

1 **Appendix A**

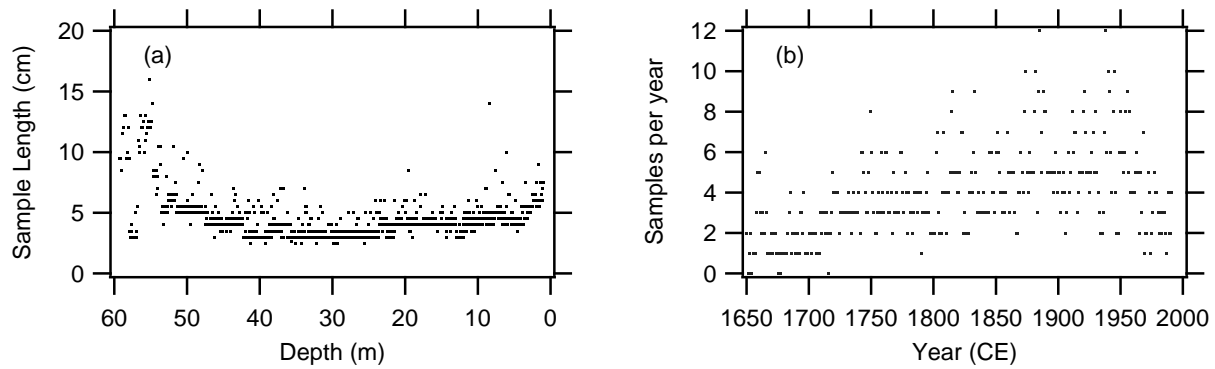
2 **Supplementary Material**

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4 **Atmospheric Depositions of Natural and Anthropogenic Trace Elements on the Guliya Ice**
5 **Cap (Northwestern Tibetan Plateau) during the last 340 years**

6 M. Roxana Sierra-Hernández^{a*}, Paolo Gabrielli^{a,b}, Emilie Beaudon^a, Anna Wegner^a, and Lonnie
7 G. Thompson^{a,b}

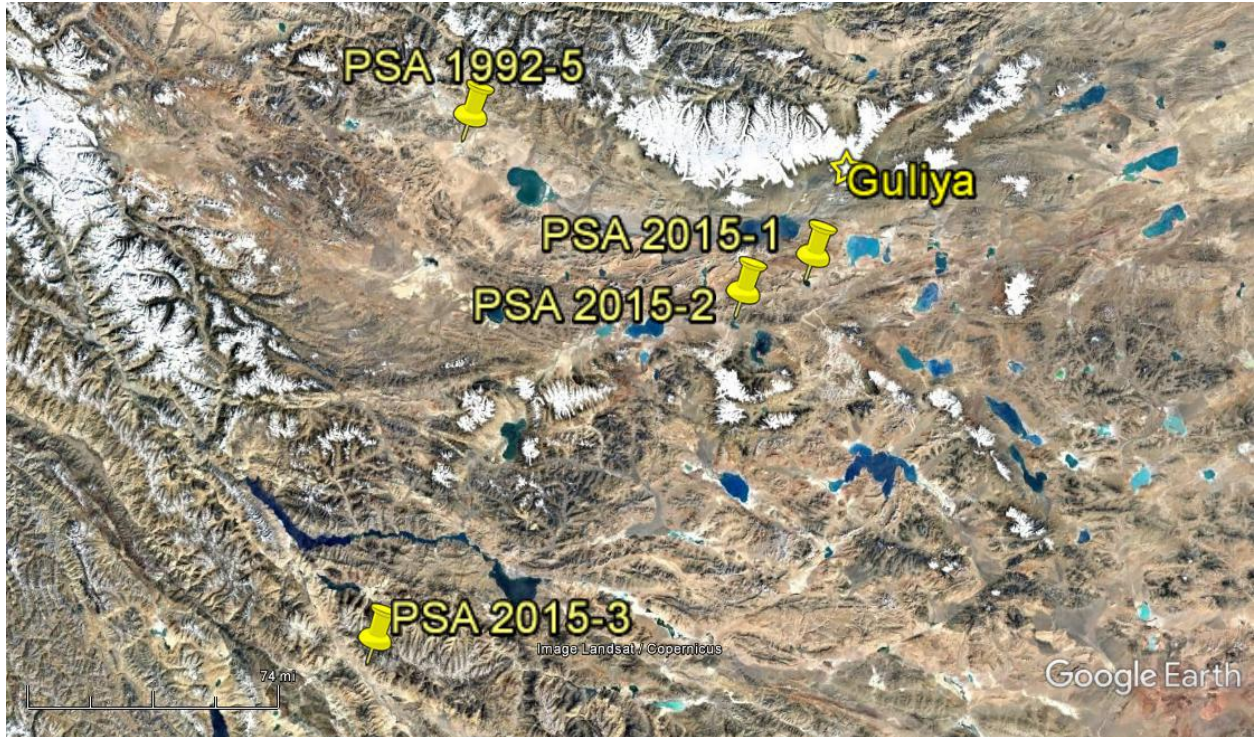
8 ^a Byrd Polar and Climate Research Center, The Ohio State University, Columbus, OH, 43210

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13 **Figure A1.** (a) Spatial resolution used for sampling the Guliya ice core, and (b) temporal
14 resolution obtained for each sample.

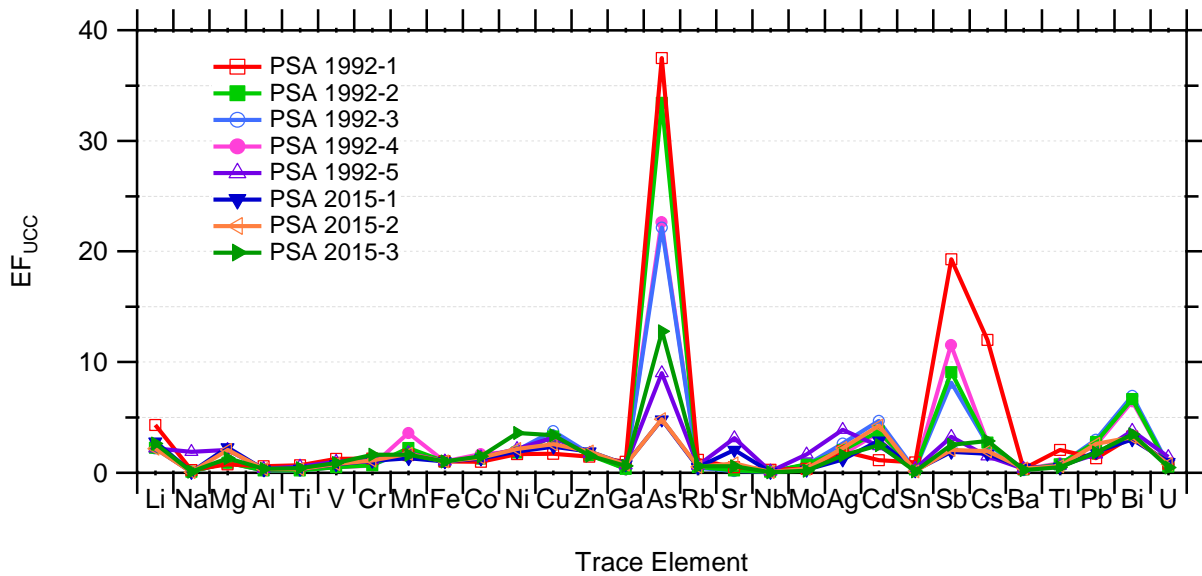
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20 **Figure A2.** Guliya Potential Source Area (PSA) locations. PSAs 1992-1 to 4 collected in close
 21 proximity to the Guliya ice cap are not shown in this map. PSA 1992-5 position is approximate.

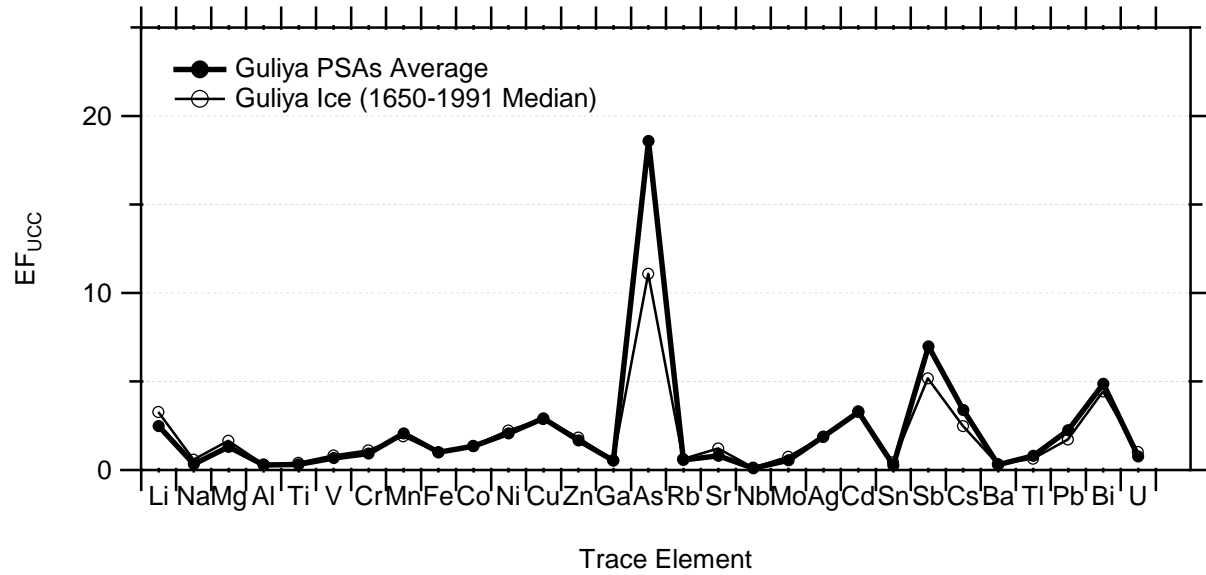
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24 **Figure A3.** Enrichment factors (EF) for the eight Guliya PSA samples using the upper
 25 continental crust (UCC) as a reference.

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28 **Figure A4.** Comparison of EF_{UCC} of the Guliya PSAs average with the median EFs of the Guliya
 29 ice core record (1650-1991).

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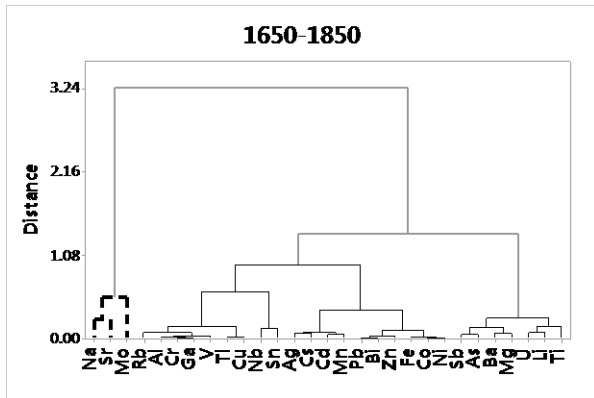
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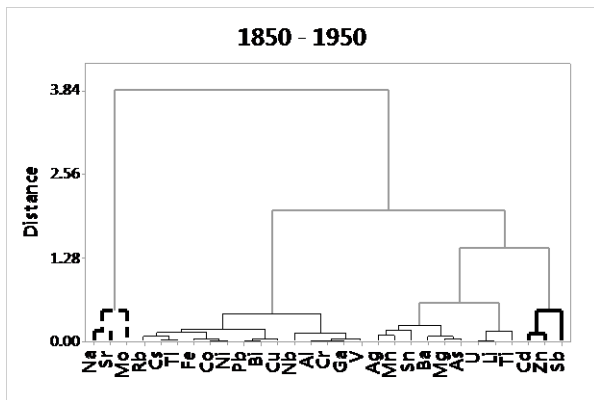
46 **Table A1.** Loadings of each TE and communality of the first 3 factors of each TE for the entire
 47 data set (1650-1991)

TE	Factor 1	Factor 2	Factor 3	Communality
Ag	0.84	-0.31	-0.27	0.88
Al	0.95	-0.24	-0.17	0.99
As	0.82	-0.45	-0.25	0.93
Ba	0.86	-0.43	-0.20	0.96
Bi	0.91	-0.25	-0.29	0.97
Cd	0.79	-0.30	-0.49	0.95
Co	0.93	-0.23	-0.25	0.98
Cr	0.95	-0.23	-0.15	0.98
Cs	0.90	-0.28	-0.26	0.96
Cu	0.91	-0.28	-0.26	0.98
Fe	0.94	-0.22	-0.23	0.99
Ga	0.96	-0.23	-0.15	0.99
Li	0.74	-0.57	-0.25	0.94
Mg	0.83	-0.45	-0.25	0.95
Mn	0.87	-0.36	-0.28	0.96
Mo	0.50	-0.81	-0.08	0.91
Na	0.04	-0.95	-0.07	0.91
Nb	0.93	-0.29	-0.03	0.95
Ni	0.93	-0.23	-0.25	0.98
Pb	0.90	-0.26	-0.30	0.97
Rb	0.93	-0.31	-0.16	0.98
Sb	0.62	-0.42	-0.60	0.93
Sn	0.85	-0.39	-0.01	0.87
Sr	0.22	-0.93	-0.15	0.93
Ti	0.82	-0.53	-0.13	0.96
Tl	0.93	-0.27	-0.21	0.98
U	0.75	-0.58	-0.19	0.94
V	0.95	-0.25	-0.13	0.99
Zn	0.85	-0.21	-0.44	0.96
Variance (%)	70	19	7	
Cum. Variance (%)	70	89	96	

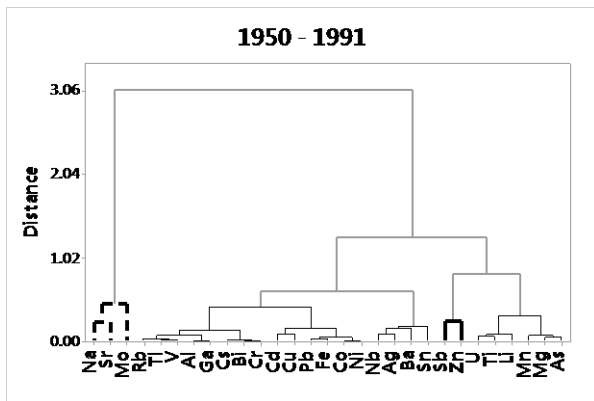
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56 **Figure A5.** Cluster analysis extracted from the first three factors during the 1650-1850 and post-
 57 1850 sub periods. Dotted line indicates the evaporitic cluster (Na-Sr-Mo) and the thick black line
 58 indicates the anthropogenic clusters.

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64 **Table A2.** Statistical summary of TE concentrations for the pre-1850 and post-1850 periods. IF indicates the medians increase factor
 65 with respect to the pre-1850 period.

TE	Minimum			Maximum			Average			Median			IF rel to pre-1850	
	pre-1850	1850-1950	1950-1991	pre-1850	1850-1950	1950-1991	pre-1850	1850-1950	1950-1991	pre-1850	1850-1950	1950-1991	1850-1950	1950-1991
Ag (pg/g)	0.2	0.3	0.3	19.0	29.6	21.6	2.5	2.8	2.7	1.7	1.8	1.7	1.1	1.0
Al (µg/g)	0.03	0.03	0.06	6.3	5.8	5.5	0.7	0.7	0.7	0.4	0.4	0.4	0.9	0.9
As (ng/g)	0.04	0.07	0.06	6.5	6.7	4.8	0.6	0.6	0.6	0.4	0.4	0.4	1.0	1.0
Ba (ng/g)	0.4	0.6	0.5	57.8	57.3	41.2	6.4	6.1	5.8	4.2	4.1	3.3	1.0	0.8
Bi (pg/g)	0.8	1.1	1.4	149.8	4887.9	174.5	15.1	25.7	16.3	9.3	9.8	8.7	1.1	0.9
Cd (pg/g)	0.9	1.0	0.9	128.2	91.2	65.7	9.1	10.5	9.6	5.6	6.8	5.8	1.2	1.0
Co (pg/g)	26	24	37	5062	4421	3908	463	456	461	262	270	248	1.0	0.9
Cr (ng/g)	0.1	0.1	0.1	11.5	10.1	8.8	1.2	1.1	1.1	0.7	0.7	0.6	0.9	0.8
Cs (pg/g)	19	24	41	8114	3513	2919	438	421	394	256	256	224	1.0	0.9
Cu (ng/g)	0.1	0.2	0.1	11.2	9.3	8.1	1.1	1.1	1.1	0.7	0.7	0.7	1.0	1.0
Fe (µg/g)	0.04	0.03	0.06	10.8	9.5	8.1	0.9	0.9	0.9	0.5	0.5	0.5	1.0	0.9
Ga (pg/g)	10	10	21	2285	2016	1789	229	212	228	144	129	123	0.9	0.9
Li (ng/g)	0.1	0.2	0.2	18.3	16.1	13.0	2.0	2.1	1.9	1.4	1.5	1.3	1.1	0.9
Mg (µg/g)	0.04	0.06	0.05	6.33	5.36	5.28	0.66	0.65	0.66	0.42	0.42	0.37	1.0	0.9
Mn (ng/g)	2	2	2	312	302	266	30	30	30	17	18	17	1.1	1.0
Mo (pg/g)	2.5	3.4	3.5	200.0	112.7	106.1	26.0	25.7	23.3	21.7	21.7	20.1	1.0	0.9
Na (µg/g)	0.02	0.02	0.04	1.9	3.2	1.1	0.4	0.4	0.3	0.3	0.3	0.3	1.0	0.8
Nb (pg/g)	3.4	3.1	8.9	969.2	447.0	543.2	82.4	67.7	77.3	60.0	49.1	50.3	0.8	0.8
Ni (ng/g)	0.1	0.1	0.1	13.4	11.6	9.8	1.2	1.2	1.2	0.7	0.7	0.6	1.0	0.9
Pb (ng/g)	0.04	0.06	0.08	8.44	8.27	6.37	0.84	0.89	0.86	0.49	0.53	0.50	1.1	1.0
Rb (ng/g)	0.1	0.1	0.2	16.8	15.5	13.1	1.9	1.8	1.8	1.2	1.1	1.0	0.9	0.8
Sb (pg/g)	2.0	4.0	3.7	332.4	412.0	273.8	41.1	54.2	53.4	28.3	37.7	36.2	1.3	1.3
Sn (pg/g)	3.5	4.3	5.0	297.3	119.7	174.3	25.8	22.1	27.2	20.4	18.1	19.5	0.9	1.0
Sr (ng/g)	0.5	0.5	0.6	133.8	105.9	35.6	12.3	13.2	9.7	9.1	9.5	7.5	1.0	0.8
Ti (ng/g)	2	3	3	297	250	257	37	33	35	25	23	22	0.9	0.9
Tl (pg/g)	0.9	0.9	1.2	126.0	108.7	102.4	13.9	13.8	13.1	8.4	8.1	7.1	1.0	0.9
U pg/g)	3.5	5.2	6.4	979.0	574.1	470.9	79.7	74.0	73.4	52.5	50.1	46.3	1.0	0.9
V (ng/g)	0.1	0.1	0.1	12.9	11.2	10.0	1.3	1.2	1.3	0.8	0.7	0.7	0.9	0.9
Zn (ng/g)	0.2	0.2	0.3	31.7	29.4	22.8	2.7	3.0	2.9	1.6	1.9	1.8	1.2	1.2

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67 **Table A3.** Statistical summary of TE Enrichment Factors (EF) for the pre-1850 and post-1850 periods. IF indicates the medians
68 increase factor with respect to the pre-1850 period. EF median values in bold indicate 95% significance relative to the pre-1850
69 (Mann-Whitney test for medians)

TE	Minimum			Maximum			Average			Median			IF rel to pre-1850	
	pre-1850	1850-1950	1950-1991	pre-1850	1850-1950	1950-1991	pre-1850	1850-1950	1950-1991	pre-1850	1850-1950	1950-1991	1850-1950	1950-1991
Ag EF	0.2	0.2	0.3	5.5	9.9	8.7	0.9	1.0	1.0	0.8	0.9	0.9	1.1	1.1
Al EF	0.8	0.8	0.8	2.1	1.9	1.9	1.2	1.2	1.2	1.1	1.1	1.1	1.0	1.0
As EF	0.3	0.2	0.3	2.9	3.6	1.9	0.6	0.7	0.7	0.6	0.6	0.6	1.0	1.0
Ba EF	0.6	0.2	0.3	5.0	8.3	2.6	1.2	1.3	1.1	1.1	1.2	1.1	1.0	1.0
Bi EF	0.5	0.1	0.2	2.1	26.9	4.4	0.9	1.1	0.9	0.9	1.0	0.9	1.1	1.0
Cd EF	0.6	0.3	0.5	8.0	15.9	5.6	1.2	1.6	1.4	1.0	1.3	1.2	1.2	1.2
Co EF	0.7	0.8	0.8	1.4	1.8	1.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cr EF	0.8	0.8	0.8	6.3	4.3	4.0	1.3	1.2	1.3	1.2	1.2	1.2	1.0	1.0
Cs EF	0.4	0.1	0.2	9.7	6.6	1.2	0.8	0.8	0.7	0.7	0.8	0.7	1.1	0.9
Cu EF	0.6	0.6	0.6	3.2	4.6	2.6	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0
Ga EF	0.7	0.7	0.8	1.9	1.7	1.6	1.1	1.1	1.1	1.1	1.0	1.1	1.0	1.0
Li EF	0.7	0.4	0.5	9.8	18.5	5.8	1.5	1.8	1.5	1.3	1.4	1.3	1.1	1.0
Mg EF	0.8	0.9	0.9	12.0	9.1	3.4	1.4	1.6	1.4	1.3	1.3	1.2	1.0	1.0
Mn EF	0.5	0.6	0.6	3.4	4.6	3.4	0.9	1.1	1.0	0.9	1.0	0.9	1.1	1.0
Mo EF	0.3	0.3	0.3	25.1	22.9	7.4	1.9	2.3	1.8	1.4	1.4	1.6	1.0	1.1
Na EF	0.2	0.2	0.2	103.3	72.9	16.2	3.4	4.2	2.8	1.8	1.9	1.6	1.1	0.9
Nb EF	0.5	0.3	0.4	6.7	7.8	2.7	1.5	1.3	1.4	1.4	1.3	1.4	0.9	1.0
Ni EF	0.8	0.9	0.9	1.5	2.0	1.4	1.1	1.1	1.1	1.1	1.1	1.1	1.0	1.0
Pb EF	0.5	0.1	0.3	4.4	6.6	1.8	0.8	0.9	0.8	0.7	0.8	0.8	1.1	1.1
Rb EF	0.6	0.2	0.3	3.0	8.0	1.7	1.1	1.2	1.1	1.1	1.1	1.0	1.0	1.0
Sb EF	0.3	0.3	0.4	11.8	40.6	13.4	0.8	1.5	1.2	0.7	0.8	0.9	1.2	1.3
Sn EF	0.4	0.3	0.6	16.2	16.5	10.4	2.0	1.9	2.3	1.8	1.7	2.1	0.9	1.2
Sr EF	0.3	0.2	0.3	27.7	63.8	13.5	2.7	3.8	2.3	1.4	1.8	1.2	1.2	0.8
Ti EF	0.7	0.7	0.8	7.6	14.5	4.0	1.5	1.6	1.4	1.3	1.3	1.3	1.0	1.0
Tl EF	0.5	0.1	0.2	1.5	6.0	1.2	0.8	0.9	0.8	0.8	0.8	0.8	1.0	1.0
U EF	0.6	0.2	0.4	9.8	17.0	5.1	1.7	1.8	1.6	1.4	1.3	1.3	1.0	1.0
V EF	0.8	0.8	0.8	2.2	1.9	1.9	1.3	1.2	1.3	1.3	1.2	1.2	0.9	1.0
Zn EF	0.8	0.8	0.9	6.9	23.0	6.1	1.1	1.5	1.3	1.1	1.2	1.1	1.1	1.0

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72 **Table A4.** Statistical summary of TE Excess Concentrations for the pre-1850 and post-1850 periods. Values in bold indicate 95%
 73 significance (Mann-Whitney test for medians) with respect to the pre-1850 period. Negative values are reported as < 0

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TE Excess	Minimum			Maximum			Average			Median			
	pre-1850	1850-1950	1950-1991	pre-1850	1850-1950	1950-1991	pre-1850	1850-1950	1950-1991	pre-1850	1850-1950	1950-1991	(1975-1991)
Ag (pg/g)	<0	<0	<0	5	27	5	<0	<0	<0	0.0	0.1	0.05	(0.2)
Bi (pg/g)	<0	<0	<0	24	4722	138	<0	9.6	<0	<0	0.3	<0	(0.3)
Cd (pg/g)	<0	<0	<0	102	53	10	<0	0.7	<0	<0	0.6	0.3	(1)
Co (pg/g)	<0	<0	<0	557	389	122	<0	10.1	<0	2.5	9.5	2.5	(1)
Cu (pg/g)	<0	<0	<0	1214	578	475	<0	<0	<0	<0	<0	<0	(26)
Ga (pg/g)	<0	<0	<0	647	106	126	<0	<0	<0	<0	<0	<0	(1.7)
Nb (pg/g)	<0	<0	<0	483	113	83	<0	<0	<0	<0	<0	<0	(1)
Ni (pg/g)	<0	<0	<0	422	535	322	<0	<0	<0	<0	15.3	<0	(<0)
Pb (pg/g)	<0	<0	<0	4199	2704	564	<0	50	<0	<0	29.9	22	(62)
Sb (pg/g)	<0	<0	<0	86	297	180	<0	6.0	3.0	<0	1.6	4	(4)
Sn (pg/g)	<0	<0	<0	126	31	39	<0	<0	<0	<0	<0	0.2	(4)
V (pg/g)	<0	<0	<0	3179	1212	836	<0	<0	<0	<0	<0	<0	(14.1)
Zn (pg/g)	<0	<0	<0	2042	7741	5460	<0	364	<0	4.8	153.0	35	(19)

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