

Table S1. Elemental concentrations and chemical species obtained from low-Z particle EPMA and FT-IR absorption peaks and chemical species obtained from ATR-FT-IR imaging data. In the last column, is given the chemical species of each particle obtained by the combined use of the two techniques.

Particle #	Size (in μm)	elemental concentrations (in atomic %)	chemical species from X-ray spectral data [minor elements]	FT-IR absorption peaks (in cm^{-1})	chemical species from ATR-FT-IR data	chemical species by the combined use of two techniques
(A) Ca-containing particles (41 particles)						
1. CaCO_3 (2 particles)						
3	4.35	C(17.9)N(2.1)O(61.2) Mg(0.7)Al(1.0) Si(1.9)Ca(15.3)	CaCO_3 [N,Mg,Al,Si]	784,843,869,1036,1156, 1369,1397,1581,1631, 1793,2917,3401	CO_3^{2-} , cristoballite, organic(CH), H_2O	CaCO_3 /cristoballite/ organic/ H_2O
89	3.32	C(23.4)O(57.5)Mg(0.9) Al(1.2)Si(2.4)S(1.2) K(0.6)Ca(12.2)Fe(1.0)	CaCO_3/C [Mg,Al,Si,S,K,Fe]	790,872,1022,1404	CO_3^{2-} , montmorillonite	CaCO_3 /montmorillonite/ elemental carbon
2. amorphous CaCO_3 (4 particles)						
57	10.12	C(16.2)N(14.6)O(60.5) Cl(2.1)Ca(6.6)	$\text{Ca}(\text{CO}_3, \text{NO}_3)/\text{C}$ [Cl]	836,864,1111,1418,1483, 1636,3304	CO_3^{2-} , NO_3^- , SO_4^{2-} , montmorillonite, organic(humic), H_2O	ACC/ $\text{Ca}(\text{SO}_4, \text{NO}_3)/$ montmorillonite/ organic/ H_2O
58	2.50	C(18.7)N(5.1)O(49.8) Mg(1.3)Al(4.3)Si(9.0) S(0.3)K(1.3)Ca(10.3)	$\text{Ca}(\text{CO}_3, \text{NO}_3)/\text{C}$ [S,Mg,Al,Si,K]	828,869,929,1031,1415, 1480,1630,1665,2939,3364	CO_3^{2-} , NO_3^- , SO_4^{2-} , montmorillonite, organic(CH, humic), H_2O	ACC/ $\text{Ca}(\text{NO}_3)_2/$ montmorillonite/organic/ H_2O
62	14.01	C(20.5)N(9.0)O(56.3) S(1.9)Ca(11.5)Cl(0.9)	$\text{Ca}(\text{CO}_3, \text{NO}_3)/\text{C}$ [S, Cl]	817,862,1120,1420,1484, 1630,2865,2929,3312	CO_3^{2-} , NO_3^- , SO_4^{2-} , organic(CH, humic), H_2O	ACC/ $\text{Ca}(\text{NO}_3, \text{SO}_4)/$ organic/ H_2O
63	9.70	C(14.5)N(13.8)O(58.3) Mg(1.3)Al(1.4)Si(2.5) S(0.6)Ca(7.5)	$\text{Ca}(\text{CO}_3, \text{NO}_3)/\text{C}$ [Mg,Al,Si,S]	830,863,1065,1140,1409, 1483,1636,2953,3238	CO_3^{2-} , NO_3^- , quartz, organic(CH, humic), H_2O	ACC/ $\text{Ca}(\text{NO}_3)_2/\text{quartz}/$ organic/ H_2O
3. chloride-containing particles (3 particles)						
43	1.95	O(43.7)Mg(3.9)Al(2.4) Ca(13.3)Cl(36.7)	$\text{CaCl}_2/\text{MgCl}_2$	IR-inactive		(Ca,Mg)Cl
48	2.50	O(44.9)Mg(4.4)Al(1.9) Ca(9.5)Cl(39.0)	$\text{CaCl}_2/\text{MgCl}_2$ [Al]			(Ca,Mg)Cl

52	1.14	O(49.3)Na(2.1)Mg(3.9) Si(5.0)Ca(6.4)Cl(33.3)	CaCl ₂ /MgCl ₂ [Na,Si,Cl]			(Ca,Mg)Cl
4. nitrate-containing particles (10 particles)						
17	3.64	C(23.3)N(13.5)O(49.1) Na(0.9)Mg(0.9)Al(1.6) Si(3.6)K(0.5) Ca(6.0)Cl(0.4)	Ca(CO ₃ ,NO ₃)/C [Na,Mg,Al, Si,K,Cl]	828,866,920,1060,1355, 1392,1599,1622,1653,2988, 3335	CO ₃ ²⁻ ,NO ₃ ⁻ , quartz, organic(CH,humic), H ₂ O	Ca(CO ₃ ,NO ₃)/quartz/ montmorillonite/ organic/H ₂ O
25	4.21	C(16.3)N(7.8)O(56.9) Mg(0.4)Al(1.6)Si(2.2) Ca(14.7)	Ca(CO ₃ ,NO ₃) [Mg,Al,Si]	828,869,1020,1375,1388, 1662,1790,3094,3250	CO ₃ ²⁻ ,NO ₃ ⁻ , montmorillonite, organic,H ₂ O	Ca(CO ₃ ,NO ₃)/ montmorillonite/organic/H ₂ O
27	3.41	C(10.1)N(15.9)O(51.7) Na(9.9)Mg(1.0)Al(0.7) Si(0.9)Ca(9.9)	(Na,Ca)(CO ₃ ,NO ₃) [Mg,Al,Si]	833,862,1038,1352,1416, 1605,1663,2916,3230	CO ₃ ²⁻ ,NO ₃ ⁻ ,quartz, organic(CH,humic), H ₂ O	(Na,Ca)(CO ₃ ,NO ₃)/quartz/ organic/H ₂ O
42	3.77	C(24.1)N(10.2)O(50.3) Na(0.2)Mg(1.0)Al(2.4) Si(5.3)K(0.3) Ca(5.5)Fe(0.7)	Ca(CO ₃ ,NO ₃)/C [Na,Mg,Al, Si,K,Fe]	760,810,840,869,963,1026, 1124,1369,1403,1644,2916, 3211	CO ₃ ²⁻ ,NO ₃ ⁻ ,Si-O, organic(CH,humic), H ₂ O	Ca(CO ₃ ,NO ₃)/Si-O/ organic/H ₂ O
47	3.93	C(16.6)N(1.9)O(63.7) Mg(0.4)Al(1.0)Si(1.5) K(0.3)Ca(14.6)	CaCO ₃ [N,Mg,Al,Si,K]	834,867,1045,1364,1385, 1644,1793,2915,3331	CO ₃ ²⁻ ,NO ₃ ⁻ , Si-O, organic(CH),H ₂ O	Ca(CO ₃ ,NO ₃)/Si-O/ organic/H ₂ O
49	2.81	C(20.8)N(7.1)O(56.7) Na(0.6)Mg(0.9)Al(0.8) Si(1.4)Ca(11.7)	Ca(CO ₃ ,NO ₃) [C,Na,Mg,Al,Si]	787,798,831,869,1031,1412, 1615,1648,2912,3378	CO ₃ ²⁻ ,NO ₃ ⁻ ,quartz, organic(CH, COO), H ₂ O	Ca(CO ₃ ,NO ₃)/ quartz/organic/H ₂ O
55	10.39	C(24.6)N(12.5)O(51.9) Mg(3.9)Al(0.3)Si(1.3) Ca(5.6)	(Mg,Ca)(CO ₃ ,NO ₃) [Al,Si]	827,862,1060,1413,1641, 2948,3256	CO ₃ ²⁻ ,NO ₃ ⁻ ,Si-O, organic(CH,humic), H ₂ O	(Mg,Ca)(CO ₃ ,NO ₃)/ Si-O/organic/H ₂ O
64	4.44	C(28.7)N(5.0)O(51.3) Na(0.4)Mg(1.9)Al(0.6) Si(0.9)Ca(9.3)Cl(2.0)	Ca(CO ₃ ,NO ₃) [C,Na,Mg,Al,Si,Cl]	845,869,1095,1388,1405, 1625,3283	CO ₃ ²⁻ ,NO ₃ ⁻ ,SO ₄ ²⁻ , H ₂ O	(Ca,Mg)(CO ₃ ,NO ₃ ,SO ₄ ,Cl)/ H ₂ O
94	3.31	C(15.5)N(10.1)O(46.3) Na(2.2)Mg(2.7)Al(2.9) Si(4.8)Cl(9.1)K(0.7) Ca(5.8)	Ca(CO ₃ ,NO ₃) [C,Na,Mg,Al,Si,Cl]	773,788,842,872,10381124, 1372,1426,1634,2929,3326	CO ₃ ²⁻ ,NO ₃ ⁻ ,quartz, organic(CH,humic), H ₂ O	Ca(CO ₃ ,NO ₃ ,Cl)/ quartz/organic/H ₂ O
108	2.34	C(25.5)N(5.4)O(37.2) Mg(1.3)Al(6.5)Si(10.0) S(0.5)K(2.2) Ca(9.3)Cl(2.0)	Ca(CO ₃ ,NO ₃) [C,Mg,Al,Si,S,K,Cl]	794,825,869,1017,1378, 1419,1605,2925	CO ₃ ²⁻ ,NO ₃ ⁻ ,quartz, organic(CH,humic)	(Ca,K,Mg)(CO ₃ ,NO ₃ ,Cl)/ quartz/organic
5. sulfate-containing particles (8 particles)						

10	4.57	C(6.5)N(7.4)O(58.9) Na(8.7)Mg(1.2)Al(0.7) Si(0.8)S(6.8) K(0.3)Ca(8.8)	(Na,Ca)(SO ₄ ,CO ₃ , NO ₃) [Mg,Al,Si,K]	833,1125,1259,1346,1618, 1676,2846,2916,3397,3532	NO ₃ ⁻ , SO ₄ ²⁻ , Si-O, organic(CH,humic), H ₂ O	(Na,Mg,Ca)(SO ₄ ,NO ₃)/ organic/H ₂ O
35	4.66	C(7.4)O(53.3)Na(3.0) Mg(5.6)Si(13.6)S(2.4) P(3.2)Ca(11.4)	(Mg,Ca)(CO ₃ ,NO ₃) [Na,Si,P]	816,875,946,1020,1100, 1375,1390,1605,1642, 2854,2928,3373	CO ₃ ²⁻ ,NO ₃ ⁻ , SO ₄ ²⁻ , montmorillonite, organic(CH,humic), H ₂ O	(Mg,Ca)(SO ₄ ,CO ₃ ,NO ₃)/ montmorillonite/organic/H ₂ O
51	1.71	C(17.4)O(56.9)Na(3.0) S(10.5)Ca(12.2)	Ca(CO ₃ ,SO ₄) [Na]	1095	SO ₄ ²⁻	CaSO ₄ /elemental carbon
61	2.17	O(70.9)S(14.5)Ca(14.6)	CaSO ₄	1125,3509	OH,SO ₄ ²⁻	CaSO ₄ ·2H ₂ O
65	2.23	C(6.1)O(65.2)Na(1.1) S(13.1)Ca(12.2)	Ca(CO ₃ ,SO ₄) [Na]	1095,1402,1605	CO ₃ ²⁻ ,SO ₄ ²⁻ , organic	CaSO ₄ /organic
74	2.91	O(72.0)S(13.2) Cl(1.2)Ca(13.7)	CaSO ₄ [Cl]	1108	SO ₄ ²⁻	CaSO ₄
80	3.12	C(3.8)O(68.7)Mg(0.7) Al(0.3)S(13.2)Ca(13.4)	Ca(CO ₃ ,SO ₄) [Mg,Al]	1122,1419,1618,1486	CO ₃ ²⁻ ,SO ₄ ²⁻ , organic, H ₂ O	Ca(CO ₃ ,SO ₄)/organic/H ₂ O
81	1.67	N(1.7)O(71.3)Al(1.1) S(13.0)Ca(13.0)	CaSO ₄ [N,Al]	1131	SO ₄ ²⁻	CaSO ₄
6. nitrate- and sulfate-containing particles (14 particles)						
2	9.70	C(16.2)N(11.1)O(56.0) S(3.4)Ca(11.4)Cl(2.0)	Ca(CO ₃ ,NO ₃ ,SO ₄) [C,Cl]	811,865,1118,1365,1419, 1584,1662,2858,2925,3378	CO ₃ ²⁻ ,NO ₃ ⁻ ,Si-O, organic(CH,humic), H ₂ O	Ca(CO ₃ ,NO ₃ ,SO ₄ ,Cl)/ organic/H ₂ O
14	3.34	C(17.8)N(6.9)O(58.6) Na(0.7)Mg(0.8)Al(0.4) Si(2.5)S(4.7)Ca(7.5)	Ca(CO ₃ ,NO ₃ ,SO ₄)/ C [Na,Mg,Al,Si]	791,825,862,1031,1125, 1402,1615,1648,3243	CO ₃ ²⁻ ,NO ₃ ⁻ ,SO ₄ ²⁻ , quartz, organic(humic), H ₂ O	Ca(CO ₃ ,NO ₃ ,SO ₄)/ quartz/organic/H ₂ O
16	6.66	C(25.3)N(15.4)O(48.1) Na(0.8)S(2.4) Ca(6.3)Cl(1.7)	Ca(CO ₃ ,NO ₃) [Na,S,Cl]	811,872,1125,1362,1426, 1593,1630,1670,2993,3378	CO ₃ ²⁻ ,NO ₃ ⁻ ,SO ₄ ²⁻ , organic(CH,humic), H ₂ O	Ca(CO ₃ ,NO ₃ ,SO ₄ ,Cl)/ organic/H ₂ O
32	4.22	C(29.2)N(8.8)O(47.4) Na(0.5)Mg(1.0)Al(1.3) Si(2.7)S(2.4) Ca(6.2)Cl(0.6)	Ca(CO ₃ ,NO ₃ ,SO ₄)/ C [Na,Mg,Al,Si,Cl]	835,872,1061,1108,1370, 1422,1594,2851,2925,3331	CO ₃ ²⁻ ,NO ₃ ⁻ ,SO ₄ ²⁻ , quartz, organic(CH,humic), H ₂ O	Ca(CO ₃ ,NO ₃ ,SO ₄)/ quartz/organic/H ₂ O
34	2.85	C(10.6)N(2.3)O(61.1) Na(0.8)Mg(2.9)Al(1.6) Si(0.7)S(9.7) K(0.6)Ca(10.2)	(Mg,Ca)(CO ₃ ,SO ₄) [N,Na,Mg,Al,Si,K]	821,865,1115,1368, 1395,1621,3391	CO ₃ ²⁻ ,NO ₃ ⁻ ,SO ₄ ²⁻ , H ₂ O	(Ca,Mg)(CO ₃ ,NO ₃ ,SO ₄)/H ₂ O

50	3.98	C(13.6)N(6.9)O(61.1) Na(0.6)Mg(0.7) S(6.8)Ca(10.4)	Ca(CO ₃ ,NO ₃ ,SO ₄) [C,Na,Mg]	814,860,1120,1375, 1394,1631,3352,3466	CO ₃ ²⁻ ,NO ₃ ⁻ ,SO ₄ ²⁻ , H ₂ O	Ca(CO ₃ ,NO ₃ ,SO ₄)/H ₂ O
53	4.56	C(13.1)N(4.0)O(62.4) Mg(0.7)Al(0.9)Si(1.7) S(6.9)K(0.2)Ca(10.1)	Ca(CO ₃ ,NO ₃ ,SO ₄) [C,Mg,Al,Si,K]	815,869,1024,1112, 1405,1638,3229	CO ₃ ²⁻ ,NO ₃ ⁻ , SO ₄ ²⁻ , montmorillonite	Ca(CO ₃ ,NO ₃ ,SO ₄)/ montmorillonite/H ₂ O
59	4.94	C(10.5)N(5.1)O(57.7) Na(0.7)Mg(0.9)Al(1.2) Si(2.2)S(10.3) K(0.4)Ca(11.0)	Ca(CO ₃ ,NO ₃ ,SO ₄) [Na,Mg,Al,Si,K]	834,872,900,1027,1103, 1351,1399,1617,1634, 2852,2913,3401	CO ₃ ²⁻ ,NO ₃ ⁻ ,SO ₄ ²⁻ , montmorillonite, organic(CH,humic), H ₂ O	Ca(CO ₃ ,NO ₃ ,SO ₄)/ montmorillonite/organic/H ₂ O
70	7.60	C(18.3)N(8.4)O(53.4) Na(1.3)Mg(1.4)Al(2.7) Si(4.6)S(1.3)K(0.7) Ca(6.8)Fe(0.9)	Ca(CO ₃ ,NO ₃) [C,Na,Mg,Al, Si,K,Fe]	821,859,946,1017,1051, 1149,1159,1388, 1419,1635,3356	CO ₃ ²⁻ ,NO ₃ ⁻ ,SO ₄ ²⁻ , muscovite/ (Na,Ca)-feldspar, organic(humic), H ₂ O	Ca(CO ₃ ,NO ₃ ,SO ₄)/ muscovite/(Na,Ca)-feldspar/ organic/H ₂ O
82	3.18	C(21.7)N(7.0)O(54.2) Na(0.5)Mg(2.2)Al(1.5) Si(4.1)S(3.1)K(0.3) Ca(5.3)Cl(0.3)	Ca(CO ₃ ,NO ₃ ,SO ₄) [C,Na,Mg,Al, Si,K,Cl]	827,872,926,1013,1086, 1388,1625,2955,3326	CO ₃ ²⁻ ,NO ₃ ⁻ ,SO ₄ ²⁻ , quartz,muscovite, organic(humic), H ₂ O	Ca(CO ₃ ,NO ₃ ,SO ₄)/ quartz/muscovite/ organic/H ₂ O
85	3.79	C(23.7)N(7.0)O(49.8) Mg(0.7)Al(0.8)Si(1.1) S(3.1)Ca(7.5)Cl(6.3)	Ca(CO ₃ ,NO ₃ ,SO ₄) [C,Mg,Al,Si,Cl]	1139,1380,1451,1611,3317	CO ₃ ²⁻ ,NO ₃ ⁻ ,SO ₄ ²⁻ , organic(humic), H ₂ O	Ca(CO ₃ ,NO ₃ ,SO ₄ ,Cl)/ organic/H ₂ O
99	3.26	C(11.0)O(60.6)Na(1.2) Mg(2.9)Al(1.0)Si(1.3) P(1.3)S(10.3) K(0.3)Ca(10.1)	(Mg,Ca)(CO ₃ ,SO ₄) [Na,Al,Si,P,K]	830,870,904,1091,1412	CO ₃ ²⁻ ,NO ₃ ⁻ , montmorillonite, SO ₄ ²⁻	(Ca,Mg,Na)(CO ₃ ,NO ₃ ,SO ₄)/ montmorillonite
105	3.28	C(13.5)N(6.6)O(56.1) Na(5.0)Mg(1.5) S(6.5)Ca(10.6)	(Na,Ca)(CO ₃ ,NO ₃ , SO ₄) [Mg]	841,861,1122,1361,1423, 1605,2860,2934,3361	CO ₃ ²⁻ ,NO ₃ ⁻ ,SO ₄ ²⁻ , organic(CH,humic), H ₂ O	(Ca,Na,Mg)(CO ₃ ,NO ₃ ,SO ₄)/ organic/H ₂ O
109	6.66	C(12.4)N(8.7)O(56.6) S(2.6)Ca(11.9)Cl(7.9)	Ca(CO ₃ ,SO ₄ ,Cl)	842,1132,1449	CO ₃ ²⁻ ,NO ₃ ⁻ ,SO ₄ ²⁻	Ca(CO ₃ ,NO ₃ ,SO ₄ ,Cl)
(B) NaNO₃-containing particles (33 particles)						
1. crystalline NaNO₃ particles (10 particles)						
4	4.04	N(20.1)O(54.3) Na(23.7)Mg(1.8)	NaNO ₃ [Mg]	833,1109,1263,1349,1788	NO ₃ ⁻ ,NO ₂ ⁻ ,SO ₄ ²⁻	Na(NO ₃ ,SO ₄)
11	3.43	N(20.4)O(53.8)Na(25.8)	NaNO ₃	833,1266,1346	NO ₃ ⁻ ,NO ₂ ⁻	NaNO ₃
18	4.12	C(9.3)N(18.0)O(49.1) Na(16.9)Mg(2.5)	(Na,Mg)(NO ₃ ,SO ₄) [C,Ca]	833,1141,1256,1356	NO ₃ ⁻ ,NO ₂ ⁻ ,SO ₄ ²⁻	(Na,Mg,Ca)(NO ₃ ,SO ₄)/ elemental carbon

		S(2.8)Ca(1.6)				
19	2.86	C(11.3)N(16.4)O(47.1) Na(17.8)Mg(2.0)S(1.0) Cl(2.7)Ca(1.8)	NaNO ₃ [C,Mg,S,Cl,Ca]	833,1131,1256,1356	NO ₃ ⁻ ,NO ₂ ⁻ ,SO ₄ ²⁻	(Na,Mg,Ca)(NO ₃ ,SO ₄ ,Cl)/ elemental carbon
60	1.91	C(2.9)N(18.9) O(54.0)Na(24.2)	NaNO ₃ [C]	785,801,836,1035,1109, 1250,1346,1788	NO ₃ ⁻ ,NO ₂ ⁻ , SO ₄ ²⁻ ,quartz	Na(NO ₃ ,SO ₄)/quartz/ elemental carbon
75	3.08	C(11.0)N(14.9)O(50.6) Na(22.5)S(1.1)	NaNO ₃ [C,S]	833,1247,1349	NO ₃ ⁻ ,NO ₂ ⁻	NaNO ₃ /elemental carbon
76	2.10	C(11.6)N(16.5) O(47.5)Na(24.4)	NaNO ₃ [C]	836,1259,1352	NO ₃ ⁻ ,NO ₂ ⁻	NaNO ₃ /elemental carbon
79	2.91	N(21.7)O(53.7) Na(23.6)Ca(1.0)	NaNO ₃ [Ca]	833,1064,1254,1352,1786	NO ₃ ⁻ ,NO ₂ ⁻	NaNO ₃
95	1.42	C(29.7)N(13.7)O(34.4) Na(18.2)Mg(4.2)	(Na,Mg)NO ₃ [C]	833,1365	NO ₃ ⁻	(Na,Mg)NO ₃ / elemental carbon
102	3.22	N(21.1)O(50.9)Na(28.1)	NaNO ₃	836,1096,1240,1356	NO ₃ ⁻ ,NO ₂ ⁻ ,SO ₄ ²⁻	Na(NO ₃ ,SO ₄)
2. NaNO₃ particles internally mixed with other chemical species (23 particles)						
1	4.46	C(7.6)N(17.5)O(50.5) Na(19.8)Cl(3.5)Ca(1.1)	NaNO ₃ [C,Cl,Ca]	833,872,1048,1118,1253, 1349,1391,1605,2923,3365	NO ₃ ⁻ ,NO ₂ ⁻ ,SO ₄ ²⁻ , CO ₃ ²⁻ ,quartz, organic(CH,humic), H ₂ O	(Na,Ca)(NO ₃ ,CO ₃ ,SO ₄ ,Cl)/ quartz/organic/H ₂ O
5	2.80	C(21.0)N(14.8)O(42.3) Na(19.7)Mg(2.1)	NaNO ₃ [C,Mg]	834,1121,1253,1349,1561, 1605,1788,2858,2923	NO ₃ ⁻ ,NO ₂ ⁻ ,SO ₄ ²⁻ , organic(CH,humic)	(Na,Mg)(NO ₃ ,SO ₄)/organic
8	4.46	N(21.0)O(53.3) Na(24.7)Cl(1.1)	NaNO ₃ [Cl]	833,1013,1260,1346, 1602,1785	NO ₃ ⁻ ,NO ₂ ⁻ , montmorillonite, organic(humic)	NaNO ₃ / montmorillonite/organic
15	8.49	N(19.6)O(54.9)Na(17.2) Cl(6.1)Ca(2.2)	NaNO ₃ [Cl,Ca]	830,1109,1346,1596, 1653,3358	NO ₃ ⁻ ,SO ₄ ²⁻ , organic(humic)	(Na,Ca)(NO ₃ ,SO ₄)/organic
23	2.95	C(10.4)N(16.5)O(49.5) Na(16.4)Mg(1.9)Cl(1.0) K(1.2)Ca(3.1)	(Na,Ca)NO ₃ [C,Mg,Cl,Ca,K]	836,865,1125,1247,1356, 1404,1593,1625,2923,3365	NO ₃ ⁻ ,NO ₂ ⁻ ,SO ₄ ²⁻ , CO ₃ ²⁻ , organic(CH,humic), H ₂ O	(Na,Ca)(NO ₃ ,SO ₄ ,CO ₃)/ organic/H ₂ O
29	2.53	N(20.1)O(53.4)Na(26.5)	NaNO ₃	833,1125,1259,1349,1564, 1600,2846,2923	NO ₃ ⁻ ,NO ₂ ⁻ ,SO ₄ ²⁻ , organic(CH,humic)	Na(NO ₃ ,SO ₄)/ organic
30	3.51	C(25.2)N(9.7)O(44.3) Na(16.4)Mg(2.1) S(0.7)Cl(1.5)	NaNO ₃ [C,Mg,S,Cl]	836,1130,1263,1349,1410, 1564,1602,2852,2929	NO ₃ ⁻ ,NO ₂ ⁻ ,SO ₄ ²⁻ , CO ₃ ²⁻ , organic(CH,humic),	(Na,Mg)(NO ₃ ,CO ₃ ,SO ₄ ,Cl)/ organic
33	4.72	N(22.7)O(57.7)Na(19.7)	NaNO ₃	833,1115,1253,1346,1561,	NO ₃ ⁻ ,NO ₂ ⁻ ,SO ₄ ²⁻ ,	Na(NO ₃ ,SO ₄)/

				1585,1690,1788,2858, 2920,3410	organic(CH,humic), H ₂ O	organic/H ₂ O
38	3.11	N(20.8)O(54.1) Na(22.3)Mg(2.9)	NaNO ₃ [Mg]	833,1130,1259,1352,1561, 1609,1785,2852,2916	NO ₃ ⁻ ,NO ₂ ⁻ ,SO ₄ ²⁻ , organic(CH,humic)	(Na,Mg)(NO ₃ ,SO ₄)/organic
44	3.02	N(20.2)O(53.0) Na(25.3)Ca(1.6)	NaNO ₃ [Ca]	833,1253,1349,1561,1596, 1791,2929,3301	NO ₃ ⁻ ,NO ₂ ⁻ , organic(CH,humic), H ₂ O	(Na,Ca)NO ₃ / organic/H ₂ O
46	1.80	C(12.7)N(15.1)O(49.0) Na(21.1)Ca(2.1)	NaNO ₃ [C,Ca]	836,869,1255,1349,1391	NO ₃ ⁻ ,NO ₂ ⁻ ,CO ₃ ²⁻	(Na,Ca)(NO ₃ ,CO ₃)
54	6.22	C(4.9)N(22.6)O(52.2) Na(17.2)Ca(3.1)	(Na,Ca)NO ₃ [C]	831,862,1013,1110,1250, 1349,1400,1634,1788,3301	NO ₃ ⁻ ,NO ₂ ⁻ ,CO ₃ ²⁻ , SO ₄ ²⁻ , montmorillonite	(Na,Ca)(NO ₃ ,CO ₃ ,SO ₄)/ montmorillonite/H ₂ O
66	3.32	C(1.1)N(18.0)O(48.1) Na(10.5)Mg(1.6)Al(2.0) Si(3.7)S(3.7) Cl(4.1)Ca(7.2)	(Na,Ca)(NO ₃ ,SO ₄) [Mg,Al,Si,Cl]	772,788,836,1042,1247, 1352,1561,1788,2852,2923	NO ₃ ⁻ ,NO ₂ ⁻ ,quartz, organic(CH,humic)	(Na,Mg,Ca)(NO ₃ ,Cl)/ quartz/organic
68	3.56	C(8.2)N(18.2)O(50.6) Na(19.4)Mg(2.5)S(1.1)	NaNO ₃ [C,Mg,S]	1128,1362,1561	NO ₃ ⁻ ,SO ₄ ²⁻ ,organic	(Na,Mg)(NO ₃ ,SO ₄)/organic
73	3.34	C(5.0)N(7.3)O(54.7) Na(13.1)Mg(0.9)Al(4.4) Si(11.7)Cl(0.7) K(0.5)Ca(1.8)	Na(CO ₃ ,NO ₃) [Mg,Al,Si,Cl,K,Ca]	824,859,1026,1118,1349, 1416,1593,2865,2923,3371	NO ₃ ⁻ ,NO ₂ ⁻ ,CO ₃ ²⁻ , quartz, organic(CH,humic)	(Na,Mg,Ca)(NO ₃ ,CO ₃)/ quartz/organic
83	3.72	C(7.5)N(16.2)O(47.9) Na(22.7)Mg(2.5) Al(1.6)Si(1.7)	NaNO ₃ [C,Mg,Al,Si]	827,1054,1263,1349,1564	NO ₃ ⁻ ,NO ₂ ⁻ ,Si-O ⁻ , organic(humic)	NaNO ₃ /organic
90	3.16	N(18.3)O(47.7)Na(17.6) Mg(1.6)Al(1.0)Si(1.4) S(4.1)Cl(1.1)Ca(7.3)	(Ca,Na)(NO ₃ ,SO ₄) [Mg,Al,Si,Cl]	833,1042,1125,1259,1349, 1564,1589,1788,2858,2916	NO ₃ ⁻ ,NO ₂ ⁻ ,SO ₄ ²⁻ , organic(CH,humic)	(Na,Mg,Ca)(NO ₃ ,SO ₄ ,Cl)/ organic
96	3.15	N(19.0)O(52.2)Na(24.3) S(2.2)Cl(0.9)Ca(1.4)	NaNO ₃ [S,Cl,Ca]	830,1125,1256,1349, 1561,1596,2916	NO ₃ ⁻ ,NO ₂ ⁻ ,SO ₄ ²⁻ , organic(CH,humic)	Na(NO ₃ ,SO ₄ ,Cl)/ organic
100	3.26	C(5.0)N(21.6) O(51.3)Na(22.1)	NaNO ₃ [C]	833,1118,1263,1349,1561, 1599,1788,2833,2923	NO ₃ ⁻ ,NO ₂ ⁻ ,SO ₄ ²⁻ , organic(CH,humic)	Na(NO ₃ ,SO ₄)/ organic
103	3.18	N(20.3)O(50.6) Na(28.2)Mg(1.0)	NaNO ₃ [Mg]	832,1128,1253,1352,1567, 1599,2858,2923	NO ₃ ⁻ ,NO ₂ ⁻ ,SO ₄ ²⁻ , organic(CH,humic)	Na(NO ₃ ,SO ₄)/ organic
104	3.89	C(8.4)N(13.9)O(51.6) Na(17.8)Mg(1.1)Al(1.1) Si(1.5)Cl(0.6)Ca(4.1)	(Na,Ca)NO ₃ [C,Mg,Al,Si,Cl,Ca]	827,872,1051,1256, 1356,1391,1628	NO ₃ ⁻ ,NO ₂ ⁻ ,CO ₃ ²⁻ , quartz, organic(humic)	(Na,Mg,Ca)(NO ₃ ,CO ₃)/ quartz/organic
106	2.52	N(20.1)O(52.3)	NaNO ₃	830,1130,1255,1356,	NO ₃ ⁻ ,NO ₂ ⁻ ,SO ₄ ²⁻ ,	Na(NO ₃ ,SO ₄ ,Cl)/organic

		Na(25.5)Cl(2.1)	[Cl]	1560,2916	organic(CH,humic)	
107	2.85	C(1.8)N(13.9)O(52.9) Na(24.7)Mg(2.1) Al(1.2)Si(2.4)Ca(0.9)	NaNO ₃ [C,Mg,Al,Si,Ca]	843,872,1045,1120,1256, 1352,1410,1564,2928	NO ₃ ⁻ ,NO ₂ ⁻ ,SO ₄ ²⁻ , CO ₃ ²⁻ ,Si-O, organic(CH,humic), H ₂ O	(Na,Mg,Ca)(NO ₃ ,CO ₃ ,SO ₄)/ organic/H ₂ O
(C) Silicate particles (24 particles)						
1. Silicate particles without water (14 particles)						
9	9.15	C(16.1)N(4.5)O(56.8) Na(1.0)Mg(3.2)Al(5.2) Si(9.8)K(1.0)Ca(2.4)	AlSi/C [N,Na,Mg,K,Ca]	786,833,944,1027,1127, 1345,1588,1652,2899,3322	montmorillonite, NO ₃ ⁻ , organic(CH,humic)	montmorillonite/ (Mg,Ca)NO ₃ /organic
20	5.43	C(7.6)N(1.3)O(56.0) Mg(0.9)Al(13.8)Si(17.0) K(2.2)Ca(0.5)Fe(0.7)	AlSi [C,N,Mg,K,Ca,Fe]	812,897,931,1007,1077, 1134,1390,1636,2904,3654	muscovite,CO ₃ ²⁻ , organic(CH)	muscovite/CO ₃ /organic
21	3.75	C(1.4)O(62.4)Al(0.5) Si(35.6)Ca(0.2)	SiO ₂ [C,Al,Ca]	770,794,1051	quartz	quartz
24	7.52	C(5.1)O(60.3)Na(1.1) Mg(0.5)Al(14.4)Si(15.2) K(2.9)Ca(0.4)	AlSi [C,Na,Mg,K,Ca]	753,821,926,1006,1160, 1400,1639,3630	muscovite,CO ₃ ²⁻ , organic(humic)	muscovite/CO ₃ /organic
41	8.63	C(20.8)N(4.3)O(51.5) Mg(1.2)Al(4.3)Si(13.4) K(0.3)Ca(3.6)Fe(0.7)	AlSi/C [N,Mg,K,Ca,Fe]	779,792,836,872,1005,1038, 1381,1404,1625,2846, 2923,3217	quartz, montmorillonite, CO ₃ ²⁻ ,NO ₃ ⁻ , organic(CH)	quartz/montmorillonite/ (Mg,Ca)(CO ₃ ,NO ₃)/organic
67	4.05	C(3.5)O(64.1) Al(0.3)Si(32.0))	SiO ₂ [C,Al]	769,790,1045,1352	quartz,NO ₃ ⁻	quartz
77	2.91	C(2.0)N(1.2)O(60.0) Na(1.0)Al(14.5) Si(20.6)K(0.8)	AlSi [C,N,Na,K]	779,841,1026,1151	montmorillonite	montmorillonite
84	3.67	C(28.8)O(44.1)Mg(0.6) Al(6.5)Si(9.7)S(0.9) K(0.3)Ca(0.3)Fe(8.8)	AlSi/C [Mg,S,K,Ca,Fe]	786,796,933,987,1014,1040, 1077,1167,1378,1622, 2939,3302	montmorillonite, quartz,NO ₃ ⁻ , organic(CH,humic)	montmorillonite/quartz/FeOx /NO ₃ /organic
87	3.07	C(16.4)N(1.2)O(53.7) Mg(2.1)Al(6.7)Si(17.3) S(0.9)K(0.2)Ca(1.5)	AlSi/C [N,Mg,S,K,Ca]	782,801,830,869,1054, 1179,1381,1390	quartz,NO ₃ ⁻ , CO ₃ ²⁻	quartz/(Mg,Ca)(CO ₃ ,NO ₃)
91	1.94	C(15.8)N(6.5)O(51.1) Na(2.2)Mg(2.8)Al(3.3) Si(12.8)S(0.6)K(0.6) Ca(3.8)Fe(0.6)	SiOx/C [N,Na,Mg,S, K,Ca,Fe]	833,863,1037, 1355,1415,2988	quartz,CO ₃ ²⁻ ,NO ₃ ⁻ , organic(CH)	quartz/ (Na,Mg,Ca)(CO ₃ ,NO ₃)/ organic

92	3.23	C(5.8)N(1.6)O(58.0) Na(4.6)Mg(0.8)Al(8.1) Si(19.7)K(0.3) Ca(0.3)Fe(0.9)	AlSi [C,N,Na,Mg, K,Ca,Fe]	871,908,990,1010,1057, 1081,1116,1160,1420, 1631,2910,3356,3609	montmorillonite, Na-feldspar,CO ₃ ²⁻ , organic(CH)	montmorillonite/Na-feldspar/ CO ₃ /organic
93	2.52	C(4.4)O(63.1)Al(0.5)Si(3 2.0)	SiO ₂ [C,Al]	769,795,1042	quartz	quartz/elemental carbon
98	4.64	C(10.9)N(4.7)O(52.1) Na(0.8)Mg(1.9)Al(9.1) Si(18.3)K(0.5) Ca(1.1)Fe(0.8)	AlSi/C [N,Na,Mg,K, Ca,Fe]	795,833,1022,1120,1352, 1637,2858,2916,3269	montmorillonite, NO ₃ ⁻ ,organic(CH)	montmorillonite/ (Na,Mg)NO ₃ /organic
101	11.15	C(58.8)O(27.8)Na(1.7) Mg(0.4)Al(3.2)Si(6.9)S(0.5)K(0.2)Ca(0.5)	AlSi/C [Na,Mg,S,K,Ca]	800,877,913,997,1034,1124, 1418,1619,2859,3214	AlSi-O,CO ₃ ²⁻ , organic(CH,humic)	montmorillonite/CO ₃ / organic
2. Silicate particles with water (10 particles)						
13	5.49	C(25.4)N(9.0)O(51.9) Mg(0.4)Al(2.0)Si(6.1) S(0.2)Ca(4.4)Fe(0.6)	AlSi/C [N,Mg,S,Ca,Fe]	776,820,855,1038, 1400,1625,3256	cristobalite,CO ₃ ²⁻ , NO ₃ ⁻ , organic(humic), H ₂ O	cristobalite/Ca(CO ₃ ,NO ₃)/ organic/H ₂ O
22	4.62	C(23.9)N(8.3)O(51.7) Mg(1.4)Al(2.4)Si(8.0) K(0.2)Ca(3.1)Fe(1.0)	AlSi/C [N,Mg,K,Ca,Fe]	789,873,950,1030, 1405,1618,3318	montmorillonite, CO ₃ ²⁻ ,NO ₃ ⁻ , organic(humic), H ₂ O	montmorillonite/ Ca(CO ₃ ,NO ₃)/organic/H ₂ O
26	2.64	C(19.4)N(8.7)O(52.3) Na(0.8)Mg(0.7)Al(0.9) Si(14.1)S(0.3)Ca(3.0)	SiO ₂ /C (Na,Mg,K,Ca)	775,832,863,1053,1348, 1387,1607,1641,2842, 2810,3297	cristobalite, CO ₃ ²⁻ , NO ₃ ⁻ , organic(CH,humic), H ₂ O	cristobalite/Ca(CO ₃ ,NO ₃)/ organic/H ₂ O
28	3.14	C(18.6)N(4.6)O(51.0) Na(0.5)Mg(1.1)Al(6.5) Si(10.3)K(0.4)Ca(2.0) Fe(4.8)Cl(0.3)	AlSi/C [N,Na,Mg,K, Ca,F,Cl]	863,987,1020,1391, 1622,2859,2926,3308	montmorillonite, CO ₃ ²⁻ ,NO ₃ ⁻ , organic(CH,humic), H ₂ O	montmorillonite/ Ca(CO ₃ ,NO ₃)/ organic/H ₂ O
40	3.70	C(11.6)N(7.0)O(55.3) Mg(3.5)Al(5.8)Si(9.9) K(0.9)Ca(4.3)Fe(1.8)	AlSi/C [N,Mg,K,Ca,Fe]	753,824,833,866,910,1006, 1158,1367,1404,1618, 1639,1705,3314	vermiculite, CO ₃ ²⁻ ,NO ₃ ⁻ , organic(humic), H ₂ O	vermiculite/CO ₃ /NO ₃ / organic/H ₂ O
45	4.27	C(5.3)N(1.6)O(54.1) Na(0.5)Mg(0.3)Al(8.4) Si(23.4)K(6.1)Ca(0.3)	AlSi [C,N,Na,Mg,K,Ca]	866,993,1086,1109,1410, 1623,1639,3314	K-feldspar,CO ₃ ²⁻ , NO ₃ ⁻ , organic(humic), H ₂ O	K-feldspar/CO ₃ /NO ₃ / organic/H ₂ O

56	4.80	C(24.2)N(8.6)O(49.6) Mg(1.6)Al(3.0)Si(6.3) S(0.3)K(0.4) Ca(5.3)Fe(0.8)	AlSi/C [N,Mg,S,K,Ca,Fe]	773,833,863,917,967,1022, 1114,1137,1398,1632,3275	Ca-feldspar, CO ₃ ²⁻ ,NO ₃ ⁻ , organic(CH,humic), H ₂ O	Ca-feldspar/Ca(CO ₃ ,NO ₃)/ organic/H ₂ O
69	5.34	C(8.1)N(2.2)O(48.7) Na(0.3)Mg(3.3)Al(9.8) Si(19.7)K(2.8) Ca(1.4)Fe(3.8)	AlSi [C,N,Na,Mg, K,Ca,Fe]	763,849,875,990,1088,1366, 1404,1637,3326	montmorillonite, CO ₃ ²⁻ ,NO ₃ ⁻ ,H ₂ O	montmorillonite/ (Mg,Ca,K)(CO ₃ ,NO ₃)/H ₂ O
72	3.58	C(24.7)N(8.3)O(50.6) Na(0.4)Al(1.0)Si(8.5) S(0.9)Ca(5.3)Cl(0.4)	SiO ₂ /C [N,Na,S,Ca,Cl]	779,804,860,1055,1106, 1404,1615,2916,3314	quartz,CO ₃ ²⁻ ,NO ₃ ⁻ , SO ₄ ²⁻ , organic(CH,humic), H ₂ O	quartz/Ca(CO ₃ ,NO ₃ ,SO ₄)/ organic/H ₂ O
97	2.74	C(15.8)N(5.4)O(48.7) Na(1.5)Mg(2.0)Al(4.0) Si(14.0)K(0.9)Ca(7.9)	AlSi/C [N,Na,Mg,K,Ca]	820,870,913,1007,1345, 1405,1625,1725,2932,3241	montmorillonite, CO ₃ ²⁻ ,NO ₃ ⁻ , organic(CH, humic),H ₂ O	montmorillonite/ (Na,Ca)(CO ₃ ,NO ₃)/ organic/H ₂ O
(D) Miscellaneous particles (11 particles)						
1. carbonaceous particles (4 particles)						
6	7.67	C(34.3)N(35.6)O(26.4) S(3.2)Cl(0.5)	organic	965,1035,1088,1244,1387, 1435,1552,1627,1727,2967, 3022,3324	organic(-CO, C=C,COO ⁻ ,CH, C=O,NO,SO)/NH ₄ ⁺ /SO ₄ ²⁻ /H ₂ O	WSOA/(NH ₄) ₂ SO ₄
31	10.00	C(39.7)N(8.3)O(41.1) Na(3.8)S(4.3)Ca(2.8)	organic/ (Na,Ca)(NO ₃ ,SO ₄)	1166,1367,1442,1597,1710, 2857,2922,3389	organic(-COH, COO ⁻ ,CH,C=O)/ H ₂ O	WSOA
37	2.99	C(67.7)N(3.6) O(26.1)Na(2.5)	organic	1398,1594,1619,1673,3242	Organic (COO ⁻ ,C=O),H ₂ O	WSOA
86	3.33	C(64.7)N(4.2)O(27.8) S(0.2)K(0.2) Ca(2.9)Cl(0.1)	organic	IR-inactive		elemental carbon
2. fly ash particles (2 particles)						
71	3.16	C(2.2)N(1.1)O(62.5) Na(0.4)Mg(0.3)Al(12.3) Si(20.0)K(0.6)Fe(0.7)	fly ash (AlSi)	826,913,1014	Si-O	fly ash - AlSi
78	3.01	C(1.5)O(55.6)Na(7.1) Mg(0.6)Al(16.3)Si(17.1) K(0.9)Fe(0.5)	fly ash (AlSi)	833,1040,1349,1392,1557	Si-O,CO ₃ ²⁻ ,NO ₃ ⁻	fly ash - Mg(CO ₃ ,NO ₃)/AlSi

3. Mg-containing particles (2 particles)						
12	5.71	C(26.6)O(56.4)Mg(17.0)	MgCO ₃ /C	833,1085,1137,1159,1208, 1352,1423,1692	NO ₃ ⁻ ,organic(CH)	Mg(NO ₃) ₂ /organic
36	3.23	N(8.7)O(58.9)Na(4.8) Mg(8.1)Al(1.8)Si(5.9) P(3.3)S(3.0)Ca(5.6)	(Na,Mg,Ca)(NO ₃ ,S O ₄)	739,836,880,1006,1066, 1154,1358,1565,1599, 2860,2917,3424,	NO ₃ ⁻ , montmorillonite, organic(CH,humic), H ₂ O	Mg(NO ₃) ₂ /montmorillonite/ organic/H ₂ O
4. iron oxide particles (2 particles)						
7	2.50	C(20.5)N(9.1)O(47.0) S(0.6)Fe(22.8)	FeOx/C	1048,1543,1643,2905	Si-O, organic(humic,CH)	FeOx/Si-O/organic
39	8.87	C(16.3)N(3.1)O(48.4) Mg(1.7)Al(1.6)Si(2.5) S(2.1)Fe(20.3)Zn(4.0)	FeOx/C	882,949,1029,1167, 1596,2938,3310	montmorillonite, organic(humic,CH), H ₂ O	FeOx/montmorillonite/ organic
5. aluminum particle (1 particle)						
88	3.17	C(13.8)N(5.1)O(52.1) Mg(0.3)Al(21.3)Si(0.4) S(0.9)K(0.6)Ca(5.6)	AlOx/Ca(CO ₃ ,NO ₃) [Mg,Si,S,K]	786,795,824,871,1040,1084, 1360,1393,1531,1611, 1641,3315	quartz,CO ₃ ²⁻ , NO ₃ ⁻ ,SO ₄ ²⁻ , organic(humic), H ₂ O	AlOx/quartz/ Ca(CO ₃ ,NO ₃ ,SO ₄)/ organic/H ₂ O

Figure S1. The second SEI obtained in a higher magnification than the overall SEI shown in Figure 1.

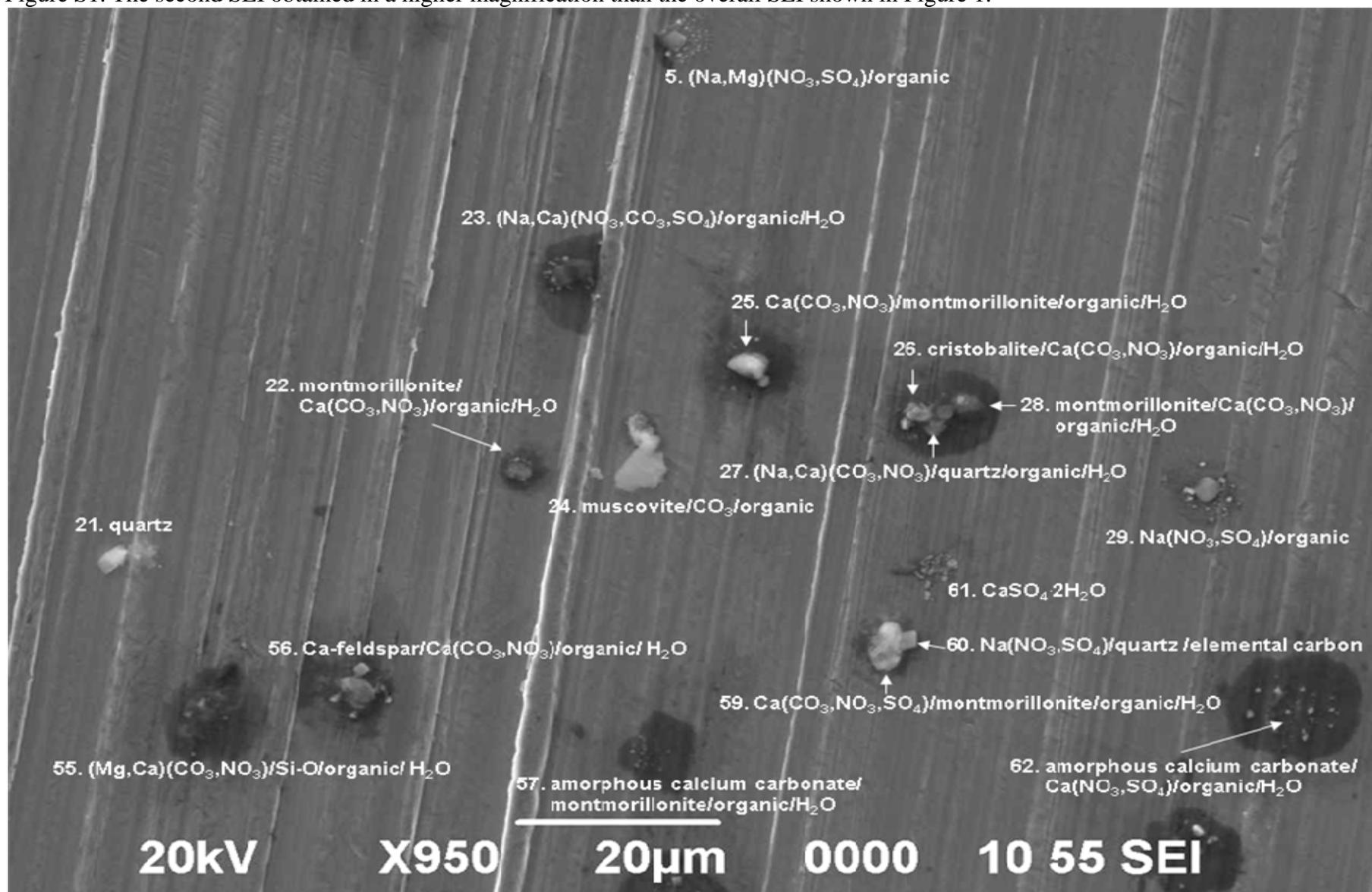


Figure S2. The third SEI obtained in a higher magnification than the overall SEI shown in Figure 1.

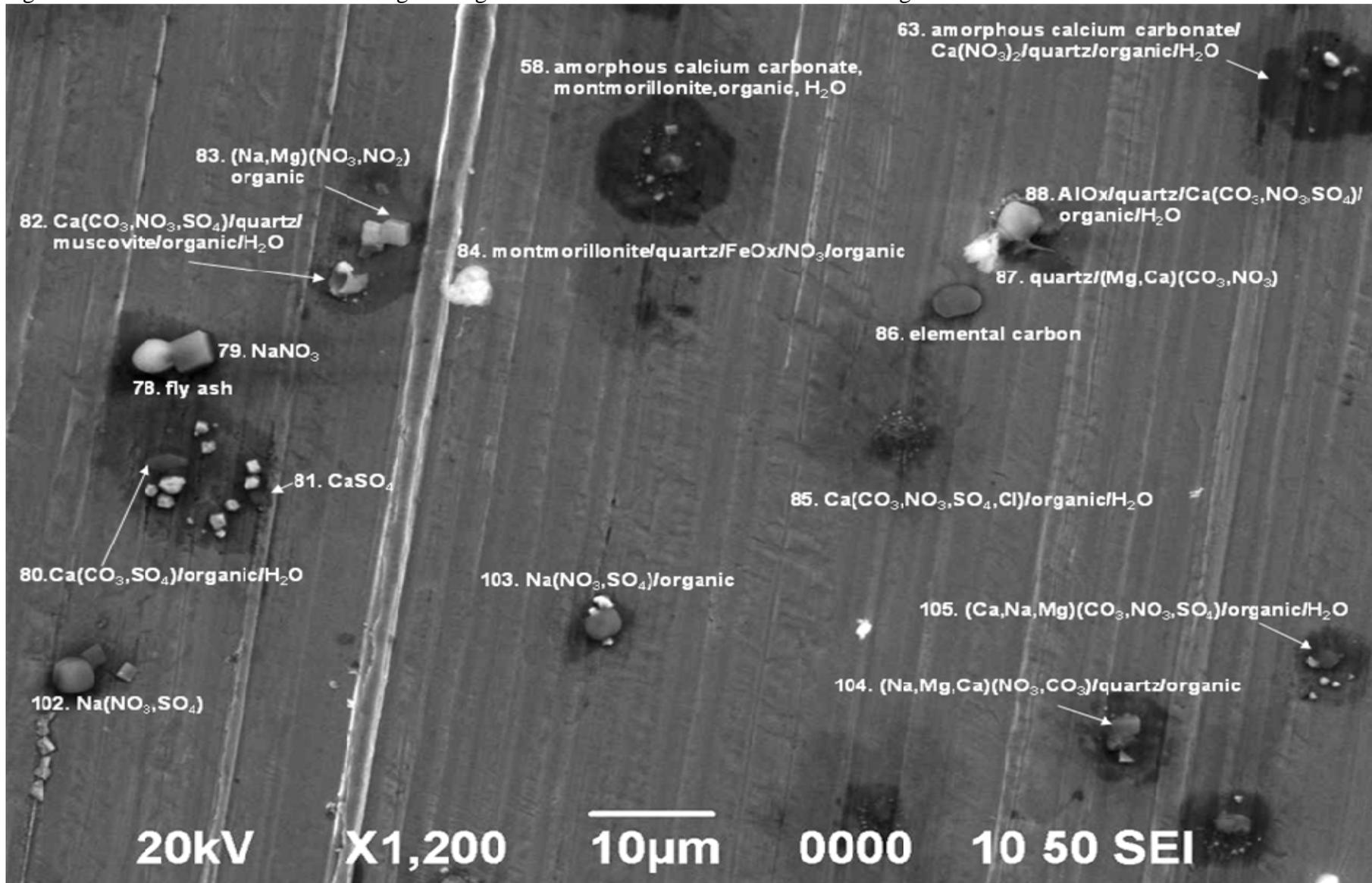


Figure S3. The fourth SEI obtained in a higher magnification than the overall SEI shown in Figure 1.

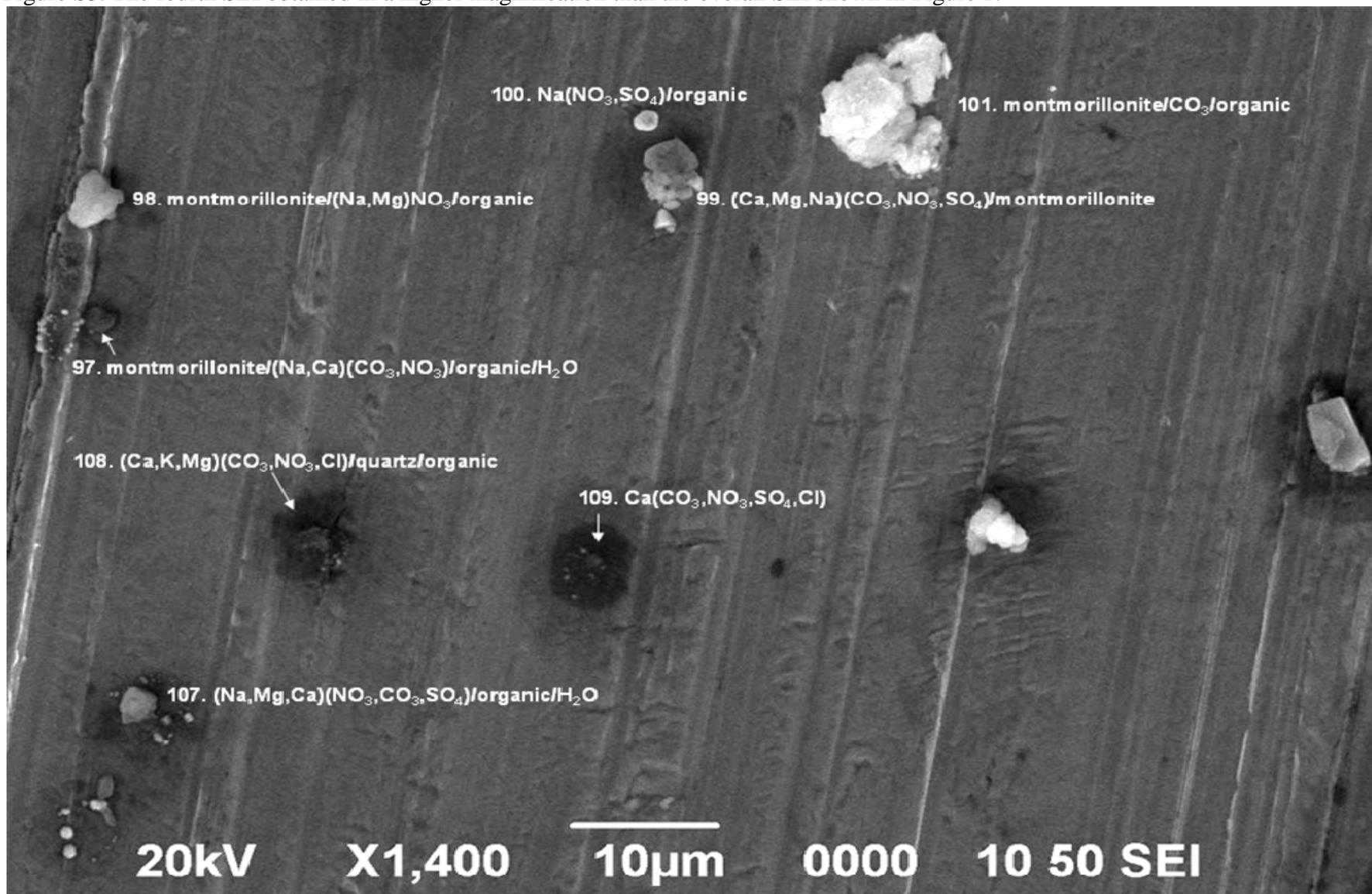


Figure S4. The fifth SEI obtained in a higher magnification than the overall SEI shown in Figure 1.

