

Supporting Information

A 125-year record of climate and chemistry variability at the Pine Island Glacier ice divide, Antarctica

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Summary

There are 4 pages in this Supporting Information, including 3 tables, 1 figure, and references.

Table S1 – Instrumental conditions and measurement parameters for the CCI Thermo Electron Element2 ICP-SFMS instrument.

Forward power	1280 W
Coolant gas	~16 l min ⁻¹
Auxiliary gas	~0.85 l min ⁻¹
Sample gas	~0.8 l min ⁻¹
Sample cone	Ni; 1.1 mm
Skimmer cone	Ni; 0.8 mm
Sample inlet	ESI ApexQ
Nebulizer	ESI PFA-ST
Resolution (m/Δm)	Low: 400; medium: 4.000 and high: 10.000
Sample uptake rate	100 μL min ⁻¹
Sensitivity	800,000 cps (counts per second) for 100 ng l ⁻¹ ¹¹⁵ In
Total measurement time per sample	2min20s

Table S2 – Average instrument and procedural blanks, and procedural detection limits (DL) compared to studies analyzed in the same ICP-SFMS and similar instruments.

Elements	This work ^a		Dixon, 2013 ^b		Osterberger <i>et al.</i> , 2006 ^c		Krachler <i>et al.</i> , 2005 ^d		Barbante <i>et al.</i> , 1999 ^e	
	Blanks	DL	Blanks	DL	Blanks	DL	Blanks	DL	Blanks	DL
Al (ng/g)	0.31±0.11	0.33	0.21	0.14	0.070	0.040	0.2	0.093	-	-
Ba (pg/g)	0.49±0.13	0.38	0.35	0.63	< LD	0.33	3.14	0.38	5.9	1.8
Ca (ng/g)	0.18±0.03	0.09	0.095	0.034	< LD	0.110	-	-	-	-
Fe (ng/g)	0.03±0.02	0.05	0.12	0.077	< LD	0.010	0.008	0.0018	0.06	0.033
K (ng/g)	0.05±0.02	0.06	0.26	0.038	-	-	-	-	-	-
Mg (ng/g)	0.79±0.13	0.38	0.42	0.24	-	-	-	-	-	-
Mn (pg/g)	0.72±0.31	0.94	0.45	1.25	< LD	1	0.8	0.28	5.2	1.8
Na (ng/g)	0.25±0.07	0.21	0.38	0.30	-	-	-	-	-	-
S (ng/g)	0.36±0.02	0.06	1.13	0.27	< LD	0.29	-	-	-	-
Sr (pg/g)	0.73±0.25	0.74	0.23	0.23	0.2	0.3	8.11	0.65	-	-
Ti (pg/g)	0.57±0.22	0.66	3.81	2.65	< LD	0.7	-	-	-	-

^a Error corresponds to 1 σ . LD calculated by 3 σ of 10 DI water samples (ICP-SFMS. Element 2/UMaine); ^b LD calculated by 3 σ of 8 DI water samples (ICP-SFMS. Element 2/UMaine); ^c LD calculated by 3 σ of 10 DI water samples (ICP-SFMS. Element 2/UMaine); ^d LD calculated by 3 σ of 15 DI water samples (ICP-SFMS. Finnigan MAT/Bremen. Germany), and ^e LD calculated by 3 σ of 5 DI water samples (ICP-SFMS. Finnigan MAT/Bremen. Germany).

Table S3 – Mean measured concentration and mean calculated contributions from dust, sea-salt, volcanoes, and biogenic activities in MJ ice core, expressed both in concentrations and percentages.

	Mean measured concentration	Mean dust contribution ^a		Mean sea-salt contribution ^a		Mean volcanic contribution ^a		Mean biogenic contribution ^a	
		Conc.	%	Conc.	%	Conc.	%	Conc.	%
		Al (ng/g)	2.64	2.64	100	-	-	< 0.01	< 1
Ba (pg/g)	9.31	9.31	> 100	-	-	-	-	-	-
Ca (ng/g)	3.01	1.00	30	0.83	25	< 0.01	< 1	-	-
Fe (ng/g)	0.62	0.62	> 100	-	-	< 0.01	< 1	-	-
K (ng/g)	1.78	0.98	51	0.80	42	< 0.01	< 1	-	-
Mg (ng/g)	9.27	0.46	5	2.60	30	-	-	-	-
Mn (pg/g)	28.10	18.00	64	0.0004	< 1	3.84	14	-	-
Na (ng/g)	21.91	0.88	4	21.91	100	< 0.01	< 1	-	-
S (ng/g)	10.24	0.03	< 1	1.82	18	1.49	15	5.93	58
Sr (pg/g)	23.21	10.79	44	15.92	66	-	-	-	-
Ti (pg/g)	14.15	14.15	> 100	0.002	< 1	< 0.01	< 1	-	-

^aIt should be emphasized that the contributions should be considered as rather tentative, especially for volcanic contribution. This is for instance obvious for the sum of the four different natural contributions does not give 100%; sometimes we get less than 100% and sometimes much more than 100%.

Fractionation of sea-salt occurs when a component or components, of sea water splits away from the main body of sea water, leaving behind a deficit of that species (Hall and Wolff, 1998). It can be recognized by obtaining negative non-sea-salt (nss) sulfur concentrations. The Mount Johns record shows a deficit of nss sulfur during the winter months in a few years. To assess the extent of depletion, a downward correction of k is obtained by simple linear regression of nss sulfur vs sodium (Wagenbach et al., 1998). This correction is then added to the conventional value of k (i.e., 0.0837 in this study, we are used the main concentrations of the ocean water as reference values (Lide, 2005)). For the MJ record shown in Figure S1 the slope is -0.0068, and the k corrected becomes 0.0769 (instead of 0.0837).

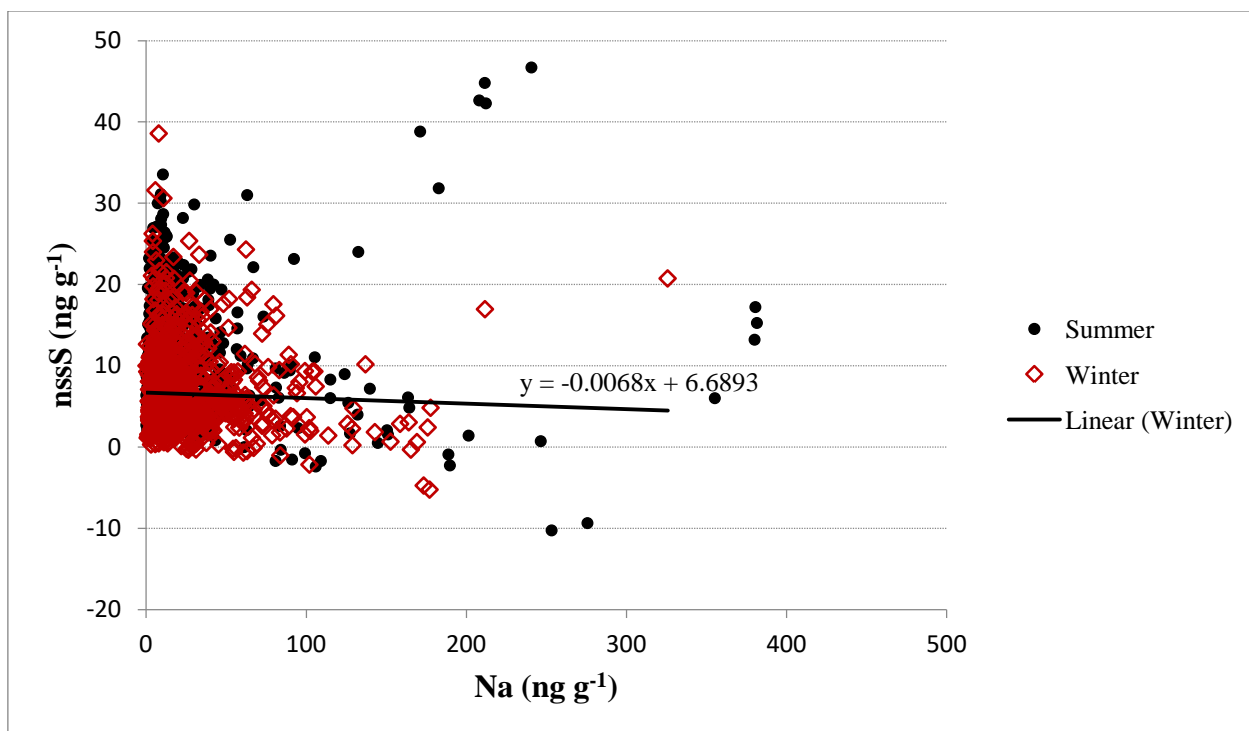


Figure S1: Scatter plot for non-sea-salt sulfur (calculate using sodium) vs sodium for the complete Mount Johns trace elements record (winter values shown as open squares and summer points as filled circles). The regression line is calculated using the winter values only, $y = -0.0068x + 6.6893$.

References

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