Supplement of The Cryosphere, 13, 309–324, 2019
https://doi.org/10.5194/tc-13-309-2019-supplement
© Author(s) 2019. This work is distributed under
the Creative Commons Attribution 4.0 License.

The Cryosphere
Open Access

Supplement of

Quantifying the light absorption and source attribution of insoluble light-absorbing particles on Tibetan Plateau glaciers between 2013 and 2015

Xin Wang et al.

Correspondence to: Xin Wang (wxin@lzu.edu.cn) and Baiqing Xu (baiqing@itpcas.ac.cn)

The copyright of individual parts of the supplement might differ from the CC BY 4.0 License.

Table S1. Statistics of the ice variables measured using an ISSW for each glacier.

Site	Layer	Sampling Time	Season	Ice Depth	Sample Depth (cm)		C_{BC}^{equiv}	C_{BC}^{max}	C_{BC}^{est}	$f_{non\text{-}BC}^{est}$	$\mathring{A}_{tot}$	OC	Al	Fe
				(cm)	Top	Bottom	(ng g^{-1})	(ng g^{-1})	(ng g^{-1})	(%)		(ppm)	(ppm)	(ppm)
Region1. Qiyi Glacier (39°14’28” N, 97°45’27” E)														
1	1	2013.08.01	Monsoon	17	0	17	610	450	391(205,488)	36(12,64)	2.50	1.38	0.25	0.30
2	1	2013.08.02	Monsoon	5	0	5	2651	1541	721(—,1414)	73(41,—)	3.73	11.59	3.35	2.41
3	1	2013.08.03	Monsoon	24	0	24	103	82	80(51,92)	22(2,46)	2.05	0.18	0.02	0.02
4	1	2013.08.15	Monsoon	8	0	8	160	128	68(23,93)	57(36,91)	2.98	0.60	0.08	0.09
5	1	2014.09	Monsoon	——	0	0	324	225	202(103,258)	38(12,65)	2.56	0.93	0.14	0.25
6	1	2014.09.01	Monsoon	9	16	25	47	35	28(15,37)	41(15,76)	2.51	0.12	0.04	0.04
7	1	2014.09.01	Monsoon	25	0	9	86	63	51(25,64)	41(17,70)	2.58	0.27	0.04	0.06
	2				9	17	47	34	25(13,35)	47(20,74)	2.65	0.15	0.03	0.05
	3				17	25	55	40	27(14,40)	52(20,76)	2.69	0.15	0.08	0.09
8	1	2014.09.01	Monsoon	23	0	11.5	212	158	137(69,168)	35(13,73)	2.52	0.54	0.07	0.09
	2				11.5	23	94	80	74(49,85)	21(—,53)	1.95	0.10	0.02	0.04
9	1	2014.09.01	Monsoon	35	0	9	120	87	63(32,89)	47(19,68)	2.69	0.35	0.12	0.14
	2				9	17.5	90	66	44(26,67)	51(17,66)	2.62	0.21	0.07	0.15
	3				17.5	26	75	60	42(27,60)	45(13,64)	2.38	0.13	0.06	0.10
	4				26	35	326	240	189(98,252)	42(15,66)	2.58	0.85	0.25	0.28
10	1	2014.09.01	Monsoon	38	0	22	218	157	138(57,162)	37(18,70)	2.69	0.77	0.04	0.04
	2				22	30	993	726	622(288,754)	37(17,68)	2.61	2.16	0.29	0.23
	3				30	38	749	552	497(229,579)	34(15,67)	2.57	2.09	0.11	0.11
11	1	2014.09.01	Monsoon	18	10	28	614	441	393(158,460)	36(18,73)	2.72	1.86	0.08	0.07
12	1	2014.09.01	Monsoon	30	0	23	140	102	90(43,108)	36(15,67)	2.56	0.45	0.06	0.05
	2				23	30	448	336	312(151,355)	30(13,63)	2.48	1.37	0.01	0.03
13	1	2014.09.01	Monsoon	25	0	12.5	2589	2230	1877(1182,2109)	28(10,49)	2.02	2.29	0.09	0.10
	2				12.5	25	802	555	418(128,500)	48(31,83)	2.95	3.44	0.06	0.11

Site	Layer	Sampling Time	Season	Ice Depth	Sample Depth (cm)		C_{BC}^{equiv}	C_{BC}^{max}	C_{BC}^{est}	$f_{non\text{-}BC}^{est}$	$\mathring{A}_{tot}$	OC	Al	Fe
				(cm)	Top	Bottom	(ng g^{-1})	(ng g^{-1})	(ng g^{-1})	(%)		(ppm)	(ppm)	(ppm)
14	1	2014.09.01	Monsoon	——	0	0	176	112	96(33,124)	45(23,79)	2.91	0.71	0.05	0.09
15	1	2014.09.01	Monsoon	——	0	0	229	191	91(24,123)	60(41,88)	3.09	1.06	0.04	0.07
16	1	2015.09.01	Monsoon	36	0	12	26	29	——	——	0.80	——	0.05	0.05
	2				12	24	83	64	57(37,72)	32(5,51)	2.18	0.08	0.09	0.11
	3				24	36	112	87	81(49,96)	28(6,52)	2.20	0.25	0.04	0.05
17	1	2015.09.13	Monsoon	16	0	8	380	263	221(81,271)	42(22,76)	2.84	1.47	0.13	0.12
	2				8	16	1146	795	654(259,823)	43(21,75)	2.80	2.89	0.35	0.34
18	1	2015.09.13	Monsoon	10	0	10	239	175	149(67,180)	38(17,70)	2.64	0.79	0.06	0.08
19	1	2015.09.13	Monsoon	38	0	11	95	67	52(21,68)	45(21,79)	2.80	0.34	0.08	0.07
	2				11	22	92	60	38(12,61)	59(27,82)	3.08	0.34	0.15	0.13
	3				22	30	166	117	85(39,121)	49(20,72)	2.78	0.51	0.17	0.19
	4				30	38	196	132	98(34,136)	50(24,78)	2.95	0.74	0.18	0.18
Region2. Qiumianleiketage Glacier (36°41’47” N, 90°43’44” E)														
20	1	2014.05.11	Non-monsoon	35	0	22	995	662	558(143,678)	44(25,85)	3.06	3.97	0.22	0.16
	2				22	35	316	216	176(55,219)	44(24,81)	2.96	1.26	0.09	0.11
21	1	2014.05.11	Non-monsoon	24	0	8	763	561	442(223,584)	42(16,68)	2.61	2.08	0.55	0.63
	2				8	16	322	228	177(76,233)	45(20,77)	2.77	1.10	0.23	0.25
	3				16	24	297	214	167(72,216)	44(20,76)	2.75	1.01	0.16	0.19
22	1	2014.05.11	Non-monsoon	25	0	8.5	139	93	62(19,93)	56(27,86)	3.08	0.54	0.12	0.15
	2				8.5	16.5	264	202	165(92,211)	37(12,64)	2.45	0.64	0.15	0.19
	3				16.5	25	269	192	157(72,201)	42(18,69)	2.68	0.85	0.13	0.17
Region3.Meikuang Glacier (35°40’24” N, 94°11’10” E)														
23	1	2015.05.04	Non-monsoon	22	0	11	2107	1290	1055(102,1329)	50(31,95)	3.35	8.56	0.39	0.31
	2				11	22	4696	2817	2292(109,2938)	51(31,97)	3.43	16.89	0.73	0.66
24	1	2015.05.04	Non-monsoon	10	0	10	1291	746	553(—,772)	57(34,—)	3.56	6.04	0.50	0.51

Site	Layer	Sampling Time	Season	Ice Depth	Sample Depth (cm)		C_{BC}^{equiv}	C_{BC}^{max}	C_{BC}^{est}	$f_{non\text{-}BC}^{est}$	$\mathring{A}_{tot}$	OC	Al	Fe
				(cm)	Top	Bottom	(ng g^{-1})	(ng g^{-1})	(ng g^{-1})	(%)		(ppm)	(ppm)	(ppm)
25	1	2015.05.05	Non-monsoon	52	0	14	301	217	178(85,229)	41(16,70)	2.65	0.88	0.19	0.21
	2				14	25	49	34	26(11,35)	47(20,81)	2.78	0.16	0.03	0.05
	3				25	36	48	36	27(14,36)	44(16,70)	2.56	0.13	0.03	0.05
	4				36	44	66	50	36(21,51)	45(15,68)	2.53	0.16	0.04	0.09
	5				44	52	135	98	75(39,103)	44(16,69)	2.62	0.37	0.13	0.15
26	1	2015.05	Non-monsoon	40	0	8	96	72	55(31,75)	43(14,75)	2.52	0.22	0.03	0.10
	2				8	16	129	95	58(35,95)	55(19,71)	2.65	0.29	0.04	0.23
	3				16	24	158	118	96(47,120)	39(16,68)	2.58	0.47	0.04	0.09
	4				24	32	177	125	94(40,126)	47(21,74)	2.79	0.60	0.09	0.14
	5				32	40	361	311	256(190,322)	29(2,41)	1.91	0.29	0.15	0.39
27	1	2015.05.05	Non-monsoon	40	0	10	222	172	156(86,182)	30(10,60)	2.32	0.61	0.05	0.08
	2				10	20	233	176	150(78,183)	36(14,65)	2.47	0.67	0.08	0.13
	3				20	30	257	192	157(73,194)	39(17,70)	2.63	0.83	0.09	0.13
	4				30	40	440	320	260(119,331)	41(17,68)	2.68	1.39	0.23	0.27
28	1	2015.05.055	Non-monsoon	45	0	8	624	450	339(97,414)	46(27,84)	3.00	2.38	0.11	0.11
	2				8	19	184	132	102(38,127)	44(24,77)	2.83	0.67	0.04	0.07
	3				19	28	97	70	52(18,65)	47(26,83)	2.92	0.39	0.02	0.04
	4				28	36	83	60	43(14,55)	48(28,86)	2.95	0.34	0.02	0.03
	5				36	45	241	176	151(68,181)	37(17,71)	2.64	0.77	0.09	0.07
29	1	2015.05.11	Non-monsoon	60	0	13	122	81	61(20,83)	50(25,86)	2.99	0.50	0.06	0.09
	2				13	26	103	72	61(25,76)	41(20,77)	2.76	0.39	0.04	0.05
	3				26	37	181	141	133(76,153)	27(7,57)	2.25	0.44	0.05	0.05
	4				37	60	83	57	31(15,58)	62(23,85)	2.93	0.23	0.15	0.18
30	1	2015.10	Monsoon	43	0	11.5	34	33	29(26,36)	16(—,17)	1.37	——	0.09	0.12
	2				11.5	23	24	23	19(17,24)	20(—,22)	1.46	——	0.07	0.08

Site	Layer	Sampling Time	Season	Ice Depth	Sample Depth (cm)		C_{BC}^{equiv}	C_{BC}^{max}	C_{BC}^{est}	$f_{non\text{-}BC}^{est}$	$\mathring{A}_{tot}$	OC	Al	Fe
				(cm)	Top	Bottom	(ng g^{-1})	(ng g^{-1})	(ng g^{-1})	(%)		(ppm)	(ppm)	(ppm)
	3				23	33	720	465	324(77,456)	55(30,88)	3.15	5.66	0.96	0.96
	4				33	43	1372	873	613(100,830)	55(34,92)	3.26	14.60	0.50	0.48
31	1	2015.10	Monsoon	8	0	8	882	659	460(272,686)	48(14,66)	2.56	1.83	1.36	1.22
32	1	2015.10	Monsoon	40	0	10	197	156	132(75,159)	33(11,59)	2.34	0.47	0.07	0.11
	2				10	21	287	223	187(103,229)	35(12,62)	2.40	0.74	0.08	0.15
	3				21	30	277	208	175(86,212)	37(15,67)	2.55	0.83	0.09	0.13
	4				30	40	964	733	669(341,772)	31(12,62)	2.43	2.09	0.12	0.14
Region4. Yuzhufeng Glacier (35°38’43” N, 94°13’36” E)														
33	1	2014.04.11	Non-monsoon	30	0	10	953	671	520(212,691)	46(20,76)	2.82	2.70	0.42	0.54
	2				10	20	600	420	363(134,439)	40(20,76)	2.82	2.05	0.15	0.15
	3				20	30	167	115	91(31,117)	46(23,82)	2.92	0.65	0.07	0.09
34	1	2014.04.19	Non-monsoon	39	0	12	1147	787	634(216,817)	45(22,80)	2.93	4.06	0.46	0.57
	2				12	21	630	410	328(76,421)	48(26,87)	3.13	2.72	0.23	0.24
	3				21	30	125	75	50(1,74)	60(35,—)	3.47	0.65	0.08	0.09
	4				30	39	120	77	58(13,79)	52(28,86)	3.15	0.54	0.07	0.08
35	1	2014.05.18	Non-monsoon	15	0	7.5	171	113	95(30,118)	44(24,83)	2.95	0.71	0.03	0.06
	2				7.5	15	647	426	358(115,451)	45(23,80)	2.95	2.26	0.13	0.21
36	1	2014.05.19	Non-monsoon	24	0	12	92	64	50(22,67)	45(19,75)	2.77	0.31	0.05	0.08
	2				12	24	161	132	137(93,152)	15(—,37)	1.82	0.22	0.02	0.05
37	1	2014.05.19	Non-monsoon	43	0	8	274	182	117(36,185)	57(26,89)	3.10	1.02	0.23	0.36
	2				8	16	134	86	64(17,91)	53(25,87)	3.11	0.53	0.08	0.12
	3				16	24	62	40	28(6,41)	54(28,91)	3.18	0.28	0.04	0.05
	4				24	34	52	35	24(8,35)	53(25,86)	3.01	0.20	0.03	0.06
	5				34	43	163	106	87(28,114)	47(23,82)	2.98	0.67	0.05	0.10
38	1	2014.05.19	Non-monsoon	45	0	22	823	533	471(116,574)	43(23,85)	3.08	3.11	0.10	0.13

Site	Layer	Sampling Time	Season	Ice Depth	Sample Depth (cm)		C_{BC}^{equiv}	C_{BC}^{max}	C_{BC}^{est}	$f_{non\text{-}BC}^{est}$	$\mathring{A}_{tot}$	OC	Al	Fe
				(cm)	Top	Bottom	(ng g^{-1})	(ng g^{-1})	(ng g^{-1})	(%)		(ppm)	(ppm)	(ppm)
	2				22	33.5	543	354	294(78,379)	46(23,85)	3.07	2.17	0.16	0.23
	3				33.5	45	522	340	292(73,362)	44(24,85)	3.08	2.16	0.12	0.14
39	1	2014.10	Monsoon	17	0	8	186	123	81(24,121)	56(29,86)	3.09	0.77	0.09	0.20
	2				8	17	417	292	233(94,295)	44(22,77)	2.79	1.51	0.15	0.21
40	1	2015.10	Monsoon	35	0	8	1022	660	502(182,721)	51(22,80)	2.96	3.15	0.81	0.78
	2				8	16	317	201	165(37,205)	48(29,88)	3.03	1.42	0.07	0.07
	3				16	23	392	201	162(—,210)	59(41,—)	3.70	2.38	0.05	0.05
	4				23	35	155	92	72(8,93)	54(34,—)	3.32	0.86	0.03	0.05
41	1	2015.10	Monsoon	36	0	8	2630	1608	1169(72,1603)	56(33,96)	3.41	9.16	0.74	0.75
	2				8	15	469	301	218(47,306)	53(28,90)	3.19	1.92	0.23	0.31
	3				15	25.5	824	650	——	93(13,63)	2.45	0.07	0.37	3.51
	4				25.5	36	606	417	227(110,420)	63(24,81)	2.94	1.61	0.26	1.01
42	1	2015.10	Monsoon	30	0	10	148	115	101(55,119)	32(12,59)	2.35	0.40	0.02	0.06
	2				10	20	220	190	158(116,197)	28(2,42)	1.90	0.18	0.03	0.23
	3				20	30	518	397	319(184,413)	38(12,61)	2.41	0.99	0.10	0.33
43	1	2015.10	Monsoon	39	0	12	698	529	445(236,553)	36(13,63)	2.48	1.52	0.12	0.32
	2				12	21	191	142	76(46,137)	60(22,74)	2.73	0.42	0.08	0.39
	3				21	30	294	206	140(56,203)	52(24,81)	2.90	1.02	0.11	0.30
	4				30	39	699	555	406(268,568)	42(11,58)	2.33	1.16	0.24	0.89
44	1	2015.10	Monsoon	24	0	8	82	63	43(25,63)	47(16,69)	2.55	0.19	0.06	0.12
	2				8	16	171	151	——	60(2,44)	1.92	——	0.15	0.79
	3				16	24	382	326	——	110(6,49)	2.05	——	0.42	3.39
Region5. Hariqin Glacier (33°08’23” N, 92°05’34” E)														
45	1	2015.10	Monsoon	30	0	15	45	33	23(9,30)	50(25,88)	2.88	0.16	0.02	0.03
	2				15	22	47	34	23(7,30)	52(29,93)	3.01	0.19	0.01	0.03

Site	Layer	Sampling Time	Season	Ice Depth	Sample Depth (cm)		C_{BC}^{equiv}	C_{BC}^{max}	C_{BC}^{est}	$f_{non\text{-}BC}^{est}$	$\mathring{A}_{tot}$	OC	Al	Fe
				(cm)	Top	Bottom	(ng g^{-1})	(ng g^{-1})	(ng g^{-1})	(%)		(ppm)	(ppm)	(ppm)
	3				22	30	55	35	20(—,30)	63(40,—)	3.52	0.29	0.02	0.04
46	1	2015.10	Monsoon	27	0	11	36	24	13(4,22)	64(32,84)	3.16	0.14	0.02	0.05
	2				11	19	38	28	21(12,29)	44(14,77)	2.47	0.08	0.04	0.04
	3				19	27	40	30	21(11,30)	47(18,84)	2.61	0.10	0.03	0.04
47	1	2015.05.30	Non-monsoon	——	0	0	53	38	24(17,41)	55(13,72)	2.54	0.08	0.06	0.11
48	1	2015.05.30	Non-monsoon	——	0	0	3990	2702	2131(682,2784)	47(23,81)	2.97	9.64	1.11	1.05
49	1	2015.10.19	Monsoon	46	0	11	333	235	181(68,235)	46(22,77)	2.86	1.68	0.24	0.20
	2				11	22	797	547	412(131,534)	48(26,82)	2.98	6.11	0.38	0.32
	3				22	34	104	79	63(33,81)	39(14,65)	2.53	0.24	0.08	0.09
	4				34	46	171	140	138(92,159)	19(—,41)	1.96	0.31	0.04	0.05
Region6. Xiaodongkemadi Glacier (33°04’08” N, 92°04’24” E)														
50	1	2013.05.23	Non-monsoon	14	0	14	337	236	186(84,252)	45(18,73)	2.75	1.00	0.17	0.29
51	1	2014.05.01	Non-monsoon	54	0	9	36	32	——	——	1.76	——	0.05	0.09
	2				9	18	77	63	54(37,68)	30(2,48)	2.08	0.09	0.03	0.08
	3				18	27	24	21	——	——	1.82	——	0.02	0.04
	4				27	36	38	33	——	——	1.86	——	0.04	0.06
	5				36	45	55	45	33(23,46)	40(8,59)	2.22	0.07	0.03	0.08
	6				45	54	105	84	68(45,89)	35(7,54)	2.21	0.17	0.06	0.11
52	1	2014.05	Non-monsoon	36	0	16	1188	663	267(—,696)	78(36,—)	3.63	4.91	2.40	2.13
	2				16	26	233	158	136(56,176)	42(17,75)	2.79	0.76	0.10	0.15
	3				26	36	134	81	62(12,89)	54(27,94)	3.22	0.59	0.08	0.11
53	1	2014.05.23	Non-monsoon	36	0	9	2224	1447	1347(402,1606)	39(21,82)	2.96	5.91	0.25	0.18
	2				9	18	411	265	238(68,293)	42(22,83)	3.01	1.59	0.10	0.10
	3				18	27	255	157	85(22,169)	67(27,92)	3.24	0.88	0.40	0.49
	4				27	36	74	48	——	86(25,90)	3.04	0.09	0.09	0.32

Site	Layer	Sampling Time	Season	Ice Depth	Sample Depth (cm)		C_{BC}^{equiv}	C_{BC}^{max}	C_{BC}^{est}	$f_{non\text{-}BC}^{est}$	$\mathring{A}_{tot}$	OC	Al	Fe
				(cm)	Top	Bottom	(ng g^{-1})	(ng g^{-1})	(ng g^{-1})	(%)		(ppm)	(ppm)	(ppm)
54	1	2014.05.23	Non-monsoon	23	0	5	2770	1849	1637(596,2031)	41(19,77)	2.86	6.97	0.64	0.67
	2				5	23	457	313	282(109,342)	38(18,74)	2.79	1.51	0.14	0.12
55	1	2014.05.19	Non-monsoon	39	0	10	37	27	24(12,29)	36(13,59)	2.51	0.12	0.02	0.02
	2				10	20	23	17	15(8,19)	34(12,57)	2.42	0.07	0.01	0.01
	3				20	30	24	18	16(11,20)	31(5,70)	2.14	0.04	0.01	0.02
	4				30	39	202	162	155(95,178)	23(3,47)	2.11	0.40	0.06	0.06
56	1	2015.05.11	Non-monsoon	63	0	8.5	38	37	30(28,39)	19(—,26)	1.38	——	0.03	0.06
	2				8.5	17	31	31	28(25,33)	8(—,19)	1.24	——	0.02	0.05
	3				17	30	16	18	18(15,19)	——	1.08	——	0.01	0.03
	4				30	43	36	33	32(25,36)	9(—,28)	1.53	——	0.01	0.02
	5				43	53	45	36	31(22,40)	32(3,49)	2.07	0.05	0.03	0.06
	6				53	63	111	77	71(33,86)	37(15,63)	2.59	0.39	0.03	0.05
57	1	2015.05.25	Non-monsoon	60	0	10	29	25	21(15,26)	26(1,52)	1.88	0.03	0.01	0.03
	2				10	20	18	17	17(13,19)	9(—,26)	1.40	——	0.01	0.01
	3				20	30	14	13	12(9,14)	16(—,39)	1.62	——	0.01	0.01
	4				30	40	16	14	12(10,15)	20(—,32)	1.59	——	0.01	0.02
	5				40	50	13	12	11(8,13)	17(—,44)	1.69	0.01	0.01	0.01
	6				50	60	143	120	116(78,132)	19(—,42)	1.90	0.19	0.04	0.05
58	1	2015.10	Monsoon	29	0	10	68	57	51(36,61)	25(1,44)	1.93	0.08	0.02	0.05
	2				10	20	116	107	98(79,115)	16(—,26)	1.49	——	0.03	0.12
	3				20	29	337	252	108(87,245)	68(20,72)	2.69	0.55	0.07	0.82
59	1	2015.10	Monsoon	30	0	10	54	31	15(—,29)	72(40,—)	3.63	0.27	0.04	0.08
	2				10	19	25	18	9(6,18)	65(20,91)	2.77	0.05	0.03	0.06
	3				19	30	56	45	31(21,46)	45(9,78)	2.41	0.09	0.06	0.06
60	1	2015.10	Monsoon	19	0	10	99	82	67(48,86)	32(4,50)	2.02	0.11	0.03	0.12

Site	Layer	Sampling Time	Season	Ice Depth	Sample Depth (cm)		C_{BC}^{equiv}	C_{BC}^{max}	C_{BC}^{est}	$f_{non\text{-}BC}^{est}$	$\mathring{A}_{tot}$	OC	Al	Fe
				(cm)	Top	Bottom	(ng g^{-1})	(ng g^{-1})	(ng g^{-1})	(%)		(ppm)	(ppm)	(ppm)
	2				10	19	148	99	84(29,104)	43(23,76)	2.89	0.60	0.03	0.05
Region7. Gurenhekou Glacier (30°11’17” N, 90°27’23” E)														
61	1	2014.05.28	Non-monsoon	10	0	10	4674	3634	3080(1876,3884)	34(9,55)	2.29	5.22	1.35	0.91
62	1	2014.05.28	Non-monsoon	19	0	9	255	182	153(73,192)	40(17,70)	2.62	0.80	0.18	0.15
	2				9	19	173	131	115(66,142)	34(10,60)	2.36	0.42	0.10	0.12
63	1	2015.10	Monsoon	10	0	10	1281	941	736(350,944)	43(19,70)	2.64	2.61	0.34	0.40
64	1	2015.10	Monsoon	60	0	22	38	29	23(13,30)	40(14,59)	2.43	0.10	0.01	0.04
	2				22	35	30	23	15(10,24)	52(14,79)	2.46	0.05	0.02	0.05
	3				35	47.5	38	29	17(14,30)	55(12,73)	2.37	0.04	0.05	0.09
	4				47.5	60	63	52	46(29,54)	27(7,52)	2.09	0.13	0.02	0.03
65	1	2015.10	Monsoon	65	0	7	35	30	25(19,32)	28(1,57)	1.86	0.03	0.02	0.04
	2				7	15	50	35	20(9,33)	61(26,85)	2.90	0.15	0.03	0.09
	3				15	22	37	29	19(12,28)	48(18,75)	2.51	0.09	0.01	0.05
	4				22	29	28	29	——	——	1.34	——	0.02	0.10
	5				19	40	49	36	26(16,38)	47(14,71)	2.49	0.10	0.03	0.09
	6				40	48	41	33	19(16,33)	54(11,72)	2.30	0.02	0.03	0.11
	7				48	56.5	58	46	30(19,44)	48(16,72)	2.45	0.12	0.05	0.09
	8				56.5	65	152	113	73(40,109)	52(21,74)	2.66	0.40	0.06	0.22
66	1	2015.10	Monsoon	25	0	10	334	235	154(75,238)	54(22,77)	2.80	0.95	0.30	0.45
	2				10	17	102	76	49(30,77)	52(17,81)	2.60	0.21	0.12	0.15
	3				17	25	63	45	26(11,42)	58(27,88)	2.92	0.21	0.04	0.09
67	1	2015.10	Monsoon	10	25	35	144	115	72(59,119)	50(10,61)	2.25	0.08	0.24	0.38

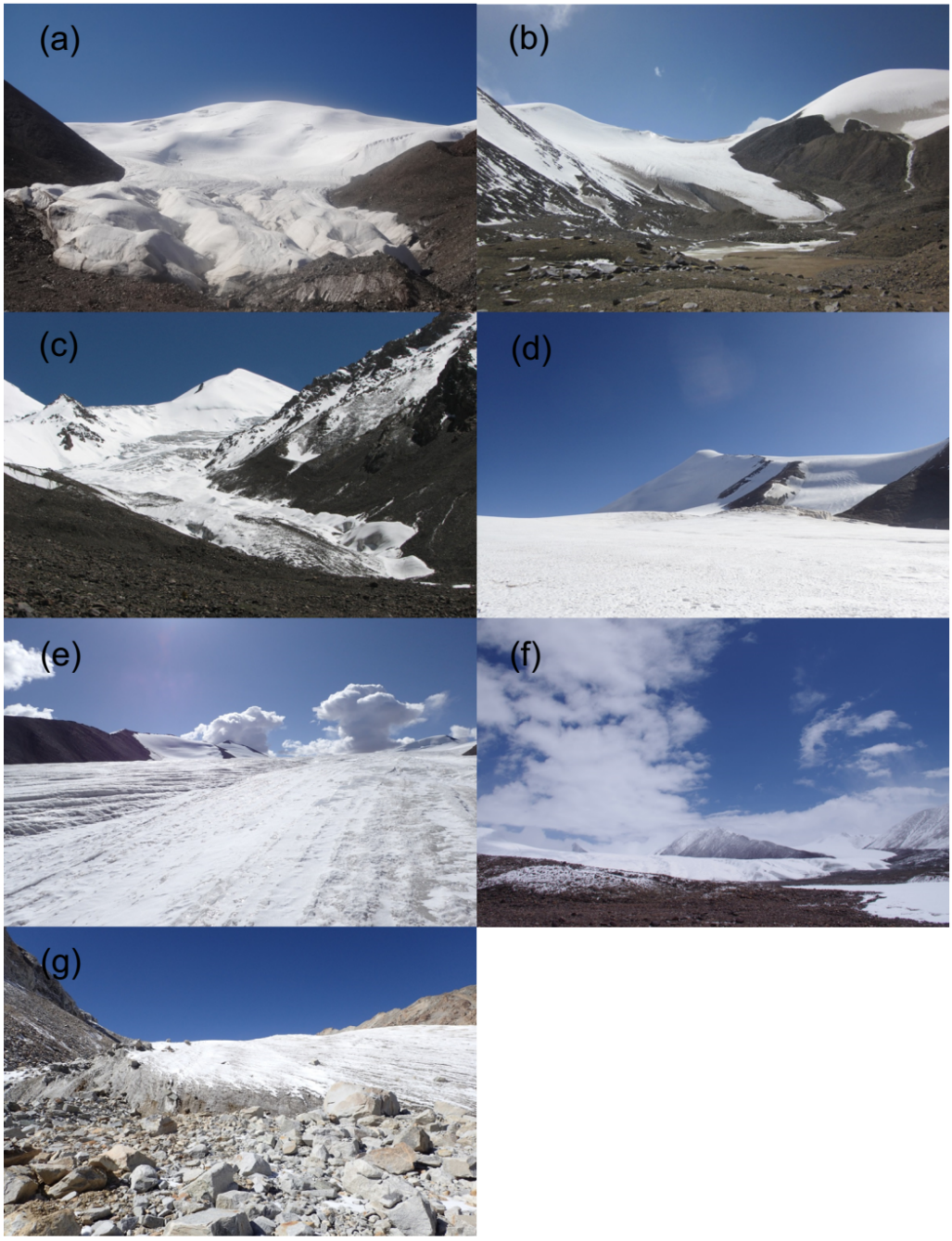

Figure S1. Pictures of ice sampling location in the (a) Qiyi, (b) Qiumianleiketage, (c) Meikuang, (d) Yuzhufeng, (e) Hariqin, (f) Xiaodongkemadi, (g) Gurenhekou glaciers, respectively.

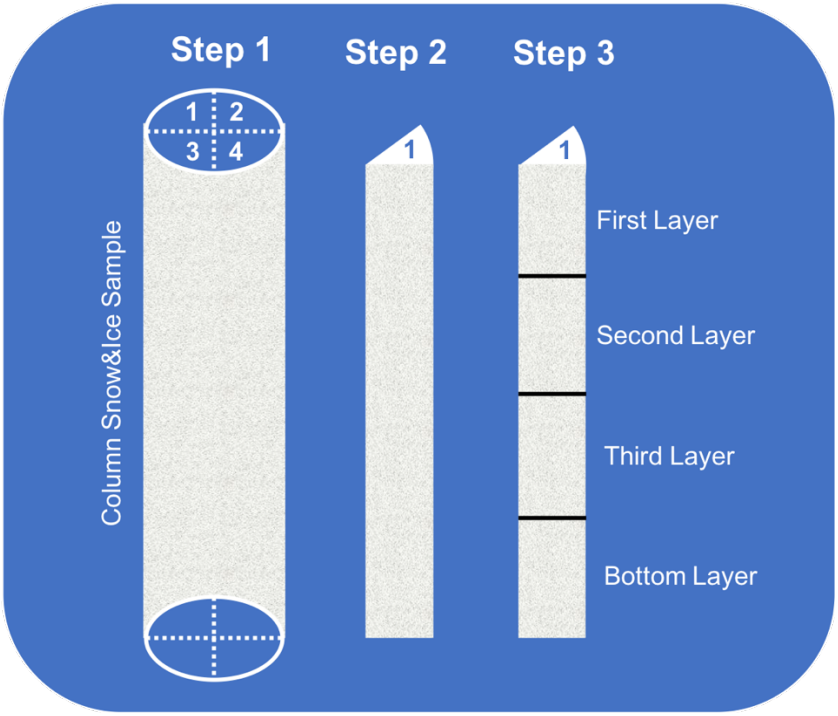

Figure S2. The cutting processes of the column ice samples collected in each glacier following clean protocols.

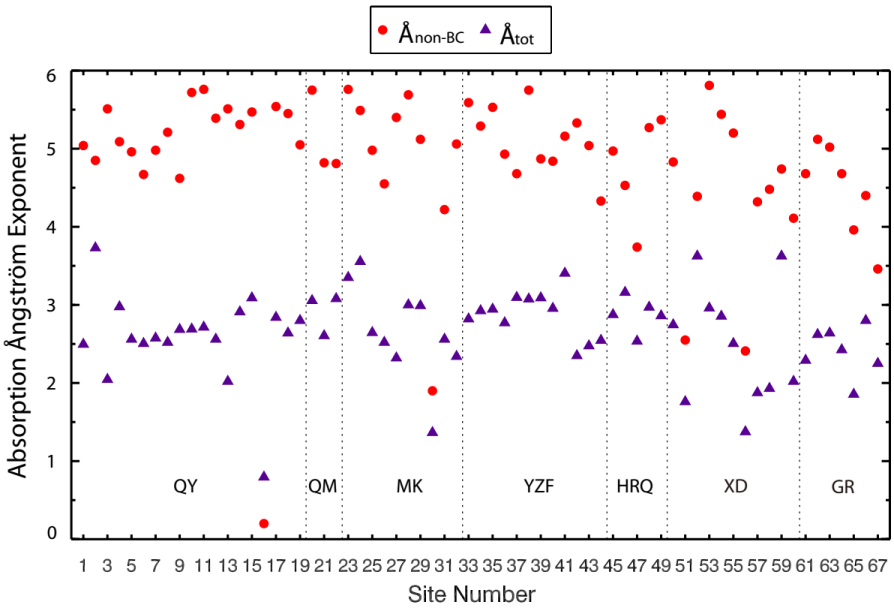

Figure S3. The absorption Ångström exponent of ice samples for non-BC particulate constituents ($Å_{non\text{-}BC}$, red dots), and total particulate constituents ($Å_{tot}$, blue triangles) in each site.

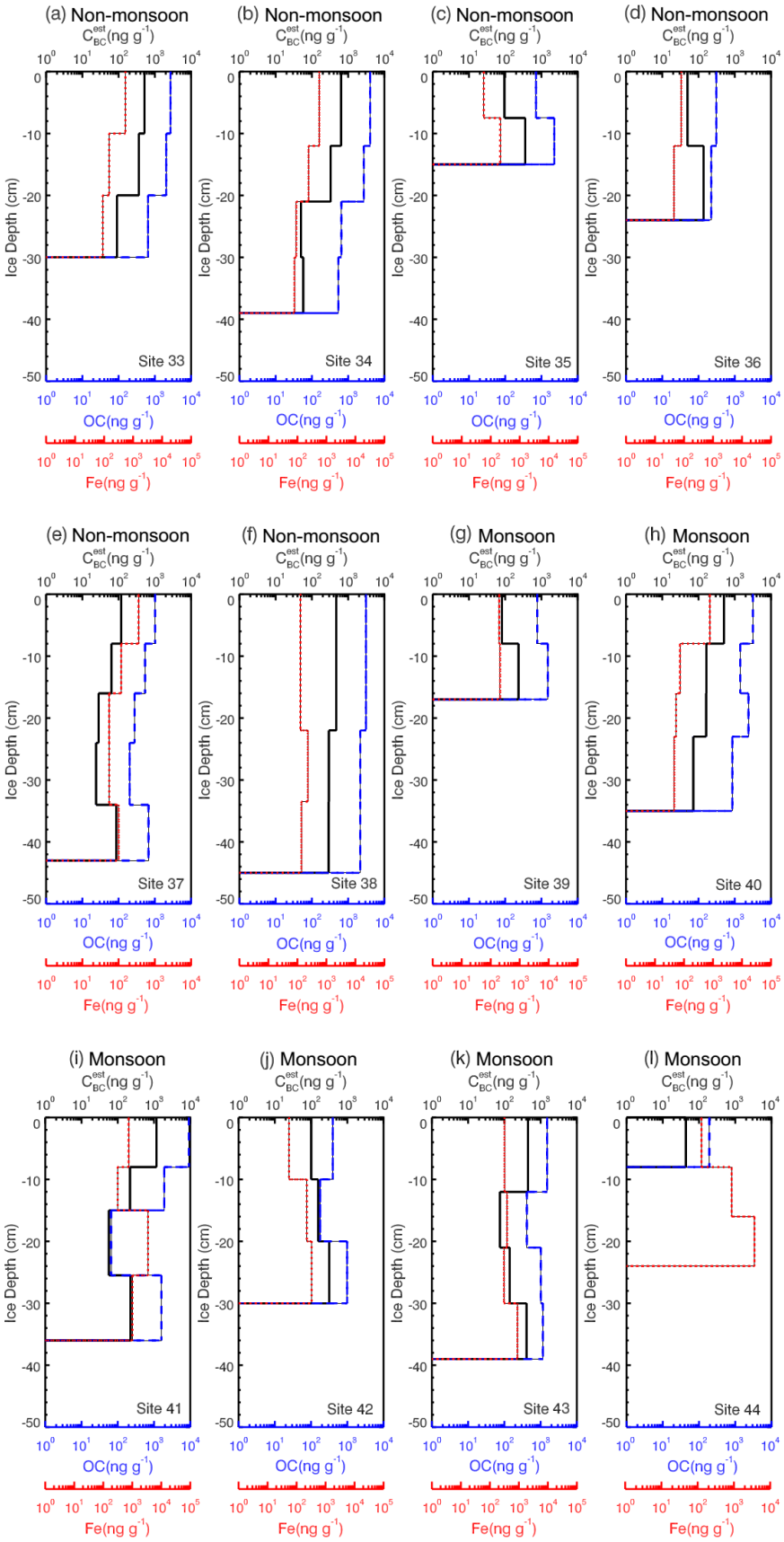

Figure S4. Vertical profiles of mass mixing ratios of BC, OC, and Fe for each sample in the YZF glacier. Note that the ice samples for more than one layer are plotted in this figure.

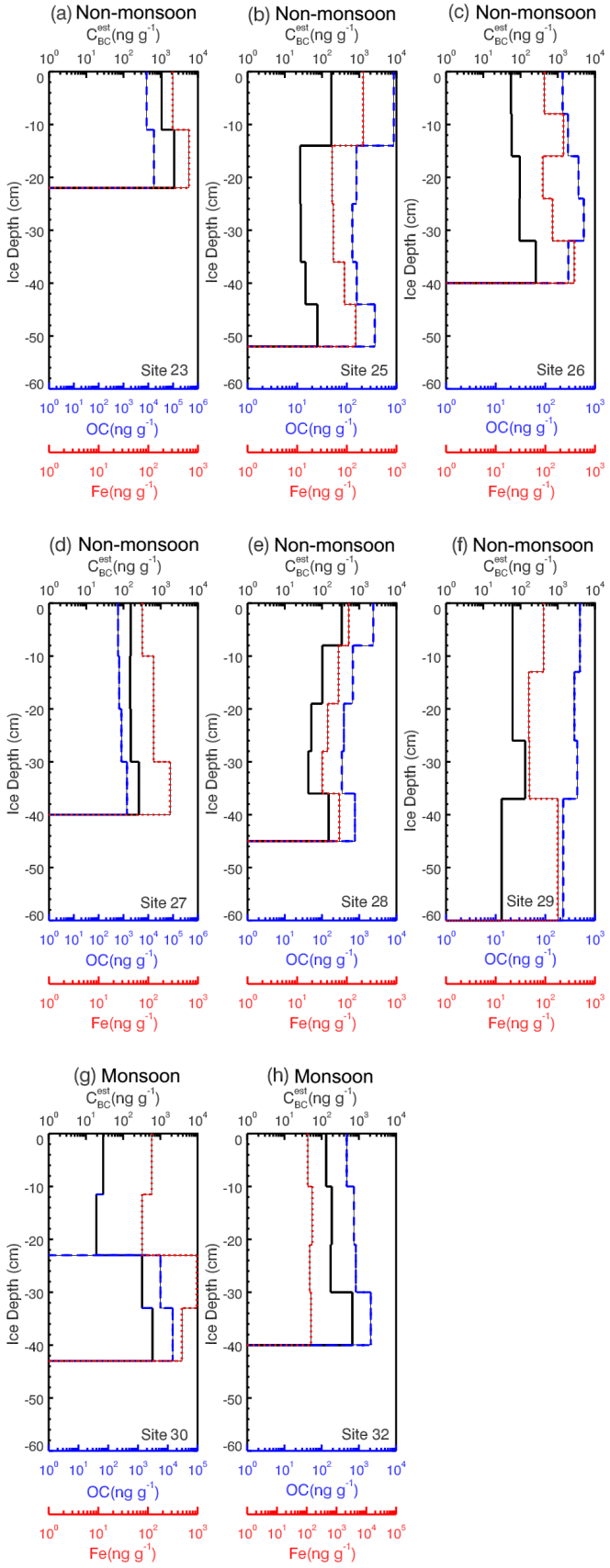

Figure S5. Vertical profiles of mass mixing ratios of BC, OC, and Fe for each sample in the MK glacier.

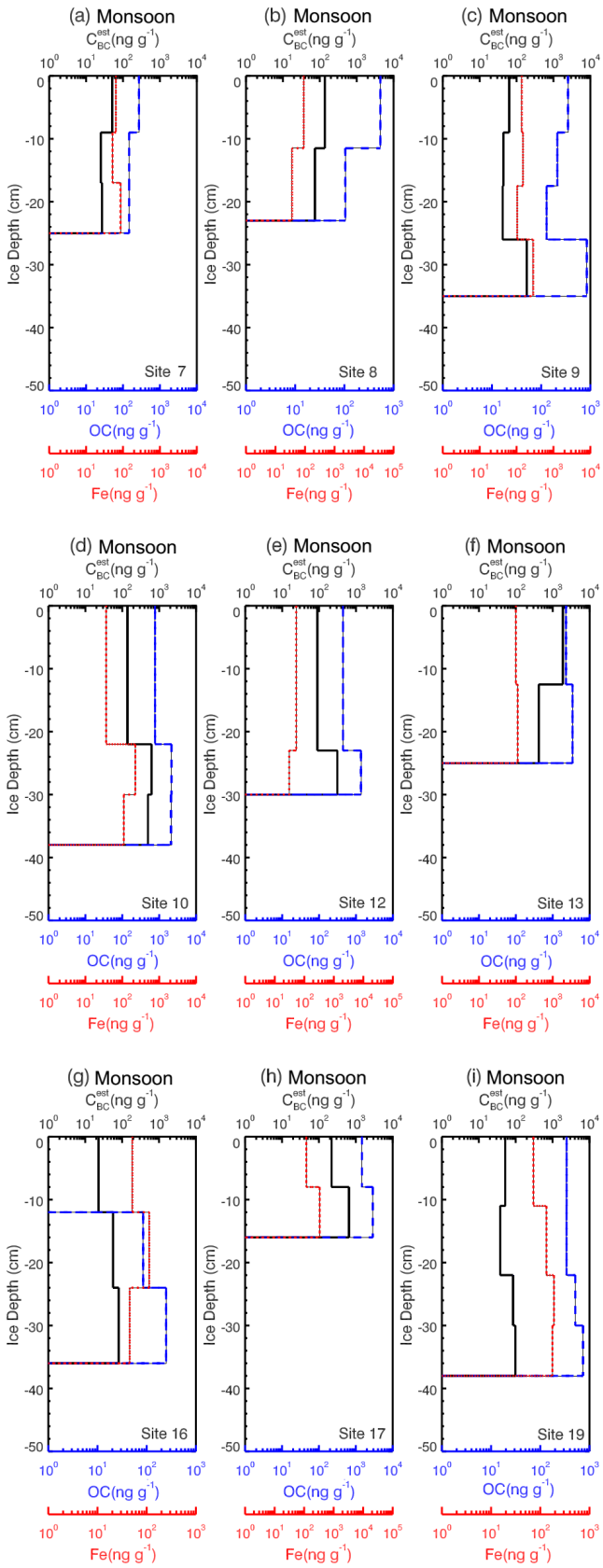

Figure S6. Vertical profiles of mass mixing ratios of BC, OC, and Fe for each sample in the QY glacier.

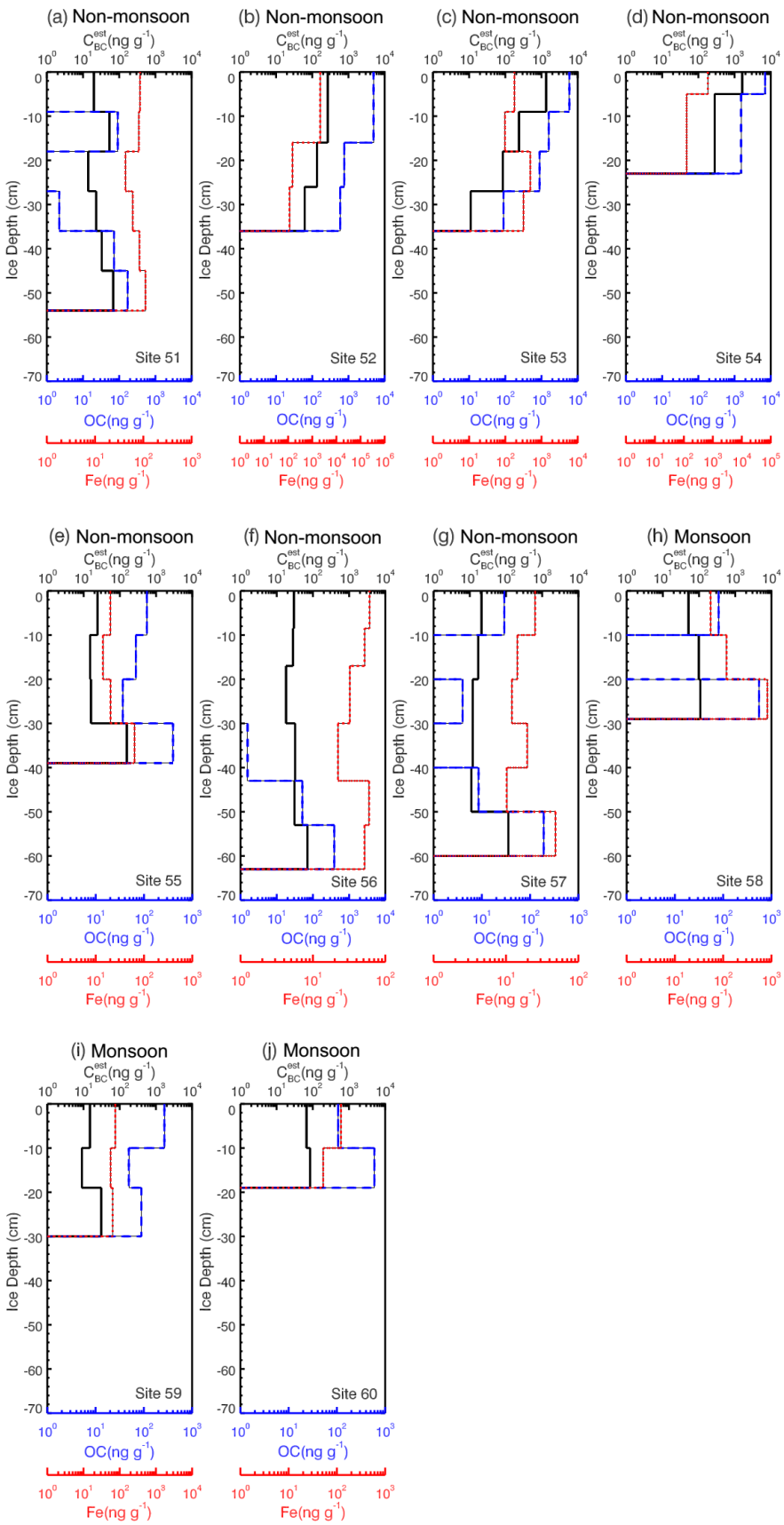

Figure S7. Vertical profiles of mass mixing ratios of BC, OC, and Fe for each sample in the XD glacier.

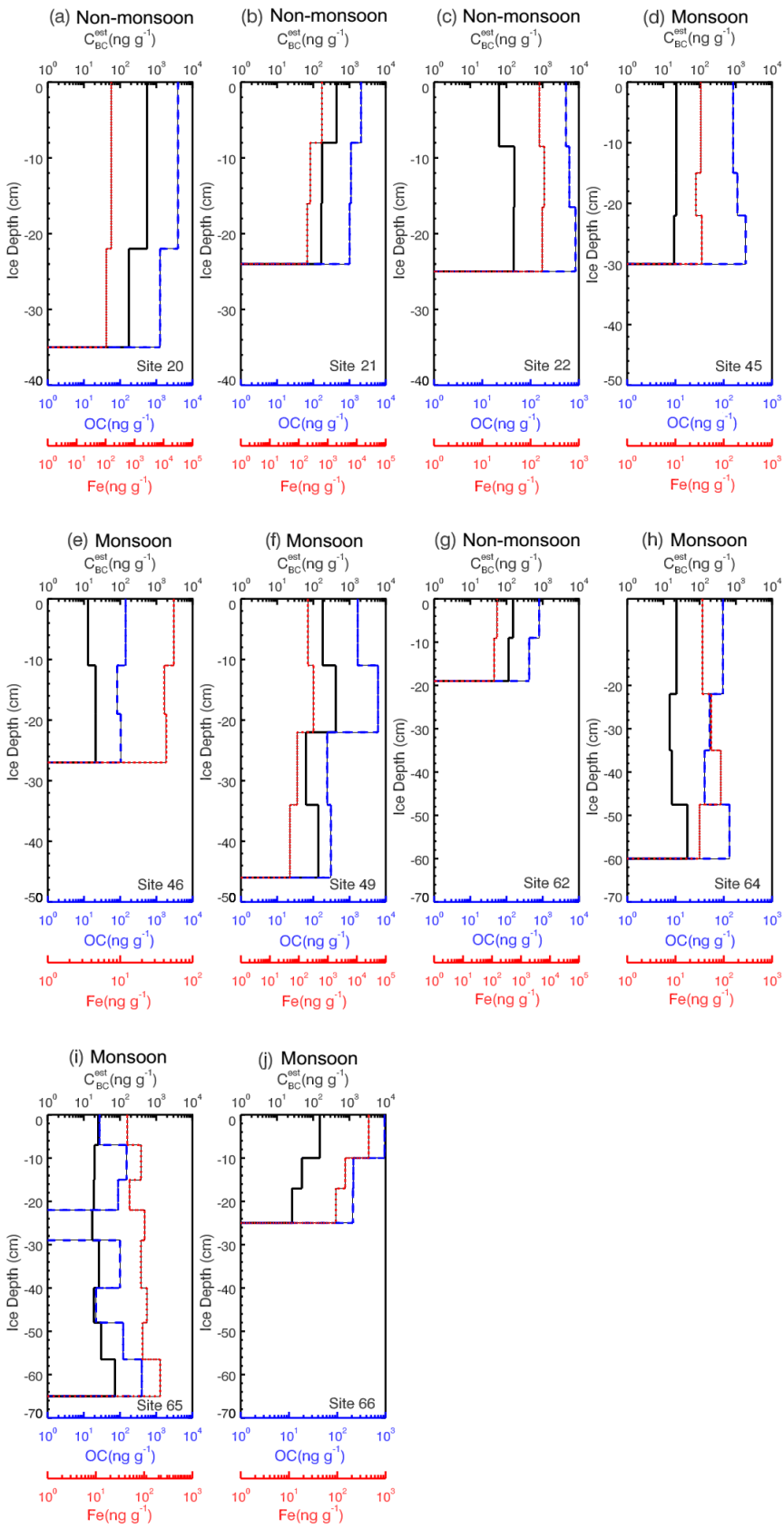

Figure S8. Vertical profiles of mass mixing ratios of BC, OC, and Fe of (a), (b), and (c) in the QM glacier, (d), (e), and (f) in the HRQ glacier, (g), (h), (i), and (j) in the GR glacier.

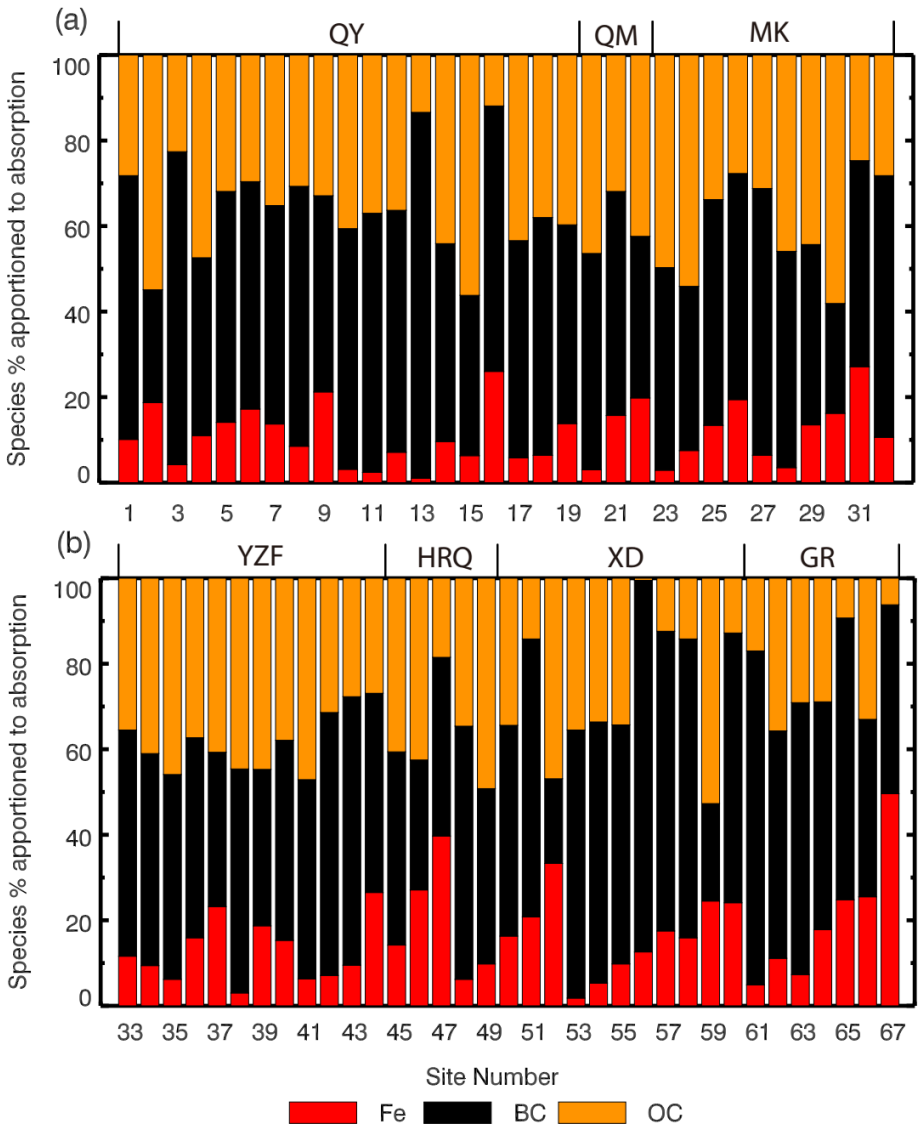

Figure S9. Relative contributions to total light absorption by BC, OC, and Fe oxide (assumed to be in the form of goethite) for surface ice samples in each sampling site (See Table 1).