

TABLE DR1. LAKE SUPERIOR SEDIMENT CORE SAMPLE DEPTHS AND CRYPTOTEPHRA SHARD CONCENTRATIONS

Site names, core sections, and sample names	Average depth of sample in core section (cm)	Average depth of sample, meters below lake floor (mblf)	Sample sediment mass (g)	Tephra shards (counts)	Tephra shard concentrations (counts g <sup>-1</sup> )
<b>Keweenaw Bay (KB)</b>					
BH09K-SUP09-1A-1K-4 (10 cm samples)					
LS 01	5	3.600	2.6447	3	1.1343
LS 02	15	3.700	1.4053	4	2.8463
LS 03	25	3.800	1.1099	22	19.821
LS 04	35	3.900	0.9645	11	11.404
LS 05	45	4.000	1.2741	6	4.7092
LS 06	55	4.100	1.1521	7	6.0758
LS 07	65	4.200	1.1103	5	4.5032
LS 08	75	4.300	1.4109	26	18.427
LS 09	85	4.400	0.8297	198	238.64
LS 10	95	4.500	1.2719	24	18.869
LS 11	105	4.600	0.9234	10	10.829
LS 12	115	4.700	1.1543	11	9.5295
LS 13	125	4.800	1.1986	15	12.514
LS 14	135	4.900	1.4921	23	15.414
LS 15	145	5.015	2.417	27	11.170
BH09K-SUP09-1A-1K-5 (10 cm samples)					
LS 16	5	5.19	0.7506	5	6.6613
LS 17	15	5.29	0.8451	8	9.4663
BH09K-SUP09-1A-1K-4 (1 cm subsamples)					
LS 18	80.50	4.355	0.8896	30	33.723
LS 19	81.50	4.365	0.8467	132	155.89
LS 20	82.50	4.375	1.1386	81	71.139
LS 21	83.50	4.385	0.9832	151	153.58
LS 22	84.50	4.395	1.1399	225	197.38
LS 23	85.50	4.405	1.4697	645	438.86
LS 24	86.50	4.415	1.7648	875	495.80
LS 25	87.50	4.425	1.5554	353	226.95
LS 26	88.50	4.435	1.3662	10	7.3195
LS 27	89.50	4.445	0.9802	17	17.343
<b>Isle Royale (IR)</b>					
BH11IR-SUP11-1A-1P-3 (10 cm samples)					
LS 31	5	2.679	N.D.*	2	N.D.*
LS 32	15	2.779	N.D.*	2	N.D.*
LS 33	25	2.879	N.D.*	222	N.D.*
LS 34	35	2.929	N.D.*	5	N.D.*
LS 35	45	3.079	N.D.*	1	N.D.*
LS 36	55	3.179	N.D.*	1	N.D.*
LS 37	65	3.279	N.D.*	0	N.D.*
BH11IR-SUP11-1A-1P-4 (10 cm samples)					
LS 38	107.5	5.239	N.D.*	0	N.D.*
LS 39	117.5	5.339	N.D.*	2	N.D.*
LS 40	127.5	5.439	N.D.*	3	N.D.*
BH11IR-SUP11-1A-1P-3 (1 cm subsamples)					
LS 41	20.50	2.834	1.5000	5	3.3333
LS 42	21.50	2.844	2.0000	5	2.5000

LS 43	22.50	2.854	2.8000	5	1.7857
LS 44	23.5	2.864	2.2	36	16.363
LS 45	24.5	2.874	2	79	39.500
LS 46	25.5	2.884	0.9	57	63.333
LS 47	26.5	2.894	0.7	119	170.00
LS 48	27.5	2.904	1.3	256	196.92
LS 49	28.5	2.914	1.5	5634	3756.0
LS 50	29.5	2.924	2	66	33.000

\*N.D. = no data.

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TABLE DR2. ELECTRON MICROPROBE ANALYSIS (EMPA) RESULTS\*

<u>Pyne-O'Donnell et al. (2012)</u>												
UA 2149												
Arithmetic mean	75.65	0.23	13.50	1.57	-0.01	0.28	1.45	4.76	2.47	0.11	N.D. <sup>†</sup>	98.74
2SD	1.240	0.23	0.982	0.43	0.20	0.26	0.31	0.44	0.49	0.06	N.D. <sup>†</sup>	2.220
<u>Mount St Helens Wn reference, from Pyne-O'Donnell et al. (2012)</u>												
UA 2151												
Arithmetic mean	74.78	0.21	13.99	1.65	0.02	0.33	1.69	4.88	2.35	0.09	N.D. <sup>†</sup>	96.94
2SD	1.694	0.30	0.989	0.56	0.33	0.29	0.45	0.57	0.41	0.07	N.D. <sup>†</sup>	4.24
<u>White River Ash (eastern lobe) reference, from Pyne-O'Donnell et al. (2012)</u>												
UA 1119												
Arithmetic mean	73.79	0.21	14.47	1.62	0.06	0.35	1.88	4.11	3.18	0.34	N.D. <sup>†</sup>	97.38
2SD	0.837	0.07	0.449	0.37	0.05	0.08	0.30	0.21	0.27	0.08	N.D. <sup>†</sup>	3.26
<u>Newberry Pumice reference, from Pyne-O'Donnell et al. (2012)</u>												
UA 2158												
Arithmetic mean	73.54	0.23	14.25	1.99	0.07	0.15	0.86	4.85	3.94	0.13	N.D. <sup>†</sup>	98.37
2SD	0.950	0.12	0.615	0.13	0.05	0.06	0.11	1.07	0.47	0.07	N.D. <sup>†</sup>	1.72
<u>East Lake Tephra reference, from Pyne-O'Donnell et al. (2012)</u>												
UA 2157												
Arithmetic mean	73.72	0.21	13.97	1.72	0.06	0.21	0.97	4.86	4.14	0.13	N.D. <sup>†</sup>	97.53
2SD	1.39	0.25	1.03	0.68	0.37	0.35	0.29	0.39	0.93	0.06	N.D. <sup>†</sup>	3.7
<u>Kamchatka references, from Kyle et al. (2011)</u>												
Kizimen volcano												
Arithmetic mean	77.07	0.24	12.75	1.31	0.03	0.24	1.59	3.48	3.04	0.16	0.03	100
2SD	0.6	0.08	0.5	0.12	0.06	0.18	0.12	N.D. <sup>†</sup>	0.18	0.04	0.06	1.94
Karymsky volcano												
Arithmetic mean	74.69	0.39	13.47	1.86	0.04	0.36	1.49	4.33	3.01	0.22	0.05	100
2SD	0.56	0.06	0.32	0.2	0.06	0.18	0.16	N.D. <sup>†</sup>	0.18	0.2	0.06	1.98
Avachinsky volcano												
Arithmetic mean	75.08	0.19	14.54	1.6	0.08	0.43	2.78	3.69	1.35	0.09	0.05	100
2SD	0.7	0.04	0.34	0.14	0.08	0.04	0.2	N.D. <sup>†</sup>	0.12	0.08	0.04	1.78
Ksudach volcano												
Arithmetic mean	70.37	0.64	14.61	4.35	0.16	0.87	3.05	4.3	1.24	0.14	0.15	100
2SD	0.84	0.06	0.44	0.34	0.1	0.1	0.22	N.D. <sup>†</sup>	0.1	0.06	0.06	2.32
Kurile Lake caldera												
Arithmetic mean	76.39	0.23	13.15	1.52	0.06	0.27	1.52	4.52	2.09	0.14	0.03	100
2SD	1.46	0.08	0.86	0.18	0.08	0.18	0.26	N.D. <sup>†</sup>	0.26	0.04	0.04	3.44
<u>Southwestern Alaskan references, from Carson et al. (2002)</u>												
Horizon A												
Arithmetic mean	57.30	1.88	15.28	9.79	0.23	2.79	5.69	4.21	1.65	N.D. <sup>†</sup>	N.D. <sup>†</sup>	99.66
2SD	2.02	0.32	1.88	1.76	0.24	1.22	1.02	1.27	0.52	N.D. <sup>†</sup>	N.D. <sup>†</sup>	1.25
Horizon B												
Arithmetic mean	77.22	0.11	13.58	1.69	0.13	0.15	1.41	4.11	1.55	N.D. <sup>†</sup>	N.D. <sup>†</sup>	100.00
2SD	1.38	0.12	0.68	0.26	0.10	0.06	0.42	0.78	0.30	N.D. <sup>†</sup>	N.D. <sup>†</sup>	0.00
Funk/Fisher ash 1												
Arithmetic mean	68.80	0.55	15.32	4.21	0.24	0.60	2.24	4.86	2.43	N.D. <sup>†</sup>	N.D. <sup>†</sup>	99.25

2SD		1.36	0.14	0.74	0.48	0.22	0.14	0.28	0.80	0.26	N.D. <sup>†</sup>	N.D. <sup>†</sup>	0.88
Funk/Fisher ash 2													
Arithmetic mean		68.87	0.56	15.37	4.24	0.19	0.62	2.34	4.73	2.41	N.D. <sup>†</sup>	N.D. <sup>†</sup>	99.33
2SD		1.04	0.12	0.54	0.58	0.12	0.14	0.24	0.66	0.22	N.D. <sup>†</sup>	N.D. <sup>†</sup>	0.88
Funk/Fisher ash 3													
Arithmetic mean		52.88	1.62	16.32	11.20	0.23	4.07	8.84	3.21	0.87	N.D. <sup>†</sup>	N.D. <sup>†</sup>	99.24
2SD		1.27	0.24	0.92	1.6	0.16	1.44	0.86	0.60	0.24	N.D. <sup>†</sup>	N.D. <sup>†</sup>	0.86
Funk/Fisher ash 4													
Arithmetic mean		69.15	0.60	15.44	4.38	0.18	0.64	2.39	4.20	2.39	N.D. <sup>†</sup>	N.D. <sup>†</sup>	99.37
2SD		1.96	0.66	0.44	0.60	0.16	0.22	0.96	0.72	0.18	N.D. <sup>†</sup>	N.D. <sup>†</sup>	0.46
<u>ATHO-G standard</u>													
Arithmetic mean		75.47	0.257	12.36	3.188	0.107	0.092	1.680	4.038	2.751	0.036	0.018	99.74
2SD		0.398	0.034	0.226	0.246	0.090	0.025	0.150	0.242	0.104	0.028	0.024	1.95
<u>GOR132-G</u>													
Arithmetic mean		46.36	0.287	11.16	10.24	0.132	22.45	8.48	0.794	0.041	0.008	0.039	98.21
2SD		0.173	0.073	0.180	0.392	0.099	0.339	0.177	0.077	0.023	0.018	0.030	1.61
<u>StHs6/80-G standard</u>													
Arithmetic mean		63.84	0.703	17.85	4.39	0.066	1.968	5.297	4.384	1.329	0.009	0.165	99.24
2SD		0.776	0.079	0.282	0.250	0.099	0.096	0.113	0.843	0.087	0.021	0.037	2.38

*Microprobe operating conditions note:*

EMPA for the Lake Superior samples and the fused volcanic glass standards ATHO-G, GOR132-G, and StHs6/80-G was conducted at the University of Oxford Research Laboratory for Archaeology and the History of Art with a JEOL JX8600 electron microprobe, in wavelength dispersive mode, with 15-keV accelerating voltage, 6-nA beam current, and a 10-μm defocused beam. On-peak count times were as follows: 10 s for Na; 30 s for Si, Al, K, Ca, Fe, Mg, Ti, and Mn; and 60 s for P. We applied a suite of characterized minerals and oxide standards to calibrate the electron probe while accuracy and precision were monitored by intermittent analysis of fused volcanic glass standards ATHO-G, GOR132-G, and StHs6/80-G from the Max-Planck-Institut für Chemie-Dingwell (MPI-DING) collection (Jochum et al., 2005; Jochum et al., 2006).

Llao Rock tephra reference material analyses from Foit and Mehringer (2016) were conducted at the GeoAnalytical Laboratory located in the Geology Department (School of the Environment) at Washington State University, WA, USA, using Cameca Camebax and JOEL JXA 8500F electron microprobes. Both instruments were operated with a 8-μm beam diameter, 12 nA beam current, and 15kV accelerating voltage.

Tephra reference material analyses from Pyne-O'Donnell et al. (2012) were conducted at the Electron Microprobe Laboratory, University of Alberta using a JEOL 8900 electron microprobe with a 10-μm beam diameter, 6-nA beam current and 15-keV accelerating voltage. Where analyses of smaller shards required a 5-μm beam diameter, a Cameca SX100 was employed with a reduced beam current of 3-nA and measurement of SiO<sub>2</sub> by energy-dispersive spectrometry.

Kamchatka tephra reference material analyses from Kyle et al. (2011) were conducted at New Mexico Tech, Socorro, NM, USA, using a Cameca SX-100 electron microprobe with a 10 nA beam current and 15-kV accelerating voltage. Peak counts were 20 seconds for all elements, except Na, Cl, S, and F which were counted for 40, 40, 60, and 100 seconds, respectively. Depending on the glass shard sizes, a 5, 10, 15, 20, or 25 μm-diameter beam was used.

Aleutian tephra reference material analyses from Carson et al. (2002) were conducted at the University of Wisconsin-Madison, WI, USA, using a Cameca SX-51 electron microprobe with a 7-10-μm beam diameter, 6 nA Faraday beam current, and 15-keV accelerating voltage. Each analysis represents a single tephra grain.

*References in the "Microprobe operating conditions note" only.*

Jochum, K.P., Nohl, U., Herwig, K., Lammel, E., Stoll, B., and Hofmann, A.W., 2005, GeoReM: A new geochemical database for reference materials and isotopic standards: Geostandards and Geoanalytical Research, v. 29, p. 333–338, doi:<https://doi.org/10.1111/j.1751-908X.2005.tb00904.x>.

Jochum, K.P., et al., 2006, MPI-DING reference glasses for in situ microanalysis: New reference values for element concentrations and isotope ratios: Geochemistry Geophysics Geosystems, v. 7, Q02008, doi:<https://doi.org/10.1029/2005GC001060>.

\*Glass shard data normalized to water-free compositions (100 wt %) and displayed alongside original analytical totals.

† N.D. = no data.