

Table 2S – Compositions (in wt% and mole fraction) of melt (i.e., glass), bulk fluid, and apatite at run conditions.

Experimental Run	1-12-05A	1-12-05B	CS-14-18A	CS-14-18B	CS-14-18C
Melt (wt%)					
SiO ₂	72.32 ± 1.12	72.98 ± 0.68	74.30 ± 0.32	74.00 ± 0.86	74.18 ± 0.52
TiO ₂	0.11 ± 0.02	0.12 ± 0.02	0.09 ± 0.03	0.09 ± 0.03	0.12 ± 0.02
Al ₂ O ₃	12.37 ± 0.24	12.13 ± 0.25	12.37 ± 0.08	12.35 ± 0.1	12.14 ± 0.12
MgO	0.07 ± 0.01	0.07 ± 0.01	0.05 ± 0.01	0.06 ± 0.01	0.05 ± 0.01
CaO	0.95 ± 0.24	1.03 ± 0.06	0.43 ± 0.14	0.27 ± 0.02	0.14 ± 0.02
MnO	0.04 ± 0.01	0.04 ± 0.03	0.02 ± 0.03	0.03 ± 0.02	0.02 ± 0.02
FeO	0.91 ± 0.12	0.80 ± 0.12	0.76 ± 0.14	0.47 ± 0.15	0.41 ± 0.07
Na ₂ O	4.18 ± 0.13	4.07 ± 0.12	4.27 ± 0.25	3.61 ± 0.14	4.25 ± 0.31
K ₂ O	5.72 ± 0.18	5.08 ± 0.15	4.39 ± 0.08	5.61 ± 0.14	4.41 ± 0.14
P ₂ O ₅	0.01 ± 0.01	0.02 ± 0.01	0.01 ± 0.02	0.02 ± 0.02	0.07 ± 0.03
SO ₂	0.002 ± 0.004	0.001 ± 0.002	0.001 ± 0.001	0.005 ± 0.004	0.009 ± 0.006
F	0.008 ± 0.01	0.11 ± 0.12	0.08 ± 0.01	0.15 ± 0.02	bdl
Cl	0.42 ± 0.02	0.48 ± 0.01	0.36 ± 0.01	0.31 ± 0.01	0.30 ± 0.01
Total	97.11	96.94	97.12	96.98	96.14
H ₂ O, FTIR	Nd	Nd	2.22	2.81	2.72
A/CNK ^a	0.84	0.86	0.99	0.99	1.01
N/NK ^a	0.53	0.55	0.60	0.49	0.59
Cl solubility in melt	0.46	0.47	0.35	0.30	0.29
Experimental Run	1-12-05A	1-12-05B	CS-14-18A	CS-14-18B	CS-14-18C
Apatite (wt%)					
SiO ₂	0.51 ± 0.22	0.49 ± 0.12	0.41 ± 0.16	0.24 ± 0.18	0.45 ± 0.19
TiO ₂	0.01 ± 0.01	0.01 ± 0.01	0	0.01 ± 0.01	0.01 ± 0.01
Al ₂ O ₃	0.01 ± 0.01	0.02 ± 0.01	0.09 ± 0.08	0.03 ± 0.03	0.11 ± 0.11
MgO	0.01 ± 0.01	0.02 ± 0.01	0.03 ± 0.02	0.10 ± 0.03	0.13 ± 0.05
CaO	54.00 ± 0.38	53.60 ± 0.72	54.1 ± 0.3	54.2 ± 0.35	53.1 ± 0.54
MnO	0.03 ± 0.02	0.01 ± 0.01	0.03 ± 0.03	0.05 ± 0.03	0.07 ± 0.02
FeO	0.06 ± 0.02	0.07 ± 0.02	0.13 ± 0.07	0.09 ± 0.04	0.26 ± 0.06
Na ₂ O	0.15 ± 0.08	0.37 ± 0.33	0.25 ± 0.15	0.14 ± 0.12	0.44 ± 0.14
K ₂ O	0.05 ± 0.03	0.08 ± 0.02	0.09 ± 0.03	0.04 ± 0.06	0.09 ± 0.04
P ₂ O ₅	40.48 ± 0.24	40.36 ± 0.35	40.24 ± 0.76	40.18 ± 0.35	39.83 ± 0.64
F	1.96 ± 0.29	1.55 ± 0.30	1.46 ± 0.37	1.49 ± 0.09	1.57 ± 0.19
Cl	1.16 ± 0.12	1.38 ± 0.25	1.81 ± 0.14	2.45 ± 0.23	2.13 ± 0.23
SO ₂	0.01 ± 0.01	0.01 ± 0.01	0.19 ± 0.10	0.06 ± 0.10	0.23 ± 0.11
BaO	0.03 ± 0.03	0.03 ± 0.03	0.03 ± 0.03	0.02 ± 0.02	0.03 ± 0.03
Ce ₂ O ₃	0.66 ± 0.09	0.43 ± 0.11	0.42 ± 0.21	0.21 ± 0.17	0.53 ± 0.08
SrO	Nd	Nd	Nd	Nd	Nd
Total	99.47	98.87	99.31	99.32	98.99
X _{Cl} ^{apatb}	0.17	0.20	0.27	0.34	0.31
X _F ^{apatb}	0.52	0.41	0.39	0.42	0.42
X _{OH} ^{apatb}	0.31	0.39	0.34	0.24	0.27
Wt% Cl in fluid(s)	9.5	9.0	3.7	12.8	9.1
Exchange Coefficients					
K _{dCl-F} ^{apat-felsicmelt}	0.012	0.21	0.29	0.74	0.33
K _{dOH-Cl} ^{apat-felsicmelt}	0.13	0.15	0.11	0.039	0.048
K _{dOH-F} ^{apat-felsicmelt}	0.0016	0.032	0.03	0.029	0.016
Partition Coefficients					
D _{Cl} ^{apat/mt}	2.8	2.9	5.1	7.5	7.1
D _{XOH} ^{apat/mt}	1.0	1.2	1.4	0.81	0.94
D _{Cl} ^{fluid(s)/mt}	22.6	18.8	10.4	41.2	30.4
D _{Cl} ^{apat /fluid(s)}	0.12	0.15	0.49	0.18	0.23
D _F ^{apat/mt}	245	14.1	18.3	10.5	22.4

Table 3 continued.

Experimental Run Melt (wt%)	CS-14-18D	CS-15-01B	CS-15-02	CS-15-03	CS-15-04A
SiO ₂	73.83 ± 0.56	Insufficient	74.5 ± 0.38	74.1 ± 0.26	74.90 ± 0.28
TiO ₂	0.07 ± 0.02	Glass	0.06 ± 0.04	0.1 ± 0.04	0.09 ± 0.04
Al ₂ O ₃	12.31 ± 0.19		12.20 ± 0.14	12.30 ± 0.14	12.20 ± 0.08
MgO	0.05 ± 0.005		0.05 ± 0.02	0.08 ± 0.02	0.08 ± 0.02
CaO	0.45 ± 0.09		0.10 ± 0.05	0.20 ± 0.08	0.08 ± 0.03
MnO	0.04 ± 0.03		0.02 ± 0.02	0.01 ± 0.01	0.01 ± 0.01
FeO	0.78 ± 0.08		0.77 ± 0.14	0.83 ± 0.14	0.75 ± 0.06
Na ₂ O	4.18 ± 0.12		4.63 ± 0.05	4.52 ± 0.12	4.30 ± 0.08
K ₂ O	4.44 ± 0.19		4.54 ± 0.15	4.60 ± 0.11	5.27 ± 0.23
P ₂ O ₅	0.04 ± 0.03		0.02 ± 0.02	0.11 ± 0.26	0.05 ± 0.06
SO ₂	0.008 ± 0.006		0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.01
F	0.16 ± 0.02		0.04 ± 0.02	0.01 ± 0.02	0.02 ± 0.02
Cl	0.31 ± 0.01		0.24 ± 0.01	0.29 ± 0.01	0.28 ± 0.01
Total	96.65		97.18	97.15	98.04
H ₂ O, FTIR	2.82		2.54	2.82	2.51
A/CNK ^a	0.98		0.96	0.96	0.94
N/NK ^a	0.59		0.61	0.60	0.55
Cl solubility in melt	0.36		0.33	0.34	0.32
Experimental Run Apatite (wt%)	CS-14-18D	CS-15-01B	CS-15-02	CS-15-03	CS-15-04A
SiO ₂	0.46 ± 0.27	0.38 ± 0.16	0.26 ± 0.13	0.32 ± 0.25	0.21 ± 0.04
TiO ₂	0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.01
Al ₂ O ₃	0.04 ± 0.05	0.04 ± 0.06	0.01 ± 0.01	0.03 ± 0.05	0.01 ± 0.01
MgO	0.06 ± 0.03	0.04 ± 0.05	0.28 ± 0.05	0.21 ± 0.10	0.24 ± 0.09
CaO	53.7 ± 0.61	54.80 ± 0.25	54.41 ± 0.97	54.50 ± 1.86	53.66 ± 1.21
MnO	0.06 ± 0.07	0.01 ± 0.02	0.05 ± 0.05	0.28 ± 0.12	0.16 ± 0.17
FeO	0.12 ± 0.07	0.21 ± 0.30	0.19 ± 0.01	0.38 ± 0.22	0.24 ± 0.13
Na ₂ O	0.28 ± 0.17	0.29 ± 0.12	0.35 ± 0.08	0.40 ± 0.28	0.42 ± 0.16
K ₂ O	0.13 ± 0.13	0.14 ± 0.06	0.14 ± 0.03	0.09 ± 0.01	0.11 ± 0.02
P ₂ O ₅	40.02 ± 0.48	40.52 ± 0.25	40.64 ± 0.57	39.83 ± 1.57	40.55 ± 0.38
F	1.93 ± 0.35	2.38 ± 0.23	1.40 ± 0.29	1.41 ± 0.29	0.58 ± 0.18
Cl	1.51 ± 0.35	1.52 ± 0.58	2.03 ± 0.56	1.76 ± 0.25	3.19 ± 0.41
SO ₂	0.22 ± 0.12	0.19 ± 0.15	0.09 ± 0.11	0.03 ± 0.05	0.01 ± 0.01
BaO	0.01 ± 0.03	0.02 ± 0.03	0.01 ± 0.01	0.03 ± 0.03	0.02 ± 0.03
Ce ₂ O ₃	0.37 ± 0.27	0.12 ± 0.16	0.30 ± 0.23	0.08 ± 0.12	0.42 ± 0.25
SrO	Nd	Nd	Nd	Nd	Nd
Total	99.30	100.93	100.74	99.36	99.75
X _{Cl} ^{apatb}	0.22	0.22	0.30	0.26	0.47
X _F ^{apatb}	0.51	0.63	0.37	0.38	0.15
X _{OH} ^{apatb}	0.27	0.15	0.33	0.36	0.38
Wt% Cl in fluid(s)	2.3	14.4	1.1	0.97	15.8
Exchange Coefficients					
K _{dCl-F} ^{apat-felsicmelt}	0.42	Nd	0.25	0.044	0.40
K _{dOH-Cl} ^{apat-felsicmelt}	0.07	Nd	0.053	0.074	0.045
K _{dOH-F} ^{apat-felsicmelt}	0.03	Nd	0.013	0.0033	0.018
Partition Coefficients					
D _{Cl} ^{apat/mt}	4.9	Nd	8.5	6.1	11.4
D _{XOH} ^{apat/mt}	0.89	Nd	1.2	1.2	1.4
D _{Cl} ^{fluid(s)/mt}	7.5	Nd	4.8	3.3	56.4
D _{Cl} ^{apat /fluid(s)}	0.65	0.11	1.8	1.8	0.20
D _F ^{apat/mt}	12.1	Nd	35	141	29

Table 3 continued.

Experimental Run	CS-15-04B	CS-15-04C	CS-15-05A	CS-15-05B	CS-15-05C
Melt (wt%)					
SiO ₂	74.3 ± 0.38	75.20 ± 0.53	74.63 ± 0.29	75.04 ± 0.11	74.77 ± 0.15
TiO ₂	0.08 ± 0.05	0.07 ± 0.03	0.09 ± 0.03	0.10 ± 0.02	0.06 ± 0.02
Al ₂ O ₃	12.20 ± 0.23	11.80 ± 0.19	12.06 ± 0.09	12.22 ± 0.13	11.98 ± 0.09
MgO	0.04 ± 0.02	0.04 ± 0.01	0.05 ± 0.01	0.06 ± 0.02	0.05 ± 0.01
CaO	0.03 ± 0.01	0.07 ± 0.06	0.28 ± 0.15	0.28 ± 0.08	0.09 ± 0.02
MnO	0.02 ± 0.02	0.02 ± 0.01	0.02 ± 0.02	Bdl	0.02 ± 0.01
FeO	0.45 ± 0.20	0.21 ± 0.08	0.76 ± 0.05	0.75 ± 0.15	0.75 ± 0.11
Na ₂ O	3.71 ± 0.43	3.45 ± 0.16	4.16 ± 0.21	4.48 ± 0.07	4.13 ± 0.26
K ₂ O	5.97 ± 0.48	5.75 ± 0.17	4.52 ± 0.08	4.57 ± 0.10	4.99 ± 0.05
P ₂ O ₅	0.16 ± 0.02	0.11 ± 0.03	0.04 ± 0.02	0.04 ± 0.02	0.05 ± 0.03
SO ₂	0.01 ± 0.02	0.01 ± 0.01	0.009 ± 0.004	0.008 ± 0.007	0.008 ± 0.005
F	0.01 ± 0.01	0.05 ± 0.03	0.13 ± 0.04	0.07 ± 0.03	0.05 ± 0.01
Cl	0.24 ± 0.02	0.24 ± 0.02	0.19 ± 0.02	0.17 ± 0.01	0.29 ± 0.01
Total	97.28	97.21	96.95	97.78	97.22
H ₂ O, FTIR	2.58	2.62	3.11	2.99	2.82
A/CNK ^a	0.97	0.95	0.99	0.95	0.97
N/NK ^a	0.49	0.48	0.58	0.60	0.56
Cl solubility in melt	0.27	0.27	0.34	0.35	0.30
Apatite (wt%)					
Experimental Run	CS-15-04B	CS-15-04C	CS-15-05A	CS-15-05B	CS-15-05C
SiO ₂	0.15 ± 0.09	0.27 ± 0.18	0.51 ± 0.15	0.36 ± 0.06	0.42 ± 0.07
TiO ₂	0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.01	0.002 ± 0.003
Al ₂ O ₃	0.03 ± 0.03	0.02 ± 0.01	0.03 ± 0.02	0.003 ± 0.003	0.02 ± 0.03
MgO	0.38 ± 0.04	0.34 ± 0.05	0.05 ± 0.01	0.05 ± 0.03	0.15 ± 0.07
CaO	53.82 ± 0.79	52.70 ± 0.79	53.53 ± 0.47	53.48 ± 0.35	52.28 ± 0.99
MnO	0.06 ± 0.02	0.18 ± 0.02	0.05 ± 0.01	0.03 ± 0.02	0.10 ± 0.08
FeO	0.21 ± 0.05	1.20 ± 0.23	0.19 ± 0.16	0.12 ± 0.06	0.21 ± 0.09
Na ₂ O	0.59 ± 0.04	0.74 ± 0.24	0.23 ± 0.07	0.21 ± 0.03	0.43 ± 0.25
K ₂ O	0.11 ± 0.05	0.09 ± 0.04	0.13 ± 0.03	0.08 ± 0.01	0.12 ± 0.05
P ₂ O ₅	41.55 ± 0.41	41.02 ± 0.79	39.29 ± 0.37	40.20 ± 0.27	39.89 ± 1.01
F	0.40 ± 0.07	0.32 ± 0.05	1.82 ± 0.18	1.89 ± 0.15	1.03 ± 0.20
Cl	3.70 ± 0.48	3.82 ± 0.33	1.32 ± 0.28	1.39 ± 0.17	2.48 ± 0.40
SO ₂	0.01 ± 0.01	0.01 ± 0.01	0.29 ± 0.10	0.30 ± 0.04	0.13 ± 0.11
BaO	0.01 ± 0.01	0.02 ± 0.04	0.02 ± 0.03	0.02 ± 0.03	0.01 ± 0.01
Ce ₂ O ₃	0.02 ± 0.02	0.11 ± 0.14	0.53 ± 0.06	0.51 ± 0.06	0.64 ± 0.18
SrO	Nd	Nd	0.05 ± 0.04	0.03 ± 0.02	0.05 ± 0.02
Total	101.20	101.73	97.69	98.55	98.00
X _{Cl} ^{apatb}	0.54	0.56	0.19	0.20	0.36
X _F ^{apatb}	0.11	0.08	0.48	0.50	0.27
Apparent X _{OH} ^{apatb}	0.36	0.36	0.32	0.30	0.36
Wt% Cl in fluid(s)	30.1	39.2	0.7	0.3	8.7
Exchange Coefficients					
K _{dCl-F} ^{apat-felsicmelt}	0.40	2.6	0.51	0.31	0.40
K _{dOH-Cl} ^{apat-felsicmelt}	0.03	0.029	0.051	0.042	0.052
K _{dOH-F} ^{apat-felsicmelt}	0.012	0.077	0.026	0.013	0.021
Partition Coefficients					
D _{Cl} ^{apat/mt}	15.4	15.9	6.9	8.1	8.5
D _{XOH} ^{apat/mt}	1.3	1.3	1.0	0.95	1.2
D _{Cl} ^{fluid(s)/mt}	125	163	3.7	1.7	30
D _{Cl} ^{apat /fluid(s)}	0.12	0.097	1.9	4.8	0.28
D _F ^{apat/mt}	40	6.3	14	27	22

Table 3 continued.

Experimental Run	CS-15-05D	CS-15-06	CS-15-07	CS-15-09A	CS-15-09B
Melt (wt%)					
SiO ₂	75.11 ± 0.26	74.96 ± 0.67	74.75 ± 0.40	74.55 ± 0.66	74.38 ± 0.43
TiO ₂	0.06 ± 0.03	0.08 ± 0.03	0.07 ± 0.03	0.02 ± 0.01	0.05 ± 0.03
Al ₂ O ₃	12.06 ± 0.15	12.17 ± 0.17	12.15 ± 0.12	11.91 ± 0.15	12.06 ± 0.10
MgO	0.05 ± 0.01	0.04 ± 0.02	0.05 ± 0.01	0.06 ± 0.01	0.05 ± 0.01
CaO	0.10 ± 0.03	0.04 ± 0.04	0.16 ± 0.05	0.62 ± 0.04	0.35 ± 0.06
MnO	0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.02	0.02 ± 0.02	0.01 ± 0.02
FeO	0.82 ± 0.08	0.30 ± 0.07	0.43 ± 0.12	0.79 ± 0.09	0.80 ± 0.07
Na ₂ O	4.35 ± 0.13	5.25 ± 0.13	5.17 ± 0.15	3.56 ± 0.27	4.05 ± 0.16
K ₂ O	4.45 ± 0.07	3.78 ± 0.07	3.71 ± 0.02	4.67 ± 0.04	4.97 ± 0.12
P ₂ O ₅	0.03 ± 0.03	0.26 ± 0.08	0.03 ± 0.03	0.02 ± 0.01	0.03 ± 0.03
SO ₂	0.003 ± 0.004	0.006 ± 0.01	0.01 ± 0.01	0.009 ± 0.007	0.005 ± 0.006
F	0.06 ± 0.03	0.11 ± 0.02	0.09 ± 0.02	0.03 ± 0.04	0.04 ± 0.02
Cl	0.10 ± 0.01	0.30 ± 0.02	0.31 ± 0.01	0.04 ± 0.01	0.03 ± 0.01
Total	97.21	97.31	96.92	96.33	96.86
H ₂ O, FTIR	2.44	2.74	2.62	3.7	3.2
A/CNK ^a	0.99	0.95	0.95	0.99	0.95
N/NK ^a	0.60	0.68	0.68	0.54	0.55
Cl solubility in melt	0.32	0.32	0.33	0.35	0.34
Experimental Run	CS-15-05D	CS-15-06	CS-15-07	CS-15-09A	CS-15-09B
Apatite (wt%)					
SiO ₂	0.42 ± 0.05	0.29 ± 0.11	0.47 ± 0.27	0.80 ± 0.23	0.84 ± 0.13
TiO ₂	0.01 ± 0.01	0.004 ± 0.003	0.003 ± 0.006	0.01 ± 0.01	0.01 ± 0.01
Al ₂ O ₃	0.01 ± 0.01	0.01 ± 0.01	0.03 ± 0.04	0.19 ± 0.04	0.001 ± 0.001
MgO	0.08 ± 0.06	0.30 ± 0.06	0.12 ± 0.03	0.03 ± 0.02	0.10 ± 0.05
CaO	53.19 ± 0.59	52.03 ± 0.69	53.27 ± 0.39	54.96 ± 0.88	55.86 ± 0.17
MnO	0.07 ± 0.06	0.13 ± 0.04	0.02 ± 0.01	0.01 ± 0.01	0.02 ± 0.02
FeO	0.22 ± 0.17	0.27 ± 0.04	0.08 ± 0.02	0.12 ± 0.06	0.03 ± 0.03
Na ₂ O	0.26 ± 0.06	0.55 ± 0.10	0.31 ± 0.05	0.02 ± 0.02	0.02 ± 0.02
K ₂ O	0.10 ± 0.03	0.08 ± 0.01	0.09 ± 0.05	0.003 ± 0.004	0.01 ± 0.01
P ₂ O ₅	40.14 ± 0.65	40.60 ± 0.41	40.17 ± 0.81	38.78 ± 1.50	39.40 ± 0.01
F	1.80 ± 0.50	0.66 ± 0.12	1.62 ± 0.04	1.06 ± 0.26	0.89 ± 0.13
Cl	1.31 ± 0.30	3.60 ± 0.09	2.04 ± 0.11	0.14 ± 0.03	0.40 ± 0.07
SO ₂	0.28 ± 0.04	0.06 ± 0.08	0.23 ± 0.12	0.37 ± 0.06	0.05 ± 0.02
BaO	0.01 ± 0.02	0.01 ± 0.01	0.06 ± 0.05	0.03 ± 0.03	0.01 ± 0.01
Ce ₂ O ₃	0.49 ± 0.05	0.56 ± 0.13	0.49 ± 0.07	0.39 ± 0.27	0.02 ± 0.03
SrO	0.05 ± 0.03	0.04 ± 0.02	0.03 ± 0.02	0.03 ± 0.03	0.02 ± 0.01
Total	98.33	99.09	98.91	96.74	97.66
X _{Cl} ^{apat} ^b	0.19	0.53	0.30	0.02	0.06
X _F ^{apat} ^b	0.48	0.18	0.43	0.28	0.24
Apparent X _{OH} ^{apat} ^b	0.33	0.29	0.27	0.70	0.70
Wt% Cl in fluid(s)	0.6	28.4	9.2	1.4	4.3
Exchange Coefficients					
K _{dCl-F} ^{apat-felsicmelt}	0.47	2.07	0.38	0.11	0.63
K _{dOH-Cl} ^{apat-felsicmelt}	0.033	0.031	0.054	0.22	0.076
K _{dOH-F} ^{apat-felsicmelt}	0.016	0.064	0.02	0.025	0.048
Partition Coefficients					
D _{Cl} ^{apat/mt}	13.8	12.0	6.6	3.9	13.6
D _{XOH} ^{apat/mt}	1.2	1.03	0.96	2.4	2.7
D _{Cl} ^{fluid(s)/mt}	6.5	95.2	29.9	38	145
D _{Cl} ^{apat /fluid(s)}	2.1	0.13	0.22	0.1	0.09
D _F ^{apat/mt}	30	6	18	35.3	22.2

Table 3 continued.

Experimental Run	CS-15-16A	1-15-14A	1-15-14B	CS-15-18	1-15-10A ^c
Melt (wt%)					
SiO ₂	74.81 ± 0.13	74.06 ± 0.83	75.33 ± 0.33	73.7 ± 0.23	71.68 ± 0.12
TiO ₂	0.04 ± 0.04	0.06 ± 0.03	0.06 ± 0.05	0.07 ± 0.01	0.07 ± 0.02
Al ₂ O ₃	12.36 ± 0.08	12.40 ± 0.15	12.57 ± 0.08	12.22 ± 0.27	11.72 ± 0.07
MgO	0.05 ± 0.01	0.06 ± 0.01	0.05 ± 0.01	0.06 ± 0.01	0.03 ± 0.01
CaO	0.70 ± 0.12	0.48 ± 0.11	0.54 ± 0.03	0.23 ± 0.15	2.07 ± 0.04
MnO	0.03 ± 0.03	0.04 ± 0.02	0.04 ± 0.02	0.03 ± 0.01	0.02 ± 0.02
FeO	0.99 ± 0.14	1.02 ± 0.02	1.02 ± 0.13	0.7 ± 0.05	0.64 ± 0.09
Na ₂ O	3.89 ± 0.09	4.47 ± 0.37	3.86 ± 0.14	4.68 ± 0.22	3.63 ± 0.10
K ₂ O	4.66 ± 0.05	4.34 ± 0.18	4.42 ± 0.08	5.35 ± 0.14	3.38 ± 0.04
P ₂ O ₅	0.03 ± 0.03	0.10 ± 0.03	0.17 ± 0.03	0.06 ± 0.07	0.08 ± 0.06
SO ₂	0.004 ± 0.002	0.003 ± 0.005	0.004 ± 0.002	0.005 ± 0.004	0.003 ± 0.004
F	0.19 ± 0.07	0.06 ± 0.04	0.05 ± 0.07	0.05 ± 0.04	0.10 ± 0.02
Cl	0.11 ± 0.01	0.42 ± 0.01	0.09 ± 0.01	0.36 ± 0.01	0.32 ± 0.01
Total	97.86	97.50	98.20	97.46	93.74
H ₂ O, FTIR	2.9	2.35	2.3	2.54	5.76
A/CNK ^a	0.97	0.96	1.04	0.88	0.87
N/NK ^a	0.56	0.61	0.57	0.57	0.62
Cl solubility in melt	0.40	0.39	0.37	0.35	0.62
Experimental Run	CS-15-16A	1-15-14A	1-15-14B	CS-15-18	1-15-10A ^c
Apatite (wt%)					
SiO ₂	1.02 ± 0.31	0.26 ± 0.14	0.18 ± 0.02	0.16 ± 0.07	1.53 ± 0.16
TiO ₂	0.01 ± 0.01	0.003 ± 0.005	0.01 ± 0.01	0.003 ± 0.007	0.01 ± 0.005
Al ₂ O ₃	0.05 ± 0.03	0.003 ± 0.01	0.12 ± 0.1	0.003 ± 0.004	0.27 ± 0.10
MgO	0.12 ± 0.01	0.13 ± 0.01	0.18 ± 0.02	0.13 ± 0.03	0.09 ± 0.06
CaO	53.67 ± 0.79	54.33 ± 0.73	54.72 ± 1.3	54.33 ± 0.30	53.40 ± 0.36
MnO	0.01 ± 0.02	0.03 ± 0.03	0.22 ± 0.03	0.03 ± 0.03	0.03 ± 0.02
FeO	0.19 ± 0.15	0.13 ± 0.03	0.39 ± 0.07	0.13 ± 0.04	0.26 ± 0.06
Na ₂ O	0.07 ± 0.04	0.18 ± 0.08	0.11 ± 0.05	0.18 ± 0.04	0.20 ± 0.06
K ₂ O	0.03 ± 0.02	0.09 ± 0.03	0.05 ± 0.02	0.09 ± 0.03	0.13 ± 0.03
P ₂ O ₅	40.21 ± 0.77	41.10 ± 0.40	40.48 ± 1.12	41.10 ± 0.25	39.80 ± 0.61
F	2.21 ± 0.11	1.90 ± 0.06	1.74 ± 0.15	1.90 ± 0.07	2.00 ± 0.09
Cl	0.64 ± 0.09	1.72 ± 0.09	1.24 ± 0.04	1.72 ± 0.15	0.86 ± 0.27
SO ₂	0.07 ± 0.10	0.006 ± 0.01	0.001 ± 0.01	0.006 ± 0.004	0.03 ± 0.004
BaO	0.01 ± 0.01	0.01 ± 0.01	0.02 ± 0.03	0.01 ± 0.02	0.01 ± 0.03
Ce ₂ O ₃	0.02 ± 0.02	0.26 ± 0.23	0.03 ± 0.07	0.26 ± 0.08	0.05 ± 0.03
SrO	0.04 ± 0.02	0.03 ± 0.02	0.05 ± 0.02	0.03 ± 0.02	0.02 ± 0.01
Total	98.29	100.00	99.36	99.99	98.29
X _{Cl} ^{apatb}	0.09	0.25	0.18	0.25	0.13
X _F ^{apatb}	0.59	0.51	0.46	0.51	0.53
Apparent X _{OH} ^{apatb}	0.32	0.24	0.36	0.24	0.34
Wt% Cl in fluid(s)	0.62	4.2	0.40	34.2	7.6
Exchange Coefficients					
K _{dCl-F} ^{apat-felsicmelt}	0.50	0.14	0.39	0.13	0.14
K _{dOH-Cl} ^{apat-felsicmelt}	0.067	0.086	0.038	0.098	0.074
K _{dOH-F} ^{apat-felsicmelt}	0.034	0.012	0.015	0.013	0.010
Partition Coefficients^β					
D _{Cl} ^{apat/mt}	5.7	4.1	13.9	4.8	2.8
D _{XOH} ^{apat/mt}	1.0	0.9	1.4	1.2	0.7
D _{Cl} ^{fluid(s)/mt}	5.5	10.0	4.0	96.2	17.8
D _{Cl} ^{apat / fluid(s)}	1.04	0.41	3.4	0.05	0.09
D _F ^{apat/mt}	11.6	30.7	36.4	38	20

Table 3 continued.

Experimental Run	1-15-10B	1-15-13A	1-15-13B	CS-14-17B ^c	CS-14-17C ^c
Melt (wt%)					
SiO ₂	71.89 ± 0.18	73.32 ± 0.68	73.87 ± 0.30	74.01 ± 0.92	73.25 ± 0.68
TiO ₂	0.08 ± 0.01	0.08 ± 0.04	0.08 ± 0.05	0.08 ± 0.04	0.07 ± 0.01
Al ₂ O ₃	11.70 ± 0.02	12.29 ± 0.17	12.25 ± 0.21	11.90 ± 0.36	11.60 ± 0.23
MgO	0.04 ± 0.01	0.06 ± 0.01	0.09 ± 0.01	0.06 ± 0.01	0.02 ± 0.01
CaO	1.17 ± 0.05	0.29 ± 0.03	0.45 ± 0.11	0.32 ± 0.03	0.02 ± 0.02
MnO	0.04 ± 0.01	0.01 ± 0.01	0.01 ± 0.01	0.02 ± 0.02	0.02 ± 0.03
FeO	0.77 ± 0.06	0.39 ± 0.06	0.70 ± 0.11	0.52 ± 0.03	0.70 ± 0.06
Na ₂ O	3.78 ± 0.02	3.34 ± 0.18	3.56 ± 0.05	4.32 ± 0.16	4.01 ± 0.30
K ₂ O	3.91 ± 0.06	4.00 ± 0.06	4.01 ± 0.03	4.33 ± 0.10	4.88 ± 0.07
P ₂ O ₅	0.005 ± 0.006	0.11 ± 0.10	0.09 ± 0.08	0.02 ± 0.03	0.35 ± 0.04
SO ₂	bdl	0.004 ± 0.01	0.002 ± 0.001	0.002 ± 0.004	0.005 ± 0.006
F	0.18 ± 0.02	0.19 ± 0.07	0.16 ± 0.04	0.02 ± 0.04	0.03 ± 0.01
Cl	0.23 ± 0.01	0.14 ± 0.01	0.18 ± 0.01	0.31 ± 0.01	0.21 ± 0.02
Total	93.79	94.23	95.45	95.91	95.15
H ₂ O, FTIR	5.85	5.59	5.52	Nd	Nd
A/CNK ^a	0.93	1.19	1.11	0.99	0.97
N/NK ^a	0.60	0.56	0.57	0.59	0.55
Cl solubility in melt	0.51	0.34	0.40	0.32	0.29
Experimental Run	1-15-10B	1-15-13A	1-15-13B	CS-14-17B ^c	CS-14-17C ^c
Apatite (wt%)					
SiO ₂		0.20 ± 0.20	0.12 ± 0.01		
TiO ₂		0.01 ± 0.01	bdl		
Al ₂ O ₃		0.01 ± 0.01	0.02 ± 0.03		
MgO		0.50 ± 0.26	0.14 ± 0.02		
CaO		52.60 ± 1.06	53.30 ± 0.36		
MnO		0.23 ± 0.08	0.25 ± 0.04		
FeO		1.1 ± 0.48	0.81 ± 0.10		
Na ₂ O		0.14 ± 0.05	0.14 ± 0.07		
K ₂ O		0.04 ± 0.04	0.04 ± 0.01		
P ₂ O ₅		40.80 ± 0.30	41.50 ± 0.20		
F		0.89 ± 0.05	0.76 ± 0.04		
Cl		2.38 ± 0.22	2.09 ± 0.15		
SO ₂		0.01 ± 0.01	0.01 ± 0.01		
BaO		0.01 ± 0.01	0.02 ± 0.02		
Ce ₂ O ₃		0.04 ± 0.04	0.07 ± 0.02		
SrO		0.10 ± 0.03	0.06 ± 0.02		
Total		99.01	99.27		
X _{Cl} ^{apatb}		0.35	0.31		
X _F ^{apatb}		0.24	0.20		
Apparent X _{OH} ^{apatb}		0.41	0.49		
Wt% Cl in fluid(s)	4.0	5.7	4.2	9.5	2.8
Exchange Coefficients					
K _{dCl-F} ^{apat-felsicmelt}	Nd	3.77	2.6	Nd	Nd
K _{dOH-Cl} ^{apat-felsicmelt}	Nd	0.015	0.026	Nd	Nd
K _{dOH-F} ^{apat-felsicmelt}	Nd	0.058	0.067	Nd	Nd
Partition Coefficients					
D _{Cl} ^{apat/mt}	Nd	16.7	11.9	Nd	Nd
D _{XOH} ^{apat/mt}	Nd	0.89	1.1	Nd	Nd
D _{Cl} ^{fluid(s)/mt}	17.8	39.9	23.9	31.1	13.7
D _{Cl} ^{apat /fluid(s)}	Nd	0.42	0.50	Nd	Nd
D _F ^{apat/mt}	Nd	4.6	4.8	Nd	Nd

Table 3 continued.

Experimental Run	CS-14-17D ^c	1-95-9E ^d	1-95-9F ^d	1-95-9B ^d	1-95-9D ^d
Melt (wt%)					
SiO ₂	74.57 ± 0.16	74.59	72.34	75.23	73.2
TiO ₂	0.12 ± 0.02	0.22	0.24	0.31	0.25
Al ₂ O ₃	11.94 ± 0.22	12.49	12.3	12.74	12.24
MgO	0.04 ± 0.02	0.14	0.15	0.13	0.14
CaO	0.15 ± 0.11	0.71	0.33	0.62	0.32
MnO	0.03 ± 0.02	0.05	0.03	0.08	0.02
FeO	0.34 ± 0.08	1.1	0.81	0.97	0.81
Na ₂ O	3.45 ± 0.18	3.53	3.33	3.27	3.44
K ₂ O	5.74 ± 0.09	5.32	7.63	5.24	6.89
P ₂ O ₅	0.09 ± 0.02	0.02	0.01	0.01	0.01
SO ₂	0.005 ± 0.009	Nd	Nd	Nd	Nd
F	0.03 ± 0.02	0.13	0.14	0.08	0.10
Cl	0.25 ± 0.01	0.33 ± 0.02	0.32 ± 0.04	0.02 ± 0.01	0.35 ± 0.01
Total	96.75	98.63	97.63	98.72	97.76
H ₂ O, FTIR	Nd	Nd	Nd	Nd	Nd
A/CNK ^a	0.98	0.97	0.86	1.05	0.89
N/NK ^a	0.48	0.50	0.40	0.49	0.43
Cl solubility in melt	0.27	0.36	0.41	0.36	0.38
Experimental Run	CS-14-17D ^c	1-95-9E ^d	1-95-9F ^d	1-95-9B ^d	1-95-9D ^d
Apatite (wt%)					
SiO ₂		No apatite	No apatite	No apatite	No apatite
TiO ₂					
Al ₂ O ₃					
MgO					
CaO					
MnO					
FeO					
Na ₂ O					
K ₂ O					
P ₂ O ₅					
F					
Cl					
SO ₂					
BaO					
Ce ₂ O ₃					
SrO					
Total					
X _{Cl} ^{apatb}	Nd				
X _F ^{apatb}	Nd				
Apparent X _{OH} ^{apatb}	Nd				
Wt% Cl in fluid(s)	18.3	45	6	16	0.5
Partition Coefficient					
D _{Cl} ^{fluid(s)/mt}	74.6	138.5	18.2	49.8	25

Table 3 continued.

Experimental Run	1-95-9C ^d	1-95-10F ^d
Melt (wt%)		
SiO ₂	73.2	72.63
TiO ₂	0.25	0.22
Al ₂ O ₃	12.24	12.11
MgO	0.13	0.14
CaO	0.32	0.66
MnO	0.02	0.03
FeO	0.81	1.01
Na ₂ O	3.44	3.45
K ₂ O	6.89	5.54
P ₂ O ₅	0.01	0.01
SO ₂	Nd	Nd
F	0.10	0.18
Cl	0.35± 0.03	0.37 ± 0.01
Total	97.76	96.35
H ₂ O, FTIR	Nd	Nd
A/CNK ^a	0.89	0.94
N/NK ^a	0.43	0.49
Cl solubility in melt	0.35	0.40
Experimental Run	1-95-9C ^d	1-95-10F ^d
Apatite (wt%)		
SiO ₂	No apatite	No apatite
TiO ₂		
Al ₂ O ₃		
MgO		
CaO		
MnO		
FeO		
Na ₂ O		
K ₂ O		
P ₂ O ₅		
F		
Cl		
SO ₂		
BaO		
Ce ₂ O ₃		
SrO		
Total		
X _{Cl} ^{apat} ^b		
X _F ^{apat} ^b		
Apparent X _{OH} ^{apat} ^b		
Wt% Cl in fluid(s)	36	27
Partition Coefficient		
D _{Cl} ^{fluid(s)/mt}	103	73

Note: Runs with “CS-“ prefix were conducted in cold seal vessels and runs with “1-“ prefix involved internally heated pressure vessel. D_{XOH} = partition coefficient for OH ion on molar basis; all other partition coefficients D_i calculated on a wt% basis. Exchange coefficients defined in text. Reported errors are 1 sigma deviations.

Nd = data not determined; bdl = below detection limit.

^aMolar ratios of (Al₂O₃/Na₂O+CaO+K₂O) and (Na₂O/Na₂O+K₂O) of melt.

^bMole fractions of volatile components in apatite determined via Piccoli and Candela (2002) (apparent X_{OH}^{apat} computed by difference).

^cApatite grains too small for accurate EMPA.

^dLow-phosphorus, apatite-deficient runs.