DATA REPOSITORY ITEM – 1. ANALYTICAL METHODS

Gold-coated polished grain mounts were analysed for H_2O using a Cameca ims-4f ion-microprobe at University of Edinburgh. A primary beam of nominally 10 keV $^{16}O^-$ ions was focussed to an ~10 micron spot at the sample surface. Beam currents were 1-2 nA, and positive secondary ions were extracted at 4500 V, with an energy offset of 75 eV, ±25 eV energy window and 25 µm image field. H_2O was analysed as ^1H and normalised to ^{30}Si, as subsequently measured by electron microprobe analysis (EMPA) of the same spot. Working curves were derived at the beginning and end of each analysis day using at least 5 rhyolite glass standards, ranging in H_2O content from 0.13 to 5.6 wt%, analysed in triplicate, under the same conditions. Because ^1H ion-yield increases with the SiO_2 of the glass (Shimizu, 1997) we use the correlation between $^1H/^{30}Si$, rather than $^1H/^{30}Si \times SiO_2$ (Shimizu, 1997), and H_2O to derive the working curve. Weighted linear least squares regression provided a best-fit transfer function. Fully propagated uncertainties on the measured H_2O content are typically 1-4% relative. Background H_2O concentration, determined by analysing plagioclase host crystals, is ~ 300 ppm. TiO_2 (as ^{47}Ti) and Na_2O (as ^{23}Na) were also measured in standards and glass inclusions.

Major elements were analysed in melt inclusions, after ion-probe analysis, by EMPA on carbon-coated samples at the University of Bristol using either a JEOL733 4-spectrometer or a Cameca SX100 5-spectrometer microprobes, with mineral, oxide and glass standards for calibration. Considerable care was taken to minimise Na migration during EMPA by using a low accelerating voltage (15 kV), low beam current (2 nA), defocused spot (15 µm diameter) and reduced counting times on Na (3-4 s on background and 6-7 s on peak), which along with Si and K was always analysed first. All elements other than Na were analysed for at least 10 s (background) and 20 s (peak). For glasses analysed by SX100 we can demonstrate minimal Na loss by the close correspondence between Na_2O as analysed by EMPA and Na_2O analysed by ion-probe (average absolute deviation, *aad* = 0.42 wt% Na_2O, *n*=37). H_2O as determined using the "by difference from 100%" method for SX100 analyses has an *aad* of 0.55 wt% against ion-probe analyses of the same glass inclusions. The *aad* for nine hydrous andesite and rhyolite glass standards, with 0.1-5.8 wt% H_2O (Mandeville et al., 2002) on the SX100 is 0.36 wt%. Analysis of hydrous glasses using the JEOL733 was less accurate due to persistent Na migration, even with low beam currents. This is evident from low Na_2O contents compared to ion-probe analyses of the same glasses. For this reason we have used the ion-probe Na_2O contents for the glasses analysed by JEOL733. By this method the agreement between volatile by difference and ion-probe determined H_2O is 0.89 wt% (*n*=65). Consequently, SX100 analysed glasses are deemed to have slightly greater precision (and reliability) than those analysed by JEOL. However, where both techniques have been applied to the same large melt inclusion agreement is very good. The nature of the EMPA technique used is noted in the data table. Only data are presented when there is a good analytical total (98-102 wt%, including H_2O), and good agreement (±15% relative) between ion-probe and EMPA TiO_2 contents.

REFERENCES

Mandeville C., et al., 2002, Determination of molar absorptivities for infrared absorption bands of H_2O in andesitic glasses: American. Mineralogist. v. 87, p. 813-821.

Shimizu N., Principles of SIMS and modern ion microprobes. in *Modern Analytical Geochemistry*, Gill Ed. (Longman 1997) 235-242

DATA REPOSITORY ITEM – 2. GLASS ANALYSES

NOTES.

All analyses given as weight per cent. Blank space indicates element not analysed. *b.d.* is below detection.

a. Major elements analysed by JEOL833 microprobe; Na_2O is taken from ion-probe analysis.
b. All major elements (including Na_2O) analysed by SX100 microprobe
c. Textural variety of glass analysed: *PI*, plagioclase-hosted inclusion; *AI,* amphibole hosted; *OI*, orthopyroxene-hosted; *GM*, groundmass; *T*, melt tube or channel.
d. Determined by ion-microprobe. 1 s.d., fully propagated from calibration and ion counting statistics, given in parentheses.
e. Equilibrium H_2O pressure (in MPa), calculated at 900 °C using method of Newman & Lowenstern (2002)
f. Smithsonian sample USNM 115379-34 from Melson (1983)
g. Smithsonian sample 115418-60 from Melson (1983)

REFERENCES.

Melson, W.G., 1983, Monitoring the 1980-1982 eruptions of Mount St. Helens: Compositions and abundances of glass: Science v. 221, p. 1387-1391.

Newman, S., Lowenstern, J.B., 2002, VolatileCalc: a silicate melt–H_2O–CO_2 solution model written in Visual Basic for Excel: Computers and Geosciences v. 28, p. 597-604.

Table DR1a. May 18th 1980 Plinian eruption ("white pumice")

sample	Type[c]	SiO_2	TiO_2	Al_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	Cl	F	SO_2	H_2O[d]	Total	P_{H_2O}[e]
KCHB-4A[a]	AI	68.05	0.33	12.96	2.72	0.12	0.98	1.95	5.60	1.93					4.63(13)	99.26	142
KCHB-7A[b]	AI	69.01	0.37	14.07	2.19	0.02	0.36	2.25	5.54	1.85	*bd*	0.11	*bd*	0.15	3.19(6)	99.09	77
KCHB-8A[a]	AI	70.19	0.35	14.70	2.52	0.03	0.34	2.24	6.51	1.72					1.83(6)	100.43	29
KCHB-11A[a]	AI	65.81	0.51	15.03	2.13	*bd*	0.37	2.35	5.65	2.44					4.92(21)	99.20	157
KCHB-11B[a]	AI	69.71	0.21	14.15	2.48	*bd*	0.45	2.23	6.39	2.03					2.66(5)	100.29	56
PLZ-7A1[a]	PI	72.73	0.32	13.39	2.06	0.03	0.50	1.62	5.42	2.24					2.22(4)	100.53	41
PLZ-8A2[a]	PI	71.45	0.41	13.90	2.38	0.12	0.71	2.12	5.86	2.19					2.58(4)	101.72	53
PLZ-22A1[a]	PI	67.12	0.30	13.20	1.82	*bd*	0.50	2.07	5.75	2.05	0.18				5.41(13)	98.41	182
PLZ-22A2[a]	PI	67.00	0.37	13.90	2.41	0.14	0.65	2.18	4.37	2.09					5.08(11)	98.19	165
PLZ-24A1[a]	PI	70.39	0.46	13.50	2.28	0.07	0.59	1.95	5.76	1.92					3.32(9)	100.22	82
PLZ-33A2[a]	PI	68.48	0.37	12.84	2.18	0.06	0.63	1.74	6.36	1.89	0.16				4.60(8)	99.31	141
KCPL-6A[a]	PI	68.39	0.26	14.47	1.84	0.14	0.52	2.18	5.91	2.03					5.14(10)	100.86	168
KCPL-9A[a]	PI	66.13	0.25	14.18	1.86	0.13	0.74	2.14	5.71	1.88					5.03(9)	98.03	162
KCPL-9B[a]	PI	67.85	0.36	14.85	1.82	0.02	0.57	2.16	5.80	2.19					4.87(11)	100.48	154
KCPL-11A[a]	PI	68.67	0.34	13.82	1.84	0.13	0.47	1.80	5.94	1.94					5.21(8)	100.15	172
KCPL-12A[a]	PI	68.25	0.10	14.64	1.30	0.04	0.48	2.00	5.99	1.94					4.74(9)	99.47	148
KCPL-12B[a]	PI	69.36	0.30	14.49	1.67	0.10	0.57	2.24	6.00	1.98	*bd*				4.58(10)	101.29	140
KCPL-13A[a]	PI	69.58	0.01	12.71	1.01	*bd*	0.26	1.59	5.76	2.10	0.18				4.79(9)	97.99	150
KCPL-15A[a]	PI	68.79	0.36	13.75	1.94	*bd*	0.47	1.78	5.83	1.94					4.89(8)	99.74	155
KCPL-16A[a]	PI	67.02	0.38	14.08	2.13	0.09	0.60	2.20	5.77	1.95					5.10(10)	99.31	166
KCPL-19A[a]	PI	66.49	0.45	13.75	2.09	0.06	0.45	2.16	5.81	2.02	0.10				5.65(13)	99.03	194
006-6A[a]	PI	69.27	0.42	13.82	2.15	0.02	0.60	2.08	6.15	2.00					3.79(6)	100.30	102
006-9A[a]	PI	65.91	0.33	13.74	2.03		0.71	2.27	5.75	2.15	0.76				5.92(10)	99.57	208
006-10A[a]	PI	64.91	0.41	13.31	2.78	0.02	0.71	1.95	5.49	1.99	0.33				6.38(11)	98.27	232
006-14A[a]	PI	69.66	0.28	14.23	2.13		0.61	2.07	6.14	1.94					3.73(5)	100.78	100
006-19A[a]	PI	71.23	0.32	13.90	1.95		0.41	2.04	5.91	2.24					1.57(3)	99.56	22
006-19B[a]	PI	68.22	0.29	13.63	1.68	*bd*	0.47	1.93	5.81	2.09	0.26				5.42(10)	99.79	182
006-19C[a]	PI	69.44	0.29	13.95	2.84	0.01	0.62	2.11	6.26	1.97					3.54(6)	101.03	91
MAY-6-1[b]	PI	67.11	0.31	13.92	1.93	0.04	0.47	2.06	5.45	2.09	0.06	0.09	0.07	*bd*	5.42(8)	99.00	182
MAY-6-2[b]	PI	63.99	0.24	17.04	1.49	*bd*	0.35	4.15	4.89	1.58	0.30	0.10	0.07	*bd*	6.40(10)	100.60	233
MAY-5-1[b]	PI	67.42	0.39	13.79	2.10	0.03	0.59	2.15	4.27	1.93	0.05	0.08	0.02	0.02	5.93(8)	98.76	209
MAY-5-2[b]	PI	69.13	0.38	14.98	2.42	0.05	0.69	2.28	5.23	1.89	0.05	0.11	0.06	0.03	3.44(5)	100.72	87
MAY-4-1[b]	PI	71.60	0.37	14.99	1.96	0.09	0.47	2.16	5.16	2.02	0.08	0.12	0.04	*bd*	1.73(2)	100.79	26
MAY-4-2[b]	PI	66.90	0.21	13.78	1.84	0.10	0.55	1.93	5.23	2.12	0.10	0.10	0.04	*bd*	5.83(9)	98.74	204
PLZ-gm1[a]	GM	70.98	0.43	14.49	2.17	0.10	0.57	2.32	5.86	1.94					1.00(4)	99.85	9
PLZ-gm3[a]	GM	69.44	0.36	15.26	2.27	*bd*	0.45	2.29	5.96	1.99					2.22(3)	100.24	41
006-gm1[a]	GM	71.96	0.32	14.20	2.13		0.49	2.14	5.93	2.17					1.58(2)	100.93	22
006-gm2[a]	GM	71.96	0.35	14.22	3.01		0.56	2.22	5.70	2.03					1.24(3)	101.27	14
MAY-6-gm1[a]	GM	71.88	0.32	14.89	2.38	0.11	0.64	2.65	5.23	2.03	0.30				0.51(7)	100.94	2
MAY-6-gm2[a]	GM	71.39	0.38	14.55	2.65	0.11	0.60	2.37	5.18	1.92					0.65(9)	99.80	4
KCHB-gm1[a]	GM	71.07	0.31	14.84	2.40	*bd*	0.57	2.55	6.06	1.85					1.28(3)	100.94	15
KCHB-gm3[a]	GM	71.10	0.35	14.87	2.06	0.16	0.51	2.62	6.28	1.66					1.17(2)	100.78	13
KCHB-gm4[a]	GM	70.55	0.43	14.65	2.27	*bd*	0.62	2.30	5.98	2.06					0.98(2)	99.84	9

Table DR1b. May18th 1980 Blast deposit (“grey pumice” or “cryptodome”)

sample	**Type**[c]	**SiO_2**	**TiO_2**	**Al_2O_3**	**FeO**	**MnO**	**MgO**	**CaO**	**Na_2O**	**K_2O**	**P_2O_5**	**Cl**	**F**	**SO_2**	**H_2O**[d]	**Total**	**P_{H_2O}**[e]
SH80D-2A[a]	PI	73.78	0.43	11.43	2.87	0.08	0.69	1.07	5.07	3.32					1.95(3)	100.68	32
SH80D-2B[a]	PI	75.27	0.51	11.51	2.05	0.01	0.24	0.82	5.36	3.39					1.93(3)	101.10	32
SH80D-5A[a]	PI	77.62	0.37	10.85	1.57	0.23	0.17	0.67	5.23	3.55					1.36(2)	101.62	17
SH80D-7A[a]	PI	76.71	0.44	11.17	1.68	0.17	0.36	0.71	5.42	3.39					1.19(2)	101.24	13
SH80D-8A[a]	PI	76.28	0.41	11.53	1.94	0.10	0.28	0.69	5.35	3.35	0.15				1.28(2)	101.35	15
SH80D-9A[a]	PI	75.40	0.42	11.17	2.51	0.25	0.76	0.94	5.31	3.40	0.22				0.94(2)	101.33	8
SH80D-10A[a]	PI	76.07	0.44	10.94	1.58	0.11	0.32	0.63	5.18	3.46	0.12				0.79(1)	99.63	6
SH80D-11A[a]	PI	74.37	0.54	10.98	2.28	0.03	0.40	0.86	5.26	3.37					1.63(3)	99.71	23
34-2A[a,f]	PI	69.48	0.23	13.63	2.00	0.13	0.54	1.80	6.18	2.25	0.31				3.76(5)	100.31	101
34-3A[a,f]	PI	73.23	0.38	11.98	2.75	0.26	0.75	0.98	5.30	2.67					1.78(3)	100.07	27
34-3C[a,f]	PI	69.55	0.36	13.17	2.06	0.06	0.51	1.70	6.38	2.29					4.12(6)	100.19	118
34-4B[a,f]	PI	74.96	0.43	11.26	2.99	0.15	0.79	1.04	5.18	2.43					1.92(4)	101.17	31
34-6A[a,f]	PI	73.58	0.34	11.78	3.15	0.03	0.81	0.91	5.47	2.76					2.21(3)	101.02	40
34-8A[a,f]	PI	69.81	0.31	13.15	2.41	*bd*	0.58	1.69	6.30	2.14					3.73(7)	100.13	100
34-11A[a,f]	OI	71.15	0.29	14.65	2.27	0.26	0.35	2.21	5.86	2.45					1.83(2)	101.31	29

Table DR1c. June 12th 1980 Pumice

sample	**Type**[c]	**SiO_2**	**TiO_2**	**Al_2O_3**	**FeO**	**MnO**	**MgO**	**CaO**	**Na_2O**	**K_2O**	**P_2O_5**	**Cl**	**F**	**SO_2**	**H_2O**[d]	**Total**	**P_{H_2O}**[e]
JUN-14-1[b]	PI	69.93	0.22	15.46	1.70	*bd*	0.39	3.18	5.24	1.75	*bd*	0.08	0.08	0.05	2.94(8)	101.03	67
JUN-14-2[b]	PI	70.58	0.35	12.61	2.37	*bd*	0.51	1.27	5.57	2.45	0.27	0.14	0.05	*bd*	3.92(10)	100.08	108
JUN-13-1[b]	PI	74.62	0.25	11.95	2.16	0.06	0.34	0.75	4.76	2.48	0.11	0.11	0.12	*bd*	2.47(6)	100.17	49
JUN-15-1[a]	PI	73.80	0.34	11.88	2.35	*bd*	0.39	1.03	5.31	2.70	0.37				2.71(10)	100.87	58
JUN-15-2[a]	PI	70.19	0.37	13.06	2.30	*bd*	0.63	1.58	5.37	2.22	0.55				4.35(16)	100.60	129
JUN-1-1[b]	PI	73.95	0.45	11.81	2.18	0.05	0.48	1.02	4.65	2.53	0.05	0.12	0.01	0.05	2.00(9)	99.37	34
JUN-1-2[b]	PI	74.46	0.38	11.75	2.04	0.16	0.39	0.97	5.03	2.47	0.04	0.12	0.04	*bd*	2.35(9)	100.19	45
JUN-16-1[b]	PI	69.56	0.42	13.09	2.16	0.05	0.58	1.82	5.72	2.48	0.17	0.11	0.03	0.10	5.12(19)	101.40	167
JUN-13-2[b]	PI	74.08	0.27	11.88	1.87	0.10	0.42	0.83	4.61	2.59	0.12	0.09	*bd*	*bd*	2.74(10)	99.59	59
JUN-18-1[b]	PI	72.92	0.39	12.33	2.12	*bd*	0.41	1.05	5.01	2.69	0.05	0.15	0.03	0.01	2.96(11)	100.10	67
JUN-2-1[b]	PI	72.73	0.47	12.30	1.86	0.05	0.59	1.13	4.59	2.45	*bd*	0.13	*bd*	*bd*	3.41(13)	99.73	86
JUN-14-gm[b]	T	73.07	0.56	11.90	2.19	0.06	0.53	1.08	5.17	2.54	0.22	0.12	0.02	0.02	2.48(6)	99.94	50
JUN-15-gm[a]	T	75.90	0.42	11.81	1.98	*bd*	0.21	0.91	5.31	2.81	0.07				1.53(6)	100.94	21

Table DR1d. July 22[nd] 1980 Pumice

sample	**Type**[c]	**SiO_2**	**TiO_2**	**Al_2O_3**	**FeO**	**MnO**	**MgO**	**CaO**	**Na_2O**	**K_2O**	**P_2O_5**	**Cl**	**F**	**SO_2**	**H_2O**[d]	**Total**	**P_{H_2O}**[e]
JUL-4-1[b]	PI	70.55	0.43	13.02	2.03	0.12	0.58	1.50	5.19	2.49	0.18	0.14	0.01	0.02	3.85(10)	100.11	105
JUL-4-2[b]	PI	73.71	0.47	11.47	1.88	0.05	0.38	1.06	5.58	2.54	0.14	0.15	0.08	*bd*	2.21(6)	99.71	40
JUL-4-3[b]	PI	69.74	0.41	13.66	2.12	0.08	0.36	1.89	4.51	2.43	0.06	0.14	0.06	0.04	4.60(13)	100.10	141
JUL-12-1[b]	PI	71.74	0.37	12.61	1.85	0.04	0.28	1.22	5.08	2.33	0.12	0.17	0.08	0.09	4.26(11)	100.23	124
JUL-14-1[b]	PI	75.15	0.23	11.75	1.60	0.10	0.40	0.79	5.66	2.84	0.09	0.10	*bd*	*bd*	2.10(5)	100.81	37
JUL-14-2[b]	PI	71.42	0.14	12.36	1.12	*bd*	0.26	1.45	5.66	2.08	*bd*	0.07	0.06	*bd*	3.70(10)	98.32	98
JUL-7-1[b]	PI	74.63	0.39	12.17	1.89	0.06	0.43	0.88	5.02	2.86	*bd*	0.12	0.02	*bd*	0.68(2)	99.15	4
JUL-1-gm[a]	GM	77.02	0.45	12.04	1.58		0.20	0.90	4.62	2.85					0.25(1)	99.90	1

Table DR1e. August 7[th] 1980 Pumice

sample	**Type**[c]	**SiO_2**	**TiO_2**	**Al_2O_3**	**FeO**	**MnO**	**MgO**	**CaO**	**Na_2O**	**K_2O**	**P_2O_5**	**Cl**	**F**	**SO_2**	**H_2O**[d]	**Total**	**P_{H_2O}**[e]
AUG-13-1[b]	PI	74.63	0.32	11.44	2.00	0.01	0.29	0.90	5.10	2.73	0.03	0.16	0.12	0.06	1.81(6)	99.60	28
AUG-13-2[b]	PI	76.74	0.43	11.68	2.03	0.05	0.35	0.93	4.36	2.78	0.14	0.12	0.07	*bd*	0.44(2)	100.12	2
AUG-15-1[b]	PI	72.13	0.37	12.98	2.15	*bd*	0.55	1.42	5.04	2.26	0.07	0.12	0.10	0.05	3.95(14)	101.20	110
AUG-16-1[b]	PI	70.42	0.45	12.77	2.43	0.04	0.72	1.50	5.95	2.30	0.05	0.16	*bd*	*bd*	3.95(14)	100.72	110
AUG-17-1[b]	PI	76.57	0.30	11.30	1.98	0.06	0.18	0.56	4.83	2.79	*bd*	0.16	0.04	*bd*	1.42(5)	100.18	18
AUG-8-1[b]	PI	75.24	0.45	11.44	2.09	0.04	0.18	0.79	4.83	2.79	0.17	0.12	0.02	*bd*	1.68(6)	99.83	25
AUG-5-1[b]	PI	71.22	0.41	12.52	2.47	0.10	0.78	1.00	5.58	2.33	0.15	0.18	0.06	0.01	3.55(17)	100.35	92
AUG-11-1[b]	PI	71.79	0.19	12.99	1.29	0.01	0.30	1.32	5.71	2.23	*bd*	0.11	0.02	0.08	4.17(15)	100.21	120
AUG-11-2[b]	PI	70.78	0.22	13.81	1.34	*bd*	0.33	1.98	5.72	1.91	*bd*	0.09	0.03	*bd*	4.63(18)	100.84	142
AUG-7-1[b]	PI	74.57	0.17	11.28	2.42	0.02	0.45	0.68	5.50	2.76	0.06	0.19	0.06	*bd*	1.99(5)	100.13	34
AUG-14-1[b]	PI	74.14	0.47	11.20	2.12	0.01	0.35	0.76	4.65	3.08	0.29	0.13	0.02	*bd*	2.14(5)	99.36	38
AUG-17gm[b]	T	75.88	0.56	11.65	1.65	0.05	0.17	0.72	4.52	2.85	0.05	0.18	0.11	*bd*	1.35(5)	99.72	16
AUG-17gm2[b]	T	76.00	0.52	11.36	1.76	*bd*	0.21	0.68	4.75	2.93	0.01	0.17	0.11	0.05	1.33(6)	99.86	16
AUG-15gm[a]	GM	77.46	0.32	11.65	1.48		0.12	0.60	5.68	3.15	0.04				0.32(1)	100.82	1

Table DR1f. October 17[th] 1980 Dome

sample	**Type**[c]	**SiO_2**	**TiO_2**	**Al_2O_3**	**FeO**	**MnO**	**MgO**	**CaO**	**Na_2O**	**K_2O**	**P_2O_5**	**Cl**	**F**	**SO_2**	**H_2O**[d]	**Total**	**P_{H_2O}**[e]
60-2B[a,g]	PI	74.99	0.21	11.39	1.72	*bd*	0.34	0.62	6.04	2.99					2.47(3)	100.76	49
60-9A[a,g]	PI	76.87	0.29	11.74	1.48	0.02	0.24	0.76	5.58	2.92					0.88(1)	100.77	7
60-9B[a,g]	PI	78.25	0.34	11.30	1.75	*bd*	0.14	0.48	5.50	3.02					0.56(1)	101.33	3
60-14A[a,g]	PI	71.72	0.29	12.27	1.84	0.21	0.48	1.20	5.94	2.34	0.13				3.73(5)	100.15	100
60-17A[a,g]	PI	77.27	0.61	10.98	1.55	*bd*	0.19	0.54	5.85	2.87					0.67(1)	100.52	4
60-17B[a,g]	PI	74.94	0.34	11.16	2.01	0.30	0.46	0.78	5.80	2.83					2.66(4)	101.26	56
60-17D[a,g]	PI	76.98	0.39	11.54	1.99	0.09	0.15	0.75	5.93	3.02					1.03(3)	101.88	10
60-20A[a,g]	PI	75.49	0.19	11.94	1.65	0.19	0.18	0.61	6.06	2.60					2.33(4)	101.24	44