



Supplement of

Concentration and size distribution of black carbon over the ablation area of Potanin glacier: enrichment ability of surface weathering granular ice of water-insoluble particles with snow/ice melting

Sayako Ueda et al.

Correspondence to: Sayako Ueda (ueda.sayako.u2@f.mail.nagoya-u.ac.jp)

The copyright of individual parts of the supplement might differ from the article licence.

Table S1: BC, mineral dust, and OM mass concentrations of an ice core sample collected at st2c on 31 August 2022

Top	Bottom	BC	Dust	OM	Top	Bottom	BC	Dust	OM
[m depth]	[m depth]	[ng g ⁻¹]	[mg g ⁻¹]	[mg g ⁻¹]	[m depth]	[m depth]	[ng g ⁻¹]	[mg g ⁻¹]	[mg g ⁻¹]
0	0.1	-	-	0.021	2.15	2.29	-	0.002	0.007
0.1	0.15	4.3	0.000	0.060	2.29	2.43	7.4	0.000	0.000
0.15	0.205	127.2	4.375	0.217	2.43	2.54	-	0.001	0.000
0.205	0.305	4.3	0.004	0.000	2.54	2.65	-	0.000	0.000
0.305	0.395	-	0.000	0.010	2.65	2.76	4.7	0.000	0.000
0.395	0.495	3.4	0.001	0.000	2.76	2.86	16.4	0.000	0.000
0.495	0.595	-	0.001	0.009	2.86	2.97	7.2	0.050	0.009
0.595	0.695	-	0.000	0.014	2.97	3.05	2.7	0.005	0.000
0.695	0.795	-	0.001	0.000	3.05	3.145	3.4	0.002	0.000
0.795	0.895	-	0.003	0.000	3.145	3.225	5.7	0.002	0.000
0.895	0.98	5.6	0.000	0.000	3.225	3.335	1.5	0.007	0.011
0.98	1.09	-	0.001	0.000	3.335	3.445	2.8	0.000	0.000
1.09	1.2	-	0.002	0.000	3.445	3.545	-	-	-
1.2	1.32	-	0.040	0.009	3.545	3.635	-	-	-
1.32	1.42	-	0.007	0.010	3.635	3.725	-	-	-
1.42	1.51	-	0.019	0.014	3.725	3.86	5.2	0.002	0.000
1.51	1.605	-	0.000	0.000	3.86	4	-	0.000	0.009
1.605	1.705	-	0.000	0.000	4	4.105	-	0.003	0.000
1.705	1.825	-	0.000	0.009	4.105	4.215	-	0.000	0.000
1.825	1.97	-	0.062	0.009					
1.97	2.07	-	0.163	0.013					
2.07	2.15	-	0.013	0.011					

Table S2: BC, mineral dust, and OM mass concentrations of an ice core sample collected at st3c on 1 September 2022

Top	Bottom	BC	Dust	OM	Top	Bottom	BC	Dust	OM
[m depth]	[m depth]	[ng g ⁻¹]	[mg g ⁻¹]	[mg g ⁻¹]	[m depth]	[m depth]	[ng g ⁻¹]	[mg g ⁻¹]	[mg g ⁻¹]
0	0.13	17.3	0.150	2.395	2.17	2.27	2.6	0.000	0.000
0.13	0.23	1.3	0.000	0.000	2.27	2.37	-	0.000	0.000
0.23	0.33	-	0.000	0.000	2.37	2.47	5.1	0.000	0.001
0.33	0.43	-	0.000	0.000	2.47	2.57	12.3	0.012	0.000
0.43	0.53	1.5	0.000	0.000	2.57	2.68	-	0.011	0.000
0.53	0.63	-	0.000	0.000	2.68	2.76	3.3	0.000	0.000
0.63	0.73	-	0.010	0.000	2.76	2.86	4.3	0.000	0.002
0.73	0.83	0.1	0.000	0.003	2.86	2.975	-	0.000	0.000
0.83	0.95	3.2	0.000	0.002	2.17	2.27	2.6	0.000	0.000
0.95	1.03	-	0.000	0.001	2.27	2.37	-	0.000	0.000
1.03	1.11	4.2	0.000	0.001	2.37	2.47	5.1	0.000	0.001
1.11	1.31	-	0.000	0.001	2.47	2.57	12.3	0.012	0.000
1.31	1.41	3.7	0.012	0.000	2.57	2.68	-	0.011	0.000
1.41	1.51	3.7	0.000	0.002	2.68	2.76	3.3	0.000	0.000
1.51	1.61	2.4	0.000	0.002	2.76	2.86	4.3	0.000	0.002
1.61	1.7	3.6	0.012	0.000	2.86	2.975	-	0.000	0.000
1.7	1.79	-	0.000	0.003					
1.79	1.89	-	0.000	0.000					
1.89	1.99	-	0.000	0.000					
1.99	2.09	3.3	0.000	0.002					
2.09	2.17	1.8	0.000	0.000					

Table S3-1: Sample information and BC mass concentrations of snow, ice, and precipitation samples in summer 2023

Sample ID	Sampling date	Site	Type and sampling details		BC [ng g ⁻¹]
BC23#02	2023/6/30	st2c	surface water		4.0
BC23#03	2023/7/1	st5r	surface snow		5.9
BC23#04	2023/7/1	Base camp	snow	7/1 16:00–20:00	3.2
BC23#05	2023/7/2	Base camp	snow	7/1 20:00 – 7/2 5:00	2.2
BC23#06	2023/7/3	st2c	surface snow	0–2 cm 225 cm ²	6.9
BC23#07	2023/7/3	st2c	granular ice	2–4 cm 225 cm ²	32.2
BC23#08	2023/7/3	st2c	surface snow	0–3 cm 225 cm ²	8.8
BC23#09	2023/7/3	st2c	granular ice	3–5 cm 225 cm ²	18.1
BC23#10	2023/7/3	st2c	surface snow	0–2 cm 400 cm ²	22.7
BC23#11	2023/7/3	st2c	granular ice	2–4 cm 400 cm ²	29.7
BC23#12	2023/7/8	ACC	melt forms	0–10.5 cm	5.4
BC23#13	2023/7/8	ACC	rounded grains	10.5–17.0 cm	10.2
BC23#14	2023/7/8	ACC	water-bearing layer & melt forms	17.0–20.0 cm	3.7
BC23#15	2023/7/8	ACC	ice layer & melt forms	20–24 cm	84.0
BC23#16	2023/7/10	Base camp	rain	7/9/19:40–7/10 7:00	6.1
BC23#17	2023/7/12	st5r	surface water		2.7
BC23#18	2023/7/12	st4c	surface water		7.1
BC23#19	2023/7/14	st2c	surface water		8.4
BC23#20	2023/8/5	st2c	surface water		1.8

Table S3-2: Sample information and BC mass concentrations of snow, ice, and precipitation samples in summer 2023

Sample ID	Sampling date	Site	Type and sampling details		BC [ng g ⁻¹]
BC23#21	2023/8/5	st2c	surface water		6.4
BC23#22	2023/8/7	Base camp	rain	8/7 7:15–16:30	3.1
BC23#23	2023/8/8	st5r	surface water		10.9
BC23#24	2023/8/8	st4c	surface water		3.2
BC23#25	2023/8/8	st5r	surface ice	84 cm ² , 36 g	555.1
BC23#26	2023/8/8	st4c	surface ice	110 cm ² , 55.5 g	159.1
BC23#27	2023/8/9	st3c	surface water		7.2
BC23#28	2023/8/11	Base camp	rain	8/11 8:40–10:00	1.8
BC23#29	2023/8/12	st2c	surface water		4.0
BC23#30	2023/8/12	st2c	surface ice	100 cm ² , 62.2 g	42.0

Table S4-1: Sample information and BC mass concentrations of snow, ice, and precipitation samples in summer 2024

Sample ID	Sampling date	Site	Type		Surface granular ice thickness [cm]	BC _g ⁻¹ [ng g ⁻¹]
BC24#01	2024/7/22	st2c	surface ice	dark	1	38.5
BC24#02	2024/7/22	st2c	surface ice	dark	1.5	16.5
BC24#03	2024/7/22	st2c	surface ice	dark	1.45	96.4
BC24#04	2024/7/22	st2c	surface ice	white	2.25	16.4
BC24#05	2024/7/22	st2c	surface ice	white	2.125	10.3
BC24#06	2024/7/22	st2c	surface ice	white	1.25	8.4
BC24#08	2024/7/22	st2c	surface ice for experiment	meltwater		15.4
BC24#09	2024/7/22	st2c		residual snow		4.5
BC24#10	2024/7/24	st2c	surface ice		2	47.5
BC24#11	2024/7/24	st2c	surface ice		1.175	179.6
BC24#12	2024/7/24	st2c	surface ice		3.375	92.9
BC24#13	2024/7/24	st2c	surface ice		1.75	44.5
BC24#14	2024/7/26	st5r	surface ice	dark	2.5	600.7
BC24#15	2024/7/26	st5r	surface ice	dark	1.875	269.7
BC24#16	2024/7/26	st5r	surface ice	dark	1.25	184.2
BC24#17	2024/7/26	st5r	surface ice	dark	2.25	134.0
BC24#18	2024/7/26	st5r	surface ice	dark	4.5	255.5
BC24#19	2024/7/26	st5r	surface ice	white	7.5	17.1
BC24#20	2024/7/26	st5r	surface ice	white	2.75	41.3
BC24#21	2024/7/26	st5r	surface ice	white	2	379.1
BC24#22	2024/7/26	st5r	surface ice	white	2.5	56.9
BC24#23	2024/7/26	st5r	surface ice	white	2	71.3
BC24#24	2024/7/27	st4c	surface ice	dark	0.75	38.5

Table S4-2: Sample information and BC mass concentrations of snow, ice, and precipitation samples in summer 2024

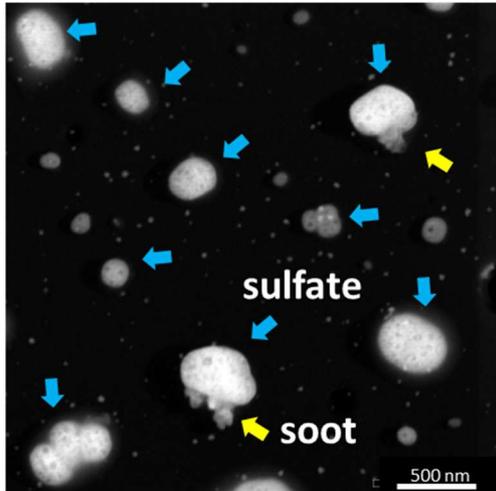
Sample ID	Sampling date	Site	Type and sampling details		Surface granular ice thickness [cm]	BC ₁ [ng g ⁻¹]
BC24#25	2024/7/27	st4c	surface ice	dark	0.75	115.5
BC24#26	2024/7/27	st4c	surface ice	dark	5	37.9
BC24#27	2024/7/27	st4c	surface ice	dark	3.625	56.6
BC24#28	2024/7/27	st4c	surface ice	dark	2.25	31.2
BC24#29	2024/7/27	st4c	surface ice	white	2.875	16.7
BC24#30	2024/7/27	st4c	surface ice	white	3.375	45.5
BC24#31	2024/7/27	st4c	surface ice	white	1.75	28.9
BC24#32	2024/7/27	st4c	surface ice	white	1.75	40.9
BC24#33	2024/7/27	st4c	surface ice	white	1.375	39.3
BC24#34	2024/7/30	st3c	surface ice	dark	3.75	46.8
BC24#35	2024/7/30	st3c	surface ice	dark	2.75	24.7
BC24#37	2024/7/30	st3c	surface ice	dark	2.75	124.2
BC24#38	2024/7/30	st3c	surface ice	dark	1.625	31.2
BC24#39	2024/7/30	st3c	surface ice	white	3.625	56.7
BC24#41	2024/7/30	st3c	surface ice	white	1.25	25.2
BC24#42	2024/7/30	st3c	surface ice	white	1.125	22.6
BC24#43	2024/7/30	st3c	surface ice	white	0.75	20.6
BC24#44	2024/8/1	ACC	aged snow			48.2
BC24#45	2024/8/1	ACC	aged snow			443.5
BC24#46	2024/8/1	st2c	surface ice	dark	0.875	55.0
BC24#47	2024/8/2	st2c	surface ice	dark	1.625	15.9
BC24#48	2024/8/2	st2c	surface ice	dark	1.5	36.5
BC24#49	2024/8/2	st2c	surface ice	dark	1	7.7

Table S5: Annual BC deposition flux calculated using CAM-ATRAS

Year	BC flux [ng cm ⁻² year ⁻¹]
2014	1495
2015	1439
2016	1298
2017	1193
2018	1297
2019	1178
2020	1216
2021	1352
2022	896
2023	1435

2024/7/25

Before water dialysis



After water dialysis

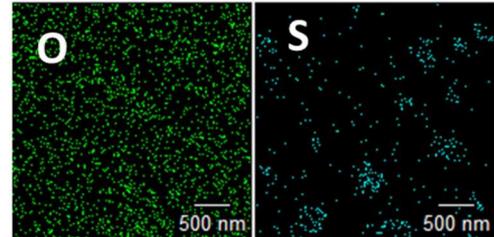
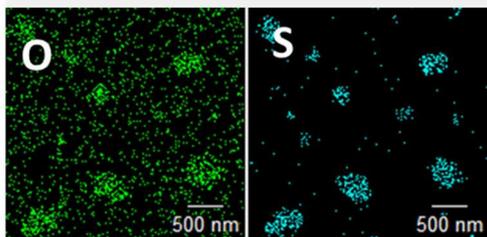
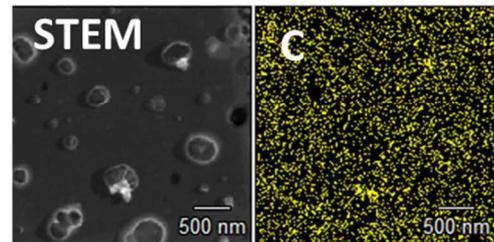
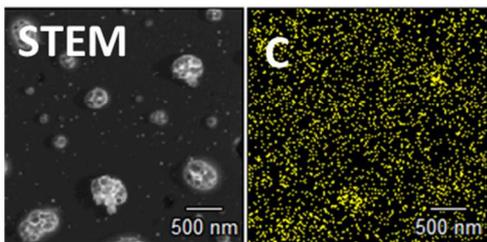
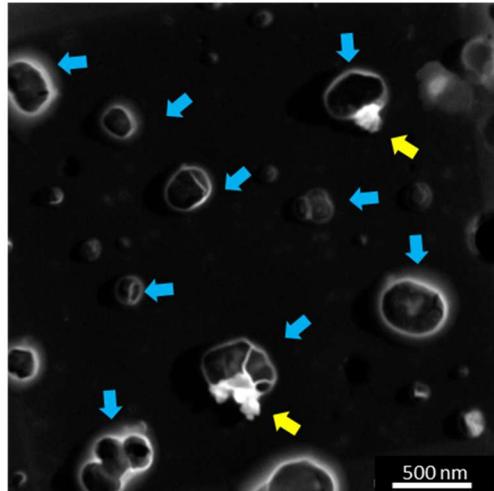
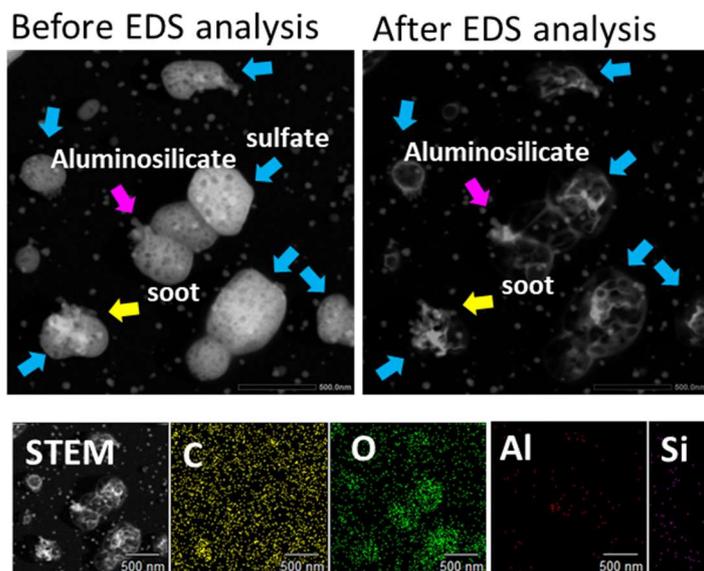


Figure S1: STEM images and elemental maps of atmospheric aerosol samples collected on 25 July 2024. The aerosol samples were collected at Base camp during 12:58–13:08 using a two-stage cascade impactor at a 0.8 L min^{-1} flow rate. The 50% cutoff diameters of the first and second stages are, respectively, 0.3 and 1.0 μm at 1 atm. The photograph is for the second stage. The condition was slight rain.

2024/7/29



2024/8/3

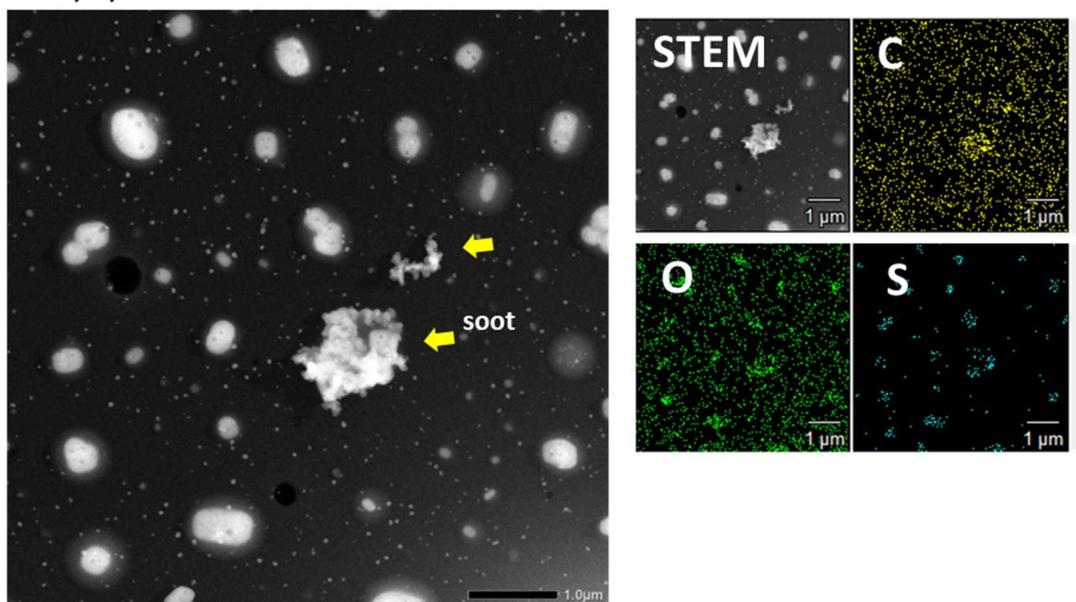


Figure S2: STEM images and elemental maps of atmospheric aerosol samples collected at Base Camp in 2024. Aerosol samples were collected during 17:50–18:02 on 29 July and during 7:57–8:10 on 3 August respectively under fine, windy conditions and fine, weak-wind conditions.

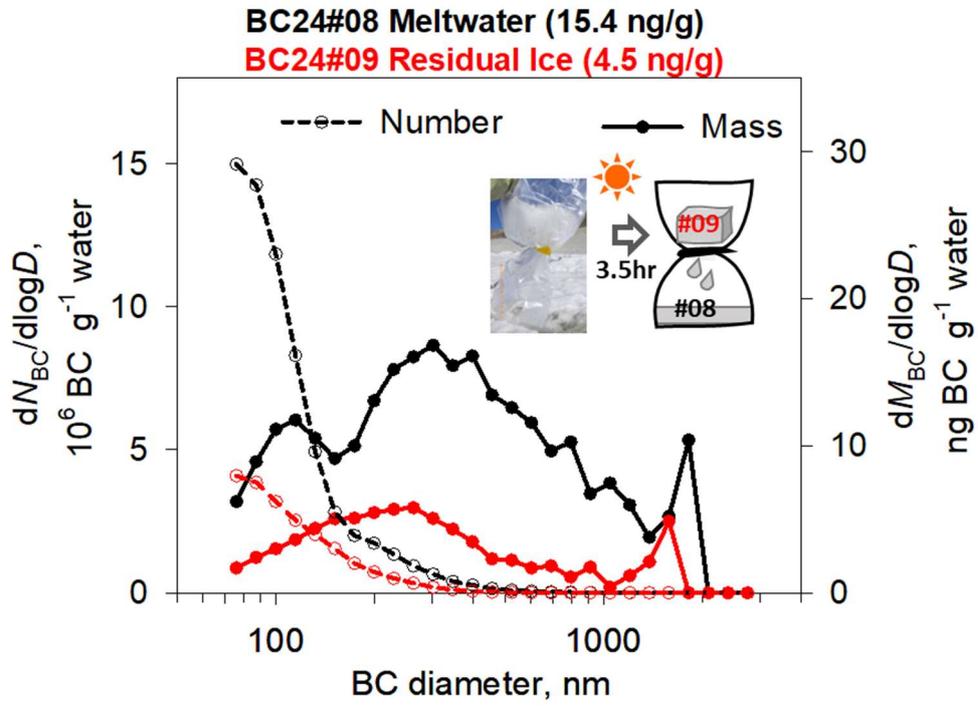


Figure S3: Number–size and mass–size distributions of BC for meltwater and residual ice originating from a surface ice sample.