	13.01	23.05	38.84	23.55	33.59	26.56	15.27	17.33
Pr	2.82	1.68	2.19	1.60	2.10	3.08	6.11	2.90	5.22	3.50	2.34	2.29
Nd	14.34	8.22	10.55	8.17	10.72	13.91	31.53	12.11	22.57	13.86	10.21	10.09
Sm	3.96	2.69	2.91	2.40	3.43	3.31	8.65	2.85	4.87	3.36	2.82	2.52
Eu	0.97	1.66	0.79	1.02	0.70	1.35	2.27	1.47	1.49	1.13	0.86	0.70
Gd	3.48	3.55	2.90	2.94	3.18	3.75	10.11	2.99	5.04	3.16	3.33	2.36
Tb	0.63	0.65	0.55	0.46	0.65	0.54	1.73	0.52	0.69	0.45	0.58	0.41
Dy	4.24	4.65	3.70	2.85	4.36	3.21	10.65	3.36	3.83	2.60	3.75	2.58
Ho	0.87	1.06	0.79	0.60	0.91	0.69	2.31	0.75	0.74	0.56	0.81	0.52
Er	2.51	3.10	2.36	1.66	2.60	1.88	6.15	2.13	2.09	1.55	2.35	1.49
Tm	0.39	0.52	0.38	0.25	0.40	0.29	0.95	0.36	0.32	0.25	0.39	0.23
Yb	2.63	3.68	2.66	1.63	2.70	1.95	6.14	2.56	2.11	1.60	2.61	1.53
Lu	0.42	0.58	0.44	0.24	0.44	0.30	0.95	0.40	0.33	0.26	0.42	0.25
Hf	3.03	4.57	3.21	1.08	2.64	1.91	6.63	6.59	3.54	2.08	2.31	2.67
Ta	0.22	0.23	0.16	0.08	0.14	0.13	0.44	0.95	0.15	0.14	0.10	0.19
Pb	5.35	8.76	9.42	5.32	4.27	7.50	8.72	9.42	18.21	9.69	6.69	6.06
Th	1.33	1.64	1.71	0.13	0.48	2.41	2.70	3.68	4.92	3.95	1.55	0.90
U	0.83	0.75	0.65	0.16	0.23	0.85	1.32	1.71	2.27	1.20	0.55	0.40
Ce/Ce*	0.90	0.88	0.99	0.95	0.96	0.95	0.93	1.00	0.88	0.97	0.95	1.00
Eu/Eu*	0.80	1.64	0.83	1.17	0.65	1.17	0.74	1.54	0.92	1.06	0.86	0.88
$^{87}Sr/^{86}Sr$		0.703343	0.703485	0.703282	0.703216	0.702979	0.703805	0.703198	0.703497	0.703201		0.703101
$^{143}Nd/^{144}Nd$		0.512991	0.513030	0.513098	0.513067	0.512975	0.512992	0.513046	0.513023	0.512975		0.513058
epsilon Nd		6.89	7.65	8.97	8.37	6.57	6.91	7.96	7.51	6.57		8.19
error (2 SD)		0.19	0.19	0.21	0.20	0.16	0.14	0.14	0.18	0.21		0.19

See Appendices 1 and 2 for interpretation of samples and analytical methods

Appendix 6. Related publication list during Ph.D studies

6.1 Published conference abstracts

1. The composition of lower crust under the San Francisco volcanic field, northern Arizona: xenolith evidence (by W. Chen and R.J. Arculus *in* : IGCP Project 304 "Lower Crustal processes" International Workshop. *The Xenolith Window Into The Lower Crust*, October, 1993, Sydney, Abstract Volume p2).

2. Ash geochemistry of Bonin and Mariana island arcs (by W. Chen and R. J. Arculus *in* : *IAVCEI General Assembly, Ancient Volcanism & Modern Analogues*, September, 1993, Canberra, Abstract Volume, p19).

6.2 Published or in press abstract and papers with supervisor

1. Bonin and Mariana arc ash geochemistry: evidence for longterm mantle source distinctiveness (by R. J. Arculus, W. Chen and W. L. Griffin, 1992, *EOS* 73: 646).

2. Provenance of Pliocene-Pleistocene ice-rafted debris, ODP Leg 145, northern Pacific Ocean (by B.C. McKelvey, W. Chen and R.J. Arculus 1995, *in* : Rea, D.K., Basov, I.A., Scholl, D.W. and Allan, J.F. (Eds) *Proc. ODP, Sci. Results,* 145: College Station, TX (Ocean Drilling Program), in press).

3. Geochemical evolution of arc system in the western Pacific: the ash and turbidite record recovered by drilling (by R.J. Arculus, J.B. Gill, H. Cambrey, W. Chen and R.J. Stern, 1995, *in* : Taylor, B and Natland, J., (Eds) *Active Margins and Marginal Basins of the Western Pacific:* Geophysical Monograph 88, Amer. Geophys. Union, 45-65.

6.3 To be published (accepted) paper and extended abstracts

1. Geochemical and isotopic characteristics of lower crustal xenoliths, San Francisco volcanic field, AZ, USA (by W. Chen and R.J. Arculus, 1995, *Lithos* in press).

2. REE and Nd-Sr isotopic geochemistry of lower crustal xenoliths, San Francisco volcanic field, AZ, U.S.A. (by W. Chen and R.J. Arculus, 1994, submitted to *CIS (Centre for Isotope Studies) Research Report 1993 -1994).*

3. REE and Sr-Nd isotopic geochemistry of volcanic ashes from the Bonin and Mariana arcs, western Pacific (by W. Chen and R.J. Arculus 1994, submitted to *CIS (Centre for Isotope Studies) Research Report 1993 -1994).*

4. Isotopic ratios-like Ba/Rb ratio: indicator for sediment incorporation in island arc magmas (by W. Chen and R.J. Arculus, 1994, submitted to *CIS (Centre for Isotope Studies) Research Report 1993 -1994).*

Appendix 7. Analytical Data for Ashes from Yasur Volcano, Tanna, Vanuatu Arc

Introduction

Three ash samples: Ash A, Ash B, and Ash C were collected during active eruptions from Yasur volcano, Vanuatu Arc by R. J. Arculus. Ash A and Ash C are about 2 grams respectively, while Ash B is approximately 100 grams. These samples were washed in deionised water in an ultrasonic bath for ~ 30 minutes, dried gently (< 105 °C), and examined under the binocular microscope. The three ash samples consist of individual glass and mineral crystal shards and lithic fragments. There are two types of glass shards: one is brown and equant, and the other is light brown with elongate shards. The brown glass shards (Ash brown or Br) and light brown with elongate glass shards (Ash L&L or LL) were handpicked, mounted in perspex, polished and carbon-coated carefully for electron microprobe analysis (EMP). Collectively, these point analyses of individual glass shards from the Yasur ashes are essentially identical, regardless of their colour (brown or light brown), size (< 0.1 mm, 0.1 ~ 0.5 mm, > 0.5 mm in diameter), and shape (equant or elongated). 73 point analyses of individual glass shards from the Yasur ashes are all listed in Table A 10-1 (11 brown and 9 L&L analyses for Ash A, 29 brown and 8 L&L for Ash B, and 16 brown for Ash C). Because of the homogeneity of major element compositions determined by EMP, three bulk glass samples handpicked by colour (Ash A brown, Ash B brown, and Ash L&L) were selected for trace element analysis by ICP-MS. The ICP-MS data of bulk glasses are presented in Table A 10-2. The major element data are the average of all individual glass point analyses, and the trace element data are the average of the duplicate analysis of bulk glass samples. The detailed analytical methods are given in Appendix 2.

Crystalline phases comprise plagioclase, clinopyroxene, olivine and titanomagnetite. Representative analyses are listed in Tables A 10-3, A 10-4, and A 10-5, respectively.

From the data of major and trace elements of glasses and mineral analyses, it is clear that the Yasur ashes are homogeneous and are trachy-andesite (Figure A 10-1). These Yasur ash samples may serve as an internal glass standard during future volcanic ash studies. Further X-ray fluorescence and laser-ablation microprobe ICP-MS analysis however, are needed to confirm these analyses determined by EMP and ICP-MS.

Table A 7-1 Major element compositions of individual glass shards from Yasur ashes

Samples	Points	SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO	K_2O	Na_2O	Total#	Mg#*	K_2O+Na_2O	K_2O/Na_2O
Ash-A, L&L	G-1 c	61.59	0.87	15.72	7.77		2.22	4.59	3.76	3.48	108.69	33.76	7.24	1.08
	G-1r1	61.36	0.97	15.49	8.16		1.83	5.00	4.11	3.08	98.37	28.58	7.19	1.33
	G-1r2	61.16	0.96	15.42	8.40		1.90	4.92	4.10	3.14	101.90	28.69	7.24	1.31
	G-6 r	60.99	1.00	15.50	8.03		1.98	4.97	4.04	3.49	103.16	30.52	7.53	1.16
	G-6 c1	61.64	0.79	15.50	8.14		2.00	4.85	4.05	3.02	102.19	30.49	7.07	1.34
	G-6 c2	61.31	0.93	15.53	8.10		1.81	4.73	4.16	3.43	103.25	28.53	7.59	1.21
	G-14 c	60.62	0.89	15.37	8.62		2.12	5.17	3.78	3.43	103.75	30.45	7.21	1.10
	G-15 c	61.29	0.94	15.60	8.09		1.83	5.12	4.00	3.13	98.63	28.73	7.13	1.28
	G-16 c	61.54	0.92	15.52	7.94		2.00	4.81	4.02	3.25	104.36	31.02	7.27	1.24
Ash A brown	G-3 c	60.89	0.90	15.18	8.50		2.02	5.26	3.87	3.38	101.56	29.72	7.25	1.14
	G-5 c	60.73	0.96	15.07	8.75		2.08	5.21	3.92	3.27	102.52	29.78	7.19	1.20
	G-7 c	61.08	0.88	15.51	8.24		2.12	5.18	3.78	3.20	102.76	31.44	6.98	1.18
	G-8 c	61.73	1.04	15.28	8.10		1.58	4.26	4.24	3.77	103.83	25.76	8.01	1.12
	G-9 c	60.80	0.76	15.20	8.79		2.07	5.12	3.91	3.36	103.29	29.53	7.27	1.16
	G-10 c	60.72	0.93	15.55	8.27	0.16	1.95	5.09	3.98	3.35	103.35	29.58	7.33	1.19
	G-10 r	60.89	0.86	15.25	8.65		2.10	5.13	3.82	3.28	102.51	30.25	7.10	1.16
	G-11 c	61.21	0.84	15.26	8.30		1.76	4.72	4.30	3.59	102.92	27.44	7.89	1.20
	G-12 c	60.95	1.07	15.22	8.30		1.96	4.99	3.97	3.54	102.85	29.60	7.51	1.12
	G-13 c	61.05	0.93	15.24	8.30		2.07	4.82	4.11	3.47	103.57	30.75	7.58	1.18
	G-17 c	60.88	0.87	15.24	8.50		2.04	5.02	3.88	3.58	103.46	29.95	7.46	1.08
Ash B L&L	g-7 c1	60.02	0.86	15.46	8.69		2.22	5.79	3.85	3.11	102.15	31.30	6.96	1.24
	g-7 c2	60.07	1.03	15.42	8.74		2.27	5.61	3.83	3.03	101.95	31.65	6.86	1.26
	g-8 c	60.37	1.00	15.35	8.65		2.19	5.42	3.81	3.21	102.58	31.12	7.02	1.19
	g-12 c1	60.97	0.83	15.36	8.57		2.00	5.18	3.94	3.15	103.69	29.41	7.09	1.25
	g-12 c2	60.90	0.93	15.60	8.17		2.16	5.05	3.91	3.29	103.40	32.03	7.20	1.19
	g-12 r	60.97	0.82	15.64	8.13		2.17	5.06	3.90	3.31	103.31	32.27	7.21	1.18
	g-22 c	60.55	0.86	15.56	8.36		2.34	5.47	3.65	3.21	103.67	33.27	6.86	1.14
	g-22 r	59.72	0.97	15.68	8.53		2.50	5.47	3.62	3.51	104.97	34.30	7.13	1.03
Ash-B, brown	g-1 c	61.23	0.98	15.37	8.26		1.81	4.71	4.10	3.53	102.55	28.12	7.63	1.16
	g-2 c	60.59	0.94	15.05	8.55		2.31	5.26	3.93	3.37	103.06	32.51	7.30	1.17
	g-3 c	60.40	0.97	15.30	8.76		2.15	5.26	3.89	3.28	102.86	30.47	7.17	1.19
	g-4 c1	60.71	0.94	15.13	8.60		2.23	5.33	3.83	3.23	102.47	31.62	7.06	1.19
	g-4 c2	60.87	0.95	15.63	8.24		2.11	5.09	3.92	3.19	103.16	31.31	7.11	1.23
	g-5 c	60.41	0.87	15.44	8.61		2.26	5.72	3.64	3.05	102.34	31.99	6.69	1.19
	g-5 r	59.73	0.96	15.62	8.52		2.41	5.77	3.75	3.23	104.94	33.57	6.98	1.16
	g-6 c	60.21	1.05	15.38	8.89		2.08	5.26	3.97	3.15	103.47	29.38	7.12	1.26

Table A 7-1 Major element compositions of individual glass shards from Yasur ashes (cont)

Samples	Points	SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO	K_2O	Na_2O	Total#	Mg#*	K_2O+Na_2O	K_2O/Na_2O
Ash-B, brown	g-9 c	59.94	1.17	15.27	8.84		2.31	5.32	3.86	3.29	104.51	31.73	7.15	1.17
	g-10 c	61.24	0.96	15.35	8.69		1.89	4.88	4.01	2.98	102.53	27.86	6.99	1.35
	g-10 r	60.77	0.93	15.33	8.47		2.10	5.08	4.04	3.29	103.78	30.62	7.33	1.23
	g-11 c	60.40	0.97	15.31	8.70		2.09	5.15	3.88	3.49	103.96	29.96	7.37	1.11
	g-13 c	59.93	0.91	15.24	9.10		2.24	5.14	3.88	3.55	104.42	30.52	7.43	1.09
	g-13 r	60.59	0.87	15.23	8.78		2.11	5.24	3.72	3.46	103.57	29.94	7.18	1.08
	g-14 c	61.00	0.94	15.37	9.16		2.05	3.97	4.30	3.21	103.42	28.52	7.51	1.34
	g-15 c	59.52	1.06	15.53	8.97		2.33	5.72	3.67	3.20	103.83	31.60	6.87	1.15
	g-16 c	60.22	1.01	15.41	8.76		2.16	5.56	3.95	2.92	103.05	30.50	6.87	1.35
	g-17 c	60.32	1.12	15.38	8.48		2.17	5.29	3.90	3.34	104.01	31.33	7.24	1.17
	g-18 c	59.83	0.95	15.55	8.76		2.23	5.51	3.78	3.40	104.32	31.21	7.18	1.11
	g-19 c	60.48	0.88	15.37	8.50		2.19	5.50	3.78	3.29	104.65	31.48	7.07	1.15
	g-20 c	59.97	0.91	15.61	8.62		2.50	5.42	3.70	3.26	104.88	34.05	6.96	1.13
	g-21 c	60.41	1.01	15.52	8.25		2.29	5.51	3.70	3.32	104.94	33.11	7.02	1.11
	g-23 c	60.40	0.89	15.62	8.55		2.16	5.70	4.00	2.68	103.11	31.01	6.68	1.49
	g-24 c	60.34	0.95	15.21	8.64		2.05	5.44	3.87	3.49	104.21	29.75	7.36	1.11
	g-25 c	60.15	0.88	15.69	8.55		2.25	4.71	4.20	3.57	82.95	31.89	7.77	1.18
	g-26 c	60.64	0.83	15.34	8.83		2.14	5.17	3.80	3.25	103.81	30.14	7.05	1.17
	g-27 r	60.10	0.97	15.58	8.69		2.16	5.61	4.11	2.78	102.69	30.71	6.89	1.48
	g-27 c	60.62	0.89	15.40	8.53		2.07	5.45	4.13	2.90	103.31	30.24	7.03	1.42
	g-28 c	60.41	0.92	15.68	8.45		2.21	5.34	3.62	3.38	104.19	31.78	7.00	1.07
Ash C, brown	g-1 r	61.54	0.81	15.37	8.13		1.80	5.00	3.85	3.50	102.96	28.33	7.35	1.10
	g-1 c	61.63	0.89	15.75	7.67		1.73	4.79	4.02	3.50	103.33	28.71	7.52	1.15
	g-2 c	60.30	0.90	15.26	8.80		2.23	5.35	3.78	3.38	103.91	31.09	7.16	1.12
	g-3 c	61.02	0.91	15.26	8.46		2.04	5.19	3.87	3.25	103.52	30.02	7.12	1.19
	g-3 r	60.23	0.97	15.35	8.82		2.21	5.39	3.84	3.20	103.70	30.82	7.04	1.20
	g-5 c	60.43	0.89	15.20	8.23		2.26	5.13	3.90	3.97	104.59	32.83	7.87	0.98
	g-5 r	62.53	0.58	15.56	6.79		2.00	4.86	4.17	3.51	102.29	34.48	7.68	1.19
	g-6 c	60.70	1.02	15.41	7.98		2.32	5.44	3.86	3.28	104.51	34.10	7.14	1.18
	g-6 r	61.16	0.85	15.47	7.48		2.21	5.62	3.81	3.41	103.60	34.53	7.22	1.12
	g-7 c	60.49	0.94	15.48	8.49		2.27	5.25	3.89	3.18	103.73	32.25	7.07	1.22
	g-8 c	60.52	0.89	15.51	8.54		2.22	5.20	3.93	3.20	104.29	31.64	7.13	1.23
	g-9 c	61.44	0.95	15.49	8.18		1.87	4.86	4.05	3.16	103.18	28.99	7.21	1.28
	g-10 c	60.02	1.08	15.43	8.60		2.15	5.41	3.97	3.36	102.98	30.84	7.33	1.18
	g-11 c	60.37	0.99	15.14	8.43		2.13	5.43	3.90	3.61	103.72	31.09	7.51	1.08
	g-12 c1	60.77	0.86	15.40	8.29		2.18	5.39	3.77	3.33	102.72	31.86	7.10	1.13
	g-12 c2	61.31	0.95	15.52	7.49		2.16	5.25	3.95	3.38	103.61	33.94	7.33	1.17

See Appendix 2 for analytical method and text for sample interpretation; Total Fe reported as FeO*; Total# is original wt %

Table A 7-2 Chemical compositions of bulk glasses from Yasur volcanic ashes

Sample	Ash-A (11)	Ash-B (29)	Ash-LL (17)	Average (73)
SiO_2	60.99	60.38	60.90	60.71
TiO_2	0.91	0.95	0.92	0.93
Al_2O_3	15.27	15.40	15.51	15.41
FeO*	8.43	8.66	8.30	8.42
MgO	1.98	2.18	2.09	2.11
CaO	4.98	5.29	5.13	5.19
K_2O	3.98	3.90	3.91	3.92
Na_2O	3.44	3.23	3.25	3.31
K_2O+Na_2O	7.42	7.13	7.16	7.22
K_2O/Na_2O	1.16	1.21	1.20	1.18
Li	19.05	20.25	19.97	19.60
Sc	21.6	23.4	19.0	20.9
V	289.2	305.9	304.5	297.2
Cr	5.39	2.53	8.19	5.79
Co	19.49	18.04	17.56	18.49
Ni	10.35	8.36	7.97	9.14
Cu	338.6	290.7	327.3	325.4
Zn	97.1	91.7	94.0	95.5
Ga	17.33	17.03	16.85	17.16
Ge	1.51	1.48	1.47	1.49
Rb	55.85	62.40	61.99	59.29
Sr	438.6	469.2	459.5	452.3
Y	34.72	39.14	38.20	36.87
Zr	147.1	163.9	160.7	155.3
Nb	2.43	2.89	2.71	2.60
Cs	1.85	1.90	1.80	1.85
Ba	652.2	678.5	673.1	666.7
La	17.51	18.36	18.63	18.12
Ce	39.05	40.68	41.42	40.28
Pr	5.47	5.79	5.91	5.70
Nd	26.35	27.33	27.72	27.07
Sm	6.24	6.44	6.70	6.44
Eu	1.56	1.67	1.68	1.63
Gd	5.94	6.14	6.35	6.13
Tb	0.93	0.97	0.98	0.96
Dy	5.49	5.61	5.87	5.64
Ho	1.16	1.19	1.23	1.19
Er	3.16	3.24	3.39	3.26
Tm	0.52	0.52	0.54	0.52
Yb	3.49	3.49	3.59	3.52
Lu	0.56	0.57	0.58	0.57
Hf	4.32	4.22	4.45	4.33
Ta	0.14	0.15	0.13	0.14
Pb	17.34	17.14	16.99	17.17
Th	3.06	3.00	2.85	2.98
U	1.64	1.66	1.65	1.65

Major element data are in wt % and trace element data are in ppm
See Appendix 2 for analytical methods and text for sample interpretation
Total Fe reported as FeO*; Major element data are normalised to 100% free of volatiles

Table A 7-3 Representative analyses of plagioclase from Yasur ashes

Sample	Points	SiO_2	Al_2O_3	Fe_2O_3*	CaO	K_2O	Na_2O	Total*	Si	Al	Fe^{3+}	Ca	K	Na	Total cations	An	Ab	Or
Ash A	A-1c	55.45	27.85	0.76	9.57	0.92	5.46	98.04	2.50	1.48	0.03	0.46	0.05	0.48	5.01	46.6	48.1	5.3
	A-1r	56.20	27.27	0.66	9.04	1.07	5.76	97.86	2.54	1.45	0.02	0.44	0.06	0.50	5.01	43.6	50.3	6.1
	A-2c1	53.48	28.91	0.85	11.39	0.73	4.63	98.11	2.43	1.55	0.03	0.55	0.04	0.41	5.01	55.2	40.6	4.2
	A-2c2	52.93	29.35	0.89	11.92	0.63	4.27	97.48	2.41	1.57	0.03	0.58	0.04	0.38	5.00	58.4	37.9	3.7
	A-3c	53.41	28.69	0.81	11.43	0.77	4.88	99.36	2.43	1.54	0.03	0.56	0.04	0.43	5.03	54.0	41.7	4.3
	A-3r	52.82	29.37	0.96	11.93	0.63	4.28	98.56	2.40	1.57	0.03	0.58	0.04	0.38	5.00	58.4	38.0	3.7
Ash B	B-1r	54.71	28.42	0.73	10.64	0.76	4.74	97.90	2.47	1.51	0.03	0.52	0.04	0.42	4.99	52.9	42.6	4.5
	B-1c	53.84	28.86	0.68	11.16	0.65	4.81	98.30	2.44	1.54	0.02	0.54	0.04	0.42	5.01	54.1	42.2	3.7
	B-2c	53.22	29.08	0.87	11.49	0.68	4.66	99.34	2.42	1.56	0.03	0.56	0.04	0.41	5.01	55.4	40.7	3.9
	B-2r	52.32	29.49	1.33	11.93	0.64	4.30	99.41	2.38	1.58	0.05	0.58	0.04	0.38	5.01	58.3	38.0	3.7
	B-3c	52.80	29.15	1.03	11.68	0.72	4.61	99.67	2.40	1.56	0.04	0.57	0.04	0.41	5.02	55.9	40.0	4.1
	B-3r	54.32	28.66	0.69	10.79	0.77	4.77	99.03	2.46	1.53	0.02	0.52	0.04	0.42	5.00	53.1	42.5	4.5
	B-4c	53.01	29.09	1.05	11.43	0.75	4.67	99.29	2.41	1.56	0.04	0.56	0.04	0.41	5.02	55.1	40.7	4.3
Ash C	C-1c1	53.78	28.67	0.94	11.37	0.70	4.54	99.39	2.44	1.53	0.03	0.55	0.04	0.40	5.00	55.7	40.2	4.1
	C-1c2	53.08	29.35	0.77	11.52	0.70	4.58	99.59	2.41	1.57	0.03	0.56	0.04	0.40	5.01	55.8	40.2	4.0
	C-1r	53.38	29.16	0.78	11.47	0.70	4.52	99.61	2.42	1.56	0.03	0.56	0.04	0.40	5.00	56.0	39.9	4.1
	C-2c1	53.21	29.10	0.98	11.50	0.75	4.45	98.49	2.42	1.56	0.03	0.56	0.04	0.39	5.01	56.2	39.4	4.4
	C-2c2	53.21	29.37	0.85	11.47	0.69	4.42	98.13	2.41	1.57	0.03	0.56	0.04	0.39	5.00	56.5	39.4	4.0
	C-2r	53.23	29.41	0.84	11.53	0.61	4.39	97.89	2.41	1.57	0.03	0.56	0.04	0.39	5.00	57.1	39.3	3.6

Total Fe reported as Fe_2O_3*; Total* is original total wt %
See Appendix 2 for analytical technique and text for sample

Table A 7-4 Representative analyses of pyroxene from Yasur ashes

Sample	Ash A-1c	Ash C-1c	Ash C-1r	Ash C-2c	Ash C-2r
SiO_2	51.22	51.50	51.92	52.15	51.43
TiO_2	0.24	0.24	0.25	0.40	0.22
Al_2O_3	1.97	2.04	2.41	1.92	2.24
Cr_2O_3	<.13	<.13	<.13	<.13	<.13
FeO*	10.85	10.53	10.45	10.26	10.66
MnO	0.35	0.38	0.37	0.39	0.43
MgO	15.69	15.85	15.78	15.93	15.64
CaO	19.09	19.08	19.25	19.51	19.31
Na_2O	0.24	<.13	<.19	<.19	<.19
Total#	99.64	99.52	100.44	100.56	99.94
Si	1.92	1.93	1.93	1.93	1.92
Ti	0.01	0.01	0.01	0.01	0.01
Al	0.09	0.09	0.11	0.08	0.10
Cr	0.00	0.00	0.00	0.00	0.00
Fe*	0.34	0.33	0.32	0.32	0.33
Mn	0.01	0.01	0.01	0.01	0.01
Mg	0.88	0.89	0.87	0.88	0.87
Ca	0.77	0.76	0.77	0.78	0.77
Na	0.02	0.00	0.00	0.00	0.00
Total cations	4.03	4.02	4.01	4.01	4.02
Si	1.91	1.92	1.92	1.93	1.91
Ti	0.01	0.01	0.01	0.01	0.01
Al	0.09	0.09	0.11	0.08	0.10
Cr	0.00	0.00	0.00	0.00	0.00
Fe^{3+}	0.10	0.05	0.04	0.04	0.06
Fe^{2+}	0.24	0.28	0.28	0.28	0.27
Mn	0.01	0.01	0.01	0.01	0.01
Mg	0.87	0.88	0.87	0.88	0.87
Ca	0.76	0.76	0.76	0.77	0.77
Na	0.02	0.00	0.00	0.00	0.00
Total cations	4.00	4.00	4.00	4.00	4.00
Wo	38.66	38.55	39.01	39.27	39.10
En	44.20	44.76	44.47	44.61	44.05
Fs*	17.14	16.69	16.53	16.11	16.85

See Appendix 2 for analytical method and text for samples
Total Fe reported as FeO*; Total# is original total wt %
Fe^{3+} and Fe^{2+} were calculated using the charge balance method of Papike et al. (1974)

Table A 7-5 Representative analyses of olivine and titanomagnetite from Yasur ashes

Olivine

Sample	Ash-B	Ash-B	Ash-C	Ash-C	Ash-C	Ash-C	Ash-C	Ash-C
Points	B-1c	B-1r	C-1c1	C-1c2	C-1r	C-2c	C-3c	C-3r
SiO_2	36.92	36.93	37.27	36.97	36.71	36.94	36.83	36.69
FeO*	29.31	28.70	28.67	28.98	28.76	28.89	28.98	29.18
MnO	0.53	0.61	0.47	0.55	0.48	0.54	0.39	0.48
NiO	<0.16	<0.16	<0.16	<0.16	0.17	<0.16	<0.16	<0.16
MgO	33.24	33.75	33.59	33.51	33.87	33.64	33.80	33.64
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Si	1.00	0.99	1.00	1.00	0.99	0.99	0.99	0.99
Fe	0.66	0.65	0.64	0.65	0.65	0.65	0.65	0.66
Mn	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Ni	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mg	1.34	1.35	1.34	1.35	1.36	1.35	1.36	1.35
Total cations	3.01	3.01	3.00	3.01	3.01	3.01	3.01	3.01
Fo	66.9	67.7	67.6	67.3	67.7	67.5	67.5	67.3

Titanomagnetite

Sample	Ash-A	Ash-A	Ash-B	Ash-C	Ash-C	Ash-C
Points	A-1c	A-2c	B-1c	C-1c	C-2c	C-3c
TiO_2	8.98	8.44	5.27	7.58	9.18	8.35
Al_2O_3	4.41	4.37	4.50	4.26	4.36	4.02
Cr_2O_3	< 0.13	< 0.13	< 0.13	0.26	< 0.13	0.22
V_2O_3	0.98	1.10	0.88	0.83	1.27	1.04
FeO*	81.63	82.13	85.23	81.42	81.30	82.50
MnO	0.46	0.33	0.29	0.31	0.40	0.33
MgO	3.55	3.62	3.84	5.34	3.49	3.55
Total	100.01	99.99	100.01	100.00	100.00	100.01
Ti	0.23	0.22	0.14	0.19	0.24	0.22
Al	0.18	0.18	0.18	0.17	0.18	0.16
Cr	0.00	0.00	0.00	0.01	0.00	0.01
V	0.03	0.03	0.02	0.02	0.04	0.03
Fe^{3+}	1.33	1.35	1.52	1.41	1.31	1.37
Fe^{2+}	1.04	1.02	0.93	0.91	1.05	1.02
Mn	0.01	0.01	0.01	0.01	0.01	0.01
Mg	0.18	0.19	0.20	0.27	0.18	0.18
Total cations	3.00	3.00	3.00	3.00	3.00	3.00

See Appendix 2 for analytical method and text for sample interpretation

Total Fe reported as FeO; Fe_2O_3-FeO are calculated on the basis of AB_2O_4 (spinel) stoichiometry

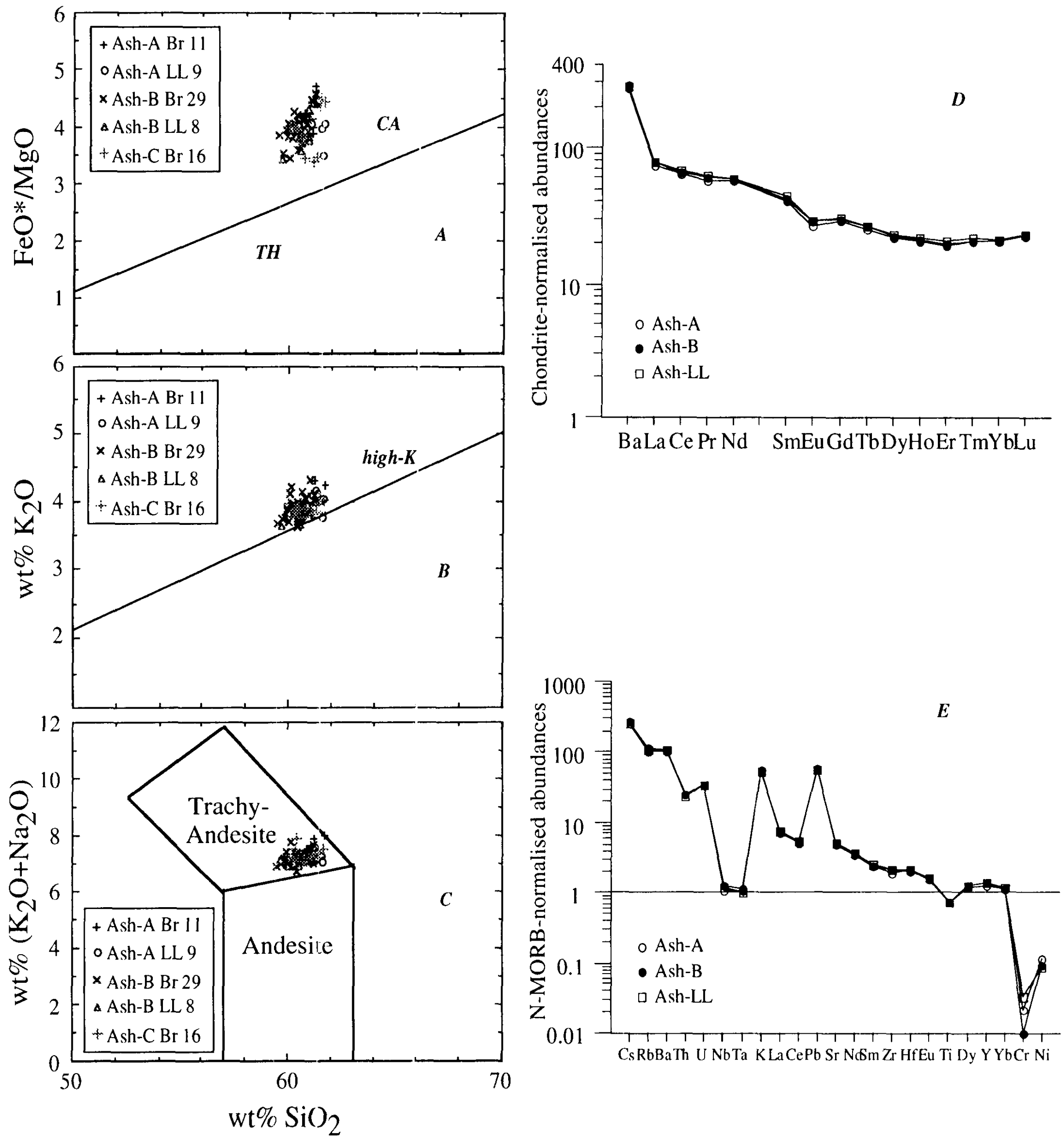

Figure A 7-1 Compositional diagrams for the Yasur volcanic ashes: A. Miyashiro's (1974) plot; B. Gill's (1981) division; C. IUGS classification (from LeBas et al., 1986); D. chondrite-normalised Ba-REE patterns; and E. N-MORB-normalised spidegrams. The normalising values are from Sun and McDonough (1989).