

Table S1. Analytical results on major oxides and trace elements of the standard reference materials obtained within the time interval of analyzing pseudotachylytes from the MSF and volcanic rocks from the KSZHT.

Oxide, element	Measured value	Reference value
Name	ST-2	
Rock type	trapp	
SiO ₂ , wt. %	48.04±0.10	47.99
TiO ₂	1.59±0.01	1.59
Al ₂ O ₃	14.64±0.05	14.63
Fe ₂ O ₃	3.15±0.05	3.14
FeO	10.34±0.03	10.33
MnO	0.21±0.01	0.21
MgO	7.50±0.02	7.51
CaO	10.42±0.05	10.42
Na ₂ O	2.32±0.01	2.32
K ₂ O	0.46±0.01	0.46
P ₂ O ₅	0.17±0.01	0.17
Name	SI-1	
Rock type	dolomitized limestone	
CO ₂	45.19±0.09	45.10
Name	AGV-2	
Rock type	andesite	
Sc, ppm	12.9±1.6	13.1
V	118±4	118.5
Cr	15±3	16.2
Co	15.0±0.6	15.5
Ni	19.7±1.7	18.9
Cu	49±2	51.5
Zn	77±10	86.7
Ga	19.3±0.4	20.4
Rb	69±1	67.8
Sr	656±9	659.5
Y	19.5±0.2	19.4
Zr	228±3	232
Nb	12.9±0.4	14.1
Cs	1.15±0.05	1.17
Ba	1145±15	1134
La	37.8±0.3	38.2
Ce	69.8±1.5	69.4
Pr	8.11±0.12	8.17
Nd	30.7±0.4	30.5
Sm	5.59±0.09	5.5
Eu	1.58±0.04	1.56
Gd	4.78±0.15	4.68

Tb	0.68±0.03	0.65
Dy	3.59±0.13	3.55
Ho	0.68±0.02	0.68
Er	1.85±0.06	1.83
Tm	0.27±0.01	0.26
Yb	1.65±0.05	1.65
Lu	0.26±0.004	0.25
Hf	5.33±0.02	5.14
Ta	0.90±0.05	0.87
Pb	13.5±1	13.1
Th	6.43±0.17	6.17
U	1.93±0.04	1.89

Measured are mean values with standard deviation calculated for 5 replicate determinations (major oxides) and for 8 replicate determinations (trace elements). Reference values are from GeoReM database [Jochum et al., 2005] for ST-2 and AGV-2 and from the official certificate for SI-1 (GSO 813-80, 2019, Research Institute of Applied Physics of Irkutsk State University (NIIPF ISU, Russia).

Jochum, K. P.; Nohi, U.; Herwig, K.; Lammel, E.; Stoll, B.; Hofmann, A. W. GeoReM: A new geochemical database for reference materials and isotopic standards. *Geostandards and Geoanalytical Research* **2005**, 29 (3), 333-338. DOI: 10.1111/j.1751-908X.2005.tb00904.x

Table S2. Analytical results on major oxides and trace elements of pseudotachylytes and mylonites from the Main Sayan fault.

	1	2	3	4	5	6	7	8
Sample	KL-9	KL-19	KL-20	KL-23	KL-24	KL-17	KL-1	KL-22
SiO ₂ , wt. %	47.87	50.54	49.29	49.60	52.72	52.59	51.86	45.47
TiO ₂	1.76	2.18	2.11	1.62	1.43	1.77	0.69	0.60
Al ₂ O ₃	13.51	13.76	13.78	13.67	13.87	15.01	14.73	17.58
Fe ₂ O ₃	5.91	4.86	6.80	5.67	7.34	4.11	2.42	2.72
FeO	7.06	9.02	7.29	8.74	6.90	7.37	7.61	5.20
MnO	0.21	0.22	0.22	0.18	0.22	0.14	0.19	0.14
MgO	7.30	5.09	5.26	5.33	5.06	4.17	5.69	7.50
CaO	9.33	8.32	9.21	5.40	6.81	4.81	6.37	9.37
Na ₂ O	2.56	2.73	2.67	2.72	2.81	2.67	2.37	1.85
K ₂ O	0.65	0.55	0.51	0.50	0.32	1.40	0.87	1.12
P ₂ O ₅	0.36	0.39	0.41	0.15	0.16	0.57	0.08	0.12
H ₂ O ⁻	0.08	0.08	0.05	0.07	N.d.	0.11	0.20	0.07
H ₂ O ⁺	3.21	1.84	1.93	4.21	1.87	3.47	4.36	4.76
CO ₂	0.37	0.12	0.50	2.20	0.67	1.40	2.40	3.39
Total	100.18	99.70	100.03	100.06	100.18	99.59	99.84	99.89
Sc, ppm	45.9	43.9	42.5	41.2	40.3	29.4	43.8	31.2
V	395	420	403	404	359	298	354	184
Cr	239	38	52	46	33	24	196	250
Co	47	36	35	42	40	27	28	29
Ni	116	22	26	32	26	20	52	115
Cu	52	33	61	30	74	70	59	60
Zn	105	85	78	71	79	66	70	69
Ga	17.7	18.3	18.0	18.1	16.6	18.6	14.9	13.7
Rb	14	6.2	6.7	14.4	5.3	54.7	29	28.2
Sr	529	242	361	273	201	413	279	362
Y	32.8	39.4	33.2	41.0	34.1	43.0	22.8	12.0
Zr	28	16.8	13.6	N.d.	N.d.	16.3	44	11.0
Nb	4.3	3.0	2.8	1.6	1.3	3.6	1.78	1.5
Cs	0.5	0.11	0.16	0.46	0.21	0.96	0.6	0.50
Ba	371	210	276	170	179	306	236	315
La	18.7	8.63	8.68	2.44	2.63	15.95	3.45	4.66
Ce	44.0	22.9	22.5	8.25	8.03	39.8	8.60	11.0
Pr	6.00	3.44	3.40	1.63	1.51	5.63	1.41	1.59
Nd	26.0	16.9	16.3	9.23	8.45	25.5	6.68	7.27
Sm	6.10	5.16	4.69	3.55	3.26	6.19	2.25	2.05
Eu	1.91	1.74	1.61	1.31	1.12	1.87	0.80	0.71
Gd	6.22	5.66	5.19	4.99	4.38	6.66	3.20	2.06
Tb	1.01	1.08	0.91	0.96	0.86	1.20	0.56	0.35
Dy	6.01	7.09	5.99	6.72	5.93	7.24	3.75	2.22
Ho	1.26	1.43	1.23	1.45	1.25	1.55	0.80	0.46
Er	3.54	4.07	3.57	4.41	3.71	4.42	2.50	1.32
Tm	0.47	0.62	0.52	0.68	0.57	0.65	0.38	0.21
Yb	3.01	3.82	3.18	4.34	3.73	4.01	2.43	1.12
Lu	0.45	0.58	0.48	0.67	0.56	0.58	0.37	0.18
Hf	0.96	0.92	0.78	0.56	0.48	0.70	0.58	0.53
Ta	0.28	0.25	0.27	0.29	0.24	0.37	0.13	0.14
Pb	3.6	3.1	3.4	N.d.	2.7	5.5	N.d.	3.4
Th	2.67	1.11	1.15	0.11	0.17	2.76	0.55	0.63
U	0.57	0.32	0.22	0.04	<0.03	0.71	0.16	0.15

Table S2. Continued

	9	10	11	12	13	14	15	16
Sample	KL-18	KL-21	KL-3	KL-8	KL-15	KL-16	KL-11	KL-6
SiO ₂ , wt. %	51.33	48.87	61.69	66.43	62.79	63.08	71.06	N.d.
TiO ₂	0.60	1.28	0.89	0.62	0.69	0.79	0.11	0.12
Al ₂ O ₃	16.21	14.29	14.88	13.98	13.67	13.87	13.42	N.d.
Fe ₂ O ₃	3.77	2.80	1.98	1.59	1.08	1.36	0.30	N.d.
FeO	8.70	8.60	4.94	3.34	4.79	5.23	0.99	N.d.
MnO	0.17	0.18	0.09	0.08	0.10	0.10	0.05	0.033
MgO	5.64	5.18	2.98	1.85	2.95	3.18	0.44	N.d.
CaO	4.32	6.60	3.98	3.08	2.83	3.22	3.13	N.d.
Na ₂ O	1.06	1.66	3.06	3.77	3.19	2.95	3.84	N.d.
K ₂ O	2.13	1.91	2.67	2.70	2.39	2.07	4.32	2.77
P ₂ O ₅	0.12	0.21	0.21	0.14	0.13	0.15	0.04	N.d.
H ₂ O ⁻	0.12	0.21	0.14	0.16	0.04	0.10	0.06	N.d.
H ₂ O ⁺	4.95	4.30	1.85	1.58	2.94	2.72	1.35	N.d.
CO ₂	1.05	3.71	0.41	0.96	2.13	1.49	1.11	N.d.
Total	100.17	99.80	99.77	100.28	99.72	100.30	100.22	N.d.
Sc, ppm	42.4	36.5	19.6	13.0	17.0	16.6	4.2	2.5
V	354	314	122	79	123	119	15	12
Cr	25	26	108	45.0	152	110	12.2	4.8
Co	40	29	20.1	13.1	17	19	2.9	1.0
Ni	23	14	50	20	62	47	6.3	N.d.
Cu	162	58	76	47	56	37	10	<4
Zn	76	78	68	73	69	70	16	<10
Ga	17.3	15.9	20.3	19.3	19.0	20.1	16.0	15.2
Rb	96.2	67.2	79	51	71.8	57.7	92	67
Sr	368	183	701	534	186	293	408	321
Y	12.8	25.0	34.3	24.7	20.4	26.7	12.3	7.3
Zr	6.5	8.4	35	28	25.2	19.5	32	55
Nb	1.1	2.3	13.9	10.7	9.3	11.9	8.4	4.3
Cs	2.12	1.10	1.4	0.5	0.67	0.89	0.5	1.3
Ba	250	534	1457	890	363	629	961	1141
La	4.11	5.87	74.5	45.2	21.2	29.7	15.3	22.1
Ce	9.81	15.0	156.2	88.5	44.6	63.2	29.7	45.0
Pr	1.47	2.27	17.19	10.43	5.33	7.28	3.34	4.83
Nd	6.65	11.0	64.1	37.6	21.3	27.3	12.4	15.9
Sm	1.92	3.06	11.07	6.48	4.46	5.49	2.37	2.62
Eu	0.61	1.02	2.58	1.56	1.00	1.25	0.52	0.64
Gd	1.96	3.84	8.55	5.74	4.01	4.81	2.04	1.76
Tb	0.34	0.68	1.11	0.83	0.65	0.77	0.31	0.24
Dy	2.24	4.35	6.54	4.60	3.71	4.77	2.02	1.46
Ho	0.47	0.89	1.27	0.92	0.76	0.95	0.43	0.24
Er	1.48	2.73	3.50	2.68	2.13	2.76	1.26	0.81
Tm	0.23	0.43	0.52	0.35	0.29	0.42	0.20	0.12
Yb	1.47	2.51	3.18	2.26	1.90	2.45	1.22	0.81
Lu	0.22	0.38	0.48	0.33	0.28	0.35	0.19	0.12
Hf	0.48	0.51	1.22	1.02	1.01	0.83	1.38	1.81
Ta	0.12	0.22	0.83	0.64	0.87	0.90	0.67	0.37
Pb	14.9	4.0	29.3	20.6	8.7	16.8	23.3	2.1
Th	0.57	0.50	14.7	10.31	6.68	10.1	2.81	5.46
U	0.17	0.15	1.55	1.10	1.28	1.27	0.55	1.65

Table S2. Continued

	17	18	19	20	21	22	23	24
Sample	KL-2	KL-10	KL-4	KL-5	KL-7	KL-25	KL-26	KL-12
SiO ₂ , wt. %	72.30	73.42	61.79	28.76	18.07	28.27	25.02	55.71
TiO ₂	0.08	0.18	0.30	0.55	0.44	0.18	0.21	0.59
Al ₂ O ₃	12.86	12.31	7.96	8.16	5.70	4.80	4.72	13.75
Fe ₂ O ₃	1.12	1.99	1.28	1.13	0.83	0.41	0.60	3.06
FeO	2.50	1.12	1.52	2.53	2.60	1.10	1.20	3.72
MnO	0.05	0.03	0.10	0.06	0.10	0.052	0.054	0.13
MgO	1.38	0.63	1.75	2.38	4.11	0.53	0.55	3.93
CaO	1.91	3.94	11.33	29.18	36.29	34.20	35.97	5.49
Na ₂ O	3.48	3.47	1.08	2.14	0.02	1.17	0.95	1.94
K ₂ O	1.62	1.01	1.68	1.10	0.94	1.06	1.12	3.20
P ₂ O ₅	0.02	0.038*	0.09	0.20	0.14	0.07	0.09	0.18
H ₂ O ⁻	0.14	0.09	0.17	0.20	0.05	0.10	0.07	0.38
H ₂ O ⁺	1.70	1.28	2.16	1.93	2.60	2.15	1.67	5.76
CO ₂	0.61	0.61	8.45	21.80	28.45	25.47	27.28	1.83
Total	99.77	100.12	99.66	100.12	100.34	99.55	99.51	99.67
Sc, ppm	15.7	13.2	7.9	7.4	6.8	5.0	5.1	27.8
V	73	29	38	69	57	40	46	203
Cr	44	4.3	50	21	48.5	30	33	107.9
Co	6.7	7.7	5.6	9.3	10.6	4.8	5.2	21.6
Ni	16	1.7	24	24	37	23	20	39
Cu	33	76	<10	<10	<4	15	14	28
Zn	56	<10	68	96	67	58	61	60
Ga	10.8	8.6	9.8	9.2	8.9	6.5	6.3	19.3
Rb	59	28	64	31	32	32.3	37.6	159
Sr	154	249	318	1812	1234	1009	1061	146
Y	11.4	7.9	17.2	15.2	16.1	13.1	12.9	17.5
Zr	13	13*	54	23	36	16.5	15.5	9.4
Nb	3.11	1.8	6.18	8.69	9.1	3.9	4.1	2.2
Cs	1.5	0.6	2.5	5.7	1.0	0.48	0.54	6.3
Ba	624	430	396	525	162	298	337	426
La	3.13	1.8	17.7	22.7	16.3	9.06	10.04	5.9
Ce	7.91	4.3	36.2	44.9	31.5	17.88	19.80	14.4
Pr	1.19	0.59	4.41	5.54	3.85	2.09	2.39	1.99
Nd	5.37	3.12	17.0	21.7	15.6	8.10	9.03	9.43
Sm	1.55	0.91	3.43	4.19	3.34	1.84	1.97	2.62
Eu	0.30	0.32	0.77	1.10	0.99	0.31	0.35	0.93
Gd	1.74	1.16	3.25	3.68	3.12	1.79	1.84	3.09
Tb	0.31	0.19	0.47	0.50	0.47	0.30	0.29	0.52
Dy	1.94	1.40	2.94	2.84	2.88	2.03	1.93	3.25
Ho	0.41	0.28	0.59	0.53	0.53	0.42	0.41	0.61
Er	1.24	0.89	1.77	1.48	1.57	1.29	1.22	1.85
Tm	0.18	0.13	0.26	0.21	0.21	0.19	0.19	0.27
Yb	1.31	0.88	1.70	1.26	1.21	1.36	1.17	1.58
Lu	0.21	0.13	0.26	0.19	0.17	0.19	0.18	0.21
Hf	0.48	0.32	1.48	0.70	1.08	0.71	0.68	0.44
Ta	0.25	0.11	0.40	0.51	0.62	0.44	0.41	0.15
Pb	5.3	2.2	9.2	10.8	N.d.	10.3	9.8	3.6
Th	0.49	0.20	3.83	4.19	2.68	2.87	2.73	0.92
U	0.17	0.10	1.26	2.88	1.57	1.19	3.76	0.56

Pseudotachylyte compositions: 1–6 – basic, moderate-Ti basalt; 7–9 – basic, low-Ti basalt; 10 – basic, transitional between moderate- and low-Ti basalts; 11–14 – intermediate, dacite; 15–16 – silicic, rhyolite. Mylonite compositions: 17–18 – aluminosilicate; 19–23 – carbonate-aluminosilicate; 24 – epidote-chlorite rock. N.d. – not determined. In KL-6, TiO₂, MnO, and K₂O were determined by ICP-MS.

Table S3. Analytical results on major oxides and trace elements of volcanic rocks from the KSZHT.

Meteo Volcano								
Sample	687/1	687/1-1*	687/2	687/2-1*	687/3	BK-10**	684/1	684/3
Age, Ma	18.1						17.7	
SiO ₂ , wt. %	49.57	N.d.	49.62	N.d.	48.99	49.77	47.99	48.8
TiO ₂	2.43	2.41	2.28	2.24	2.48	2.80	2.40	1.86
Al ₂ O ₃	14.8	N.d.	14.1	N.d.	14.60	14.03	14.9	14.8
Fe ₂ O ₃	3.28	N.d.	2.52	N.d.	3.42	12.86	2.37	1.85
FeO	8.60	N.d.	8.85	N.d.	8.40	N.d.	9.24	9.21
MnO	0.17	0.16	0.16	0.16	0.17	0.19	0.15	0.13
MgO	7.70	N.d.	7.85	N.d.	8.10	6.78	7.88	7.48
CaO	8.13	N.d.	8.13	N.d.	7.75	8.22	7.98	7.77
Na ₂ O	3.09	N.d.	2.94	N.d.	3.20	3.61	3.22	3.36
K ₂ O	1.30	1.43	1.4	1.52	1.50	1.66	1.48	1.12
P ₂ O ₅	0.46	N.d.	0.43	N.d.	0.52	0.57	0.5	0.33
H ₂ O ⁻	0.11	N.d.	0.22	N.d.	0.42	N.d.	0.82	1.16
H ₂ O ⁺	0.67	N.d.	1.87	N.d.	1.09	N.d.	1.40	1.98
Total	100.31	N.d.	100.37	N.d.	100.64	100.35	100.33	99.85
Sc, ppm	22.8	20.1	21.4	31.2	16.5	18.7	22.0	17.6
V	N.d.	192	N.d.	178	N.d.	172	N.d.	N.d.
Cr	N.d.	195	N.d.	188	N.d.	179	N.d.	N.d.
Co	N.d.	45.8	N.d.	44.8	N.d.	43.5	N.d.	N.d.
Ni	N.d.	137	N.d.	146	N.d.	161	N.d.	N.d.
Cu	36	46	51	61	45	N.d.	39	42
Zn	136	118	126	120	115	121	147	138
Ga	N.d.	19.7	N.d.	18.7	N.d.	N.d.	N.d.	N.d.
Rb	17.7	16.6	16.6	18.9	14.8	20.0	18.6	11.7
Sr	541	550	2015	1617	524	563	620	383
Y	24.7	23.2	22.2	21.5	20.6	23.3	24.1	16.9
Zr	224	218	198	248	188	217	231	135
Nb	31.4	27.0	27.4	24.9	29.4	31.4	38.5	20.7
Cs	0.14	0.08	N.d.	0.06	N.d.	N.d.	N.d.	N.d.
Ba	343	373	402	445	360	402	322	208
La	21.3	22.7	19.8	20.7	23.6	25.7	24.1	15.5
Ce	45.4	49.3	45.0	45.5	49.2	55.3	50.3	32.8
Pr	5.56	6.29	5.28	5.93	5.86	N.d.	6.05	3.88
Nd	23.2	27.5	21.7	25.9	24.1	32.0	24.9	16.7
Sm	6.12	6.54	5.66	6.05	6.28	7.3	6.48	4.64
Eu	2.06	1.99	1.86	1.91	2.03	2.23	2.04	1.49
Gd	6.22	5.87	5.46	5.65	6.03	N.d.	6.11	4.49
Tb	0.88	0.85	0.79	0.80	0.88	0.97	0.87	0.66
Dy	4.49	4.88	4.28	4.60	4.54	N.d.	4.43	3.50
Ho	0.88	0.87	0.75	0.83	0.87	N.d.	0.80	0.69
Er	2.10	2.14	2.07	2.13	2.13	N.d.	2.06	1.79
Tm	N.d.	0.31	N.d.	0.30	N.d.	N.d.	N.d.	N.d.
Yb	1.82	1.81	1.59	1.74	1.78	1.96	1.66	1.59
Lu	0.26	0.26	0.25	0.27	0.25	0.275	0.25	0.21
Hf	4.86	5.41	4.33	6.10	5.42	5.75	4.93	3.71
Ta	1.99	1.77	1.59	1.66	2.16	2.04	2.34	1.51
Pb	2.8	2.8	2.5	3.7	2.8	N.d.	2.7	2.3
Th	2.08	1.78	1.97	1.72	2.37	2.16	2.39	1.93
U	0.46	0.34	0.26	0.22	0.56	N.d.	0.73	0.50

Table S3. Continued

Meteo Volcano								
Sample	683/1	BK-11**	BK-12**	683/4	683/5	684/5	684/6	BK-13**
Age, Ma	17.7			17.6				
SiO ₂ , wt. %	48.81	48.46	49.69	47.78	48.06	46.02	46.48	47.28
TiO ₂	2.47	2.52	1.9	2.67	2.62	2.63	2.59	2.66
Al ₂ O ₃	14.25	14.56	14.61	14.9	15.2	15	14.95	14
Fe ₂ O ₃	2.87	13.1	11.83	3.2	1.32	1.67	2.28	12.97
FeO	9.43			8.72	9.86	10.43	10.18	
MnO	0.16	0.18	0.15	0.15	0.14	0.14	0.15	0.18
MgO	7.7	7.59	7.8	8.1	8.15	8.37	7.91	8.71
CaO	7.98	7.72	7.98	7.98	8.12	7.91	7.91	8.56
Na ₂ O	3.4	3.1	3.52	3.6	3.7	3.72	3.32	2.89
K ₂ O	1.6	1.53	1.08	1.85	1.75	1.78	1.9	1.78
P ₂ O ₅	0.5	0.54	0.34	0.56	0.67	0.53	0.6	0.54
H ₂ O ⁻	0.23	N.d.	N.d.	0.60	0.54	0.74	0.37	N.d.
H ₂ O ⁺	1.00	1.05	0.82	0.90	1.00	1.28	1.10	0.21
Total	100.40	100.35	99.72	101.01	101.13	100.22	99.74	99.78
Sc, ppm	19.6	19.2	18.0	18.7	20.0	20.9	19.8	17.9
V	204	137	192	194	N.d.	N.d.	N.d.	243
Cr	195	238	218	181	N.d.	N.d.	N.d.	211
Co	47.6	48.4	43.2	48.4	N.d.	N.d.	N.d.	48.2
Ni	110	104	136	127	N.d.	N.d.	N.d.	235
Cu	49	N.d.	N.d.	55	27	50	42	N.d.
Zn	139	109	115	126	138	133	139	98
Ga	20.6	N.d.	N.d.	20.9	N.d.	N.d.	N.d.	N.d.
Rb	19.2	13.5	24.5	24.1	18.2	26.0	24.9	27.6
Sr	667	451	702	745	1033	724	697	976
Y	23.3	17.5	21.4	23.6	21.9	24.4	24.1	19.9
Zr	242	151	232	246	224	233	239	127
Nb	35.2	21.2	39.1	40.7	47.0	42.4	44.1	26.6
Cs	0.39	N.d.	N.d.	0.42	0.25	0.46	0.53	N.d.
Ba	369	289	396	427	333	366	348	1768
La	25.9	24.9	15.0	31.3	27.7	28.1	28.7	27.2
Ce	56.3	50.5	31.6	65.7	84.8	60.0	86.3	56.4
Pr	7.21	N.d.	N.d.	8.20	6.96	6.66	6.96	N.d.
Nd	30.6	29.0	19.0	32.1	28.2	26.6	27.5	29.0
Sm	7.04	6.76	4.43	7.72	7.14	6.64	6.73	6.64
Eu	2.07	2.13	1.47	2.29	2.26	2.26	2.19	2.03
Gd	6.17	N.d.	N.d.	6.67	6.33	6.34	6.57	N.d.
Tb	0.86	0.89	0.64	0.95	0.89	0.90	0.96	0.84
Dy	5.08	N.d.	N.d.	5.20	4.40	4.71	4.81	N.d.
Ho	0.86	N.d.	N.d.	0.94	0.78	0.83	0.86	N.d.
Er	2.19	N.d.	N.d.	2.23	1.91	2.23	2.16	N.d.
Tm	0.31	N.d.	N.d.	0.33	N.d.	N.d.	N.d.	N.d.
Yb	1.76	1.67	1.37	1.78	1.56	1.70	1.81	1.60
Lu	0.25	0.25	0.19	0.26	0.22	0.24	0.25	0.22
Hf	5.70	5.13	3.51	5.90	5.02	4.79	5.48	5.13
Ta	2.37	1.94	1.29	2.81	2.87	2.40	2.85	2.25
Pb	3.6	N.d.	N.d.	4.6	2.4	3.8	3.9	N.d.
Th	2.38	1.99	1.55	3.41	2.56	3.02	3.53	2.85
U	0.67	N.d.	N.d.	0.95	0.85	0.86	1.01	N.d.

Table S3. Continued

Kultuk Volcano								
Sample	Klt-12***	Klt-11***	Klt-10***	Klt-6***	Klt-3***	Klt-7***	Klt-5***	Klt-5a***
Age, Ma	18							
SiO ₂ , wt. %	48.26	48.06	48.06	47.28	47.09	49.08	49.52	48.88
TiO ₂	2.24	2.32	2.26	2.29	2.17	2.43	2.42	2.41
Al ₂ O ₃	14.71	14.94	14.50	14.71	14.55	15.36	15.31	15.68
Fe ₂ O ₃	2.96	2.78	2.88	2.81	2.17	2.63	1.88	2.38
FeO	7.46	7.72	7.49	7.36	7.52	7.82	8.19	7.93
MnO	0.13	0.14	0.14	0.12	0.12	0.13	0.12	0.16
MgO	8.20	7.76	8.09	8.28	9.85	7.36	7.36	7.69
CaO	7.62	8.37	7.54	8.22	7.21	7.64	7.78	7.68
Na ₂ O	2.94	2.99	2.96	2.60	2.48	3.43	3.4	3.08
K ₂ O	1.69	1.60	1.86	1.85	1.92	1.86	1.75	1.57
P ₂ O ₅	0.58	0.56	0.63	0.62	0.63	0.62	0.62	0.63
H ₂ O ⁻	0.72	0.49	0.71	0.88	0.73	0.26	0.33	0.50
H ₂ O ⁺	2.49	2.07	2.82	3.26	3.31	1.10	1.24	1.69
Total	100.00	99.80	99.94	100.28	99.75	99.72	99.93	100.28
Sc, ppm	24.3	25.5	29.5	24.0	14.3	23.2	16.1	18.6
V	173	184	174	190	172	181	180	187
Cr	281	237	245	240	254	247	260	254
Co	44.3	47.0	44.0	44.4	46.2	41.8	42.0	44.1
Ni	127	133	109	94	139	93	96	108
Cu	41	47	50	46	34	42	46	51
Zn	119	115	132	134	115	126	124	143
Ga	21.5	19.2	21.7	21.0	19.2	22.1	21.6	21.6
Rb	14.8	15.4	19.0	19.8	16.7	17.5	16.9	13.4
Sr	1301	1645	1042	1157	1490	733	745	765
Y	20.5	21.2	21.1	20.4	19.1	22.2	22.1	22.0
Zr	188	222	223	195	170	200	185	185
Nb	32.4	32.9	34.7	37.7	38.3	35.1	35.7	34.5
Cs	0.28	0.33	0.25	0.24	0.19	0.33	0.32	0.29
Ba	281	324	293	326	360	311	276	281
La	23.7	23.7	25.1	26.1	24.4	25.1	25.1	24.9
Ce	51.3	51.1	54.6	56.0	51.7	54.6	54.5	53.9
Pr	6.65	6.32	6.99	6.89	6.55	7.04	6.99	6.93
Nd	26.5	25.0	27.9	27.1	26.0	28.1	28.1	27.8
Sm	6.57	6.15	6.89	6.56	6.37	6.97	7.03	6.94
Eu	2.14	2.12	2.18	2.14	2.03	2.24	2.30	2.31
Gd	5.77	5.67	6.05	5.81	5.58	6.11	6.13	6.23
Tb	0.86	0.86	0.91	0.87	0.83	0.90	0.91	0.92
Dy	4.33	4.37	4.56	4.31	4.06	4.57	4.52	4.62
Ho	0.81	0.84	0.84	0.82	0.76	0.87	0.87	0.86
Er	2.03	2.05	2.14	2.00	1.89	2.21	2.17	2.22
Tm	0.27	0.29	0.29	0.28	0.26	0.30	0.30	0.30
Yb	1.50	1.57	1.70	1.57	1.45	1.71	1.71	1.63
Lu	0.20	0.21	0.21	0.21	0.191	0.23	0.23	0.24
Hf	4.73	5.45	5.51	4.75	4.21	5.06	4.61	4.64
Ta	1.93	1.98	2.10	2.21	2.22	2.10	2.31	2.08
Pb	5.4	4.8	3.1	6.5	3.2	3.2	3.3	6.4
Th	2.06	2.39	2.13	2.61	2.67	2.20	2.12	2.21
U	0.74	0.73	0.86	0.89	1.29	0.74	1.15	1.26

Table S3. Continued

	Kultuk Volcano						Karerny Volcano	
Sample	Klt-4***	Klt-2***	Klt-1***	659***	Klt-9***	Klt-8***	P682	15-02
Age, Ma	18			13			13	
SiO ₂ , wt. %	48.26	48.06	46.18	47.22	48.26	48.00	45.15	44.65
TiO ₂	2.48	2.40	2.58	1.97	1.95	2.00	2.4	2.63
Al ₂ O ₃	15.26	15.26	15.04	14.36	15.15	14.81	14.8	13.76
Fe ₂ O ₃	2.32	1.46	1.44	4.74	3.59	2.74	3.13	3.46
FeO	7.74	8.23	8.92	7.57	7.95	8.78	8.08	8.18
MnO	0.14	0.13	0.16	0.15	0.14	0.15	0.17	0.17
MgO	7.28	8.78	9.02	8.54	8.06	8.48	8.49	10.16
CaO	8.19	8.09	8.56	8.1	8.00	7.72	9.52	9.54
Na ₂ O	3.09	3.09	2.38	2.85	3.26	3.06	3.12	2.7
K ₂ O	1.85	1.92	1.74	1.16	1.09	1.17	2.04	1.89
P ₂ O ₅	0.68	0.66	0.66	0.29	0.34	0.34	0.81	0.44
H ₂ O ⁻	0.52	0.45	0.67	0.63	0.51	0.50	1.98	2.1
H ₂ O ⁺	2.02	1.45	2.63	2.85	1.67	2.58	1.24	1.69
Total	99.82	99.98	99.99	100.43	99.97	100.33	100.37	100.32
Sc, ppm	16.0	15.7	16.9	23.0	29.2	25.2	19.9	15.1
V	191	190	204	N.d.	197	195	380	234
Cr	229	242	258	N.d.	201	228	350	221
Co	41.4	42.9	42.3	N.d.	47.8	42.8	79.0	49.4
Ni	79	103	128	N.d.	125	133	190	171
Cu	41	45	53	50	58	60	50	44
Zn	111	126	127	136	111	115	122	121
Ga	21.5	21.3	20.0	N.d.	20.5	20.2	N.d.	19.6
Rb	18.2	19.3	22.3	18.0	11.0	14.7	30.4	29.2
Sr	783	781	1603	527	447	460	2968	959
Y	21.1	20.9	22.0	21.0	21.0	20.6	21.1	24.0
Zr	182	182	185	150	166	149	199	211
Nb	39.1	38.5	38.4	22.8	21.3	21.5	57.7	64.0
Cs	0.31	0.31	0.23	N.d.	0.13	0.14	N.d.	0.38
Ba	323	321	357	209	213	222	568	516
La	26.5	26.5	25.8	15.5	16.0	16.6	37.5	39.9
Ce	57.5	57.0	56.5	32.9	34.9	35.8	113.9	84.5
Pr	7.21	7.06	7.10	4.05	4.65	4.75	8.07	9.78
Nd	28.2	27.7	28.3	17.3	19.1	19.6	31.9	38.2
Sm	6.77	6.70	6.99	4.75	4.99	5.15	7.77	7.89
Eu	2.23	2.20	2.36	1.65	1.72	1.71	2.15	2.52
Gd	6.10	6.02	6.24	5.03	4.98	4.95	6.41	7.36
Tb	0.91	0.90	0.95	0.75	0.75	0.77	0.91	1.05
Dy	4.50	4.42	4.72	3.80	4.22	4.23	4.36	5.49
Ho	0.84	0.83	0.86	0.71	0.82	0.82	0.82	0.91
Er	2.15	2.06	2.13	1.85	2.10	2.05	1.97	2.29
Tm	0.30	0.28	0.29	N.d.	0.29	0.31	N.d.	0.30
Yb	1.63	1.58	1.64	1.53	1.73	1.71	1.63	1.64
Lu	0.22	0.22	0.21	0.21	0.23	0.24	0.24	0.24
Hf	4.56	4.61	4.65	3.37	4.36	4.03	5.01	5.06
Ta	2.25	2.26	2.30	1.46	1.36	1.37	3.89	4.59
Pb	3.6	4.4	5.0	N.d.	3.6	3.6	3.4	2.5
Th	2.63	2.49	2.35	1.80	1.81	1.87	4.49	4.95
U	1.14	0.97	0.79	0.47	0.50	0.54	1.26	1.03

Table S3. Continued

Karerny Volcano									
Sample	15-03	15-04	15-05	15-06	15-07	15-08	15-09	15-11	15-12
Age, Ma	13								
SiO ₂ , wt. %	45.73	44.77	44.49	48.8	47.41	48.27	47.32	48.5	47.56
TiO ₂	2.51	2.73	2.59	2.38	2.12	2.27	2.41	2.33	2.36
Al ₂ O ₃	14.17	13.39	13.79	15.16	15.73	15.55	14.55	14.68	14.09
Fe ₂ O ₃	3.46	2.23	3.2	4.83	2.28	4.56	3.03	3.92	2.42
FeO	7.83	9.42	8.27	6.11	9.51	6.74	8.73	7.56	9.15
MnO	0.17	0.17	0.18	0.16	0.16	0.16	0.16	0.15	0.16
MgO	9.25	10.44	10.03	6.65	7.79	7.79	8.79	8.39	9.39
CaO	9.79	9.86	9.57	8.69	8.28	8.36	8.65	8.59	8.55
Na ₂ O	3.79	2.98	2.75	3.23	3.78	3.67	3.65	3.74	3.64
K ₂ O	1.05	1.72	1.85	1.52	1.79	1.78	1.66	1.48	1.68
P ₂ O ₅	0.72	0.66	0.64	0.54	0.6	0.6	0.63	0.6	0.66
H ₂ O ⁻	0.33	0.21	0.43	0.48	0.05	0.08	0.05	0.02	0.08
H ₂ O ⁺	1.58	1.8	2.15	1.83	0.72	0.51	0.72	0.44	0.68
Total	100.50	100.38	99.94	100.59	100.22	100.4	100.61	100.46	100.42
Sc, ppm	14.4	14.5	22.8	15.8	19.5	19.7	22.1	19.0	18.3
V	215	218	229	167	169	169	173	175	167
Cr	198	251	221	167	215	201	269	222	248
Co	46.6	51.0	50.3	39.0	45.3	41.9	46.8	45.5	47.2
Ni	150	196	187	75	135	129	146	118	153
Cu	44	45	39	44	43	41	22	29	28
Zn	159	126	121	131	314	102	115	110	117
Ga	19.7	20.0	20.1	19.7	18.1	18.3	19.1	19.0	18.5
Rb	51.9	34.8	34.2	14.8	21.1	19.5	19.6	19.4	17.6
Sr	1096	1129	1287	800	908	827	745	744	739
Y	24.8	22.5	24.2	20.0	21.5	23.2	23.5	23.4	22.4
Zr	232	202	253	165	167	172	198	168	194
Nb	73.7	55.2	63.7	32.8	36.2	38.2	42.4	40.0	44.0
Cs	0.54	0.36	0.40	0.67	0.34	0.21	0.24	0.33	0.22
Ba	585	432	521	276	507	479	398	403	374
La	45.1	35.1	39.8	22.9	27.0	28.6	28.0	26.9	28.4
Ce	93.0	76.1	85.1	49.7	58.6	64.0	61.4	59.9	62.5
Pr	10.54	8.92	9.77	6.34	6.90	7.67	7.50	7.29	7.59
Nd	40.5	36.2	38.8	26.9	27.9	30.8	30.8	30.1	31.3
Sm	8.28	7.82	7.88	6.26	6.12	6.66	6.85	6.74	6.86
Eu	2.60	2.47	2.52	2.09	2.02	2.15	2.28	2.27	2.31
Gd	7.58	7.14	7.47	5.95	5.75	6.30	6.57	6.52	6.55
Tb	1.07	1.00	1.04	0.86	0.82	0.89	0.95	0.94	0.94
Dy	5.71	5.24	5.42	4.43	4.43	4.91	5.04	5.05	5.10
Ho	0.93	0.85	0.90	0.75	0.76	0.88	0.89	0.89	0.84
Er	2.36	2.17	2.28	1.86	2.07	2.27	2.29	2.29	2.24
Tm	0.31	0.28	0.28	0.24	0.29	0.31	0.30	0.31	0.28
Yb	1.78	1.49	1.65	1.38	1.58	1.75	1.76	1.70	1.63
Lu	0.24	0.21	0.24	0.20	0.23	0.26	0.26	0.26	0.24
Hf	5.39	5.06	6.03	3.97	3.94	4.01	4.74	4.10	4.40
Ta	5.04	3.89	4.33	2.18	2.47	2.54	2.88	2.67	2.97
Pb	3.4	2.1	5.0	4.6	N.d.	3.4	2.0	2.5	2.5
Th	5.83	4.54	4.99	2.01	2.48	2.16	2.41	2.45	2.52
U	1.54	1.63	0.88	0.31	0.51	0.29	0.44	0.41	0.25

Table S3. Continued

Shirokiy Volcano								
Sample	SL16-1	SL16-2	SL16-3	SL16-4	SL16-5	SL16-6	SL16-7	SL16-8
Age, Ma	13							
SiO ₂ , wt. %	44.38	48.03	44.15	48.36	43.64	44.35	43.96	44
TiO ₂	2.72	2.22	2.76	2.23	2.82	2.85	2.67	2.68
Al ₂ O ₃	13.38	14.03	14.04	14.17	13.55	13.6	13.57	13.61
Fe ₂ O ₃	2.92	3.06	3.87	3.23	3.76	3.12	3.96	3.58
FeO	9.29	8.58	8.42	8.44	8.67	9.45	8.30	9.01
MnO	0.18	0.19	0.19	0.18	0.18	0.17	0.18	0.18
MgO	9.72	8.72	9.58	8.2	10.34	9.74	10.07	10.11
CaO	9.53	7.92	8.21	7.81	9.31	8.88	9.02	9.13
Na ₂ O	2.95	3.08	2.46	3.08	2.74	2.98	2.48	2.8
K ₂ O	1.63	1.38	0.98	1.33	1.1	1.54	1.04	1.38
P ₂ O ₅	0.59	0.42	0.61	0.43	0.63	0.61	0.60	0.57
H ₂ O ⁻	0.16	0.30	0.39	0.24	0.29	0.16	0.37	0.19
H ₂ O ⁺	2.71	2.40	3.99	1.90	3.18	2.02	3.93	2.99
Total	100.16	100.33	99.64	99.59	100.21	99.52	100.16	100.30
Sc, ppm	19.4	17.8	19.1	17.4	18.5	18.6	19.4	19.6
V	251	178	249	177	259	253	253	248
Cr	222	206	208	203	200	246	220	227
Co	55.7	49.3	54.8	48.9	57.3	57.6	55.2	57.0
Ni	172	126	163	125	173	198	171	180
Cu	59	59	52	44	51	176	50	52
Zn	133	137	129	122	131	144	143	130
Ga	21.2	20.0	21.3	19.6	21.1	21.2	21.5	20.3
Rb	29.0	13.3	41.5	13.7	34.5	36.6	43.2	30.8
Sr	764	706	1061	568	819	863	981	825
Y	21.0	21.9	21.2	21.7	21.0	21.0	21.3	20.5
Zr	224	175	224	177	226	229	229	215
Nb	45.4	25.8	45.3	26.2	45.8	45.1	46.8	43.7
Cs	0.20	<0.05	0.22	<0.05	0.22	0.21	0.23	0.18
Ba	388	362	417	284	410	397	421	373
La	32.0	20.1	32.3	20.0	33.1	32.6	32.7	30.9
Ce	69.0	43.3	70.1	43.7	71.3	70.5	70.2	66.0
Pr	8.34	5.82	8.46	5.72	8.58	8.53	8.54	7.97
Nd	33.9	24.4	34.8	23.9	35.0	34.6	35.2	32.0
Sm	7.09	5.67	7.30	5.59	7.50	7.37	7.37	6.68
Eu	2.36	1.94	2.39	1.93	2.41	2.40	2.37	2.18
Gd	6.49	5.67	6.54	5.69	6.70	6.64	6.65	6.19
Tb	0.96	0.86	0.99	0.87	0.99	0.97	0.97	0.92
Dy	4.58	4.48	4.60	4.42	4.61	4.59	4.66	4.40
Ho	0.80	0.84	0.81	0.80	0.80	0.79	0.82	0.80
Er	1.91	2.00	1.87	2.06	1.87	1.87	1.86	1.83
Tm	0.25	0.27	0.25	0.28	0.24	0.24	0.26	0.25
Yb	1.46	1.69	1.46	1.67	1.36	1.37	1.47	1.43
Lu	0.20	0.24	0.20	0.24	0.18	0.20	0.20	0.20
Hf	5.12	3.94	5.09	4.07	5.15	5.14	5.24	4.77
Ta	2.92	1.63	2.95	1.69	3.00	2.88	2.97	2.74
Pb	1.9	1.7	2.8	1.4	1.6	2.6	1.6	1.6
Th	3.27	1.80	3.26	1.88	3.38	3.30	3.29	3.15
U	0.82	0.41	0.79	0.49	0.88	0.89	1.04	0.92

N.d. – not determined; * – TiO_2 , MnO , and K_2O were determined by ICP-MS; ** – data are from [Harris, 1998], major oxides were determined by XRF, Fe_2O_3 is Fe_2O_3 tot; *** – data are from [Rasskazov et al., 2013].

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Table S4. Analytical results on Sr, Nd, and Pb isotope ratios of volcanic rocks from the KSZHT.

Meteo Volcano								
Sample	687/1	687/2	687/3	BK-10**	684/1	684/3	683/1	BK-12**
Age, Ma	18.1				17.7			
⁸⁷ Sr/ ⁸⁶ Sr	N.d.	0.704676	N.d.	0.70466	0.704362	N.d.	N.d.	0.70443
±2σ		0.000009			0.000010			
¹⁴³ Nd/ ¹⁴⁴ Nd	N.d.	0.512683	N.d.	0.512685	0.512705	N.d.	N.d.	0.512741
±2σ		0.000009			0.000017			
²⁰⁶ Pb/ ²⁰⁴ Pb	17.6508	17.6474	17.7173	17.661	17.8789	17.7940	17.8058	17.810
±2σ	0.0014	0.0020	0.0015	0.001	0.0013	0.0019	0.0017	0.001
²⁰⁷ Pb/ ²⁰⁴ Pb	15.4676	15.4674	15.4736	15.454	15.5014	15.4871	15.4859	15.496
±2σ	0.0013	0.0019	0.0013	0.001	0.0012	0.0017	0.0015	0.001
²⁰⁸ Pb/ ²⁰⁴ Pb	37.8156	37.8221	37.8531	37.785	38.0072	37.9438	37.9329	37.907
±2σ	0.0034	0.0046	0.0031		0.0030	0.0042	0.0039	

Table S4. Continued

Meteo Volcano					Kultuk Volcano			
Sample	683/4	683/5	684/5	684/6	BK-13**	Klt-12	Klt-7	Klt-2
Age, Ma	17.6					18		
⁸⁷ Sr/ ⁸⁶ Sr	0.704279	N.d.	N.d.	N.d.	0.70442	0.704493	N.d.	N.d.
±2σ	0.000013					0.000013		
¹⁴³ Nd/ ¹⁴⁴ Nd	0.512711	N.d.	N.d.	N.d.	0.512742	N.d.	N.d.	N.d.
±2σ	0.000010							
²⁰⁶ Pb/ ²⁰⁴ Pb	17.8163	17.9057	17.8448	17.8566	17.850	17.7734	17.8382	17.6584
±2σ	0.0022	0.0018	0.0017	0.0013	0.001	0.0034	0.0022	0.0026
²⁰⁷ Pb/ ²⁰⁴ Pb	15.4849	15.4927	15.4804	15.4817	15.466	15.4736	15.4878	15.4747
±2σ	0.0020	0.0015	0.0015	0.0012	0.001	0.0030	0.0019	0.0023
²⁰⁸ Pb/ ²⁰⁴ Pb	37.9359	37.8632	37.9799	37.9698	37.954	37.8037	37.8607	37.8182
±2σ	0.0048	0.0029	0.0037	0.0031		0.0075	0.0028	0.0058

Table S4. Continued

Kultuk Volcano						Karerny Volcano		
Sample	Klt-3	Klt-4	Klt-5	Klt-6	Klt-10	Klt-9	P682	15-05
Age, Ma	18					13	13	13
⁸⁷ Sr/ ⁸⁶ Sr	N.d.	N.d.	N.d.	N.d.	N.d.	0.704523		N.d.
±2σ						0.000016		
¹⁴³ Nd/ ¹⁴⁴ Nd	N.d.	N.d.	N.d.	N.d.	N.d.	N.d.		N.d.
±2σ								
²⁰⁶ Pb/ ²⁰⁴ Pb	17.5506	17.7059	17.8116	17.6884	18.1269	17.7096	18.1607	17.7559
±2σ	0.0024	0.0021	0.0030	0.0036	0.0024	0.0020	0.0020	0.0027
²⁰⁷ Pb/ ²⁰⁴ Pb	15.4476	15.4710	15.4837	15.4717	15.5046	15.4787	15.5125	15.4790
±2σ	0.0022	0.0018	0.0025	0.0031	0.0021	0.0019	0.0017	0.0023
²⁰⁸ Pb/ ²⁰⁴ Pb	37.7901	37.8693	37.8353	37.8636	38.1357	37.9245	38.1473	37.7911
±2σ	0.0054	0.0045	0.0064	0.0079	0.0053	0.0042	0.0043	0.0059

Table S4. Continued

Karerny Volcano								
Sample	15-02	15-03	15-04	15-06	15-08	15-09	15-11	15-12
Age, Ma	13							
$^{87}\text{Sr}/^{86}\text{Sr}$	N.d.	N.d.	N.d.	N.d.	N.d.	N.d.	N.d.	N.d.
$\pm 2\sigma$								
$^{143}\text{Nd}/^{144}\text{Nd}$	N.d.	N.d.	N.d.	N.d.	N.d.	N.d.	N.d.	N.d.
$\pm 2\sigma$								
$^{206}\text{Pb}/^{204}\text{Pb}$	18.1316	18.1613	18.1204	17.9674	17.2853	17.3350	17.4733	17.3991
$\pm 2\sigma$	0.0028	0.0026	0.0025	0.0019	0.0021	0.0026	0.0052	0.0022
$^{207}\text{Pb}/^{204}\text{Pb}$	15.5027	15.5075	15.5111	15.5054	15.3974	15.4000	15.4316	15.4066
$\pm 2\sigma$	0.0025	0.0022	0.0022	0.0017	0.0019	0.0023	0.0047	0.0020
$^{208}\text{Pb}/^{204}\text{Pb}$	38.1383	38.1558	38.1196	37.9426	37.4635	37.4864	37.6232	37.5047
$\pm 2\sigma$	0.0062	0.0053	0.0055	0.0044	0.0046	0.0056	0.0115	0.0050

Table S4. Continued

Shirokiy Volcano				
Sample	SL16-1	SL16-2	SL16-3	SL16-4
Age, Ma	13			
$^{87}\text{Sr}/^{86}\text{Sr}$	N.d.	N.d.	N.d.	N.d.
$\pm 2\sigma$				
$^{143}\text{Nd}/^{144}\text{Nd}$	N.d.	N.d.	N.d.	N.d.
$\pm 2\sigma$				
$^{206}\text{Pb}/^{204}\text{Pb}$	18.1591	17.7647	18.1901	17.7539
$\pm 2\sigma$	0.0030	0.0015	0.0018	0.0015
$^{207}\text{Pb}/^{204}\text{Pb}$	15.5212	15.4850	15.5205	15.4849
$\pm 2\sigma$	0.0025	0.0013	0.0016	0.0014
$^{208}\text{Pb}/^{204}\text{Pb}$	38.1885	37.8552	38.2278	37.8732
$\pm 2\sigma$	0.0065	0.0033	0.0040	0.0033

N.d. – not determined; ** – data are from [Harris, 1998] (major oxides and trace elements are shown in Table S3).