

**ESM-1.** Ground level photos of typical permafrost depressions, thaw ponds and lakes investigated in this study



Z-3





Z-4

Z-9







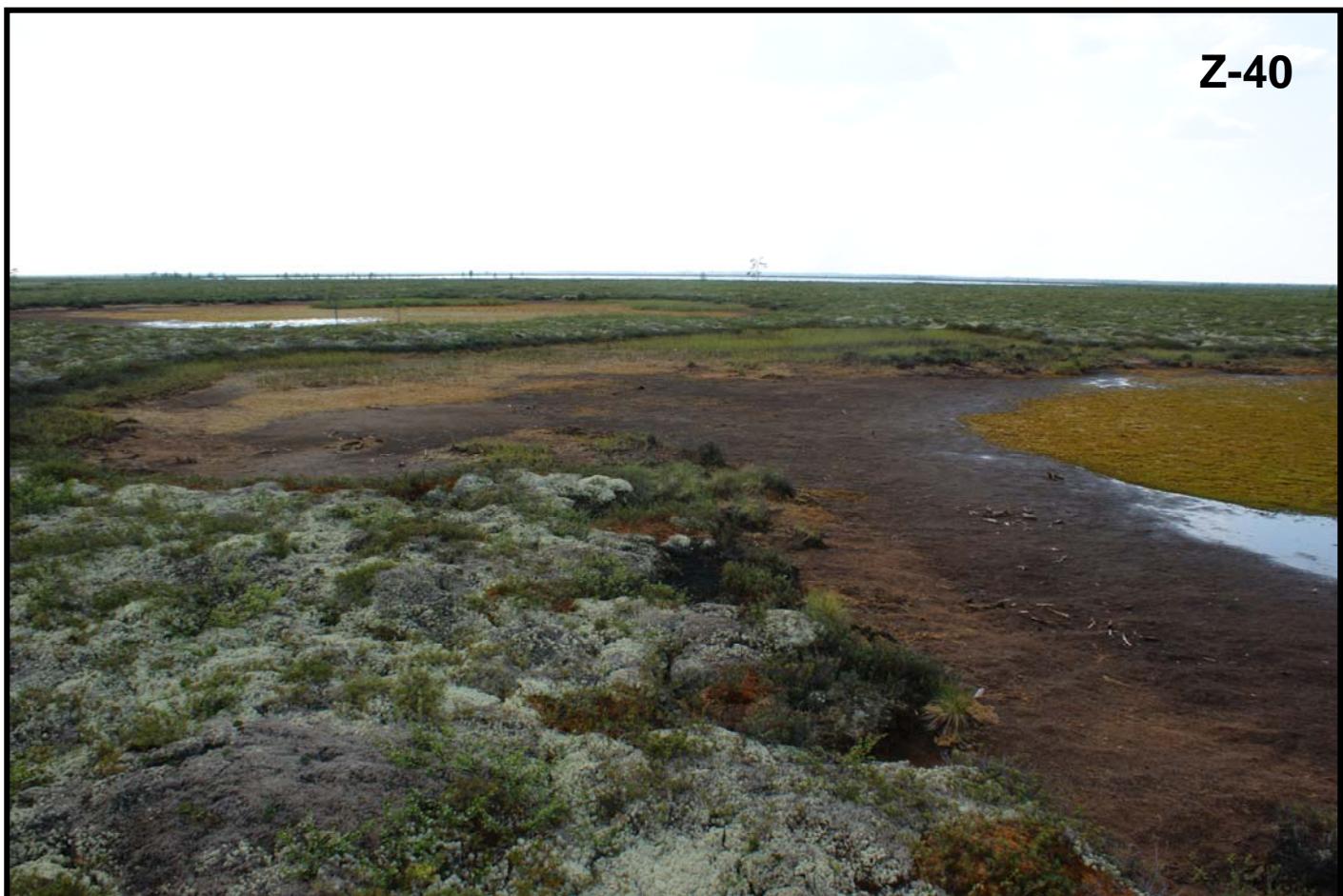
Z-29



**Z-34**



**Z-40**



**Z-36**



**ESM-2. Major and trace element composition of studied thermokarst water bodies. All concentrations are in µg/L. Detailed sample description is given in Table 1.**

| Element | Z-1    | Z-2     | Z-3      | Z-4       | Z-5       | Z-6       | Z-7      | Z-8      | Z-9       | Z-10     |
|---------|--------|---------|----------|-----------|-----------|-----------|----------|----------|-----------|----------|
| B       | 4.1    | 26.3    | 4.709    | 5.703     | 4.711     | 2.89      | 5.984    | 5.007    | 6.089     | 2.049    |
| Na      | 314.3  | 3253.0  | 50.13    | 1740      | 99.22     | 189.7     | 531.1    | 356.8    | 36.19     | 414.5    |
| Mg      | 170.3  | 914.8   | 117.1    | 639.6     | 142.9     | 146.4     | 339.3    | 295.7    | 442.3     | 83.09    |
| Al      | 42.7   | 834.3   | 31.48    | 121.4     | 142.7     | 82.25     | 131.7    | 118.1    | 100.2     | 90.6     |
| Si      | 104.0  | 1.0     | 312      | 134       | 106       | <d.l.     | 11.5     | n.d.     | 4.6       | 97       |
| P       | 0.8    | 302.1   | 1.232    | 9.458     | 18.69     | 3.556     | 17.55    | 17.06    | 2.949     | 10.43    |
| K       | 86     | 5498    | 10.11    | 125.8     | 24.68     | 67.27     | 8.482    | 13.54    | 12.89     | 66.98    |
| Ca      | 193    | 1555    | 118.8    | 1011      | 319.6     | 234.2     | 431.8    | 473.6    | 335.3     | 169.5    |
| Ti      | 0.52   | 11.7    | 0.662    | 1.522     | 1.565     | 0.6067    | 1.419    | 1.133    | 0.8738    | 1.175    |
| V       | 0.13   | 4.78    | 0.1804   | 0.5476    | 0.2559    | 0.3017    | 0.352    | 0.3506   | 0.3364    | 0.3489   |
| Cr      | 0.17   | 2.85    | 0.2964   | 0.6494    | 0.4068    | 0.2136    | 0.5716   | 0.5718   | 0.8559    | 0.5202   |
| Mn      | 14.7   | 24.7    | 19.24    | 56.14     | 12.39     | 13.11     | 21.39    | 16.04    | 20.08     | 10.08    |
| Fe      | 92     | 1487    | 51.94    | 329.7     | 272.7     | 166.2     | 309.8    | 300.3    | 271.8     | 406.9    |
| Co      | 0.0701 | 0.5351  | 0.03568  | 0.1456    | 0.1476    | 0.08208   | 0.2242   | 0.1701   | 0.1973    | 0.1164   |
| Ni      | 0.0346 | 3.1985  | 0.1551   | 0.5727    | 0.501     | 0.1743    | 0.463    | 0.3937   | 0.4598    | 0.3901   |
| Cu      | 0.0205 | 11.9682 | 0.1905   | 1.487     | 0.196     | 0.05621   | 0.1833   | 0.2043   | 0.1251    | 0.1508   |
| Zn      | 3.4920 | 37.0259 | 19.39    | 92.09     | 10.85     | 3.764     | 9.947    | 8.266    | 14.41     | 4.432    |
| Ga      | 0.0088 | 0.3675  | 0.01646  | 0.02729   | 0.02838   | 0.01151   | 0.02369  | 0.01904  | 0.03046   | 0.01567  |
| As      | 0.6363 | 4.4664  | 0.5538   | 1.019     | 0.8607    | 0.5027    | 1.126    | 1.064    | 1.164     | 0.7712   |
| Rb      | 0.2138 | 2.1338  | 0.03134  | 0.238     | 0.06173   | 0.247     | 0.01869  | 0.04349  | 0.02535   | 0.2149   |
| Sr      | 0.4694 | 25.7905 | 0.7316   | 12.15     | 4.512     | 2.63      | 5.247    | 5.754    | 4.2       | 1.698    |
| Zr      | 0.0248 | 0.3216  | 0.04243  | 0.05888   | 0.0788    | 0.04813   | 0.1476   | 0.1326   | 0.1119    | 0.1737   |
| Nb      | <d.l.  | 0.3837  | 0.08261  | <d.l.     | 0.01182   | <d.l.     | 0.03668  | 0.03654  | 0.03807   | 0.02549  |
| Mo      | 0.0025 | 0.1326  | 0.03628  | 0.01366   | 0.01331   | 0.007339  | 0.008744 | 0.01715  | 0.0202    | 0.01983  |
| Cd      | 0.0318 | 0.1317  | 0.02775  | 0.09719   | 0.02897   | 0.0173    | 0.05732  | 0.04706  | 0.06959   | 0.01113  |
| Sn      | 0.0048 | 0.1934  | 0.04984  | 0.04302   | 0.02569   | 0.005241  | 0.03037  | 0.02776  | 0.03091   | 0.01897  |
| Sb      | 0.0554 | 0.2186  | 0.06987  | 0.1403    | 0.06907   | 0.04791   | 0.07202  | 0.06463  | 0.09345   | 0.03069  |
| Te      | 0.0094 | 0.0518  | 0.02234  | 0.01623   | 0.01123   | 0.008071  | 0.009885 | 0.01179  | 0.02036   | 0.005862 |
| Cs      | 0.0079 | 0.1121  | 0.005694 | 0.01825   | 0.01233   | 0.01213   | 0.002338 | 0.004857 | 0.003459  | 0.01918  |
| Ba      | 0.2420 | 12.68   | 1.112    | 17.05     | 7.764     | 0.9769    | 6.005    | 9.721    | 8.129     | 2.642    |
| La      | 0.0049 | 0.2328  | 0.007368 | 0.03092   | 0.03087   | 0.01338   | 0.01625  | 0.01431  | 0.005189  | 0.01837  |
| Ce      | 0.0155 | 0.3935  | 0.01734  | 0.07729   | 0.08018   | 0.0255    | 0.04419  | 0.03697  | 0.0114    | 0.0551   |
| Pr      | 0.0020 | 0.0459  | 0.004164 | 0.00933   | 0.009527  | 0.002394  | 0.006144 | 0.005077 | 0.002434  | 0.006962 |
| Nd      | 0.0112 | 0.1871  | 0.01454  | 0.03912   | 0.03965   | 0.01347   | 0.03044  | 0.024    | 0.01147   | 0.03322  |
| Sm      | 0.0035 | 0.0558  | 0.003335 | 0.009196  | 0.01132   | 0.003767  | 0.01285  | 0.007637 | 0.005417  | 0.008954 |
| Eu      | 0.0013 | 0.0105  | 0.002256 | 0.003513  | 0.002962  | 0.001118  | 0.004543 | 0.003554 | 0.001998  | 0.002757 |
| Gd      | 0.0053 | 0.0534  | 0.004548 | 0.008419  | 0.01066   | 0.005306  | 0.01929  | 0.01384  | 0.006133  | 0.01006  |
| Dy      | 0.0037 | 0.0412  | 0.002888 | 0.006232  | 0.01055   | 0.006451  | 0.02451  | 0.01959  | 0.005522  | 0.01042  |
| Ho      | 0.0009 | 0.0065  | 0.00167  | 0.0009271 | 0.001907  | 0.001225  | 0.005745 | 0.004432 | 0.001264  | 0.002451 |
| Er      | 0.0018 | 0.0200  | 0.002515 | 0.002398  | 0.005756  | 0.003488  | 0.0149   | 0.0119   | 0.003345  | 0.007297 |
| Tm      | 0.0003 | 0.0031  | 0.001744 | 0.0003545 | 0.0009747 | 0.0006023 | 0.001989 | 0.001821 | 0.0009912 | 0.001328 |
| Yb      | 0.0011 | 0.0193  | 0.002611 | 0.002903  | 0.003661  | 0.00234   | 0.009494 | 0.007262 | 0.0025    | 0.006299 |
| Lu      | 0.0001 | 0.0037  | 0.001635 | 0.0004022 | 0.0007635 | 0.0002101 | 0.001544 | 0.001629 | 0.0008242 | 0.001166 |
| Hf      | 0.0026 | 0.1342  | 0.01737  | 0.004637  | 0.006417  | 0.002773  | 0.01541  | 0.01322  | 0.01254   | 0.01179  |
| W       | 0.0025 | 0.0917  | 0.07536  | 0.01051   | 0.01344   | 0.00138   | 0.0193   | 0.02287  | 0.02597   | 0.01692  |
| Pb      | 0.2531 | 4.8272  | 0.2277   | 1.467     | 0.6367    | 2.422     | 0.4823   | 0.3181   | 0.464     | 0.201    |
| Th      | 0.0005 | 0.0853  | 0.00481  | 0.003635  | 0.01036   | 0.001964  | 0.01223  | 0.009649 | 0.005784  | 0.01277  |
| U       | 0.0010 | 0.0956  | 0.002967 | 0.005075  | 0.003987  | 0.001343  | 0.003562 | 0.002807 | 0.001097  | 0.004145 |

## ESM-2, continued.

| Element | Z-12     | Z-13      | Z-14      | Z-15      | Z-16      | Z-17      | Z-18      | Z-19      | Z-20      | Z-21     |
|---------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|
| B       | 4.907    | 5.09      | 4.782     | 3.308     | 6.215     | 1.797     | 3.069     | 4.795     | 7.363     | 3.831    |
| Na      | 333.7    | 320.4     | 53.42     | 18.87     | 650.8     | 169.3     | 93.2      | 499.9     | 531.5     | 301.1    |
| Mg      | 260.8    | 202.3     | 175.4     | 89.24     | 761.4     | 95.3      | 191.2     | 212.4     | 694.5     | 80.14    |
| Al      | 141.9    | 190.7     | 66.18     | 45.38     | 76.76     | 49.46     | 56.39     | 109.3     | 299.4     | 123.3    |
| Si      | n.d.     | 143       | n.d.      | n.d.      | 69        | 16.4      | n.d.      | n.d.      | 257       | n.d.     |
| P       | 9.188    | 31.59     | 4.042     | 2.303     | 20        | 3.901     | 5.238     | 12.08     | 78.66     | 4.699    |
| K       | 24.05    | 23.35     | 14.99     | 7.445     | 293.1     | 57.72     | 43.61     | 18.43     | 84.56     | 21.02    |
| Ca      | 378      | 335.6     | 340.5     | 111.6     | 328.7     | 187.2     | 212.3     | 338.6     | 887.7     | 159      |
| Ti      | 1.144    | 2.289     | 0.4055    | 0.7015    | 1.402     | 0.62      | 0.953     | 0.9018    | 3.619     | 1.296    |
| V       | 0.3422   | 0.5061    | 0.1746    | 0.3225    | 0.6154    | 0.3084    | 0.2034    | 0.306     | 0.7548    | 0.1734   |
| Cr      | 0.5308   | 0.7258    | 0.2256    | 0.4217    | 0.9545    | 0.1763    | 0.1862    | 0.2527    | 0.8555    | 0.2996   |
| Mn      | 19.9     | 13.05     | 25.51     | 8.101     | 14.77     | 8.122     | 15.43     | 20.64     | 53.76     | 14.6     |
| Fe      | 456.6    | 618.4     | 191.4     | 53.79     | 54.85     | 76.54     | 117.6     | 161.6     | 375.7     | 134      |
| Co      | 0.2214   | 0.2341    | 0.1245    | 0.02497   | 0.08916   | 0.04806   | 0.09001   | 0.102     | 0.2533    | 0.1476   |
| Ni      | 0.4151   | 0.5863    | 0.1119    | 0.1176    | 2.766     | 0.1213    | 0.1334    | 0.1866    | 0.6683    | 0.2132   |
| Cu      | 0.1904   | 0.3466    | 0.02042   | 0.144     | 6.422     | 0.1958    | 0.02906   | 0.1002    | 0.7713    | 0.304    |
| Zn      | 6.706    | 23.26     | 8.4       | 13.19     | 32.88     | 20.74     | 4.673     | 4.416     | 19.37     | 2.577    |
| Ga      | 0.02618  | 0.04609   | 0.01133   | 0.01824   | 0.02359   | 0.009071  | 0.01486   | 0.01904   | 0.05833   | 0.01425  |
| As      | 1.161    | 1.307     | 0.5736    | 0.5853    | 0.8386    | 0.3771    | 0.4625    | 0.6231    | 1.707     | 0.7361   |
| Rb      | 0.1274   | 0.101     | 0.02467   | 0.01092   | 0.7694    | 0.1705    | 0.06361   | 0.03217   | 0.08124   | 0.08614  |
| Sr      | 4.096    | 2.822     | 3.59      | 0.89      | 0.8629    | 2.666     | 2.661     | 4.1       | 9.438     | 1.109    |
| Zr      | 0.1164   | 0.1561    | 0.02536   | 0.03998   | 0.07344   | 0.05515   | 0.03557   | 0.06684   | 0.1802    | 0.1024   |
| Nb      | 0.04044  | 0.01814   | 0.00395   | 0.03405   | 0.008718  |           | 0.01317   | <d.l.     | 0.01624   | 0.08948  |
| Mo      | 0.01914  | 0.009076  | 0.007897  | 0.01357   | 0.264     | 0.0104    | 0.005849  | 0.003632  | 0.01605   | 0.04413  |
| Cd      | 0.03557  | 0.03012   | 0.02815   | 0.01579   | 0.04681   | 0.009009  | 0.02733   | 0.02494   | 0.08421   | 0.03508  |
| Sn      | 0.02661  | 0.04908   | 0.003382  | 0.0275    | 0.1051    | 0.02087   | 0.0118    | 0.003396  | 0.05109   | 0.04402  |
| Sb      | 0.08536  | 0.08858   | 0.04518   | 0.06862   | 0.1343    | 0.0373    | 0.05621   | 0.04954   | 0.08083   | 0.07964  |
| Te      | 0.01326  | 0.009473  | 0.007356  | 0.01245   | 0.01976   | 0.01178   | 0.009449  | 0.01271   | 0.01644   | 0.01923  |
| Cs      | 0.02881  | 0.02926   | 0.003371  | 0.004787  | 0.03374   | 0.005786  | 0.008856  | 0.002252  | 0.01823   | 0.00832  |
| Ba      | 3.382    | 2.011     | 2.518     | 1.21      | 1.923     | 4.548     | 2.773     | 4.596     | 7.974     | 1.3      |
| La      | 0.03071  | 0.01814   | 0.005612  | 0.005994  | 0.03049   | 0.01787   | 0.008178  | 0.02538   | 0.03326   | 0.03853  |
| Ce      | 0.0766   | 0.05846   | 0.01515   | 0.02334   | 0.05386   | 0.03333   | 0.0202    | 0.03347   | 0.08214   | 0.09764  |
| Pr      | 0.009764 | 0.008013  | 0.002125  | 0.004038  | 0.006244  | 0.003758  | 0.003106  | 0.003909  | 0.009619  | 0.01302  |
| Nd      | 0.043    | 0.03471   | 0.008615  | 0.01858   | 0.02398   | 0.0178    | 0.01627   | 0.01845   | 0.04612   | 0.05261  |
| Sm      | 0.008999 | 0.0071    | 0.00299   | 0.005508  | 0.005396  | 0.005271  | 0.006238  | 0.004796  | 0.01204   | 0.01421  |
| Eu      | 0.002772 | 0.001873  | 0.001062  | 0.002237  | 0.00156   | 0.001546  | 0.002106  | 0.002165  | 0.003611  | 0.005539 |
| Gd      | 0.007282 | 0.009967  | 0.004426  | 0.007318  | 0.007543  | 0.007891  | 0.005957  | 0.007176  | 0.0141    | 0.01712  |
| Dy      | 0.007357 | 0.007604  | 0.00318   | 0.007119  | 0.0043    | 0.005855  | 0.006442  | 0.007565  | 0.0147    | 0.01926  |
| Ho      | 0.001788 | 0.001765  | 0.0006856 | 0.001768  | 0.0005253 | 0.001155  | 0.001504  | 0.001397  | 0.003219  | 0.005844 |
| Er      | 0.004125 | 0.004428  | 0.001951  | 0.003032  | 0.001945  | 0.003653  | 0.003214  | 0.004567  | 0.009883  | 0.01444  |
| Tm      | 0.00107  | 0.0008452 | 0.0004401 | 0.0008352 | 0.0002942 | 0.0006323 | 0.0006789 | 0.000803  | 0.001256  | 0.003212 |
| Yb      | 0.003703 | 0.003515  | 0.001308  | 0.002606  | 0.0007924 | 0.002731  | 0.002628  | 0.004085  | 0.005728  | 0.0108   |
| Lu      | 0.000762 | 0.0007175 | 0.0004173 | 0.0006256 | 0.0004183 | 0.0005456 | 0.000736  | 0.0004972 | 0.0009501 | 0.00272  |
| Hf      | 0.01343  | 0.01027   | 0.003708  | 0.006952  | 0.006787  | 0.002476  | 0.004631  | 0.003981  | 0.005726  | 0.01987  |
| W       | 0.02564  | 0.012     | 0.006946  | 0.02486   | 0.02524   | 0.006685  | 0.01583   | 0.004362  | 0.01562   | 0.08234  |
| Pb      | 0.3734   | 0.6508    | 0.1085    | 0.2868    | 0.4937    | 0.2036    | 0.1713    | 0.1403    | 0.7902    | 0.5237   |
| Th      | 0.009502 | 0.01467   | 0.001085  | 0.002235  | 0.004285  | 0.003751  | 0.002225  | 0.007497  | 0.02441   | 0.01478  |
| U       | 0.004404 | 0.005833  | 0.001277  | 0.001427  | 0.003814  | 0.002811  | 0.001799  | 0.002815  | 0.01015   | 0.00828  |

## ESM-2, continued.

| Element | Z-22     | Z-23      | Z-24     | Z-25      | Z-26     | Z-27     | Z-28     | Z-29     | Z-30     | Z-31      |
|---------|----------|-----------|----------|-----------|----------|----------|----------|----------|----------|-----------|
| B       | 3.917    | 2.286     | 4.186    | 2.039     | 2.619    | 3.875    | 3.971    | 6.196    | 7.369    | 4.204     |
| Na      | 323.9    | 246       | 885.7    | 8.701     | 386.4    | 202.2    | 33.09    | 362.5    | 1064     | 556.1     |
| Mg      | 101.1    | 94.43     | 411.6    | 52.68     | 155.4    | 92.4     | 95.25    | 152.2    | 184.2    | 191       |
| Al      | 162.2    | 84.17     | 42.68    | 51.52     | 173.1    | 88.99    | 40.93    | 235.8    | 200.2    | 114.6     |
| Si      | 8        | 877       | 22.3     | n.d.      | 43       | n.d.     | n.d.     | 114      | 3361     | 172       |
| P       | 21.2     | 5.148     | 5.909    |           | 13.37    | 6.156    | 2.237    | 11.7     | 17.36    | 11.63     |
| K       | 463.1    | 30.54     | 170.2    | 8.609     | 102.5    | 30.57    | 14.28    | 594.4    | 492.3    | 132.1     |
| Ca      | 198.3    | 282.1     | 645.7    | 117.9     | 411.3    | 141.4    | 156.3    | 236.2    | 600.3    | 411.4     |
| Ti      | 1.849    | 0.7781    | 1.287    | 0.6694    | 4.915    | 1.247    | 0.505    | 2.061    | 2.756    | 0.9641    |
| V       | 0.6198   | 0.2801    | 0.2098   | 0.251     | 1.553    | 0.2383   | 0.1916   | 1.192    | 3.007    | 0.3868    |
| Cr      | 0.5118   | 0.2205    | 0.2099   | 0.2985    | 0.5048   | 0.37     | 0.2203   | 0.9409   | 1.433    | 0.355     |
| Mn      | 8.087    | 25.76     | 18.06    | 6.075     | 16.8     | 9.237    | 10.26    | 9.517    | 4.101    | 19.64     |
| Fe      | 374.4    | 639.6     | 280.4    | 159.5     | 176.9    | 142.3    | 66.56    | 427.9    | 998.2    | 478.4     |
| Co      | 0.06314  | 0.08233   | 0.03566  | 0.03088   | 0.08973  | 0.0505   | 0.04147  | 0.2086   | 0.1129   | 0.1153    |
| Ni      | 0.47     | 0.1559    | 0.159    | 0.1446    | 0.2783   | 0.1701   | 0.09963  | 0.4698   | 1.3      | 0.2535    |
| Cu      | 1.404    | 0.04428   | 0.2187   | 0.168     | 0.5442   | 0.07196  | 0.0963   | 1.245    | 2.562    | 0.4011    |
| Zn      | 3.991    | 4.055     | 2.834    | 2.836     | 4.407    | 3.935    | 9.819    | 3.144    | 8.61     | 6.218     |
| Ga      | 0.04823  | 0.01679   | 0.01141  | 0.01607   | 0.04198  | 0.02444  | 0.01446  | 0.03421  | 0.02524  | 0.02644   |
| As      | 0.9963   | 0.5002    | 0.4313   | 0.4825    | 0.7922   | 0.6886   | 0.5401   | 1.178    | 1.837    | 0.8197    |
| Rb      | 0.2661   | 0.11      | 0.2951   | 0.006867  | 0.4702   | 0.1731   | 0.03813  | 0.08611  | 0.7277   | 0.4545    |
| Sr      | 3.835    | 3.52      | 8.754    | 1.137     | 6.802    | 1.087    | 1.144    | 3.478    | 10.09    | 5.877     |
| Zr      | 0.1245   | 0.03494   | 0.1153   | 0.03897   | 0.3235   | 0.07075  | 0.02905  | 0.1823   | 0.4491   | 0.0549    |
| Nb      | 0.1182   | <d.l.     | <d.l.    | <d.l.     | 0.003812 | 0.04745  | 0.07849  | <d.l.    | 0.007932 | 0.001581  |
| Mo      | 0.03387  | 0.004045  | 0.025    | 0.0008768 | 0.0192   | 0.01943  | 0.04213  | 0.004605 | 0.09082  | 0.0147    |
| Cd      | 0.02019  | 0.01374   | 0.006425 | 0.01818   | 0.01461  | 0.02262  | 0.02707  | 0.03515  | 0.02529  | 0.02019   |
| Sn      | 0.08258  | 0.003637  | 0.01247  | 0.007449  | 0.02131  | 0.03368  | 0.04517  | 0.01293  | 0.04165  | 0.01609   |
| Sb      | 0.06634  | 0.0165    | 0.03297  | 0.0567    | 0.08226  | 0.04979  | 0.05486  | 0.06037  | 0.06204  | 0.1031    |
| Te      | 0.01656  | 0.00144   | 0.01239  | 0.01325   | 0.005417 | 0.02462  | 0.02152  | 0.01299  | 0.008398 | 0.01227   |
| Cs      | 0.03598  | 0.01028   | 0.01038  | 0.002245  | 0.02395  | 0.02492  | 0.007227 | 0.01577  | 0.02208  | 0.03051   |
| Ba      | 1.809    | 5.554     | 4.334    | 1.209     | 7.647    | 1.121    | 2.117    | 2.795    | 5.285    | 5.027     |
| La      | 0.04971  | 0.02506   | 0.04612  | 0.007272  | 0.04727  | 0.0152   | 0.008136 | 0.299    | 0.1778   | 0.02694   |
| Ce      | 0.1045   | 0.05877   | 0.118    | 0.02246   | 0.1075   | 0.04555  | 0.01829  | 0.8931   | 0.4944   | 0.04467   |
| Pr      | 0.01392  | 0.006744  | 0.01439  | 0.003237  | 0.01268  | 0.00655  | 0.004211 | 0.1074   | 0.06207  | 0.005619  |
| Nd      | 0.06308  | 0.03098   | 0.06463  | 0.01599   | 0.06412  | 0.02884  | 0.01498  | 0.5195   | 0.2913   | 0.02335   |
| Sm      | 0.01612  | 0.006896  | 0.01459  | 0.005192  | 0.01303  | 0.007318 | 0.006393 | 0.1273   | 0.06727  | 0.007107  |
| Eu      | 0.005096 | 0.002755  | 0.003341 | 0.001095  | 0.004019 | 0.002201 | 0.002511 | 0.02935  | 0.01593  | 0.002236  |
| Gd      | 0.02078  | 0.007582  | 0.01422  | 0.004527  | 0.01464  | 0.006287 | 0.006131 | 0.1451   | 0.08164  | 0.008243  |
| Dy      | 0.02043  | 0.007869  | 0.01228  | 0.005191  | 0.01472  | 0.006821 | 0.004422 | 0.1301   | 0.06786  | 0.007772  |
| Ho      | 0.00484  | 0.001616  | 0.002696 | 0.001235  | 0.002885 | 0.001777 | 0.002059 | 0.0306   | 0.01548  | 0.001559  |
| Er      | 0.01237  | 0.004     | 0.008121 | 0.002346  | 0.00974  | 0.003614 | 0.002714 | 0.09281  | 0.04872  | 0.005047  |
| Tm      | 0.002032 | 0.0008206 | 0.00102  | 0.0004236 | 0.001504 | 0.001091 | 0.00145  | 0.01405  | 0.008448 | 0.0007816 |
| Yb      | 0.009194 | 0.003771  | 0.006849 | 0.002922  | 0.008161 | 0.002537 | 0.002099 | 0.09061  | 0.05232  | 0.004402  |
| Lu      | 0.002037 | 0.0006241 | 0.001283 | 0.0001608 | 0.001554 | 0.001241 | 0.00171  | 0.01408  | 0.00938  | 0.0007164 |
| Hf      | 0.03051  | 0.001927  | 0.005797 | 0.002037  | 0.01132  | 0.009775 | 0.01175  | 0.007739 | 0.01996  | 0.005723  |
| W       | 0.05187  | 0.003651  | 0.002186 | 0.0027    | 0.003632 | 0.04129  | 0.07701  | 0.002811 | 0.01285  | 0.007846  |
| Pb      | 1.962    | 0.2049    | 0.2009   | 0.2672    | 0.1655   | 0.5275   | 1.01     | 1.283    | 0.8935   | 0.2244    |
| Th      | 0.02366  | 0.001829  | 0.007692 | 0.001756  | 0.01595  | 0.008888 | 0.002702 | 0.02019  | 0.01741  | 0.004733  |
| U       | 0.009534 | 0.002324  | 0.006657 | 0.0007109 | 0.006716 | 0.003435 | 0.002381 | 0.0142   | 0.01447  | 0.004223  |

## ESM-2, continued.

| Element | Z-32     | Z-33     | Z-34     | Z-35      | Z-36      | Z-37     | Z-38     | Z-39     | Z-40      | Z-41       | Z-42     |
|---------|----------|----------|----------|-----------|-----------|----------|----------|----------|-----------|------------|----------|
| B       | 4.829    | 6.552    | 3.836    | 9.733     | 3.852     | 1.896    | 1.886    | 1.81     | 3.653     | 4.407      | 9.088    |
| Na      | 368.6    | 519.1    | 257.8    | 437.8     | 150.9     | 313      | 297      | 224      | 40.82     | 299.2      | 3259     |
| Mg      | 165.1    | 345.3    | 165.6    | 385.9     | 163       | 77       | 73.14    | 62.76    | 137.7     | 180.7      | 2651     |
| Al      | 230.2    | 174      | 67.17    | 184.9     | 118.7     | 147.6    | 121.8    | 89.52    | 43.36     | 43.56      | 9.354    |
| Si      | n.d.     | 29.3     | 10.5     | 159       | 48        | 108      | 33.8     | 24       | 6         | 12.6       | 7662     |
| P       | 39.92    | 17.08    | 7.461    | 13.43     | 19.44     | 12.64    | 9.414    | 10.34    | 3.343     | 3.477      | 24.73    |
| K       | 14.99    | 7.994    | 17.14    | 70.03     | 58.49     | 138.6    | 127      | 48.03    | 19.54     | 16.56      | 482.8    |
| Ca      | 306      | 548      | 200.8    | 914.5     | 311       | 161.3    | 155      | 180      | 168       | 461.1      | 4434     |
| Ti      | 3.294    | 1.58     | 0.779    | 1.442     | 1.298     | 4.029    | 3.039    | 1.144    | 0.7457    | 0.279      | 1.253    |
| V       | 0.6807   | 0.4166   | 0.2589   | 0.2655    | 0.2446    | 1.386    | 1.151    | 0.3384   | 0.2013    | 0.1689     | 0.2397   |
| Cr      | 0.7609   | 0.5905   | 0.2259   | 0.4037    | 0.3202    | 0.4258   | 0.3443   | 0.3591   | 0.2188    | 0.1732     | 0.2447   |
| Mn      | 12.69    | 24.61    | 13.98    | 21.53     | 12.15     | 10.08    | 9.587    | 10.37    | 14.5      | 15.94      | 11.84    |
| Fe      | 416.4    | 302.9    | 102.1    | 613.1     | 206.3     | 193.4    | 95.95    | 286.6    | 65.63     | 246        | 543.5    |
| Co      | 0.1246   | 0.2935   | 0.1484   | 0.1775    | 0.1261    | 0.08142  | 0.1108   | 0.1414   | 0.09604   | 0.1406     | 0.08549  |
| Ni      | 0.6818   | 0.4263   | 0.2344   | 0.1904    | 0.2946    | 0.2956   | 0.1883   | 0.3384   | 0.119     | 0.1931     | 0.4922   |
| Cu      | 0.4599   | 0.1433   | 0.1289   | 0.7562    | 0.1078    | 0.4601   | 0.1564   | 0.09631  | 0.129     | 0.1705     | 0.09428  |
| Zn      | 4.996    | 14.05    | 5.818    | 20.88     | 9.875     | 3.963    | 3.228    | 5.624    | 10.18     | 10.79      | 1.413    |
| Ga      | 0.05586  | 0.02646  | 0.01444  | 0.03583   | 0.02901   | 0.03621  | 0.02517  | 0.01661  | 0.009503  | 0.003597   | 0.004099 |
| As      | 1.443    | 1.308    | 0.5678   | 1.102     | 0.6575    | 0.7596   | 0.6827   | 0.604    | 0.6122    | 0.9644     | 0.4176   |
| Rb      | 0.112    | 0.02638  | 0.04202  | 0.2547    | 0.1456    | 0.5203   | 0.4893   | 0.1468   | 0.03517   | 0.08232    | 0.6733   |
| Sr      | 3.584    | 5.391    | 2.802    | 12.66     | 2.835     | 2.467    | 2.298    | 2.091    | 1.561     | 5.384      | 44.34    |
| Zr      | 0.2153   | 0.09575  | 0.04558  | 0.02042   | 0.05387   | 0.2819   | 0.2164   | 0.1471   | 0.02138   | 0.01935    | 0.04115  |
| Nb      | 0.0247   | 0.01135  | 0.04627  | 0.002794  | <d.l.     | 0.03169  | 0.01623  | 0.09473  | <d.l.     | <d.l.      | 0.0231   |
| Mo      | 0.01406  | 0.005692 | 0.02737  | 0.005374  | 0.008371  | 0.04529  | 0.02911  | 0.05107  | 0.005219  | -0.0006933 | 0.02547  |
| Cd      | 0.03428  | 0.06098  | 0.02564  | 0.04019   | 0.02898   | 0.008848 | 0.01406  | 0.01559  | 0.04052   | 0.01432    | 0.002428 |
| Sn      | 0.131    | 0.1098   | 0.072    | 0.02164   | 0.3826    | 0.1324   | 0.1808   | 0.07407  | 0.1826    | 1.385      | 0.1088   |
| Sb      | 0.1428   | 0.2178   | 0.1536   | 0.1149    | 0.1278    | 0.09108  | 0.1649   | 0.1216   | 0.1548    | 0.1911     | 0.05655  |
| Te      | 0.01574  | 0.0118   | 0.01386  | 0.01399   | 0.009901  | 0.01008  | 0.01021  | 0.01294  | 0.01097   | 0.006697   | 0.004958 |
| Cs      | 0.03108  | 0.004034 | 0.002773 | 0.02266   | 0.01429   | 0.02404  | 0.01964  | 0.0114   | <d.l.     | 0.01078    | 0.004354 |
| Ba      | 9.96     | 9.745    | 4.495    | 6.472     | 4.528     | 5.302    | 4.675    | 5.307    | 2.779     | 8.937      | 8.173    |
| La      | 0.03396  | 0.01627  | 0.01121  | 0.03666   | 0.01644   | 0.04713  | 0.0316   | 0.03952  | 0.002755  | 0.004793   | 0.02204  |
| Ce      | 0.09076  | 0.0474   | 0.02515  | 0.0994    | 0.04156   | 0.1095   | 0.06983  | 0.09851  | 0.01308   | 0.01104    | 0.0468   |
| Pr      | 0.01076  | 0.005595 | 0.003783 | 0.01206   | 0.005156  | 0.01277  | 0.01033  | 0.01293  | 0.002308  | 0.0013     | 0.007041 |
| Nd      | 0.04893  | 0.02907  | 0.01383  | 0.05328   | 0.02265   | 0.05324  | 0.0411   | 0.04935  | 0.01417   | 0.005513   | 0.03249  |
| Sm      | 0.01223  | 0.009669 | 0.006553 | 0.01091   | 0.006542  | 0.0156   | 0.009665 | 0.01239  | 0.00528   | 0.001382   | 0.006608 |
| Eu      | 0.004585 | 0.003662 | 0.002615 | 0.003306  | 0.001615  | 0.004019 | 0.002764 | 0.004696 | 0.001268  | 0.001329   | 0.00266  |
| Gd      | 0.01963  | 0.01234  | 0.00865  | 0.01113   | 0.005388  | 0.01723  | 0.01116  | 0.01382  | 0.004291  | 0.001411   | 0.006936 |
| Dy      | 0.02152  | 0.01446  | 0.01118  | 0.009842  | 0.004813  | 0.01421  | 0.01206  | 0.01493  | 0.005364  | 0.002229   | 0.007673 |
| Ho      | 0.004541 | 0.003244 | 0.00301  | 0.00157   | 0.001303  | 0.003363 | 0.002389 | 0.00396  | 0.001025  | 0.0004664  | 0.002035 |
| Er      | 0.01261  | 0.008667 | 0.006412 | 0.004077  | 0.002824  | 0.009829 | 0.007568 | 0.009608 | 0.002458  | 0.001039   | 0.005476 |
| Tm      | 0.001572 | 0.001398 | 0.001492 | 0.0008938 | 0.0005001 | 0.001858 | 0.001326 | 0.00226  | 0.0002328 | 0.0001404  | 0.001181 |
| Yb      | 0.007783 | 0.006013 | 0.005844 | 0.004309  | 0.002296  | 0.009946 | 0.005825 | 0.007322 | 0.001916  | 0.0001727  | 0.005833 |
| Lu      | 0.001311 | 0.000836 | 0.001467 | 0.0006597 | 0.0003909 | 0.00172  | 0.001203 | 0.002205 | 0.0001896 | 0.0002293  | 0.001292 |
| Hf      | 0.01181  | 0.006709 | 0.008033 | 0.00492   | 0.003685  | 0.01676  | 0.01327  | 0.02853  | 0.002383  | 0.001984   | 0.007228 |
| W       | 0.0155   | 0.009624 | 0.04527  | 0.007114  | 0.004451  | 0.01905  | 0.01309  | 0.08023  | 0.0007758 | 0.001862   | 0.02655  |
| Pb      | 0.9815   | 0.5784   | 0.1797   | 0.9819    | 0.3605    | 0.1386   | 0.1393   | 0.2101   | 0.2523    | 0.07144    | 0.08407  |
| Th      | 0.02482  | 0.008816 | 0.003863 | 0.002527  | 0.00611   | 0.01697  | 0.008974 | 0.01787  | 0.001958  | 0.001604   | 0.002675 |
| U       | 0.00708  | 0.003392 | 0.002408 | 0.0108    | 0.002816  | 0.005675 | 0.003163 | 0.006214 | 0.0005713 | 0.0003476  | 0.003854 |