

## Supporting Information

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**Title:** Chemical speciation of individual aerosol particles collected in Incheon, Korea by the combined use of quantitative ED-EPMA and ATR-FT-IR imaging techniques

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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.

| Particle #                                                                | size (in $\mu\text{m}$ ) | elemental concentrations (in %)                               | chemical species from EPMA data (minor elements)           | FT-IR absorption peaks (in $\text{cm}^{-1}$ ) | chemical species from ATR-FT-IR data                                                   | chemical species by the combined use of EPMA and ATR-FT-IR data                                         |
|---------------------------------------------------------------------------|--------------------------|---------------------------------------------------------------|------------------------------------------------------------|-----------------------------------------------|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| <b>(A) <math>\text{NaNO}_3</math>-containing particles (13 particles)</b> |                          |                                                               |                                                            |                                               |                                                                                        |                                                                                                         |
| 51                                                                        | 5.95                     | N(16.7)O(47.6)Na(35.7)                                        | $\text{NaNO}_3$                                            | 832, 1132, 1260, 1347, 1610, 1787             | $\text{NO}_3^-$ , $\text{NO}_2^-$ , $\text{SO}_4^{2-}$ , organic                       | $\text{Na}(\text{NO}_3, \text{NO}_2, \text{SO}_4)/\text{organic}$                                       |
| 81                                                                        | 3.65                     | N(17.1)O(52.8)Na(30.1)                                        | $\text{NaNO}_3$                                            | 832, 1116, 1263, 1348, 1597, 1788             | $\text{NO}_3^-$ , $\text{NO}_2^-$ , $\text{SO}_4^{2-}$ , organic                       | $\text{Na}(\text{NO}_3, \text{NO}_2, \text{SO}_4)/\text{organic}$                                       |
| 82                                                                        | 3.17                     | N(15.5)O(58.8)Na(25.7)                                        | $\text{NaNO}_3$                                            | 832, 1105, 1256, 1345, 1595, 1785             | $\text{NO}_3^-$ , $\text{NO}_2^-$ , $\text{SO}_4^{2-}$ , organic                       | $\text{Na}(\text{NO}_3, \text{NO}_2, \text{SO}_4)/\text{organic}$                                       |
| 67                                                                        | 4.46                     | C(1.7)N(17.1)O(51.9)Na(26.1)Mg(3.2)                           | $\text{NaNO}_3(\text{C})$                                  | 830, 1150, 1260, 1348, 1580, 1786             | $\text{NO}_3^-$ , $\text{NO}_2^-$ , $\text{SO}_4^{2-}$ , organic                       | $(\text{Na}, \text{Mg})(\text{NO}_3, \text{NO}_2, \text{SO}_4)/\text{organic}$                          |
| 64                                                                        | 3.08                     | C(3.0)N(17.1)O(53.9)Na(24.5)Mg(1.5)                           | $\text{NaNO}_3(\text{C})$                                  | 830, 1113, 1257, 1347, 1597, 1786             | $\text{NO}_3^-$ , $\text{NO}_2^-$ , $\text{SO}_4^{2-}$ , organic                       | $(\text{Na}, \text{Mg})(\text{NO}_3, \text{NO}_2, \text{SO}_4)/\text{organic}$                          |
| 69                                                                        | 5.33                     | C(5.9)N(19.1)O(47.2)Na(23.9)Mg(1.1)S(2.1)Ca(0.7)              | $\text{NaNO}_3(\text{C})$                                  | 833, 1128, 1260, 1345, 1594, 1788             | $\text{NO}_3^-$ , $\text{NO}_2^-$ , $\text{SO}_4^{2-}$ , organic                       | $(\text{Na}, \text{Mg})(\text{NO}_3, \text{NO}_2, \text{SO}_4)/\text{organic}$                          |
| 97                                                                        | 4.7                      | N(16.1)O(55.6)Na(26.1)Mg(2.2)                                 | $\text{NaNO}_3(\text{Mg})$                                 | 829, 1117, 1255, 1342, 1583, 1787             | $\text{NO}_3^-$ , $\text{NO}_2^-$ , $\text{SO}_4^{2-}$ , organic                       | $(\text{Na}, \text{Mg})(\text{NO}_3, \text{NO}_2, \text{SO}_4)/\text{organic}$                          |
| 73                                                                        | 4.48                     | C(3.4)N(12.4)O(46.9)Na(34.4)Mg(0.4)                           | $\text{NaNO}_3(\text{C}, \text{Mg})$                       | 829, 1124, 1251, 1347, 1599, 1787             | $\text{NO}_3^-$ , $\text{NO}_2^-$ , $\text{SO}_4^{2-}$ , organic                       | $(\text{Na}, \text{Mg})(\text{NO}_3, \text{NO}_2, \text{SO}_4)/\text{organic}$                          |
| 94                                                                        | 4.22                     | C(6.6)N(13.8)O(53.9)Na(18.3)Mg(7.4)                           | $\text{NaNO}_3(\text{C}, \text{Mg})$                       | 830, 875, 1347, 1587, 1790                    | $\text{CO}_3^{2-}$ , $\text{NO}_3^-$ , $\text{NO}_2^-$ , $\text{SO}_4^{2-}$ , organic  | $(\text{Na}, \text{Mg})(\text{NO}_3, \text{NO}_2, \text{SO}_4)/\text{organic}$                          |
| 105                                                                       | 4.04                     | C(2.7)N(14.7)O(56.6)Na(23.4)Mg(2.7)                           | $\text{NaNO}_3(\text{C}, \text{Mg})$                       | 838, 1101, 1265, 1347, 1585                   | $\text{NO}_3^-$ , $\text{NO}_2^-$ , $\text{SO}_4^{2-}$ , organic                       | $(\text{Na}, \text{Mg})(\text{CO}_3, \text{NO}_3, \text{NO}_2, \text{SO}_4)/\text{organic}$             |
| 109                                                                       | 2.93                     | C(5.9)N(12.7)O(56.5)Na(18.9)Mg(6.1)                           | $\text{NaNO}_3(\text{C}, \text{Mg})$                       | 835, 1110, 1262, 1346, 1605, 1784             | $\text{NO}_3^-$ , $\text{NO}_2^-$ , $\text{SO}_4^{2-}$ , organic                       | $(\text{Na}, \text{Mg})(\text{NO}_3, \text{NO}_2, \text{SO}_4)/\text{organic}$                          |
| 111                                                                       | 4.68                     | N(15.6)O(39.2)Na(25)Mg(1.5)Si(0.7)S(0.6)Cl(17.3)              | $\text{NaNO}_3(\text{Mg}, \text{Si}, \text{S}, \text{Cl})$ | 833, 866, 1024, 1100, 1345, 1597, 1786        | $\text{CO}_3^{2-}$ , $\text{NO}_3^-$ , $\text{NO}_2^-$ , $\text{SO}_4^{2-}$ , organic  | $(\text{Na}, \text{Mg})(\text{CO}_3, \text{NO}_3, \text{NO}_2, \text{SO}_4)/\text{Cl}/\text{organic}$   |
| 17                                                                        | 8.39                     | C(4.9)N(15.4)O(57.8)Na(13.3)Mg(1.5)S(2.7)Cl(0.4)K(0.3)Ca(3.8) | $\text{NaNO}_3$<br>(C, Mg, S, Cl, K, Ca)                   | 832, 1134, 1259, 1344, 1637, 1786, 3389       | $\text{NO}_3^-$ , $\text{NO}_2^-$ , $\text{SO}_4^{2-}$ , organic, $\text{H}_2\text{O}$ | $(\text{Na}, \text{Ca}, \text{Mg})(\text{NO}_3, \text{NO}_2, \text{SO}_4)/\text{Cl}/\text{H}_2\text{O}$ |
| <b>(B) Ca-containing particles (35 particles)</b>                         |                          |                                                               |                                                            |                                               |                                                                                        |                                                                                                         |

|     |      |                                                                        |                                                           |                                                                                    |                                                                                                                                                        |                                                                                                       |
|-----|------|------------------------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| 27  | 7.98 | C(23.8)O(57.1)Na(0.4)<br>Mg(0.8)Al(2.5)Si(4.5)<br>S(0.2)Ca(8.3)Fe(2.4) | CaCO <sub>3</sub><br>(Na,Mg,Al,Si,S)                      | 799,873,1048,1406,1590,<br>2928                                                    | CO <sub>3</sub> <sup>2-</sup> ,quartz,<br>organic                                                                                                      | (Na,Mg,Ca)CO <sub>3</sub> /<br>quartz/organic                                                         |
| 112 | 9.51 | C(23.3)O(56.1)Na(1.8)<br>Mg(1.0)Si(0.4)Cl(2.2)<br>Ca(14.9)             | CaCO <sub>3</sub><br>(Mg,Si,Cl)                           | 869,1018,1408,1593,1632,<br>2814,3381                                              | CO <sub>3</sub> <sup>2-</sup> ,organic,<br>Si-O,H <sub>2</sub> O                                                                                       | (Na,Mg,Ca)CO <sub>3</sub> /<br>organic/Si-O/Cl/H <sub>2</sub> O                                       |
| 93  | 1.59 | C(29.7)N(4.0)O(55.5)<br>Ca(10.8)                                       | Ca(CO <sub>3</sub> ,NO <sub>3</sub> )                     | 810,868,1407,1586                                                                  | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,organic                                                                                   | Ca(CO <sub>3</sub> ,NO <sub>3</sub> )/organic                                                         |
| 10  | 4.79 | C(11.7)N(13.0)O(60.0)<br>Al(2.0)Si(3.7)Cl(0.4)<br>Ca(9.2)              | Ca(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Al,Si,Cl)       | 825,866,946,1260,1380,<br>1450,1549,1591,1632,2923,<br>3435                        | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup><br>Si-O,organic,H <sub>2</sub> O                             | Ca(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> )/organic/<br>Si-O/Cl/H <sub>2</sub> O           |
| 28  | 11.7 | C(10.6)N(3.3)O(58.7)<br>Mg(3.4)Al(3.5)Si(5.1)<br>Cl(0.5)Ca(14.7)       | Ca(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Mg,Al,Si,Cl)    | 778,796,817,871,912,1006,<br>1042,1168,1356,1400,1597,<br>1629,1795,3425,3554,3655 | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> ,<br>montmorillonite,<br>quartz,organic,<br>H <sub>2</sub> O                                            | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )/<br>montmorillonite/quartz/Cl<br>/organic/H <sub>2</sub> O |
| 29  | 7.26 | C(8.8)N(11.9)O(60.8)<br>Al(3.2)Si(5.9)Cl(0.3)<br>K(0.4)Ca(8.8)         | Ca(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Al,Si,Cl,K)     | 751,780,817,867,942,1014,<br>1040,1168,1240,1364,1427,<br>1592,1633,3462           | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>muscovite,<br>cristobalite,organic,<br>H <sub>2</sub> O | Ca(CO <sub>3</sub> ,NO <sub>3</sub> )/muscovite/<br>cristobalite/organic/Cl/K/<br>H <sub>2</sub> O    |
| 35  | 7.04 | C(13.5)N(7.7)O(63.5)<br>Mg(0.3)Al(0.6)Si(1.1)<br>K(0.3)Ca(13.1)        | Ca(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Mg,Al,Si,K)     | 729,810,872,1054,1254,<br>1377,1590,1629,2938,3476                                 | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup><br>Si-O,organic,H <sub>2</sub> O                             | (Mg,K,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )/<br>Si-O/Cl/organic/H <sub>2</sub> O                     |
| 42  | 6.11 | C(9.8)N(14.0)O(59.2)<br>Na(0.4)Mg(1.3)Al(2.4)<br>Si(4.4)Cl(0.4)Ca(8.1) | Ca(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Na,Mg,Al,Si,Cl) | 784,816,870,1049,1247,<br>1360,1407,1595,1637,2950,<br>3466                        | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> ,<br>cristobalite,<br>organic,H <sub>2</sub> O                            | (Na,Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )/<br>cristobalite/organic/Cl/H <sub>2</sub> O            |
| 61  | 3.24 | C(22.3)N(11.7)O(58.0)<br>Mg(0.7)Si(0.7)Cl(0.4)<br>Ca(5.8)Fe(0.4)       | Ca(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Mg,Si,Cl,Fe)    | 815,875,919,1353,1404,<br>1581,1635,2923,3439                                      | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,<br>Si-O,organic,H <sub>2</sub> O                                                         | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> )/<br>Si-O/organic/Cl/H <sub>2</sub> O      |
| 62  | 8.06 | C(8.0)N(14.7)O(67.5)<br>Mg(1.3)Si(0.3)Cl(0.3)<br>K(0.7)Ca(6.9)         | Ca(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Mg,Si,Cl,K)     | 817,869,1042,1115,1347,<br>1413,1587,1635,2919,3428                                | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,SO <sub>4</sub> <sup>2-</sup> ,<br>Si-O,organic,H <sub>2</sub> O                          | (Mg,K,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,SO <sub>4</sub> )/<br>Si-O/Cl/organic/H <sub>2</sub> O    |
| 66  | 8.66 | C(8.3)N(12.4)O(62.1)<br>Mg(1.1)Al(3.2)Si(4.6)<br>Cl(0.6)K(0.4)Ca(7.3)  | Ca(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Mg,Al,Si,K,Cl)  | 754,816,870,1055,1160,<br>1260,1383,1434,1595,1637,<br>2930,3466                   | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>quartz,organic,H <sub>2</sub> O                         | (Mg,K,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> )/<br>quartz/Cl/organic/H <sub>2</sub> O  |
| 68  | 8.89 | C(10.4)N(12.2)O(60.4)<br>Mg(1.4)Al(1.8)Si(6.7)<br>Cl(0.4)Ca(8.5)       | Ca(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Mg,Al,Si,Cl)    | 776,797,822,869,1048,1166,<br>1257,1372,1443,1595,1629,<br>2918,3464               | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup><br>quartz,organic,H <sub>2</sub> O                           | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> )/<br>quartz/organic/H <sub>2</sub> O       |
| 103 | 2.67 | C(28.3)N(3.6)O(54.7)                                                   | Ca(CO <sub>3</sub> ,NO <sub>3</sub> )                     | 878,951,1351,1392,1604                                                             | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,                                                                                          | (Na,Mg,K,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )/                                                      |

|     |      |                                                                                         |                                                                   |                                                              |                                                                                                                                                                 |                                                                                                              |
|-----|------|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
|     |      | Na(0.8)Mg(1.1)Al(1.3)<br>Si(2.3)S(0.3)K(0.4)<br>Ca(7.3)                                 | (Na,Mg,Al,Si,S,K)                                                 |                                                              | Si-O,organic                                                                                                                                                    | organic/Si-O                                                                                                 |
| 106 | 13.4 | C(18.2)N(5.3)O(62.6)<br>Mg(0.8)Ca(13.1)                                                 | Ca(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Mg)                     | 745,818,871,1046,1384,<br>1590,1631,1793,2951,3476           | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,<br>organic,H <sub>2</sub> O                                                                       | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )/organic/<br>H <sub>2</sub> O                                      |
| 114 | 8.07 | C(10.4)N(12.1)O(62.8)<br>Na(0.4)Mg(5.2)Al(0.5)<br>Si(0.9)S(0.2)Cl(0.9)<br>K(0.3)Ca(8.3) | Ca(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Na,Mg,Al<br>,Si,S,Cl,K) | 819,857,1054,1133,1349,<br>1413,1622,2923,3429               | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,SO <sub>4</sub> <sup>2-</sup> ,<br>Si-O,organic,H <sub>2</sub> O                                   | (Na,Mg,K,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,<br>SO <sub>4</sub> )/Si-O/Cl/organic/H <sub>2</sub> O        |
| 115 | 5.58 | C(8.7)N(11.0)O(68.2)<br>Mg(1.6)Al(0.3)Si(0.6)<br>Cl(1.5)Ca(6.0)Fe(2.2)                  | Ca(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Mg,Al,Si,Cl,Fe)         | 813,857,1041,1141,1230,<br>1360,1423,1595,1629,<br>2928,3380 | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>Si-O,organic,H <sub>2</sub> O                                    | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> )/<br>Si-O/organic/H <sub>2</sub> O                |
| 13  | 5.82 | C(9.9)N(13.8)O(62.1)<br>Mg(1.0)Al(1.2)Si(2.3)<br>Ca(9.8)                                | Ca(NO <sub>3</sub> ) <sub>2</sub><br>(C,Mg,Al,Si)                 | 796,862,948,1268,1363,<br>1413,2917,3292                     | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>Si-O,organic,H <sub>2</sub> O                                    | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> )/<br>Si-O/Cl/organic/H <sub>2</sub> O             |
| 14  | 6.27 | C(9.0)N(13.3)O(64.8)<br>Si(2.0)S(1.4)Ca(9.2)                                            | Ca(NO <sub>3</sub> ) <sub>2</sub><br>(C,Si,S)                     | 820,870,1066,1150,1261,<br>1381,1440,1640,2898,2929,<br>3494 | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>SO <sub>4</sub> <sup>2-</sup> ,Si-O,<br>organic,H <sub>2</sub> O | Ca(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> ,SO <sub>4</sub> )/<br>Si-O/organic/H <sub>2</sub> O    |
| 18  | 5.82 | C(8.4)N(16.6)O(65.8)<br>Ca(9.2)                                                         | Ca(NO <sub>3</sub> ) <sub>2</sub><br>(C)                          | 815,873,1044,1259,1372,<br>1443,1600,1636,3475               | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>organic,H <sub>2</sub> O                                         | Ca(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> )/organic/<br>H <sub>2</sub> O                          |
| 21  | 6.09 | C(8.9)N(15.3)O(63.4)<br>Si(0.2)S(1.0)Cl(0.2)<br>Ca(11.0)                                | Ca(NO <sub>3</sub> ) <sub>2</sub><br>(C,Si,S,Cl)                  | 820,860,1047,1101,1256,<br>13671425,1599,1631,2926,<br>3455  | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>SO <sub>4</sub> <sup>2-</sup> ,Si-O,<br>organic,H <sub>2</sub> O | Ca(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> ,SO <sub>4</sub> )/<br>Si-O/Cl/organic/H <sub>2</sub> O |
| 31  | 8.61 | C(6.9)N(14.0)O(63.7)<br>Mg(0.4)Al(1.0)Si(1.9)<br>S(2.3)Cl(0.3)K(0.2)<br>Ca(9.7)         | Ca(NO <sub>3</sub> ) <sub>2</sub><br>(C,Mg,Al,Si,S,Cl,K)          | 753,790,860,1046,1358,<br>1425,1594,1639,2924,3487           | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,<br>cristobalite,<br>organic,H <sub>2</sub> O                                                      | (Mg,K,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )/<br>cristobalite/organic/S/Cl/H <sub>2</sub> O                  |
| 37  | 4.2  | C(10.3)N(12.0)O(63.2)<br>Na(0.3)Mg(0.8)Al(2.6)<br>Si(4.7)Cl(0.3)K(0.3)<br>Ca(5.5)       | Ca(NO <sub>3</sub> ) <sub>2</sub><br>(C,Na,Mg,Al,Si,Cl,<br>K)     | 753,815,864,1044,1141,<br>1263,1365,1408,1590,1626,<br>3452  | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>organic,H <sub>2</sub> O                                         | (Na,Mg,K,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,<br>NO <sub>2</sub> )/quartz/Cl/organic/H <sub>2</sub> O      |
| 47  | 8.04 | C(7.8)N(14.4)O(63.8)<br>Mg(1.2)S(1.3)Cl(1.1)<br>Ca(9.4)                                 | Ca(NO <sub>3</sub> ) <sub>2</sub><br>(C,S,Cl)                     | 817,864,1123,1368,1428,<br>1580,1630,1796,3439               | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,SO <sub>4</sub> <sup>4-</sup> ,<br>Si-O,organic,H <sub>2</sub> O                                   | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,SO <sub>4</sub> )/Cl/<br>organic/H <sub>2</sub> O                  |
| 52  | 8.67 | C(9.0)N(16.5)O(61.3)<br>Mg(0.3)Al(0.6)Si(1.0)<br>S(0.9)Cl(0.7)Ca(9.8)                   | Ca(NO <sub>3</sub> ) <sub>2</sub><br>(C,Mg,Al,Si,S,Cl)            | 817,861,1043,1152,1369,<br>1421,1596,1630,2926,3468          | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,SO <sub>4</sub> <sup>2-</sup> ,<br>Si-O,organic,H <sub>2</sub> O                                   | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,SO <sub>4</sub> )/<br>Si-O/Cl/H <sub>2</sub> O                     |
| 56  | 3.75 | C(37.0)N(8.0)O(43.9)                                                                    | Ca(NO <sub>3</sub> ) <sub>2</sub>                                 | 830,871,1056,1135,1334,                                      | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,SO <sub>4</sub> <sup>2-</sup> ,                                                                    | (Na,Mg,K,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,                                                              |

|                                                          |      |                                                                         |                                                                                 |                                                                  |                                                                                                                                                |                                                                                                                  |
|----------------------------------------------------------|------|-------------------------------------------------------------------------|---------------------------------------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
|                                                          |      | Na(1.7)Mg(0.9)Al(1.6)<br>Si(3.0)P(0.3)S(0.7)<br>K(0.3)Ca(2.4)           | (C,Na,Mg,Al,P,Si,S,<br>K)                                                       | 1417,1591                                                        | Si-O,organic                                                                                                                                   | SO <sub>4</sub> /Si-O/P/organic                                                                                  |
| 87                                                       | 9.69 | C(8.8)N(15.9)O(61.2)<br>Mg(0.3)Al(1.1)Si(2.0)<br>Cl(0.4)Ca(10.4)        | Ca(NO <sub>3</sub> ) <sub>2</sub><br>(C,Mg,Al,Si,Cl)                            | 815,860,1046,1245,1379,<br>1423,1594,1629,2917,3452              | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>Si-O,organic,H <sub>2</sub> O                   | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> )/<br>Si-O/Cl/organic/H <sub>2</sub> O                 |
| 102                                                      | 8.01 | C(10.8)N(15.1)O(63.7)<br>Si(1.0)Cl(0.6)Ca(8.8)                          | Ca(NO <sub>3</sub> ) <sub>2</sub><br>(C,Si,Cl)                                  | 818,862,1052,1255,1350,<br>1404,1597,1641,2929,3480              | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>Si-O,organic,H <sub>2</sub> O                   | Ca(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> )/<br>Si-O/Cl/organic/H <sub>2</sub> O                      |
| 107                                                      | 9.5  | C(7.5)N(17.4)O(66.0)<br>Cl(0.4)Ca(8.8)                                  | Ca(NO <sub>3</sub> ) <sub>2</sub><br>(C,Cl)                                     | 818,862,1052,1255,1366,<br>1429,1599,1641,2968,3484              | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>organic,H <sub>2</sub> O                        | Ca(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> )/Cl/<br>organic/H <sub>2</sub> O                           |
| 108                                                      | 5.43 | C(8.6)N(16.3)O(65.3)<br>Cl(0.4)Ca(9.4)                                  | Ca(NO <sub>3</sub> ) <sub>2</sub><br>(C,Cl)                                     | 823,865,1045,1230,1368,<br>1422,1595,1632,2893,2923,<br>3441     | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>organic,H <sub>2</sub> O                        | Ca(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> )/Cl/<br>organic/H <sub>2</sub> O                           |
| 116                                                      | 4.52 | C(10.4)N(15.2)O(63.8)<br>S(1.3)Ca(9.3)                                  | Ca(NO <sub>3</sub> ) <sub>2</sub><br>(C,S)                                      | 820,870,1115,1263,1381,<br>1440,1640,3494                        | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>SO <sub>4</sub> <sup>2-</sup> ,H <sub>2</sub> O | Ca(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> ,SO <sub>4</sub> )/H <sub>2</sub> O                         |
| 1                                                        | 3.38 | C(11.3)N(2.9)O(50.6)<br>Mg(1.1)Al(4.0)Si(6.7)<br>S(10.0)Ca(13.1)Fe(0.3) | Ca(NO <sub>3</sub> ,SO <sub>4</sub> )<br>(C,Mg,Al,Si,S,Fe)                      | 815,865,944,1030,1130,<br>1348,1408,1596,1624,2826,<br>2917,3407 | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,SO <sub>4</sub> <sup>2-</sup> ,<br>Si-O,organic,H <sub>2</sub> O                  | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,SO <sub>4</sub> )/<br>Si-O/Cl/organic/H <sub>2</sub> O                 |
| 38                                                       | 3.33 | C(9.0)N(10.6)O(67.3)<br>Mg(0.3)Si(2.4)S(1.8)<br>Ca(8.5)                 | Ca(NO <sub>3</sub> ,SO <sub>4</sub> )<br>(C,Mg,Si,S)                            | 811,856,951,1125,1260,<br>1353,1407,1593,2923                    | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>SO <sub>4</sub> <sup>2-</sup> ,Si-O,organic     | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> ,SO <sub>4</sub> )/<br>Si-O/organic                    |
| 60                                                       | 4.46 | C(10.1)N(12.0)O(64.7)<br>Mg(0.7)Si(1.2)S(2.0)<br>K(0.3)Ca(9.1)          | Ca(NO <sub>3</sub> ,SO <sub>4</sub> )<br>(C,Mg,Si,S,K)                          | 818,878,946,1116,1259,<br>1350,1443,1580,1622,1660,<br>3257      | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>SO <sub>4</sub> <sup>2-</sup> ,Si-O,organic     | (Mg,K,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> ,<br>SO <sub>4</sub> )/Si-O/organic/H <sub>2</sub> O |
| 117                                                      | 3.57 | C(8.4)N(7.0)O(67.4)<br>Mg(0.4)Al(0.8)Si(1.5)<br>S(4.9)Ca(9.7)           | Ca(NO <sub>3</sub> ,SO <sub>4</sub> )<br>(C,Mg,Al,Si)                           | 814,870,1032,1095,1254,<br>1353,1419,1595,1650,2859,<br>3504     | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,SO <sub>4</sub> <sup>2-</sup> ,<br>Si-O,organic,H <sub>2</sub> O                  | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,SO <sub>4</sub> )/<br>Si-O/Cl/organic/H <sub>2</sub> O                 |
| 30                                                       | 7.35 | C(6.2)N(9.6)O(70.5)<br>Mg(0.5)Si(0.3)S(4.3)<br>Cl(1.0)Ca(8.3)           | Ca(CO <sub>3</sub> ,NO <sub>3</sub> ,SO <sub>4</sub> )<br>(C,Mg,Si,Cl)          | 748,819,869,1059,1124,<br>1369,1427,1601,1626,1787,<br>2894,3489 | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,SO <sub>4</sub> <sup>2-</sup> ,<br>Si-O,organic,H <sub>2</sub> O                  | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,SO <sub>4</sub> )/<br>Si-O/Cl/H <sub>2</sub> O                         |
| <b>(C) Ca- and Mg-containing particles (9 particles)</b> |      |                                                                         |                                                                                 |                                                                  |                                                                                                                                                |                                                                                                                  |
| 5                                                        | 8.61 | C(9.3)N(14.1)O(62.8)<br>Mg(8.0)Cl(0.7)Ca(4.8)                           | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Cl)                              | 817,854,1355,1420,1633,<br>3409                                  | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,H <sub>2</sub> O                                                                  | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )/Cl/H <sub>2</sub> O                                                   |
| 9                                                        | 3.74 | C(20.2)N(5.1)O(54.7)<br>Na(7.3)Mg(2.6)Si(1.0)<br>S(4.5)Ca(4.7)          | (Na,Mg,Ca)(CO <sub>3</sub> ,<br>NO <sub>3</sub> ,SO <sub>4</sub> )<br>(Mg,Si,S) | 830,882,935,1118,1264,<br>1361,1415,1590,2917                    | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>SO <sub>4</sub> <sup>2-</sup> ,Si-O,organic     | (Na,Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> ,<br>SO <sub>4</sub> )/Si-O/organic                 |
| 15                                                       | 5.95 | C(8.9)N(8.9)O(61.0)<br>Mg(3.4)Al(3.7)Si(8.6)                            | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Mg,Al,Si,Cl)                     | 815,852,953,1056,1360,<br>1417,1629,3418                         | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,<br>quartz,H <sub>2</sub> O                                                       | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )/quartz/<br>Cl/H <sub>2</sub> O                                        |

|                                                  |      |                                                                 |                                                                      |                                                        |                                                                                                                                                |                                                                                          |
|--------------------------------------------------|------|-----------------------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
|                                                  |      | Cl(0.4)Ca(5.1)                                                  |                                                                      |                                                        |                                                                                                                                                |                                                                                          |
| 33                                               | 5.53 | C(8.7)N(12.5)O(64.5)<br>Mg(7.7)S(0.3)Cl(0.9)<br>Ca(4.6)         | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(S,Cl)                 | 824,858,1375,1445,1633,<br>3448                        | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,H <sub>2</sub> O                                                                  | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )/S/Cl/<br>H <sub>2</sub> O                     |
| 45                                               | 7.97 | C(9.1)N(12.2)O(63.2)<br>Mg(8.0)Si(1.0)Cl(1.1)<br>Ca(5.4)        | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Si,Cl)                | 818,857,1352,1427,1633,<br>3409                        | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,H <sub>2</sub> O                                                                  | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )/Si/Cl/<br>H <sub>2</sub> O                    |
| 65                                               | 2.78 | C(11.0)N(10.8)O(64.1)<br>Mg(3.2)Si(2.4)Ca(8.5)                  | Ca(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Mg,Si)                     | 816,863,1062,1351,1445,<br>1635,3402                   | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,<br>quartz,H <sub>2</sub> O                                                       | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )/quartz/<br>H <sub>2</sub> O                   |
| 74                                               | 10.1 | C(7.3)N(11.8)O(62.7)<br>Mg(11.2)Si(0.6)Cl(1.2)<br>Ca(5.4)       | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Si,Cl)                | 818,850,1040,1355,1423,<br>1630,3363                   | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,Si-O,<br>H <sub>2</sub> O                                                         | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )/<br>Si-O/Cl/H <sub>2</sub> O                  |
| 88                                               | 9.86 | C(7.6)N(14.3)O(63.5)<br>Mg(8.0)Cl(1.5)Ca(5.1)                   | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Cl)                   | 810,858,1370,1431,1633,<br>3448                        | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,H <sub>2</sub> O                                                                  | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )/Cl/H <sub>2</sub> O                           |
| 110                                              | 5.68 | C(10.2)N(12.5)O(63.8)<br>Mg(8.0)Si(1.7)Cl(0.5)<br>Ca(4.6)       | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Si,Cl)                | 817,858,1045,1365,1427,<br>1635,3450                   | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,<br>Si-O,H <sub>2</sub> O                                                         | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )/<br>Si-O/Cl/H <sub>2</sub> O                  |
| <b>(D) Mg-containing particles (6 particles)</b> |      |                                                                 |                                                                      |                                                        |                                                                                                                                                |                                                                                          |
| 63                                               | 2.7  | C(10.0)N(8.3)O(64.0)<br>Mg(11.9)Si(1.6)S(0.7)<br>Cl(0.8)Ca(2.8) | Mg(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Si,S,Cl,Ca)                | 824,880,913,1125,1381,<br>1431,1612                    | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,SO <sub>4</sub> <sup>2-</sup> ,<br>Si-O,organic,H <sub>2</sub> O                  | (Mg,Ca)(CO <sub>3</sub> ,SO <sub>4</sub> )/<br>Si-O/Cl/organic                           |
| 91                                               | 4.62 | C(17.8)N(8.4)O(58.3)<br>Mg(14.5)Cl(1.0)                         | Mg(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Cl)                        | 810,850,1405,1605,1620,<br>3305                        | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,<br>organic,H <sub>2</sub> O                                                      | Mg(CO <sub>3</sub> ,NO <sub>3</sub> )/Cl/organic/<br>H <sub>2</sub> O                    |
| 104                                              | 2.48 | C(18.6)N(0.4)O(61.0)<br>Mg(19.7)Si(0.3)                         | Mg(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Si)                        | 870,956,1361,1430,1631,<br>2923,3369                   | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,<br>Si-O,organic,H <sub>2</sub> O                                                 | Mg(CO <sub>3</sub> ,NO <sub>3</sub> )/<br>Si-O/organic/H <sub>2</sub> O                  |
| 58                                               | 2.34 | C(20.2)N(4.6)O(55.3)<br>Na(3.5)Mg(11.6)S(3.2)<br>Cl(0.7)K(1.1)  | Mg(NO <sub>3</sub> ,SO <sub>4</sub> )<br>(Na,Cl,K)                   | 812,916,1081,1343,1600                                 | NO <sub>3</sub> <sup>-</sup> ,SO <sub>4</sub> <sup>2-</sup> ,organic                                                                           | (Na,Mg,K)(NO <sub>3</sub> ,SO <sub>4</sub> )/<br>Cl/organic                              |
| 46                                               | 10.5 | C(8.9)N(8.4)O(63.9)<br>Mg(10.6)Si(0.3)S(3.9)<br>Cl(1.6)Ca(2.5)  | Mg(CO <sub>3</sub> ,NO <sub>3</sub> ,SO <sub>4</sub> )<br>(Si,Cl,Ca) | 820,855,1050,1109,1346,<br>1420,1630,3378              | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,SO <sub>4</sub> <sup>2-</sup> ,<br>Si-O,H <sub>2</sub> O                          | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,SO <sub>4</sub> )/<br>Cl/Si-O/H <sub>2</sub> O |
| 118                                              | 9.0  | C(8.5)N(9.4)O(61.7)<br>Mg(12.4)S(1.9)Cl(1.9)<br>Ca(4.2)         | Mg(NO <sub>3</sub> ,CO <sub>3</sub> ,SO <sub>4</sub> )<br>(Cl,Ca)    | 814,850,1230,1138,1344,<br>1411,1636,3412              | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>SO <sub>4</sub> <sup>2-</sup> ,H <sub>2</sub> O | (Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> )/<br>Cl/H <sub>2</sub> O      |
| <b>(E) Silicate particles (38 particles)</b>     |      |                                                                 |                                                                      |                                                        |                                                                                                                                                |                                                                                          |
| 2                                                | 3.12 | C(8.2)N(6.7)O(62.7)<br>Mg(1.0)Al(7.2)Si(10.4)                   | AlSi-Ca(NO <sub>3</sub> ) <sub>2</sub><br>(C,Mg,K,Fe)                | 773,818,868,913,944,1001,<br>1122,1350,1413,1584,1641, | montmorillonite,<br>organic,CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup>                                                        | montmorillonite/organic/<br>CO <sub>3</sub> /NO <sub>3</sub>                             |

|    |      |                                                                                        |                                                            |                                                                                     |                                                                                                            |                                                                                   |
|----|------|----------------------------------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
|    |      | K(0.3)Ca(3.8)Fe(0.1)                                                                   |                                                            | 2872,2929,3445                                                                      |                                                                                                            |                                                                                   |
| 3  | 4.19 | C(47.8)N(2.2)O(34.2)<br>Na(0.5)Mg(0.7)Al(4.0)<br>Si(6.3)S(0.2)Cl(1.7)<br>K(0.3)Mn(2.2) | AlSi-C<br>(N,O,Na,Mg,S,Cl,K,<br>Mn)                        | 806,825,863,939,1035,1166,<br>1383,1418,1521,1567,1599,<br>1629,2855,2922,3410,3654 | pyrophyllite,organic,<br>CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup>                       | pyrophyllite/organic/CO <sub>3</sub> /<br>NO <sub>3</sub> /Cl/Mn/H <sub>2</sub> O |
| 6  | 3.05 | C(18.3)N(0.3)O(51.8)<br>Na(4.9)Al(8.3)Si(16.0)<br>Ca(0.4)                              | AlSi-C<br>(N,O,Na,Ca)                                      | 780,915,946,1051,1121,1436<br>1600                                                  | (Na,Ca)-feldspar,<br>organic,CO <sub>3</sub> <sup>2-</sup>                                                 | (Na,Ca)-feldspar/<br>organic/CO <sub>3</sub>                                      |
| 7  | 7.83 | C(12.6)N(0.3)O(32.1)<br>Mg(1.6)Al(15.2)Si(28.9)<br>K(7.9)Ca(1.5)                       | AlSi<br>(C,N,O,Mg,K,Ca)                                    | 766,783,826,971,987,1038,<br>1101,1133,1561,1558,1632,                              | K-Feldspar,<br>Mg vermiculite,<br>organic                                                                  | K-feldspar/<br>Mg vermiculite/organic                                             |
| 11 | 3.9  | C(8.6)N(3.5)O(42.7)<br>Mg(0.7)Al(6.6)Si(27.1)<br>K(0.6)Ca(10.3)                        | AlSi-CaCO <sub>3</sub><br>(N,Mg,K)                         | 777,792,919,976,1043,1147,<br>136,1426,1603,2906,3429                               | montmorillonite,<br>CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,organic                   | montmorillonite/quartz/<br>Ca(CO <sub>3</sub> ,NO <sub>3</sub> )organic           |
| 12 | 6.82 | C(17.3)N(5.4)O(54.8)<br>Mg(2.3)Al(5.2)Si(9.7)<br>Cl(0.3)K(0.3)Ca(4.5)<br>Fe(0.3)       | AlSi-Ca(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Mg,Cl,K,Fe) | 777,849,929,960,1014,1140,<br>1353,1420,1584,1616,2840,<br>2929,3433                | montmorillonite,<br>organic,CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup>                    | montmorillonite/organic/<br>CO <sub>3</sub> /NO <sub>3</sub>                      |
| 20 | 4.92 | C(11.8)N(5.6)O(57.1)<br>Mg(2.4)Al(6.2)Si(9.9)<br>P(0.3)K(0.7)Ca(5.9)                   | AlSi-Ca(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Mg,P,K)     | 810,881,938,1001,1125,<br>1356,1417,1588,1629,1664,<br>2929,3403                    | muscovite,CO <sub>3</sub> <sup>2-</sup> ,<br>NO <sub>3</sub> <sup>-</sup> ,organic                         | muscovite/CO <sub>3</sub> /NO <sub>3</sub> /<br>organic/P                         |
| 22 | 8.17 | C(4.1)N(1.8)O(61.9)<br>Na(6.2)Mg(0.3)Al(7.2)<br>Si(18.4)Ca(0.2)                        | AlSi<br>(C,N,O,Na,Ca)                                      | 752,767,791,873,946,1007,<br>1354,1409,1594,3506                                    | montmorillonite,<br>CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,organic                   | montmorillonite/<br>Na(CO <sub>3</sub> ,NO <sub>3</sub> )organic                  |
| 32 | 2.01 | C(15.8)N(8.1)O(57.9)<br>Na(0.4)Mg(1.1)Al(4.6)<br>Si(8.6)S(0.3)Ca(3.5)                  | AlSi-Ca(NO <sub>3</sub> ) <sub>2</sub><br>(C,Na,Mg,S,Ca)   | 779,815,855,907,951,1344,<br>1412,1594                                              | vermiculite,CO <sub>3</sub> <sup>2-</sup> ,<br>NO <sub>3</sub> <sup>-</sup> ,organic                       | vermiculite/<br>(Na,K,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )/<br>Cl/organic       |
| 41 | 3.42 | C(14.2)N(2.5)O(62.4)<br>Al(6.6)Si(12.7)P(0.3)<br>S(0.3)K(0.4)Ca(0.7)                   | AlSi-C<br>(N,O,P,S,K,Ca)                                   | 792,810,859,933,1426,2876,<br>3443                                                  | vermiculite,organic,<br>CO <sub>3</sub> <sup>2-</sup>                                                      | vermiculite/organic/CO <sub>3</sub> /P                                            |
| 44 | 4.46 | C(7.0)N(2.1)O(49.6)<br>Mg(6.7)Al(9.4)Si(17.7)<br>S(0.7)Ca(3.0)                         | AlSi<br>(C,N,O,Mg,S,Ca)                                    | 740,795,821,901,952,982,<br>1165,1348,1408,1592,1627,<br>1659,2923,3380,3654        | montmorillonite,<br>Mg vermiculite,<br>organic,CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> | montmorillonite/<br>Mg vermiculite/<br>organic/CO <sub>3</sub> /NO <sub>3</sub>   |
| 53 | 5.96 | C(9.3)N(3.1)O(64.1)<br>Mg(1.6)Al(6.5)Si(12.2)<br>K(2.3)Ca(1.0)                         | AlSi<br>(C,N,O,Mg,K,Ca)                                    | 746,765,813,871,972,1376,<br>1429,1601,1630,2928,3477                               | muscovite,CO <sub>3</sub> <sup>2-</sup> ,<br>NO <sub>3</sub> <sup>-</sup> ,organic                         | muscovite/<br>(Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )/organic                  |
| 57 | 4.82 | C(23.6)N(3.8)O(42.4)<br>Na(0.9)Mg(0.7)Al(8.3)                                          | AlSi-Ca(NO <sub>3</sub> ) <sub>2</sub><br>(C,Na,Mg,K,Fe)   | 739,764,799,872,968,1007,<br>1040,1080,1157,1385,1412,                              | (Ca,Na)-feldspar,<br>montmorillonite,                                                                      | (Ca,Na)-feldspar/<br>montmorillonite/organic/                                     |

|     |       |                                                                                               |                                                                  |                                                                          |                                                                                                                |                                                                                                             |
|-----|-------|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
|     |       | Si(16.1)K(0.3)Ca(3.8)<br>Fe(0.1)                                                              |                                                                  | 1597,2929,3403                                                           | organic,CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup>                                            | CO <sub>3</sub> /NO <sub>3</sub>                                                                            |
| 71  | 6.89  | C(8.1)N(3.0)O(56.7)<br>Na(0.3)Mg(1.2)Al(7.7)<br>Si(18.9)K(3.2)Ca(0.8)                         | AlSi<br>(C,N,O,Na,<br>Mg,K,Ca)                                   | 780,816,857,877,915,997,<br>1253,1353,1427,1590,1628,<br>2823,3450       | montmorillonite,<br>CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> , NO <sub>2</sub> ,<br>organic | montmorillonite/<br>(K,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> )/<br>organic/H <sub>2</sub> O |
| 75  | 8.15  | C(29.8)N(5.8)O(50.1)<br>Na(0.5)Mg(3.4)Al(3.2)<br>Si(5.9)S(0.3)Cl(0.2)<br>K(0.3)Ca(0.5)Fe(0.2) | AlSi-MgNO <sub>3</sub><br>(S,Cl,K,Ca,Fe)                         | 762,792,831,1004,1108,<br>1263,1347,1587,1660,2911,<br>3390,3547         | montmorillonite,<br>NO <sub>3</sub> <sup>-</sup> ,SO <sub>4</sub> <sup>2-</sup> ,organic                       | montmorillonite/organic/<br>Mg(NO <sub>3</sub> ,SO <sub>4</sub> )                                           |
| 76  | 6.46  | C(44.9)O(31.7)Na(1.1)<br>Mg(1.9)Al(5.6)Si(10.6)<br>S(1.0)Cl(0.3)K(0.6)<br>Ca(2.4)             | AlSi-C<br>(C,N,O,Na,Mg,<br>S,Cl,K,Ca)                            | 757,796,906,948,996,1070,<br>1115,1349,1601,1662,2851,<br>2909,3375      | montmorillonite,<br>(Na,K)-feldspar,<br>humic substance,<br>organic                                            | montmorillonite/<br>(Na,K)-feldspar/<br>humic substance/<br>organic/S/Cl                                    |
| 79  | 5.96  | C(8.6)O(52.5)Mg(0.7)<br>Al(6.6)Si(27.1)K(0.6)<br>Ca(10.3)                                     | AlSi-CaCO <sub>3</sub><br>(Mg,K,Ca)                              | 827,856,910,1017,1119,<br>1401,2923,3375                                 | Ca- feldspar,<br>CO <sub>3</sub> <sup>2-</sup> ,organic                                                        | Ca- feldspar/<br>(Mg,K)CO <sub>3</sub> /organic                                                             |
| 90  | 7.58  | C(15.7)N(4.2)O(59.1)<br>Na(0.3)Mg(2.6)Al(6.4)<br>Si(9.7)K(0.7)Ca(1.3)<br>Fe(0.1)              | AlSi-C<br>(N,O,Na,Mg,Cl,<br>K,Ca)                                | 741,795,996,1351,1424,<br>1584,2847,2915,3389                            | montmorillonite,<br>CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,organic                       | montmorillonite/<br>CO <sub>3</sub> /NO <sub>3</sub> /organic                                               |
| 95  | 1.96  | C(9.8)N(3.3)O(59.8)<br>Na(4.2)Mg(0.7)Al(7.0)<br>Si(13.2)K(1.3)Ca(0.8)                         | AlSi<br>(C,N,O,Na,Mg,<br>K,Ca)                                   | 799,915,1040,1085,1590                                                   | (Na,K)-feldspar,<br>organic                                                                                    | (Na,K)-feldspar/organic                                                                                     |
| 96  | 5.7   | C(7.6)N(3.1)O(66.8)<br>Na(0.3)Mg(6.7)Al(5.3)<br>Si(9.8)Ca(0.4)                                | AlSi<br>(C,N,O,Na,Mg,Ca)                                         | 750,782,874,935,997,1184,<br>1350,1429,1586,1628,2861,<br>2816,3364,3532 | montmorillonite<br>quartz,CO <sub>3</sub> <sup>2-</sup> ,<br>NO <sub>3</sub> <sup>-</sup> ,organic             | montmorillonite/quartz/<br>CO <sub>3</sub> /NO <sub>3</sub> /organic/H <sub>2</sub> O                       |
| 101 | 4.32  | C(26.3)O(34.2)Na(9.0)<br>Mg(2.7)Al(7.2)Si(11.5)<br>S(0.9)Cl(6.4)K(0.6)<br>Ca(0.7)             | AlSi-Na <sub>2</sub> CO <sub>3</sub><br>(Mg,S,Cl,K,Ca)           | 769,868,933,1440,1594,<br>2847,2904,3356                                 | vermiculite,<br>CO <sub>3</sub> <sup>2-</sup> ,organic                                                         | vermiculite/(Na,K,Ca)CO <sub>3</sub> /<br>organic/Cl                                                        |
| 113 | 3.43  | C(38.8)O(35.3)Na(4.4)<br>Mg(0.5)Al(6.0)Si(14.6)<br>S(0.2)K(0.1)Ca(0.2)                        | AlSi-C<br>(O,Na,Mg,S,K,Ca)                                       | 758,796,999,1069,1115,<br>1356,2912,3375                                 | Na-feldspar,<br>humic substance,<br>organic                                                                    | Na-feldspar/<br>humic substance/<br>organic/S/Cl                                                            |
| 4   | 7.35  | C(18.7)N(5.2)O(50.5)<br>Mg(5.0)Al(5.4)Si(10.1)<br>K(0.2)Ca(3.7)Fe(1.1)                        | SiOx-<br>(Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Al,K,Fe) | 748,818,876,1023,1361,<br>1435,1629,3512                                 | montmorillonite,<br>CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup>                                | montmorillonite/<br>(Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )                                              |
| 16  | 12.98 | C(9.2)N(6.5)O(60.7)<br>Na(0.7)Mg(3.1)Al(2.5)                                                  | SiOx-<br>(Ca,Mg)(NO <sub>3</sub> ,CO <sub>3</sub> )              | 783,818,853,1047,1356,<br>1427,1632,3388                                 | cristobalite,<br>CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,H <sub>2</sub> O                 | cristobalite/<br>(Na,Mg,K,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )/                                           |

|    |      |                                                                                               |                                                                     |                                                                     |                                                                                                                                                                          |                                                                                                                                    |
|----|------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
|    |      | Si(13.9)Cl(1.0)K(0.3)<br>Ca(2.0)Fe(0.2)                                                       | (Na,Al,Cl,K,Fe)                                                     |                                                                     |                                                                                                                                                                          | H <sub>2</sub> O                                                                                                                   |
| 19 | 8.52 | C(8.2)N(8.7)O(58.1)<br>Mg(0.8)Al(5.7)Si(10.8)<br>Cl(0.3)K(1.6)Ca(5.8)                         | SiOx-<br>(Ca,Mg)(NO <sub>3</sub> ,CO <sub>3</sub> )<br>(Al,Cl,K)    | 814,957,992,1048,1363,<br>1443,1588,1636,2922,3501                  | quartz,muscovite,<br>CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup><br>,organic                                               | quartz/muscovite/<br>(Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> )/<br>organic                                       |
| 25 | 8.55 | C(5.4)N(8.1)O(57.9)<br>Mg(0.4)Al(4.9)Si(18.6)<br>Ca(4.8)Fe(0.1)                               | SiOx-<br>(Ca,Mg)(NO <sub>3</sub> ,CO <sub>3</sub> )<br>(Al,Fe)      | 818,858,1047,1383,1440,<br>1636,3499                                | quartz,CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,<br>NO <sub>2</sub> <sup>-</sup> ,H <sub>2</sub> O                                                   | quartz/<br>(Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> )/H <sub>2</sub> O                                            |
| 34 | 7.81 | C(9.5)N(9.7)O(59.6)<br>Mg(0.6)Al(2.0)Si(13.3)<br>Ca(5.3)                                      | SiOx-Ca(NO <sub>3</sub> ) <sub>2</sub><br>(C,Al,Mg)                 | 780,817,858,1049,1368,<br>1438,1632,3449                            | cristobalite,CO <sub>3</sub> <sup>2-</sup> ,<br>NO <sub>3</sub> <sup>-</sup> ,H <sub>2</sub> O                                                                           | cristobalite/<br>Ca(CO <sub>3</sub> ,NO <sub>3</sub> )/H <sub>2</sub> O                                                            |
| 36 | 8.02 | C(10.6)N(6.8)O(56.8)<br>Mg(1.0)Al(1.1)Si(19.0)<br>Ca(4.9)                                     | SiOx-Ca(NO <sub>3</sub> ) <sub>2</sub><br>(C,Mg,Al)                 | 767,817,861,1025,1358,1430<br>,1594,1628,2930,3482                  | cristobalite,CO <sub>3</sub> <sup>2-</sup> ,<br>NO <sub>3</sub> <sup>-</sup> ,organic,H <sub>2</sub> O                                                                   | cristobalite/<br>Ca(CO <sub>3</sub> ,NO <sub>3</sub> )/organic/H <sub>2</sub> O                                                    |
| 49 | 5.16 | C(52.3)O(31.2)Na(0.8)<br>Mg(2.4)Al(3.2)Si(6.0)<br>S(1.1)Cl(0.6)K(0.9)<br>Ca(1.5)              | SiOx-C<br>(Na,Mg,Al,S,Cl,K,C<br>a)                                  | 830,870,997,1352,1591,2910                                          | montmorillonite,<br>organic,CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup>                                                                                  | montmorillonite/<br>organic/CO <sub>3</sub> /NO <sub>3</sub>                                                                       |
| 55 | 3.6  | C(2.8)N(0.3)O(66.3)<br>Al(2.0)Si(28.6)                                                        | SiOx<br>(C,N,Al)                                                    | 742,782,820,930,1000,1027,<br>1108,1631,3459                        | quartz,kaolinite,<br>organic                                                                                                                                             | quartz/kaolinite/organic                                                                                                           |
| 70 | 6.67 | C(46.2)N(2.0)O(41.7)<br>Na(0.2)Mg(0.8)Al(2.5)<br>Si(4.6)S(0.4)Cl(0.3)<br>K(0.4)Ca(0.7)Fe(0.2) | SiOx-C<br>(N,Na,Mg,Al,Si,<br>S,Cl,K,Ca,Fe)                          | 820,875,928,1004,1344,<br>1410,1583,1628,2866,<br>2926,3364         | montmorillonite,<br>organic,CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup>                                                                                  | montmorillonite/<br>organic/CO <sub>3</sub> /NO <sub>3</sub>                                                                       |
| 77 | 5.31 | C(14.0)N(3.8)O(58.1)<br>Mg(7.8)Al(3.1)Si(12.4)<br>Ca(0.7)Fe(0.1)                              | SiOx-Mg(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Al,Fe)               | 748,811,859,919,982,1084,<br>1363,1426,1581,1635,2980,<br>3363      | montmorillonite,<br>CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,organic                                                                                 | montmorillonite/<br>CO <sub>3</sub> /NO <sub>3</sub> /organic                                                                      |
| 78 | 3.43 | C(6.9)N(9.0)O(59.1)<br>Na(0.7)Mg(2.6)Al(5.4)<br>Si(8.8)S(0.8)Cl(0.4)<br>K(2.6)Ca(3.6)         | SiOx-<br>(Ca,Mg)(NO <sub>3</sub> ,CO <sub>3</sub> )<br>(Na,Al,Cl,K) | 764,783,815,862,954,1052,<br>1109,1260,1352,1408,1610,<br>2915,3414 | pyrophyllite, CO <sub>3</sub> <sup>2-</sup> ,<br>NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,SO <sub>4</sub> <sup>2-</sup> ,<br>organic,H <sub>2</sub> O | pyrophyllite/(Na,Mg,K,Ca)<br>(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> ,SO <sub>4</sub> )/Cl/orga<br>nic/H <sub>2</sub> O |
| 83 | 4.05 | C(16.7)O(59.5)Na(1.3)<br>Mg(6.1)Al(5.4)Si(10.1)<br>K(0.2)Ca(0.5)Fe(0.3)                       | SiOx<br>(C,Na,Mg,Al,K,Ca,F<br>e)                                    | 827,887,970,1430,1580,2920                                          | vermiculite,CO <sub>3</sub> <sup>2-</sup> ,<br>organic                                                                                                                   | vermiculite/(Mg,Ca)CO <sub>3</sub> /<br>organic                                                                                    |
| 84 | 4.63 | C(9.9)N(6.8)O(61.9)<br>Mg(2.9)Al(4.8)Si(10.5)<br>Ca(2.6)Ti(0.7)                               | SiOx-<br>(Ca,Mg)(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(Al,Ti)      | 817,877,948,1038,1352,1425<br>1629,3451                             | quartz,vermiculite,<br>CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup>                                                                                       | quartz/vermiculite/CO <sub>3</sub> /NO <sub>3</sub>                                                                                |
| 86 | 10.9 | C(9.2)N(10.3)O(49.4)                                                                          | SiOx-                                                               | 732,765,822,873,946,1049,                                           | cristobalite,                                                                                                                                                            | cristobalite/pyrophyllite/                                                                                                         |

|                                                  |      |                                                                                         |                                                                     |                                                                             |                                                                                                                                          |                                                                                                                |
|--------------------------------------------------|------|-----------------------------------------------------------------------------------------|---------------------------------------------------------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
|                                                  |      | Al(6.1)Si(16.5)K(3.8)<br>Ca(4.8)                                                        | (Ca,K)(NO <sub>3</sub> ,CO <sub>3</sub> )<br>(Al)                   | 1144,1232,1379,1429,1596,<br>1638,2920,3476                                 | pyrophyllite,<br>CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>organic,H <sub>2</sub> O | (K,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> )/<br>organic/H <sub>2</sub> O                        |
| 89                                               | 5.35 | C(21.4)O(50.4)Si(28.2)                                                                  | SiOx<br>(C)                                                         | 780,795,1025,1150,1353,<br>1599,2920                                        | quartz,<br>humic substance,<br>organic                                                                                                   | quartz/<br>humic substance/organic                                                                             |
| 99                                               | 6.74 | C(9.1)N(6.3)O(53.2)<br>Al(7.1)Si(18.0)K(4.2)<br>Ca(2.2)                                 | SiOx-<br>(Ca,K)(NO <sub>3</sub> ,CO <sub>3</sub> )<br>(Al,K,Ca)     | 810,866,1020,1223,1352,<br>1411,1593,1630,2923,3412                         | muscovite,CO <sub>3</sub> <sup>2-</sup> ,<br>NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>organic,H <sub>2</sub> O    | muscovite/<br>Ca(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> )/<br>organic/H <sub>2</sub> O              |
| <b>(F) carbonaceous particles (7 particles)</b>  |      |                                                                                         |                                                                     |                                                                             |                                                                                                                                          |                                                                                                                |
| 24                                               | 4.62 | C(47.8)N(12.2)O(33.6)<br>Na(1.4)Mg(0.7)Al(0.9)<br>Si(1.7)S(0.3)Cl(0.2)<br>K(0.5)Ca(0.8) | biogenic                                                            | 751,818,870,940,1042,1103,<br>1387,1466,1600,1642,2916,<br>3480             | organic,CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,<br>SO <sub>4</sub> <sup>2-</sup> ,Si-O,H <sub>2</sub> O            | organic/CO <sub>3</sub> /NO <sub>3</sub> /<br>SO <sub>4</sub> /Si-O/H <sub>2</sub> O                           |
| 26                                               | 7.05 | C(53.1)N(3.9)O(32.9)<br>Na(6.7)Mg(0.8)Si(1.2)<br>S(0.6)K(0.4)Ca(0.4)                    | organic                                                             | 817,870,1035,1097,1269,<br>1360,1384,1439,1600,1629,<br>1720,2851,2922,3445 | humic substance,<br>CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,<br>Si-O,H <sub>2</sub> O | humic substance<br>/(Na,Mg,K,Ca)<br>(CO <sub>3</sub> ,NO <sub>3</sub> ,NO <sub>2</sub> )/Si-O/H <sub>2</sub> O |
| 39                                               | 4.98 | C(56.9)N(5.5)O(34.8)<br>Mg(0.2)Al(0.8)Si(1.6)<br>K(0.2)                                 | organic                                                             | 910,1021,1604,2864,2927                                                     | organic                                                                                                                                  | organic                                                                                                        |
| 40                                               | 3.34 | C(61.7)O(31.6)Na(0.5)<br>Si(0.3)S(0.3)Cl(0.4)<br>Ca(5.3)                                | organic                                                             | 957,1407,1442,1588,1974,<br>2926                                            | organic                                                                                                                                  | organic                                                                                                        |
| 72                                               | 7.23 | C(53.7)N(5.7)O(35.1)<br>Na(1.0)Mg(1.1)Al(0.9)<br>Si(1.7)Cl(0.2)K(0.2)<br>Ca(0.3)        | organic                                                             | 773,1023,1215,1272,1429,<br>1516,1597                                       | organic,Si-O                                                                                                                             | organic/Si-O                                                                                                   |
| 80                                               | 12   | C(64.0)N(12.6)O(22.1)<br>Si(0.3)P(0.3)S(0.3)<br>K(0.2)Ca(0.2)                           | biogenic                                                            | 1040,1243,1380,1430,1529,<br>1663,2859,2929,3304                            | azlon,rayon                                                                                                                              | azlon/rayon                                                                                                    |
| 98                                               | 2.24 | C(59.5)N(0.4)O(30.9)<br>Na(0.2)Mg(0.8)Al(2.4)<br>Si(4.4)S(0.4)Cl(0.3)<br>K(0.5)Ca(0.3)  | organic                                                             | 1026,1603,2849,2904                                                         | organic,Si-O                                                                                                                             | organic/Si-O                                                                                                   |
| <b>(G) miscellaneous particles (7 particles)</b> |      |                                                                                         |                                                                     |                                                                             |                                                                                                                                          |                                                                                                                |
| 23                                               | 2.98 | C(6.2)N(4.2)O(64.0)Mg(<br>1.9)Al(3.1)Si(5.5)Ca(4.5)<br>Fe(10.6)                         | FeOx-<br>Ca(CO <sub>3</sub> ,NO <sub>3</sub> )<br>(C,N,Mg,Al,Si,Ca) | 776,799,822,876,912,1006,<br>1080,1180,1406,1591,1620,<br>2849,3452         | montmorillonite,<br>quartz,CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,<br>organic                                      | FeOx/<br>montmorillonite/quartz/<br>(Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> )/organic                         |

|                                              |      |                                                                         |                                                             |                                                                                                      |                                                                                                                               |                                                                                               |
|----------------------------------------------|------|-------------------------------------------------------------------------|-------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| 43                                           | 2.98 | C(7.6)N(5.5)O(69.5)<br>Si(1.3)S(2.6)Ca(5.4)<br>Fe(8.1)                  | FeOx-<br>Ca(NO <sub>3</sub> ,SO <sub>4</sub> )<br>(C,Si,Ca) | 758,838,920,1125,1347,<br>1440,1590,1630,2863,2926,<br>3417                                          | organic,CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,<br>SO <sub>4</sub> <sup>2-</sup> ,Si-O,H <sub>2</sub> O | FeOx/organic/<br>Ca(CO <sub>3</sub> ,NO <sub>3</sub> ,SO <sub>4</sub> )/Si-O/H <sub>2</sub> O |
| 50                                           | 9.25 | C(21.1)N(4.4)O(51.8)<br>Mg(2.4)Si(1.6)S(1.4)<br>Ca(0.4)Fe(17.8)         | FeOx<br>(C,N,Mg,Si,S,Ca)                                    | 821,878,916,1090,1386,<br>1436,1581,1660,1724,2912                                                   | organic,CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,<br>SO <sub>4</sub> <sup>2-</sup> ,Si-O                  | FeOx/organic/<br>(Mg,Ca)(CO <sub>3</sub> ,NO <sub>3</sub> ,SO <sub>4</sub> )/Si-O             |
| 8                                            | 2.05 | C(11.6)N(6.7)O(64.4)Na<br>(4.0)K(13.4)                                  | KNO <sub>3</sub><br>(Na,Mg)                                 | 834,1249,1374,1604,2935                                                                              | NO <sub>3</sub> <sup>-</sup> ,NO <sub>2</sub> <sup>-</sup> ,SO <sub>4</sub> <sup>2-</sup> ,<br>organic                        | (Na,Mg,K)(NO <sub>3</sub> ,NO <sub>2</sub> )/<br>organic                                      |
| 85                                           | 6.7  | C,N,O,Na,S,Pb,Cl,K                                                      | (K,Pb)(NO <sub>3</sub> ,SO <sub>4</sub> )                   | 753,822,882,1111,1259,<br>1369,1426,1588,1764,2926                                                   | CO <sub>3</sub> <sup>2-</sup> ,NO <sub>3</sub> <sup>-</sup> ,SO <sub>4</sub> <sup>2-</sup> ,<br>organic                       | (Na,K,Pb)(CO <sub>3</sub> ,NO <sub>3</sub> ,SO <sub>4</sub> )/<br>organic/Cl                  |
| 48                                           | 2.51 | C(3.4)O(60.4)Na(0.4)<br>Mg(0.7)Al(12.5)Si(20.9)<br>K(1.3)Ti(0.3)Fe(0.1) | fly ash                                                     | 833,941,1604                                                                                         | muscovite,organic                                                                                                             | muscovite/organic/Ti/Fe                                                                       |
| 54                                           | 3.09 | C(71.5)N(2.7)O(24.9)<br>Si(0.4)P(0.3)K(0.3)                             | fly ash                                                     | 951,1603,2859,2929                                                                                   | organic,Si-O                                                                                                                  | organic/Si-O                                                                                  |
| <b>(H) particles with no ATR-FT-IR peaks</b> |      |                                                                         |                                                             |                                                                                                      |                                                                                                                               |                                                                                               |
| 59                                           | 2.5  | C(32.6)O(44.5)Na(0.5)<br>Mg(0.3)Si(0.4)S(0.4)<br>Cl(0.2)Ca(21.1)        | CaCO <sub>3</sub>                                           | missing before ATR-FT-IR measurement                                                                 |                                                                                                                               |                                                                                               |
| 92                                           | 1.9  | C(80.3)O(16.3)Na(0.3)<br>Mg(0.4)Al(0.4)Si(1.0)<br>S(0.3)Cl(0.7)Ca(0.3)  | carbon-rich                                                 | IR-inactive elemental carbon                                                                         |                                                                                                                               |                                                                                               |
| 100                                          | 4.62 | C(4.5)N(1.8)O(65.9)<br>Na(0.4)Mg(0.9)Al(8.8)<br>Si(16.8)K(0.5)Ca(0.5)   | AlSi                                                        | missing because the particle went under another particle when it was in contact with the IRE crystal |                                                                                                                               |                                                                                               |

Figure S1. A SEI obtained in a higher magnification than an overall SEI (Figure 1).

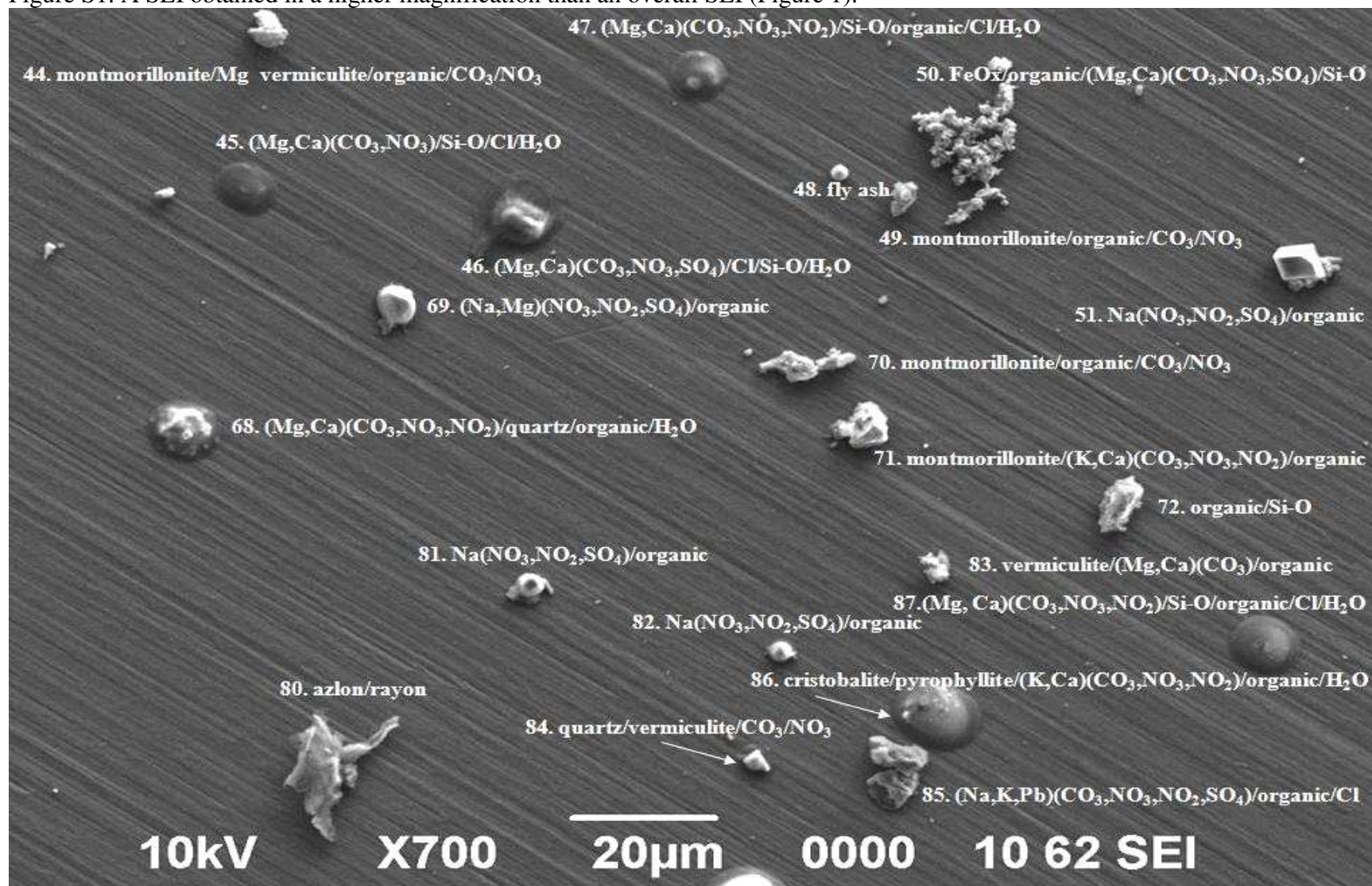


Figure S2. The second SEI obtained in a higher magnification.

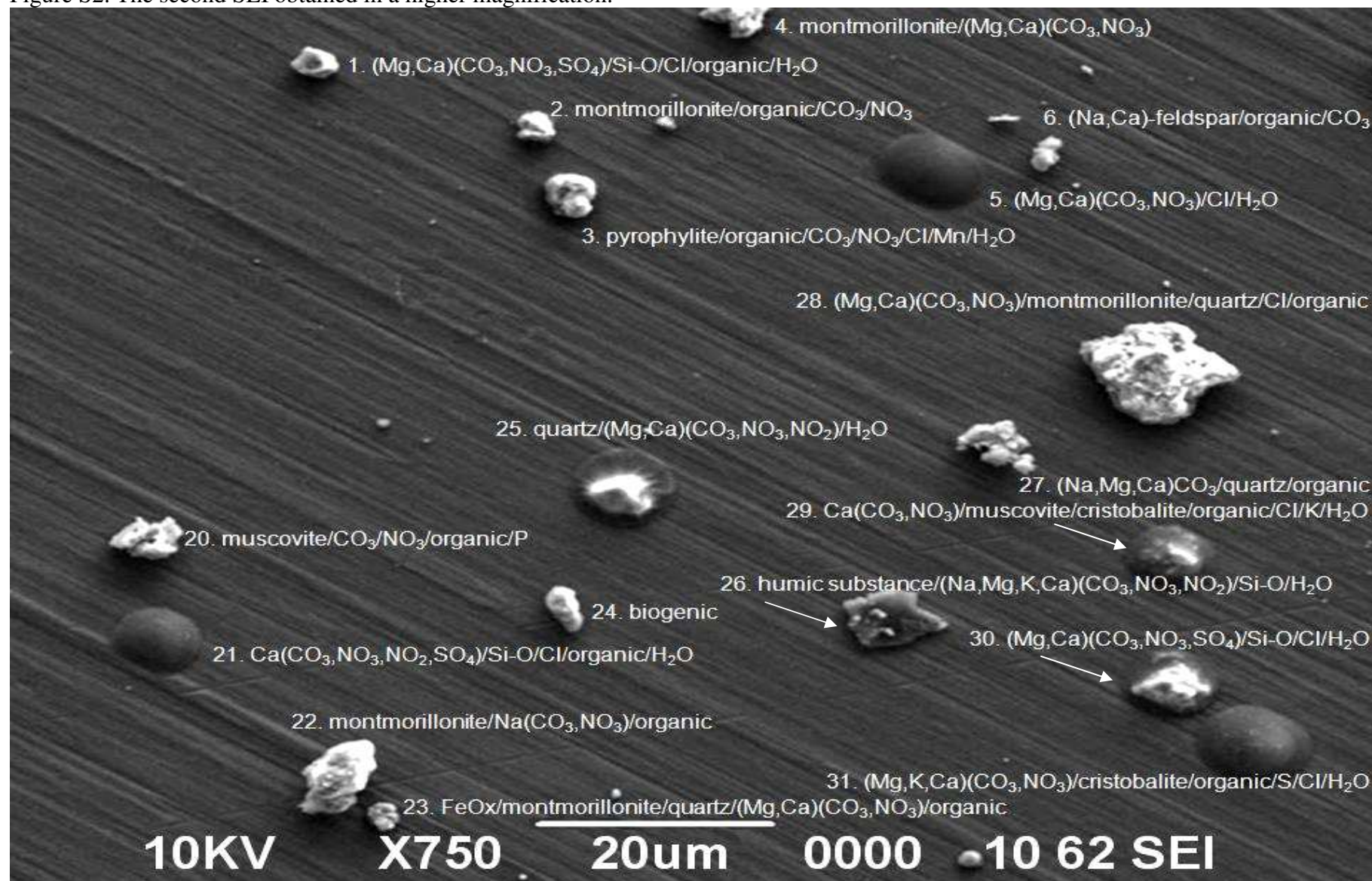


Figure S3. The third SEI obtained in a higher magnification.

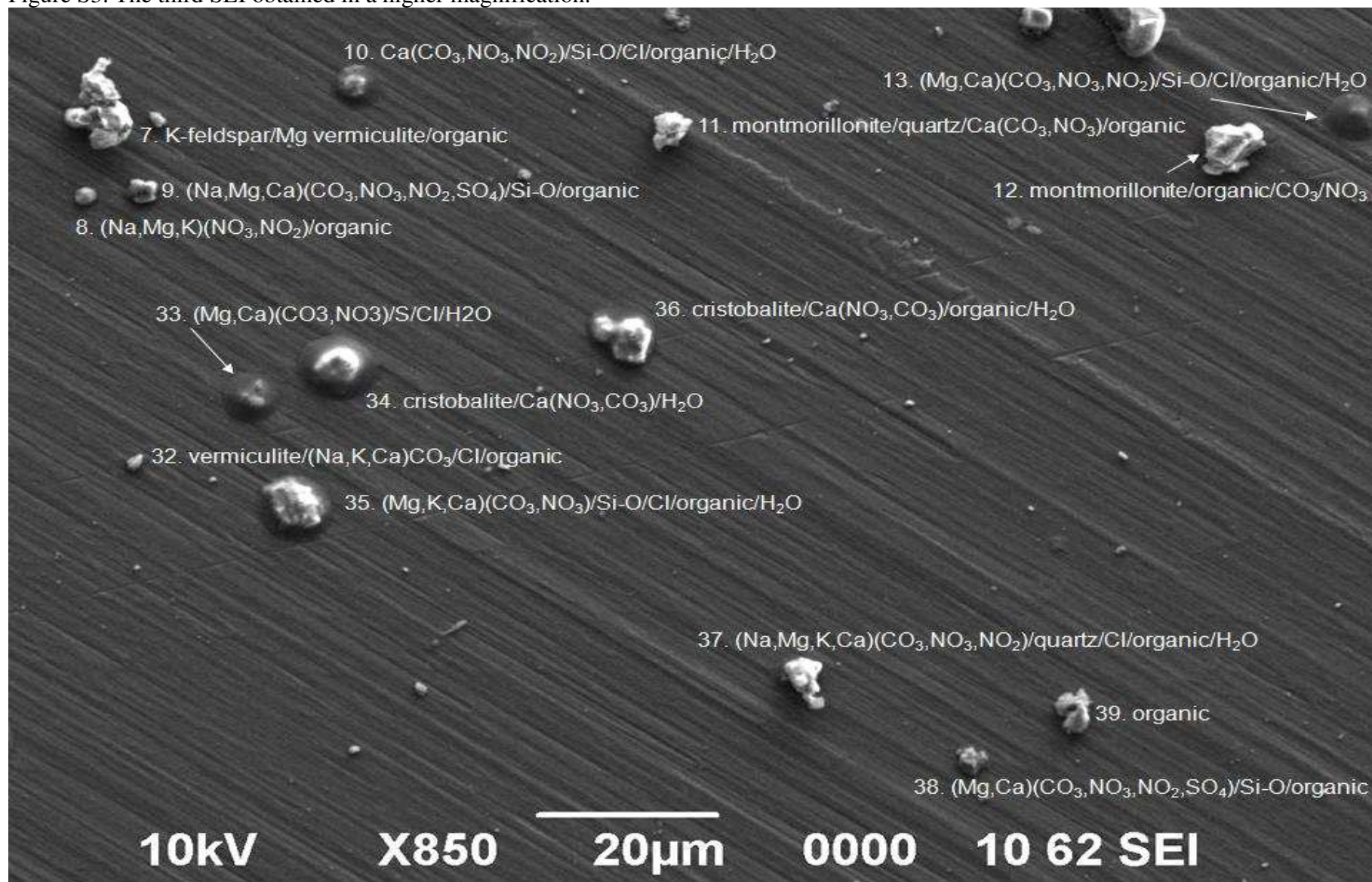


Figure S4. The fourth SEI obtained in a higher magnification.

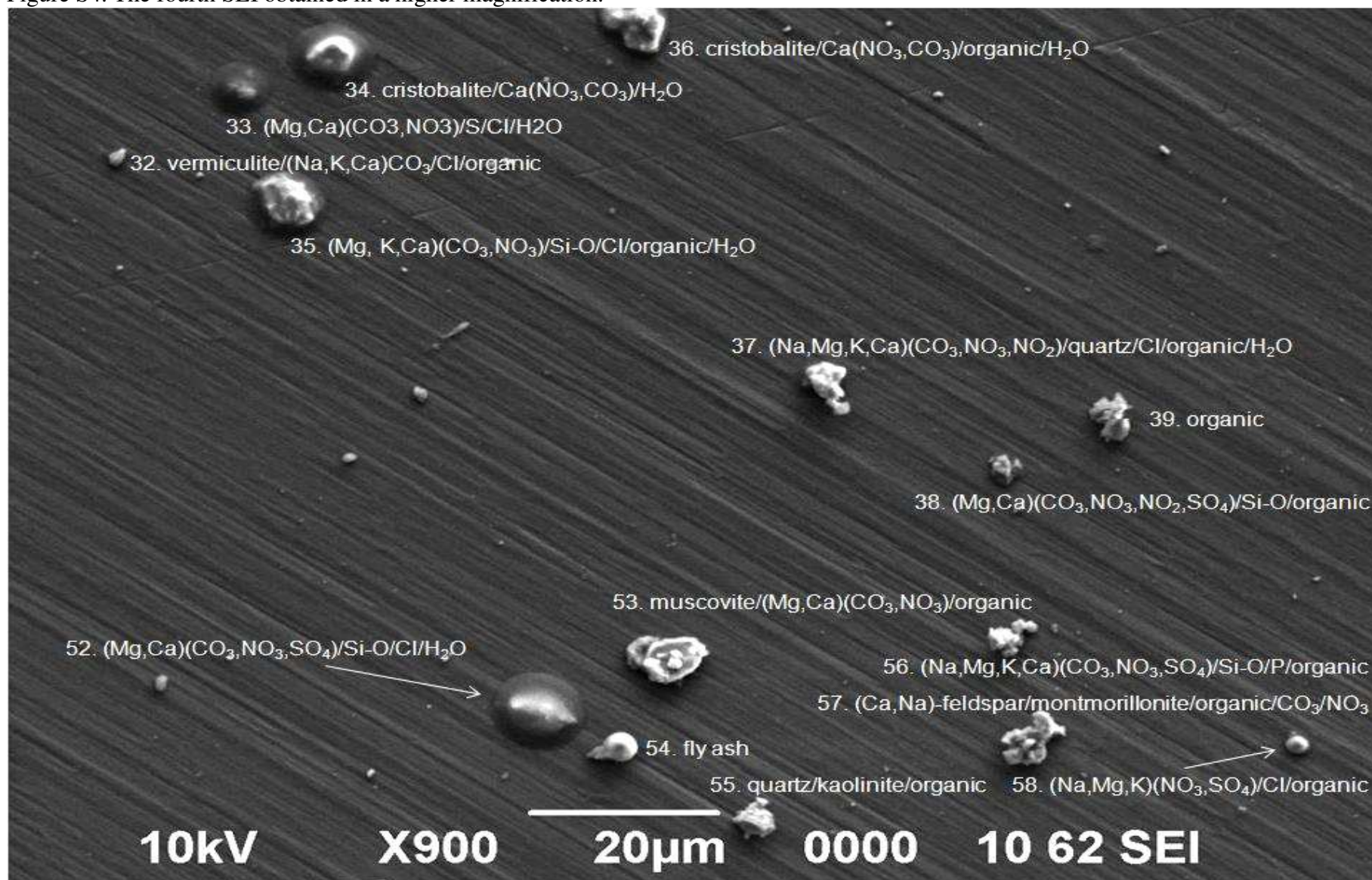


Figure S5. The fifth SEI obtained in a higher magnification.

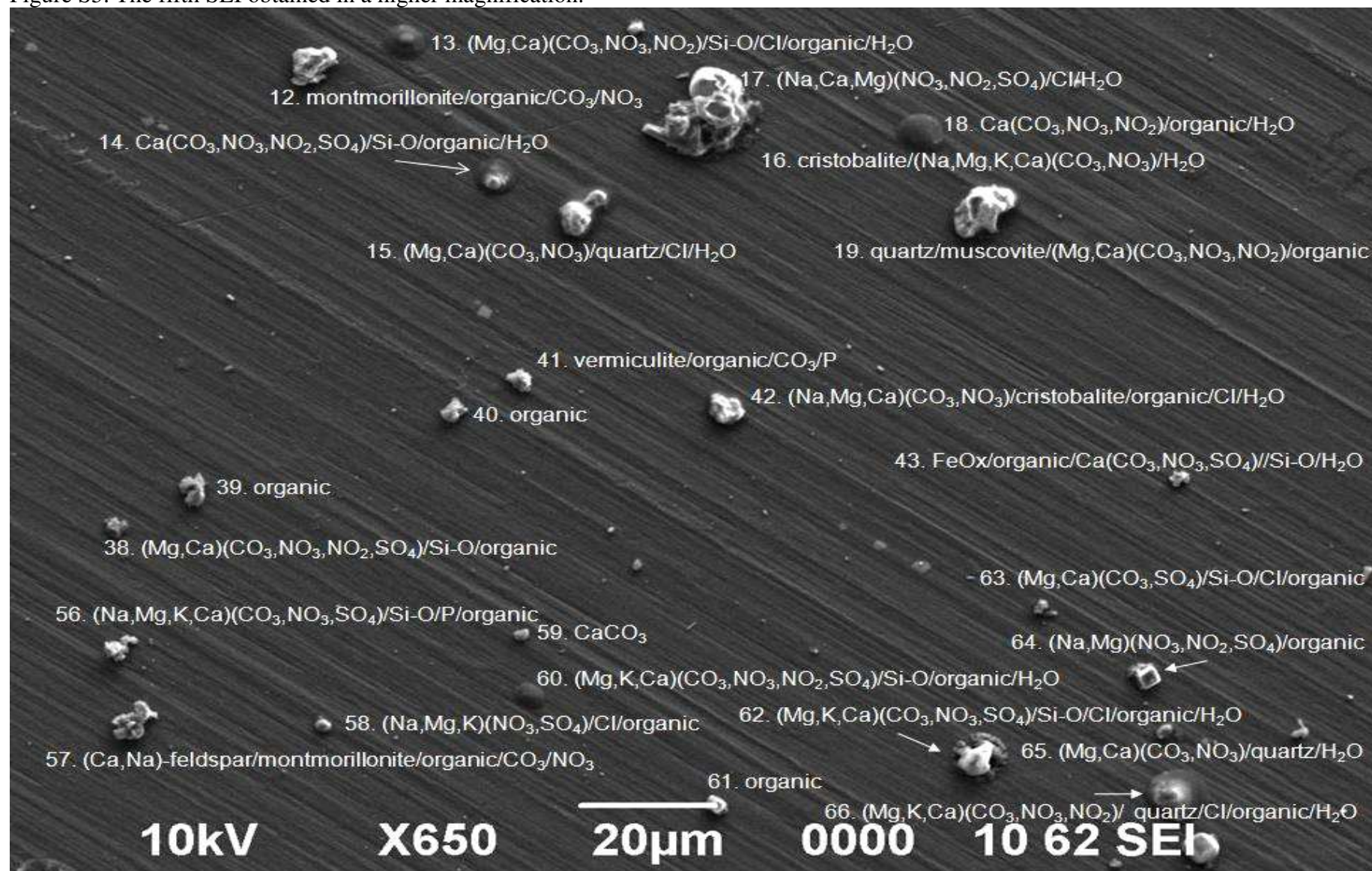


Figure S6. The sixth SEI obtained in a higher magnification.

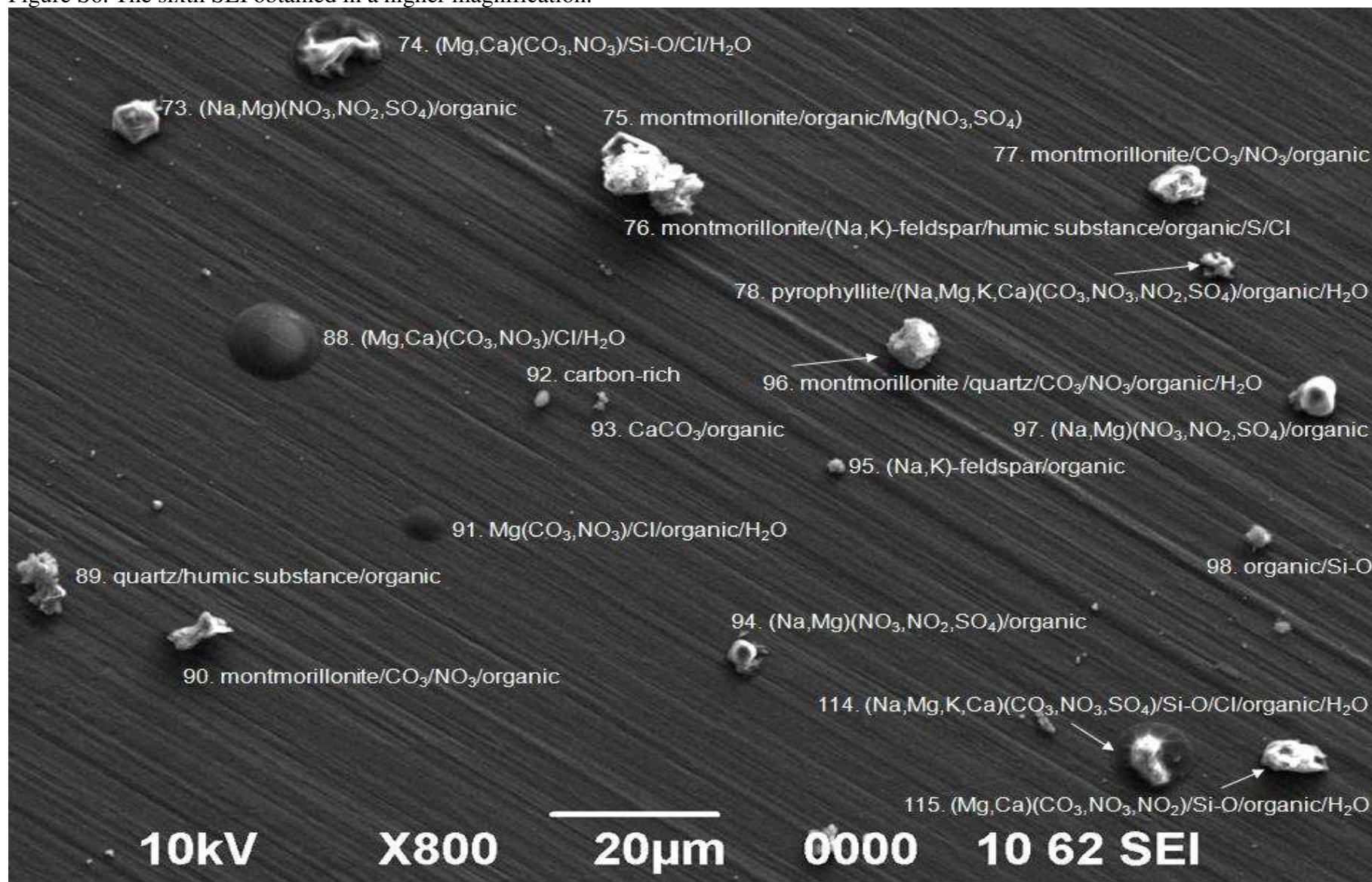


Figure S7. The seventh SEI obtained in a higher magnification.

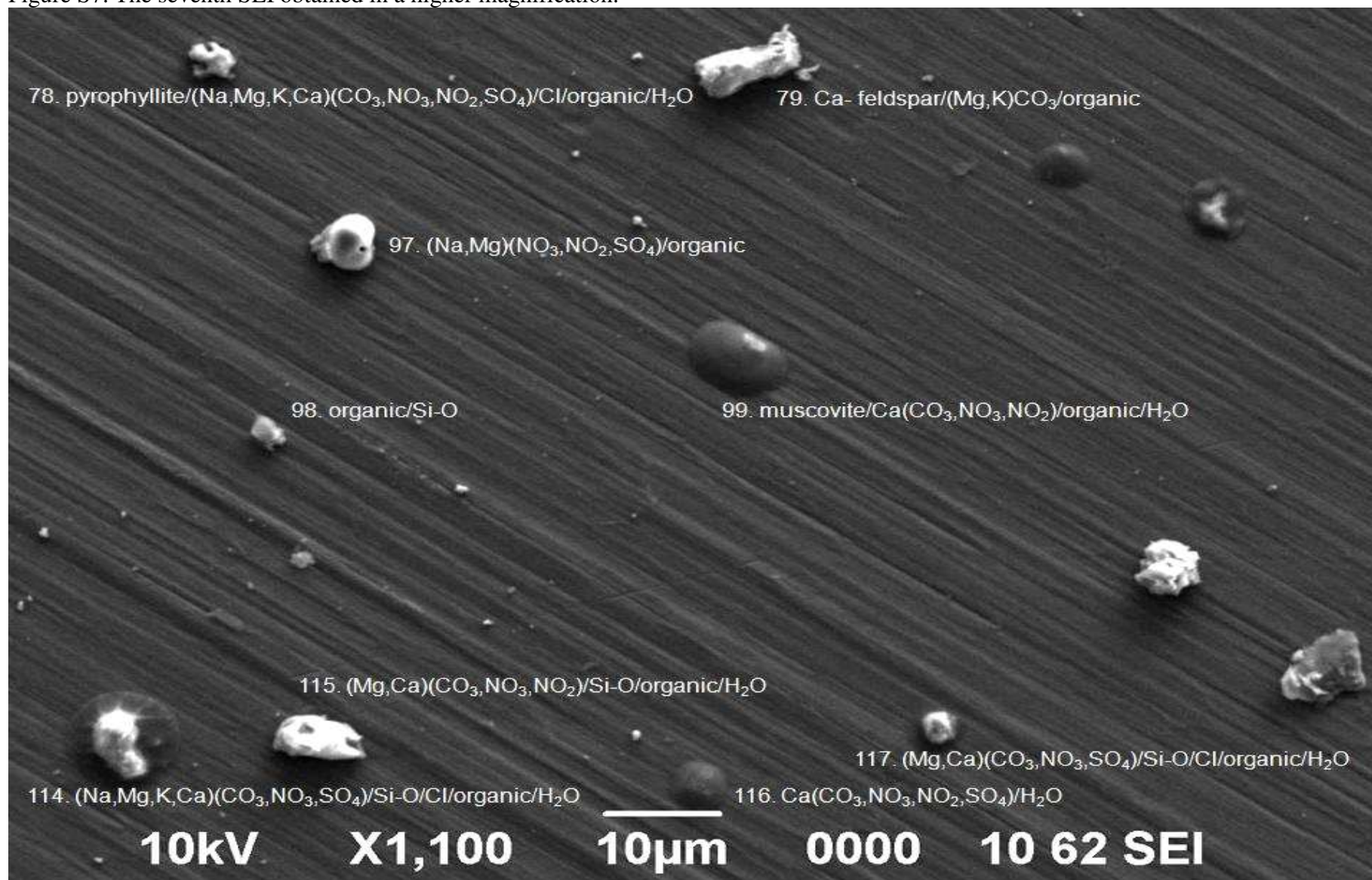


Figure S8. The eighth SEI obtained in a higher magnification.

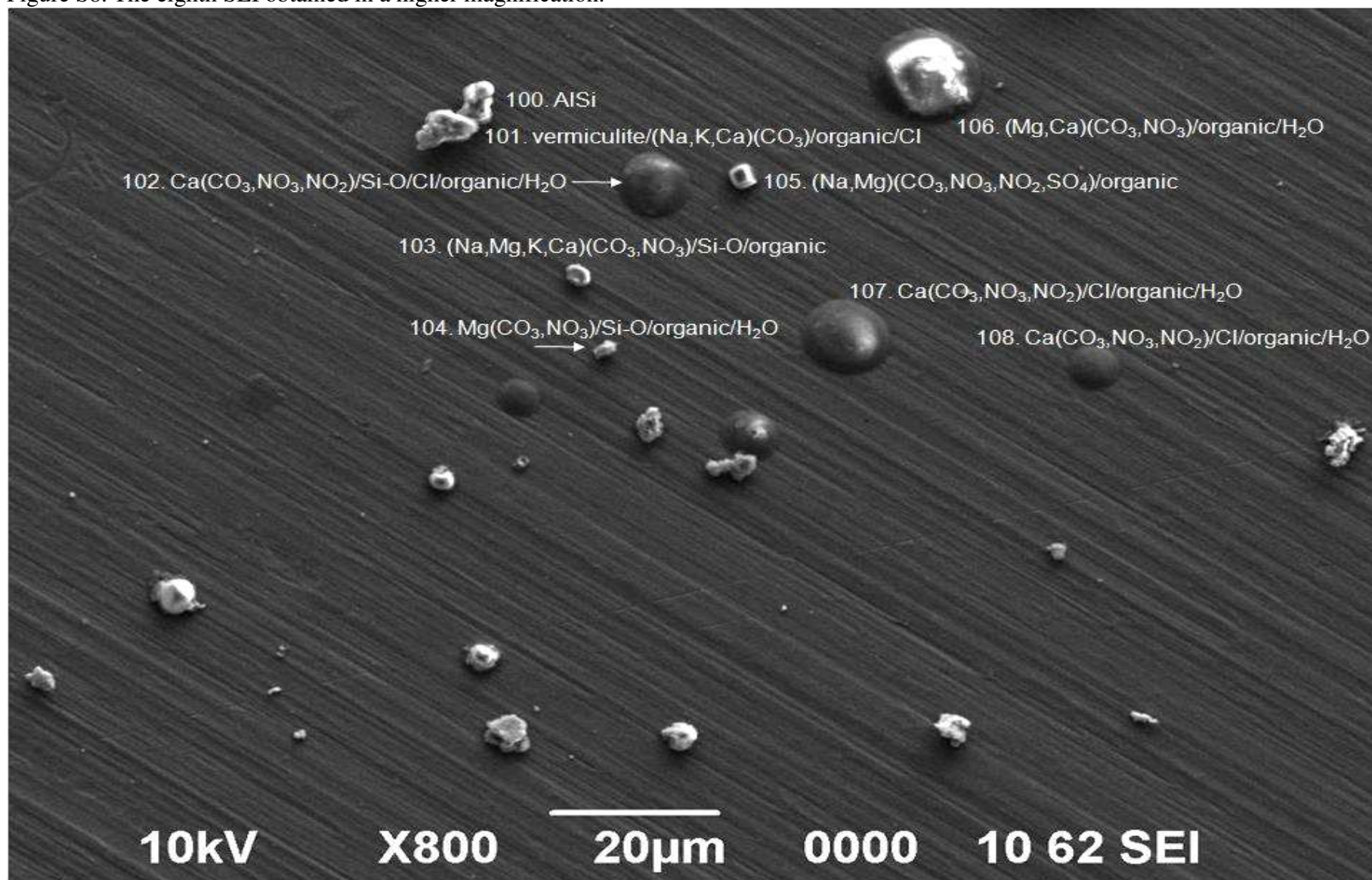


Figure S9. The ninth SEI obtained in a higher magnification.



Figure S10. (A) SEI of NaNO<sub>3</sub>-containing particle #51 obtained after ATR-FT-IR measurement; (B)-(F) X-ray spectra taken at 5 different regions of the particle.

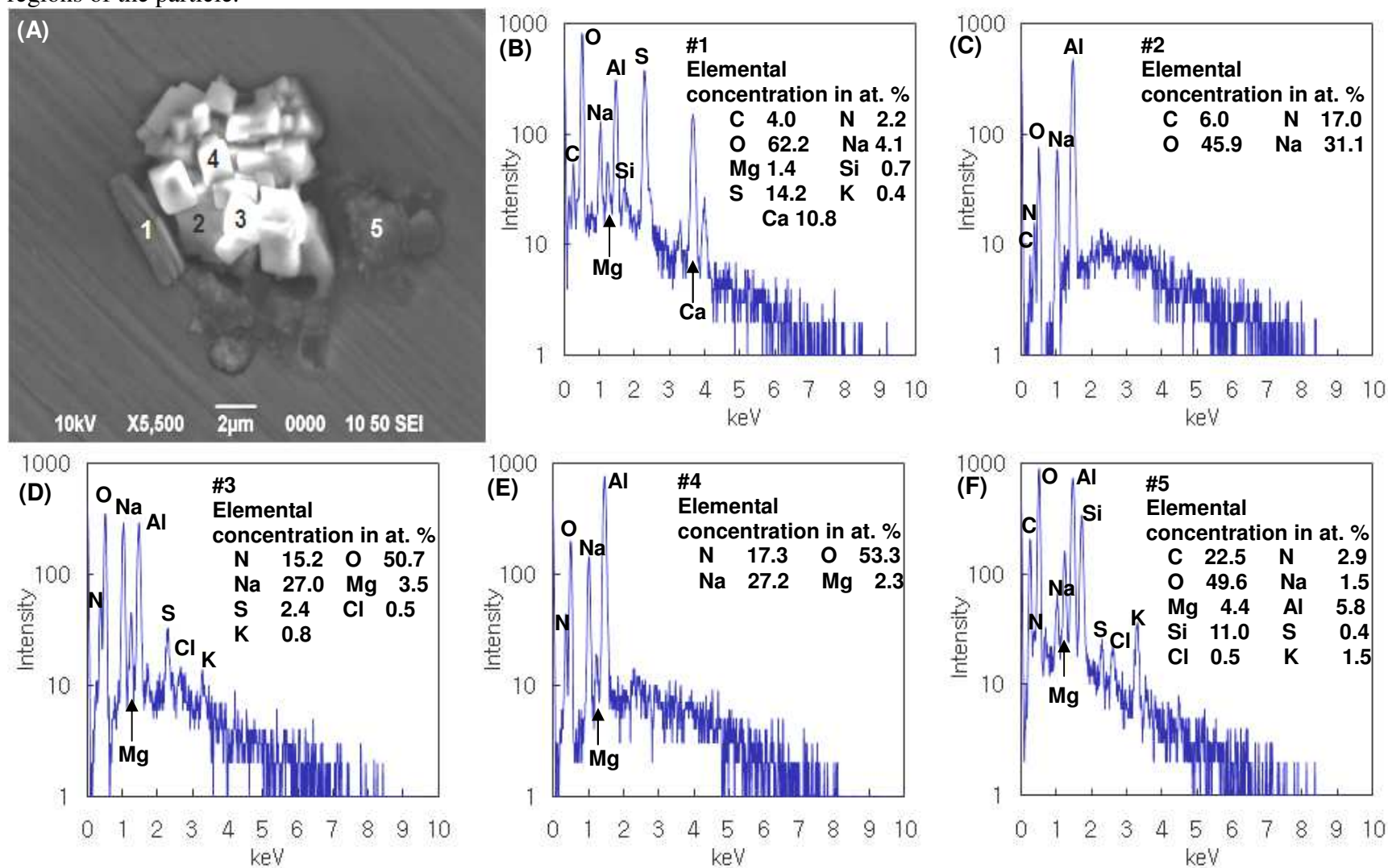


Figure S11. X-ray spectra of typical carbonaceous particles.

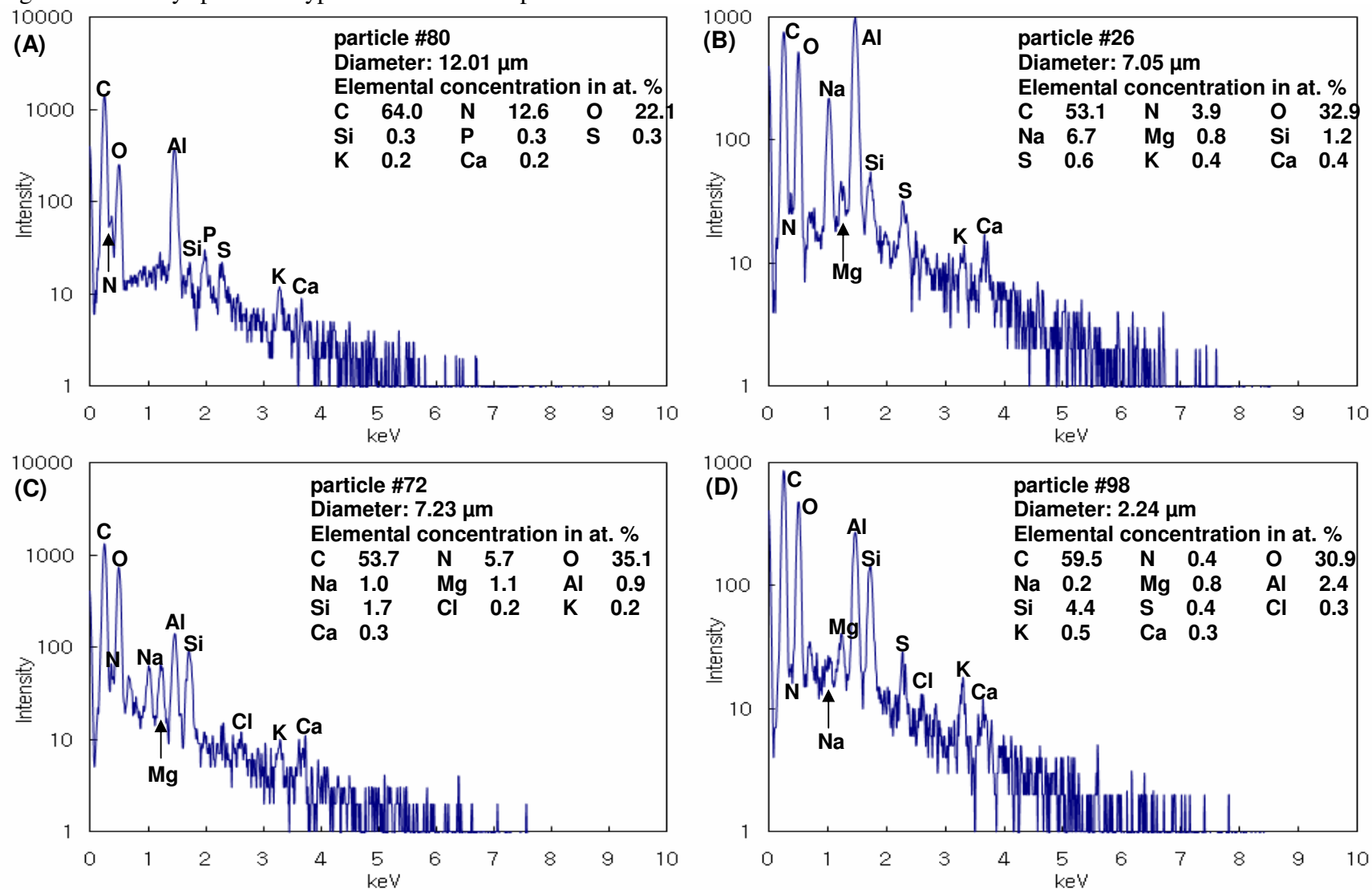


Figure S12. ATR-FT-IR spectra of typical carbonaceous particles. Data of the 2200-2530  $\text{cm}^{-1}$  region where atmospheric  $\text{CO}_2$  peaks are present were deleted for clarity.

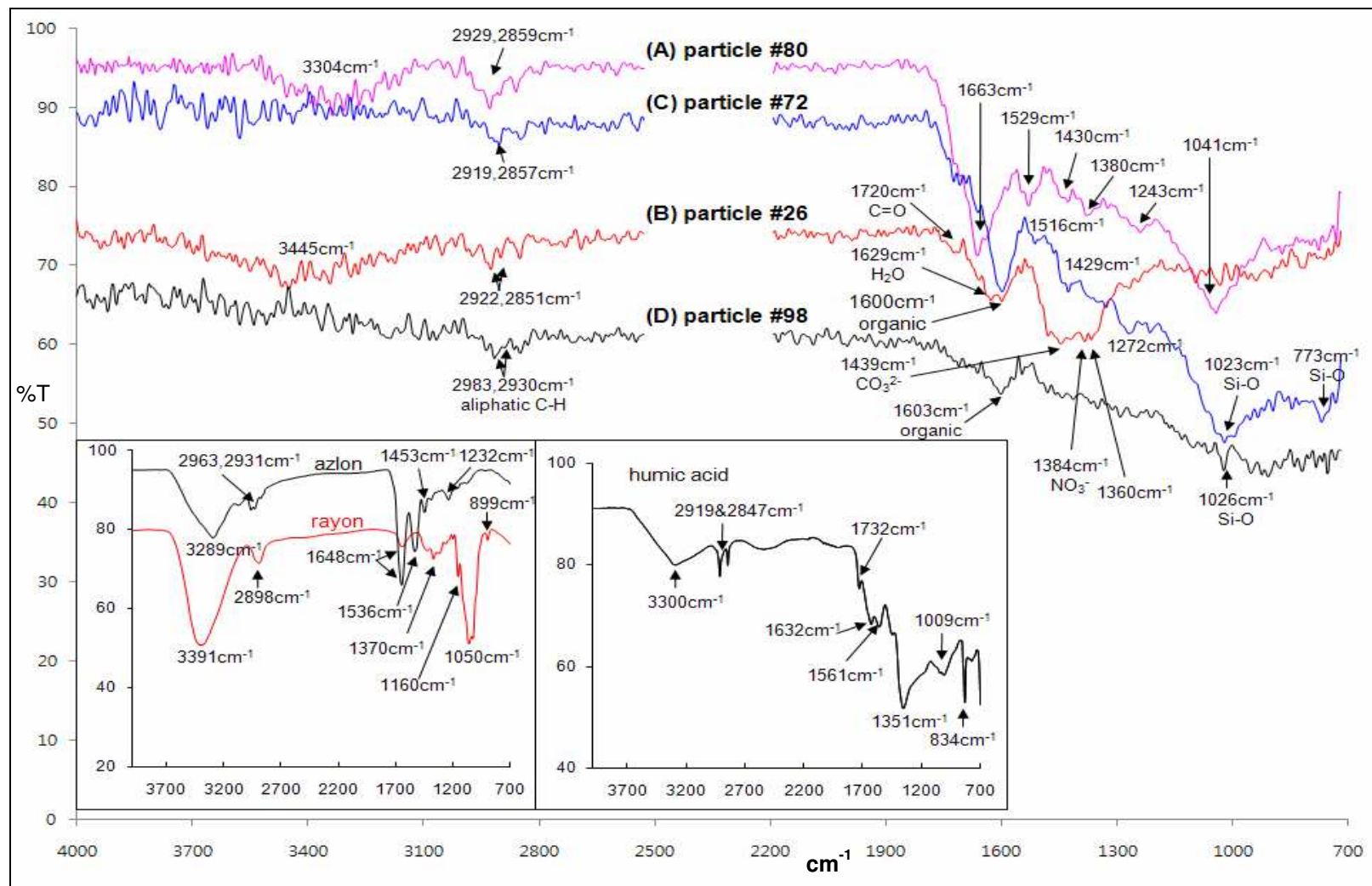


Figure S13. X-ray spectra of (A) Fe-containing; (B) fly-ash; (C) Pb-containing; (D) carbon-rich particles.

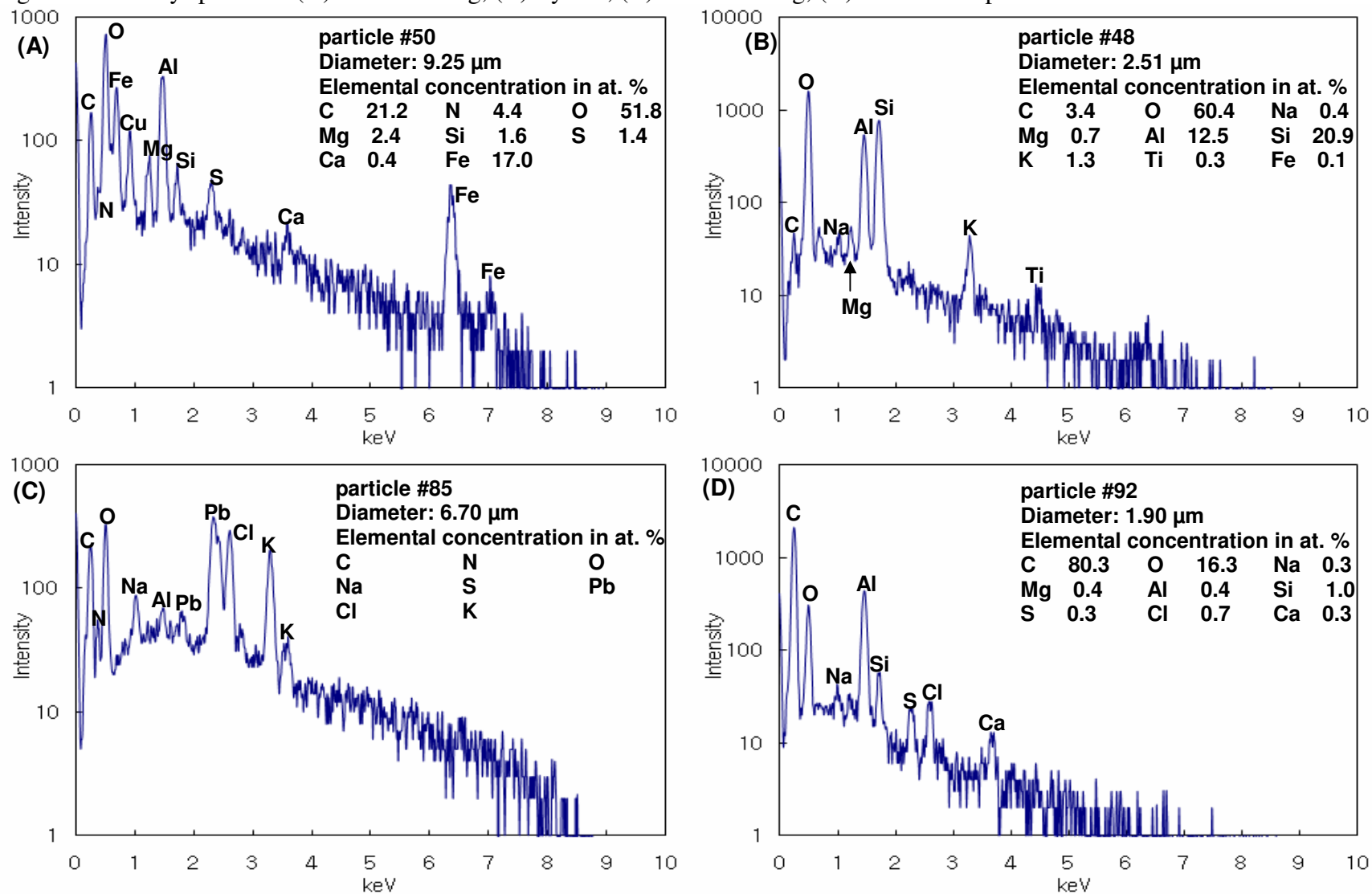


Figure S14. ATR-FT-IR spectra of (A) Fe-containing; (B) fly-ash; (C) Pb-containing; (D) carbon-rich particles. Data of the 2200-2530  $\text{cm}^{-1}$  region where atmospheric  $\text{CO}_2$  peaks are present were deleted for clarity.

