Appendix (Internet repository):

Results of MELTS modeling of $\delta^{18}O$(melt) change with fractional crystallization, using four basaltic compositions from Volynets (1994): Algorithm description and results

A series of nine crystallization experiments were performed with four basaltic compositions listed in Table 1 (from Volynets, 1994), at different pressures (1 bar to 20 kbar), water contents (1 to 3 wt%), and oxygen fugacities (MH, QFM, not fixed).

Calculations included: 1) determination of crystallization path, or liquid line of descent, at any given set of intensive parameters: identities, relative proportion, and composition of minerals crystallized; normative composition of the residual melt and its SiO_2 at each stage; 2) determination of isotopic effects at each step of crystallization. For the latter task, we used a compiled dataset of experimental mineral-mineral and mineral-melt oxygen isotope fractionations: Chiba et al., 1989; Palin et al., 1996; Matthews et al., 1983; 1998; Eiler, 2001; Chacko and Chakraborty, 2001. Mineral-melt equilibria are primarily based on Caltech CO2-melt equilibration experiments (Stolper and Epstein, 1991; Matthews et al., 1994; 1998; Palin et al., 1996; Appora et al., 2003). Following suggestions by these authors, melt was assumed to be a mixture of normative compounds, and conveniently, MELTS program provides CIPW norm of the residual melt. Such a method yields results that are usually within error of isotopic measurements and some of the fractionation errors may have opposite sign and cancel out. We assumed no difference in fractionation in solid vs molten phases (Δ(Albite solid-Albite melt) =0‰). For silica melt-quartz we used a 0.3-0.5‰ correction experimentally determined by Matthews et al. (1994).

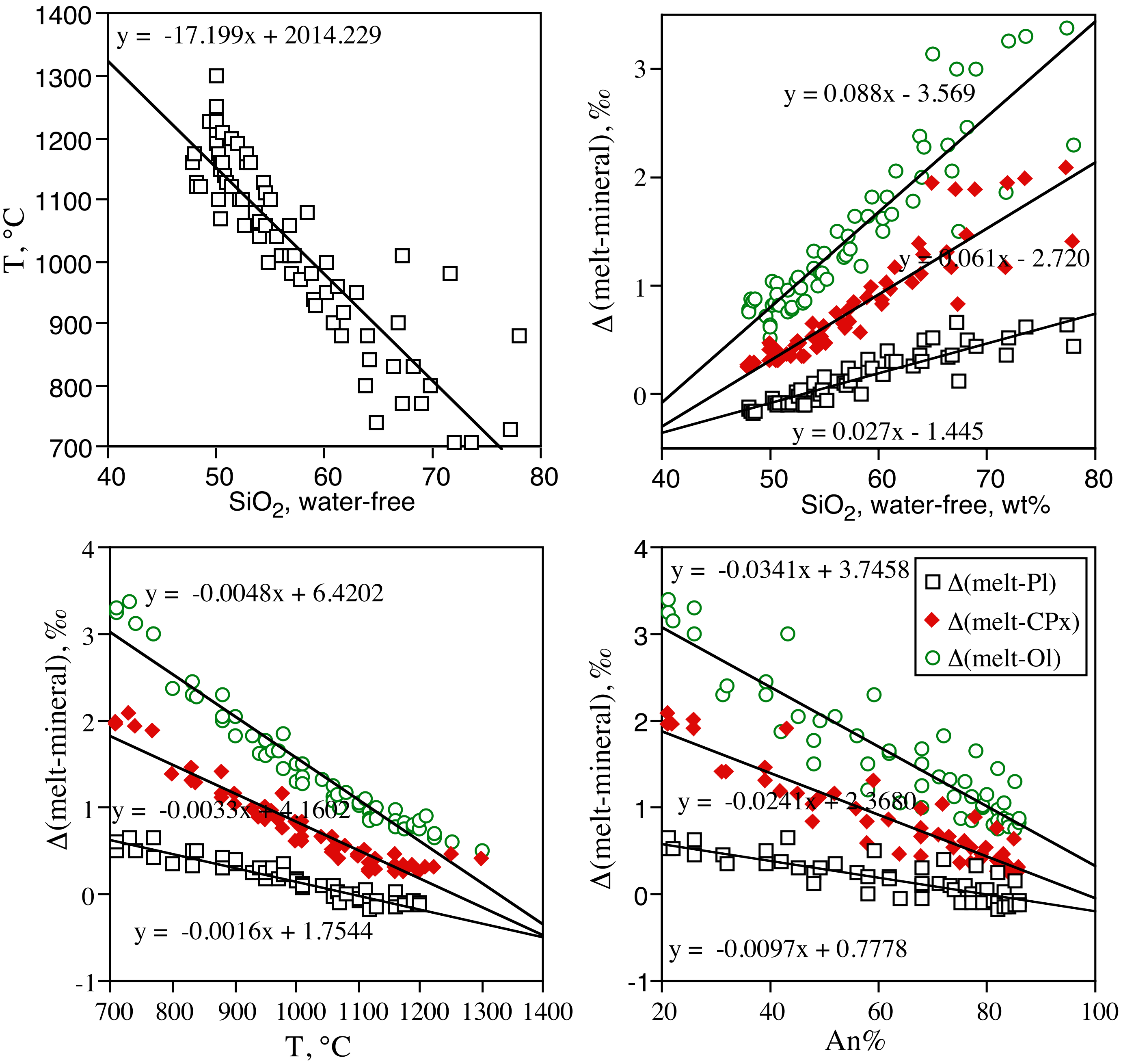
Changes in mineral-melt isotopic fractionation due to changing melt composition, temperature, and composition of plagioclase were calculated at each T step using linear combination of the above isotopic effects (e.g. Formula 1 in text) in Excel program. This explicitly accounted for isotopic fractionation due to changing melt composition with decreasing temperature.

Plagioclase composition was recorded at each step of crystallization, and Δ(melt-Pl) was calculated as a linear combination of Δ(melt-albite) and Δ(melt-anorthite). Compositional variations (such as Mg/Fe) of other phases such as pyroxenes and olivine were also recorded, but isotopic effects due to Fe-Mg change are small, and variations are usually in too narrow a Mg/Fe range to exert significant isotopic effects, and these variations were ignored.

Relative proportions of solid phases removed per increment of crystallization at each temperature and at each changing melt composition determines Δ(bulk cumulate-melt) fractionation and enables calculation of isotopic effect due to cumulate removal. Progressive steps of cumulate removal define trends of $\delta^{18}O$(melt) vs. SiO_2 and other chemical parameters that monitor fractionation.

The results are plotted on Fig. A1 using relevant coordinates. Despite differing trajectories of $\delta^{18}O$(melt) vs. % fractionation for different sets of intensive and extensive variables (not shown), isotopic effects smooth out when plotted on $\delta^{18}O$(melt) vs. SiO_2 (melt), $\delta^{18}O$(melt) vs. T, or $\delta^{18}O$(melt) vs An% diagrams (Fig. A1 here, Fig. 4 in the text). We therefore use all points to provide a single set of robust approximations of melt-mineral fractionations, and use these to derive best fit linear parameters to calculate $\delta^{18}O$(melt) from $\delta^{18}O$(Pl), $\delta^{18}O$(Cpx), and $\delta^{18}O$(Ol) given in Table 3.

Figure A1 Cumulative oxygen isotope effects due to fractional crystallization of basaltic magmas that yields approximation parameters of Table 2 in the text.



y = -17.199x + 2014.229
T, °C
SiO2, water-free
y = 0.088x - 3.569
y = 0.061x - 2.720
y = 0.027x - 1.445
Δ (melt-mineral), ‰
SiO2, water-free, wt%
y = -0.0048x + 6.4202
y = -0.0033x + 4.1602
y = -0.0016x + 1.7544
Δ(melt-mineral), ‰
T, °C
y = -0.0341x + 3.7458
y = -0.0241x + 2.3680
y = -0.0097x + 0.7778
Δ(melt-Pl)
Δ(melt-CPx)
Δ(melt-Ol)
An%

Fig. A1

Table A1 (Internet Repository) Whole-rock composition of studied rocks from Kamchatka-Kurile volcanic arc. Holocene ages are radiocarbon ages.
Analyses where only Fe_2O_3 is given, it represents the total Fe in the system

Sample	Description	Eruptive vol., km^3	SiO_2 wt%	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	H_2O-	H_2O+	LOI	SUM
Kamchatka:																	
Shiveluch																	
97044/1	1964 pumice	0.6-0.8	61.55	0.63	16.15	1.47	3.00	0.10	3.61	5.88	4.39	1.51	0.29	0.69	0.28		99.55
97051/2	Pumice (2800 yrs BP)	≥1	57.90	0.63	16.40	2.60	3.15	0.12	4.18	7.26	4.00	1.29	0.43	1.41	0.44		99.81
SH-3	SH3 pumice (1400 yrs BP)	≥2	56.67	0.76	16.81	3.06	3.40	0.14	5.08	7.83	4.47	0.98	0.16	0.22	0.35		99.93
96025/4	SH2 pumice (1000 yrs BP)	≥2	59.15	0.77	15.50	2.42	3.35	0.10	4.22	6.93	4.30	1.35	0.45	1.03	0.26		99.83
97049/2	Pumice (1450 yrs BP)	≥1	56.33	0.75	16.34	3.30	3.33	0.14	4.65	8.36	3.74	1.08	0.61	0.63	0.88		100.14
1188/1	SHsp cinder (3600 yrs BP)	≥1	50.06	0.67	12.27	3.12	5.52	0.13	15.02	8.46	2.31	1.68	0.56		0.64		100.44
OOK37	Coarse ash	≥1	53.00	0.72	15.35	3.45	4.48	0.14	8.63	8.59	3.16	0.9	0.16	0.48	0.71		100.31
97058/2	Coarse ash	≥1	52.01	1.28	15.1	3.62	4.25	0.14	9.57	7.66	2.77	0.95	0.11	1.04	1.04	0.68	100.22
5734	Lava		51.18	0.72	13.67	3.2	5.55	0.18	12.08	8.36	2.55	1.67	0.37			0.8	100.33
5764	Lava		54.22	0.8	15.66	2.55	5.17	0.16	8.4	9.02	3.05	1.28	0.27			0.07	100.65
B544/N	inclusion in dome Karan, Old Shiveluch		47.23	0.719	21.1	5.52	4.7	0.153	5.05	10.37	3.36	0.716	0.403	0.09		0.31	99.72
B541/2v	Lava, Old Shiveluch		54.71	0.95	17.45	2.63	5.00	0.151	4.69	8.26	4.1	1.19	0.249	0.13		0.37	99.88
B547	Dome Nastoiashii		60.95	0.565	16.54	2.36	2.83	0.11	4.04	6.1	4.65	1.3	0.178	0.08		0.08	99.77
B548b	inclusion in dome Karan, Old Shiveluch		62.58	0.487	16.88	4.25	0.82	0.089	3.2	5.2	4.4	1.47	0.181	0.12		0.17	99.85
Bezymianny																	
B580	Holocene lava		58.91	0.653	17.1	1.6	4.93	0.139	3.96	6.75	3.46	1.49	0.207	0.3		0.27	99.77
B574/A	late Pleistocene dome Plotina		56.00	0.705	18.29	1.76	5.53	0.165	3.44	7.09	3.63	1.09	0.251	0.22		0.44	98.6
B-584	Dome Pravilny		64.62	0.397	17.43	1.97	2.25	0.144	1.18	4.65	4.44	1.42	0.273	0.28		0.26	99.31
B600	late Pleistocene lava		55.81	0.813	17.12	2.55	5.29	0.163	5.15	7.96	3.18	1.11	0.203	0.15		0.4	99.9
Tolbachik																	
TOL-2	1974 fissure eruption	10-12	50.85	0.914	13.62	2.46	6.64	0.174	9.67	11.6	2.37	0.88	0.221	0.15		0.27	99.82
Teklentunup																	
7305	Mid Pleistocene welded tuff	>100?	57.97	ND	ND	ND	ND	ND	1.92	ND	ND	4.56	ND	ND	2.56		ND
1091/1	pre-caldera basalt		50.16	ND	ND	ND	ND	ND	7.19	ND	ND	1.85	ND	ND	0.12		
Kizimen																	
80013/4	Pumice (7500 yrs BP)	4-5	60.50	0.69	15.53	2.42	2.90	0.16	2.21	5.49	3.28	1.80	0.12	1.20	1.30	1.85	99.45
K35/1	Lava		63.72	0.58	16.94	2.24	2.85	0.11	1.84	5.7	3.68	1.49	0.26	0.12	0.17	0.14	99.84
Khangar																	
98032/4	KHG pumice (7000 yrs BP)	12-13	67.20	0.39	15.65	0.91	1.72	0.12	0.82	3.10	4.36	2.48	0.26	2.37	0.62		100.02
98032/2	KHG pumice (7000 yrs BP)	"	66.50	0.42	16.30	0.64	1.90	0.14	1.25	3.24	4.45	2.29	0.06	2.07	0.30		99.58
Uzon																	
87L-103	pre 39000 yrs BP lava		61.94	0.84	13.9	3.79	1.7	0.14	1.57	3.73	3.14	1.47	1.48	4.49	0.28		98.47
99L-101	39000 yrs BP welded tuff	>100	67.53	0.82	13.88	2.09	2.8	0.19	1.34	3.69	4.73	1.98	0.17	0.17	0.12		99.51
D493-74	post-caldera Extrusive Dome Ozernaia		72.1	0.52	13.47	1.20	2.13	0.1	0	2.46	4.17	3.51	0.15	0.28	0.08		100.17
D388i-74	post-caldera Extrusive Dome Kruglaia		71.4	0.45	14.37	1.91	0.8	0.08	0.76	2.65	5.03	2.16	0.08	0.21	0.1		100.00
D368-74	post-caldera Extrusive Dome Sestrenka		70.96	0.58	13.93	1.30	1.67	0.1	0.86	2.92	4.63	1.96	0	0.52	0.14		99.57
W-11	post-caldera Extrusive Dome Belaya		65.99	ND	ND	ND	ND	ND	0.98	ND	ND	1.3	ND	ND	0.33		ND
Maly Semyachik																	
5230/1	28000-48000 yrs BP welded tuff	≥100	67.4	0.78	15.81	1.91	1.71	0.19	1.41	3.38	4.72	2.22	0.23	0.15	0.13		100.05
Bol Semiachik																	
90L-8	Late Pleistocene welded tuff	≥100	63.82	0.99	15.56	3.37	3.39	0.15	1.88	4.38	3.86	1.98	0.23	0.59	0.28		100.48
84L-103	post-caldera Extrusive Dome Ovalnaya		70.64	0.53	14.68	1.82	1.78	0.08	0.95	3.5	3.93	1.94	0.3	0.22	0.11		100.48

Karymsky																	
808 KAR 4	pumice lapilli (7900 yrs BP)	13-16	65.38	0.64	14.40	1.72	3.22	0.12	1.12	3.93	4.15	2.38	0.15	1.16	1.20		99.57
5ab-4	pumice lapilli (7900 yrs BP)	"	69.88	0.31	13.66	1.20	1.37	0.08	0.49	1.85	4.49	2.82	0.12	0.68	3.22		100.17
99IPE-4	pumice lapilli (7900 yrs BP)	"	68.33	0.517	14.79	NA	3.27	0.086	1.07	3.22	4.48	2.33	0.111				98.21
99IPE-8	Volcanic bomb of Karymsky (1999)		61.80	0.913	16.51	NA	5.93	0.146	2.02	5.51	4.57	1.55	0.252				99.20
99IPE-22a	Lava eruption (1996)		51.87	0.728	19.02	NA	7.47	0.147	5.71	10.51	2.86	0.58	0.141				99.03
99IPE-12	pre-caldera lava		60.21	1.110	16.44	NA	7.21	0.180	2.50	6.02	4.44	1.30	0.267				99.67
99IPE-6	~40,000 yrs BP welded tuff		67.95	0.482	15.02	NA	3.16	0.091	1.02	3.20	4.30	2.39	0.103				97.71
J4257	granitic xenolith (1996)		75.69	0.162	13.21	NA	1.32	0.061	0.17	1.14	4.54	3.36	0.037				99.69
Avachinsky																	
99201/1	IAV2 tephra (7150 yrs BP)	≥8-10	59.92	0.75	19.36	2.32	2.94	0.14	2.04	6.80	3.51	0.91	0.09	1.68	0.16		100.62
99163/9	AV1 tephra (3500 yrs BP)	≥4	53.10	1.01	19.11	3.70	5.20	0.17	4.15	9.68	3.04	0.70	0.30		0.17		100.33
29135	Holocene lava		57.22	ND	ND	ND	ND	ND	3.3	ND	ND	0.7	ND		0.3		
29215	Holocene lava		50.94	ND	ND	ND	ND	ND	9.02	ND	ND	0.7	ND		0.21		
TOL-3	Holocene lava, picrite		51.85	0.52	10.56	1.73	6.19	0.16	14.55	11.76	1.77	0.372	0.11	0.12		0.48	100.17
Koryaksky																	
26061	Holocene lava		50.12	ND	ND	ND	ND	ND	9.25	ND	ND	0.91	ND		0.00		
26018	Holocene lava		58.96	ND	ND	ND	ND	ND	2.99	ND	ND	1.63	ND				
26129	Holocene lava		55.2	ND	ND	ND	ND	ND	4.53	ND	ND	1.50	ND				
Chasha Crater, Tolmachev Dol monogenetic lava field																	
98KAM2.3	OPtr coarse ash (4600 yrs BP)	0.9	65.68	0.57	13.15	0.00	1.47	0.06	0.80	1.84	3.55	3.13	0.18	1.20	5.80	2.40	99.83
Opala																	
Barany amfiteatre Crater																	
98 KAM 2.4	OP lapilli (1500 yrs BP)	36047	72.70	0.21	14.23	0.14	1.03	0.08	0.66	1.68	4.26	3.60	0.08	0.00	1.02		99.69
Summit Crater																	
98-33/2	Pumice (3500 yrs BP)	<0.5	65.50	0.65	17.64	NA	3.39	0.11	1.91	3.68	3.94	2.87	0.25				99.94
98-10	Tephra (300 yrs BP)		72.25	0.22	13.50	1.38	0.65	0.08	0.38	1.77	4.37	3.48	0.03			1.29	99.40
Gorely																	
3667	welded tuff (33000 yrs BP)	≥100	64.77	ND	ND	ND	ND	ND	1.26	ND	ND	2.64	ND		0.28		ND
Mutnovsky																	
B618/3	Holocene Lava		50.02	0.963	19.3	2.63	7.21	0.178	4.73	10.8	2.68	0.371	0.16	0.16		0.56	99.76
B615/B	Holocene Ignimbrite flow		51.52	0.895	19.11	3.78	5.11	0.168	4.46	10.02	2.76	0.527	0.173	0.23		0.47	99.22
B610A	Holocene Ignimbrite flow		59.49	0.86	17.64	0.74	5.79	0.134	2.16	6.99	3.52	1.69	0.242	0.26		0.21	99.73
B615A	Holocene Lava		51.52	0.895	19.11	3.78	5.11	0.168	4.46	10.02	2.76	0.527	0.173	0.23		0.47	99.22
Nachiki																x	
TOL-4	Holocene dome		75.59	0.135	13.05	0.33	0.38	0.103	0.1	0.65	4.17	4.49	0.05	0.22		0.4	99.67
Ksudach																	
8882/2	KSht3 pumice (1907)	0.8-1	66.92	0.50	15.80	1.41	3.30	0.16	1.08	2.68	4.40	1.45	0.07	0.39	1.45		99.61
8882/2	KSht3 pumice (1907)	"	68.45	0.51	16.16	1.44	3.38	0.16	1.1	2.74	4.5	1.48	0.07				99.99
C999	lava (older than 1600 yrs BP)		54.34	0.8	17.76	3.3	6.8	0.2	4.3	9.08	2.99	0.62	0.11		0.21		100.51
8880/5	KS1 pumice (1800 yrs BP)	18-19	67.82	0.52	13.87	0.56	2.39	0.13	0.82	2.16	4.64	1.48	0.09	0.45		4.63	99.56
8880/5	KS1 pumice (1800 yrs BP)	"	71.78	0.55	14.68	0.59	2.53	0.14	0.87	2.29	4.91	1.57	0.1				100.01
C953	post KS2 Extrusive Dome (Pariashii Utes)		65.4	0.66	17.09	1.44	3.48	0.19	1.33	4.48	4.6	1.2	0.2		0.15		100.22
86039/14	KS2 pumice (6000 yrs BP)	7-8	61.44	0.77	16.21	2.71	3.92	0.20	2.10	5.39	4.12	1.13	0.21	0.24	0.40	0.86	99.70
C918a	KS2 welded tephra (6000 yrs BP)	"	62.03	0.69	16.55	1.97	4.55	0.19	2.33	5.69	4.10	1.05	0.19		0.61		99.95
8889/2	KS3 white pumice (6300 yrs BP)	0.5-1	66.98	0.65	14.92	0.76	3.51	0.15	0.52	2.58	4.65	1.45	0.13	0.36		2.96	99.62
8889/3	KS3 black pumice (6300 yrs BP)	"	61.98	0.87	15.98	2.78	4.54	0.19	2.24	4.86	3.95	1.13	0.19	0.24		1.11	100.06
Ks-alliw	alliwalite cummulate inclusion in KS3		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			ND
C977a	KS4 black pumice (8800 yrs BP)		62.60	0.80	15.75	1.50	5.66	0.09	1.80	4.88	4.59	1.14	0.21	0.26	0.35		99.63
C977	KS4 welded tephra (8800 yrs BP)	1.5-2	62.99	0.85	16.11	2.65	1.80	0.20	1.99	4.90	4.43	1.13	0.23		0.22		97.50
KA-38a/7	subvolcanic xenolith		49.35	0.745	21	2.3	6.46	0.166	4.78	12.46	2.11	0.218	0.07	0.2		0.43	100.32
KA110-7	lava, <1500 BP		58.68	0.807	16.32	1.71	6.85	0.212	2.72	6.84	4.09	0.765	0.158	0.21		0.25	99.62
KA25A-7	subvolcanic xenolith		67.15	0.642	15.08	0.67	3.39	0.175	1.09	3.42	5.45	1.2	0.175	0.11		0.86	99.41
Ka39/7	subvolcanic xenolith		48.21	0.674	18.03	2.72	7.1	0.185	7.86	12.02	1.92	0.192	0.064	0.76		0.54	100.27
KA1/7	dome, <1500 BP		56.79	0.84	16.33	6.55	2.83	0.22	3.55	7.38	4.02	0.64	0.19	0.7		0.28	99.69

Pauzhetka																	
83L20	Mid Pleistocene welded tuff	>>100	70.34	0.5	14.39	1.46	1.14	0.09	0.94	2.61	4.22	2.93	0.26	1.32	0.11		100.31
Kurile Lake caldera eruption (7600 yrs BP)		170															
97KAM-03a	Pumice fall deposit	"	71.26	0.27	14.04	1.84		0.07	0.36	2.30	4.51	1.83	0.05			3.25	99.78
97KAM-11	Surge deposit	"	70.09	0.28	14.83	1.90		0.07	0.38	2.40	4.46	1.79	0.06			3.60	99.86
97KAM-29AB	Scoria in the ignimbrite	"	54.77	0.84	18.98	8.68		0.17	3.91	9.00	3.25	0.49	0.16			0.09	100.34
97KAM-29AL	Pumice in the ignimbrite	"	71.38	0.28	14.52	1.89		0.07	0.39	2.60	4.55	1.88	0.06			2.59	100.21
97KAM-21CG	Pumice from the ignimbrite	"	61.53	0.66	18.81	4.60		0.12	1.49	6.05	4.73	0.88	0.24			0.84	99.95
97KAM-29HW	Pumice in the ignimbrite	"	69.04	0.30	14.62	2.07		0.07	0.48	2.78	4.57	1.74	0.07			3.08	98.82
97KAM-29DL	Pumice in the ignimbrite	"	70.98	0.30	14.65	2.02		0.07	0.42	2.66	4.53	1.93	0.07			2.63	100.26
97KAM-29DB	Scoria in the ignimbrite	"	51.95	0.84	17.99	9.84		0.18	5.02	9.88	2.52	0.45	0.11			0.16	98.94
97KAM-32D1	Pumice from the ignimbrite	"	69.30	0.31	14.52	2.09		0.07	0.51	2.48	4.46	1.82	0.07			3.41	99.04
KL-1	Pumice from the ignimbrite	"	68.94									1.66					
KL-2	Pumice from the ignimbrite	"	56.52									1.34					
86680	post-caldera extrusive dome (Serdtse Alaida)		64.25	0.63	15.60	2.02	4.31	0.31	2.00	4.50	4.30	1.30	0.16	0.00	0.16		99.54
Ilyinsky Volcano																	
650	Molodoi extrusive dome (1800 yrs BP)		64.38	0.74	16.75	2.03	3.36	0.01	1.72	5.02	4.26	1.56	0.14	0.16	0.00		100.13
621	lava (1900 yrs BP)		59.50	0.77	19.06	1.57	4.03	0.62	2.08	6.64	3.64	1.25	0.21	0.00	1.57		100.94
615	lava (3000 yrs BP)		51.84	0.95	19.37	1.77	6.94	0.16	4.66	9.90	2.61	0.56	0.22	0.17	0.50		99.65
8645/1	pumice (4600 yrs BP)		61.51	0.63	17.28	1.50	3.82	0.10	2.08	4.62	3.87	1.43	0.17	0.48	2.06	0.10	99.65
96K8-24	scoria (6500 yrs BP)		51.34	0.88	17.91	4.68	4.98	0.20	5.81	10.09	2.38	0.45	0.17	0.89	0.00		99.78
96K8-14	pumice (7000 yrs BP)		55.84	0.88	18.75	2.89	3.84	0.12	1.98	5.38	3.00	1.06	0.16	1.88	0.00	3.76	99.54
Dikii Greben Volcano																	
B319-1	extrusive dome		64.3	0.66	15.73	4.03	1.28	0.11	1.74	5.54	3.64	1.47	0.25		0.42		99.17
B318-1	extrusive dome		67.32	0.64	15.19	3.02	1.91	0.1	1.84	4.12	3.72	1.69	0.25		0.15		99.95
B333-1	lava		52.5	1.23	17.82	5.04	5.43	0.15	4.49	8.09	3.58	0.87	0.4		0.15		99.75
B319-6	extrusive dome		64.16	0.69	15.44	3.44	2.34	0.12	2.65	4.97	3.48	1.37	0.36		0.2		99.22
B325-1	mafic inclusion in lava		54.23	0.75	17.5	7.37	2.87	0.17	2.64	9.58	2.92	0.81	0.17		0.69		99.70
B325	lava (>2000 yrs BP)		65.34	0.67	15.03	3.22	3.05	0.12	2.25	4.97	3.67	1.45	0.29		0.24		100.30
B334	extrusive dome (<6000 yrs BP)		70.24	0.49	14.12	2.88	1.2	0.09	1.33	2.56	4.24	2.19	0.11		1		100.45

Kurile Island Arc

Mendeleev Volcano (Kunashir I)																	
7585	extrusive dome (4200 yr BP)	~1	74.85	0.422	12.86	1.73	0.59	0.05	0.42	2.32	4.28	0.99	0.04	0.93		0.27	99.73
7587	mafic inclusion in extrusive dome		55.51	0.83	17.11	7.74	2.4	0.19	4.15	7.68	2.44	0.2	0.08	1.45		0.38	100.16
Golovnin Volcano (Kunashir I)																	
416-4	pumice of caldera-forming eruption	>>100															
G-117	post-caldera extrusive dome	<<1	63.63	0.5	16.38	2.29	4.04	0.07	2.38	5.78	2.8	0.42	0.05		0.48	0.86	99.68
116b	pre-caldera basalt	<<1	49.25	0.62	19.57	4.11	4.94	0.16	6.78	11.69	1.92	0.13	0.13	0.24		0.7	100.24
116-1a	pre-caldera basalt	<<1	49.25	0.62	19.57	4.11	4.94	0.16	6.78	11.69	1.92	0.13	0.13	0.24			
Kudriavy Volcano (Iturup I)																	
B605	lava (1880 AD)	~0.5	57.09	0.68	18.92	8.19		0.16	3.5	9.3	2.55	0.57	0.1				101.06
Zavaritsky Volcano (Simushir I)																	
Zav-1	welded tuff	>>100	67.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Alaid Volcano (Atlasov I)																	
92-233	1971 AD basalt	<1	48.5	1.03	17.55	5.16	6.33	0.19	4.71	10.15	3.1	1.72	0.21	0.1	0.09		98.84
Brouton Volcano (Brouton I)																	
B15-307	Holocene basaltic lava	<1	58.22	0.67	16.3	2.24	5.77	0.14	3.36	7.04	3.46	2.09	0.21	0.15	0.34		99.97

Table A2, Appendix. Starting compositions for MELTS crystallization experiments; Basalts 1,3,4 are typical Kamchatkan end-member compositions from Volynets (1994); Basalt 2 is a typical MORB-like basalt.

	Basalt 1	Basalt 2	Basalt 3	Basalt 4
	high-Mg	tholeiite	high-Al	shoshonite
SiO_2	50.38	48.49	48.32	51.86
TiO_2	0.48	1.01	0.85	0.67
Al_2O_3	16.24	17.68	19.55	20.44
Fe_2O3	2.63	0.87	3.06	4.09
FeO	6.38	7.56	7.56	2.5
MnO	0.17	0.08	0.16	0.12
MgO	10.50	8.90	7.01	2.66
CaO	11.63	12.46	11.26	8.34
Na_2O	1.56	2.67	1.90	3.28
K_2O	0.35	0.20	0.32	3.30
P_2O_5	0.07	0.08	0.12	0.58
LOI	0.19	0.20	0.09	0.82
SUM	100.58	100.20	100.2	99.66