Supplement of

Vertical mobility of pyrogenic organic matter in soils: a column experiment

Marcus Schiedung et al.

Correspondence to: Samuel Abiven (abiven@biotite.ens.fr)

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Figure S1: Full DRIFT spectra of all three used fresh and oxidized PyOM. For details see figure 1 and table 2.
Figure S2: Breakthrough curves (BTC) for topsoil and subsoil of the sandy and loamy soil as average of control columns and columns with fresh and oxidized PyOM addition (± 1 SE). The percolation fraction represent each a percolation for 6 minutes with a flow of 1 ml min$^{-1}$. Only the BTCs of the loamy topsoil were conducted with a flow of 2 ml min$^{-1}$. 
Table S1: Diffusion coefficients $D$, convective velocity $v$ and dispersivities $\lambda$ fitted for all columns for sandy and loamy soil.

| Column replicate | $v$ [cm min$^{-1}$] | $D$ [cm$^2$ min$^{-1}$] | $\lambda$ [cm] |
|------------------|---------------------|-------------------------|---------------|
| **Sandy topsoil**|                     |                         |               |
| Control          | 1                   | 0.31                    | 0.036         | 0.12         |
|                  | 2                   | 0.36                    | 0.035         | 0.10         |
|                  | 3                   | 0.31                    | 0.027         | 0.09         |
|                  | 4                   | 0.30                    | 0.030         | 0.09         |
| Fresh PyOM       | 1                   | 0.31                    | 0.038         | 0.12         |
|                  | 2                   | 0.33                    | 0.053         | 0.16         |
|                  | 3                   | 0.34                    | 0.041         | 0.12         |
|                  | 4                   | 0.29                    | 0.039         | 0.13         |
| Oxidized PyOM    | 1                   | 0.28                    | 0.057         | 0.21         |
|                  | 2                   | 0.29                    | 0.033         | 0.12         |
|                  | 3                   | 0.29                    | 0.031         | 0.11         |
|                  | 4                   | 0.31                    | 0.057         | 0.19         |
| **Sandy subsoil**|                     |                         |               |
| Control          | 1                   | 0.28                    | 0.030         | 0.10         |
|                  | 2                   | 0.29                    | 0.024         | 0.08         |
|                  | 3                   | 0.28                    | 0.025         | 0.09         |
|                  | 4                   | 0.31                    | 0.020         | 0.08         |
| Fresh PyOM       | 1                   | 0.27                    | 0.041         | 0.15         |
|                  | 2                   | 0.27                    | 0.058         | 0.21         |
|                  | 3                   | 0.33                    | 0.076         | 0.23         |
|                  | 4                   | 0.31                    | 0.056         | 0.18         |
| Oxidized PyOM    | 1                   | 0.27                    | 0.023         | 0.09         |
|                  | 2                   | 0.28                    | 0.037         | 0.13         |
|                  | 3                   | 0.29                    | 0.029         | 0.10         |
|                  | 4                   | 0.28                    | 0.050         | 0.18         |
| Column replicate | \( v \) [cm min\(^{-1}\)] | \( D \) [cm\(^2\) min\(^{-1}\)] | \( \lambda \) [cm] |
|-----------------|----------------|----------------|--------|
| **Loamy topsoil** |    |    |        |
| Control         | 1  | 0.72 | 0.326  | 0.46   |
|                 | 2  | 0.77 | 0.081  | 0.10   |
|                 | 3  | 0.85 | 0.318  | 0.37   |
|                 | 4  | 0.71 | 0.310  | 0.44   |
| Fresh PyOM      | 1  | 0.50 | 0.271  | 0.54   |
|                 | 2  | 0.54 | 0.097  | 0.18   |
|                 | 3  | 0.50 | 0.116  | 0.23   |
|                 | 4  | 0.42 | 0.053  | 0.13   |
| Oxidized PyOM   | 1  | 0.49 | 0.121  | 0.25   |
|                 | 2  | 0.63 | 0.142  | 0.23   |
|                 | 3  | 0.54 | 0.141  | 0.26   |
|                 | 4  | 0.53 | 0.142  | 0.27   |
| **Loamy subsoil** |    |    |        |
| Control         | 1  | 0.28 | 0.027  | 0.10   |
|                 | 2  | 0.27 | 0.042  | 0.15   |
|                 | 3  | 0.26 | 0.039  | 0.15   |
|                 | 4  | 0.28 | 0.030  | 0.12   |
| Fresh PyOM      | 1  | 0.27 | 0.041  | 0.15   |
|                 | 2  | 0.25 | 0.065  | 0.26   |
|                 | 3  | 0.24 | 0.056  | 0.24   |
|                 | 4  | 0.25 | 0.050  | 0.20   |
| Oxidized PyOM   | 1  | 0.39 | 0.229  | 0.59   |
|                 | 2  | 0.29 | 0.036  | 0.12   |
|                 | 3  | 0.29 | 0.029  | 0.10   |
|                 | 4  | 0.29 | 0.040  | 0.14   |
Table S2: pH, EC, percolated native soil organic carbon (nSOC), excess isotope-amount fraction $xE^{13}C$, PyOM-C and proportion of PyOM-C on TOC (PyOM-C: percolated TOC) for all percolates of the sandy and loamy soil ($\pm$ 1 SE).

| Percolation [l m$^{-2}$] | pH [-] | EC [mS cm$^{-1}$] | Percolated nSOC [mg l$^{-1}$] | $xE^{13}C$ [%] | PyOM-C [µg l$^{-1}$] | PyOM-C: perc. TOC [%] |
|--------------------------|--------|------------------|-----------------------------|--------------|-----------------|---------------------|
| **Sandy topsoil**        |        |                  |                             |              |                 |                     |
| Control                  |        |                  |                             |              |                 |                     |
| 1,000                    | 3.42 (0.02) | 2.30 (0.01) | 12.12 (0.24) |
| 3,000                    | 3.70 (0.04) | 2.25 (0.01) | 4.12 (0.07) |
| 8,000                    | 4.05 (0.01) | 2.21 (0.01) | 1.51 (0.03) |
| 13,000                   | 4.25 (0.02) | 2.24 (0.01) | 1.51 (0.13) |
| 18,000                   | 4.34 (0.02) | 2.27 (0.01) | 0.68 (0.09) |
| Fresh PyOM              |        |                  |                             |              |                 |                     |
| 1,000                    | 3.72 (0.03) | 2.48 (0.01) | 45.54 (7.69) | 0.070 (0.008) | 997.0 (72.0) | 2.4 (0.3) |
| 3,000                    | 3.95 (0.02) | 2.23 (0.01) | 4.67 (0.30) | 0.037 (0.002) | 57.7 (8.2) | 1.3 (0.1) |
| 8,000                    | 4.18 (0.04) | 2.23 (0.01) | 2.04 (0.33) | 0.017 (0.001) | 12.0 (3.4) | 0.6 (0.1) |
| 13,000                   | 4.41 (0.02) | 2.24 (0.01) | 1.69 (0.19) | 0.013 (0.002) | 6.9 (0.5) | 0.4 (0.1) |
| 18,000                   | 4.51 (0.03) | 2.24 (0.01) | 1.32 (0.19) | 0.015 (0.001) | 6.3 (0.9) | 0.5 (0.1) |
| Oxidized PyOM           |        |                  |                             |              |                 |                     |
| 1,000                    | 3.62 (0.02) | 2.51 (0.01) | 28.16 (2.09) | 0.263 (0.010) | 2,862.9 (319.5) | 9.2 (0.5) |
| 3,000                    | 3.93 (0.02) | 2.28 (0.01) | 4.45 (0.14) | 0.104 (0.007) | 1,662.8 (8.7) | 3.7 (0.2) |
| 8,000                    | 4.18 (0.02) | 2.25 (0.01) | 1.71 (0.08) | 0.050 (0.002) | 30.0 (1.8) | 1.8 (0.1) |
| 13,000                   | 4.36 (0.01) | 2.24 (0.01) | 1.35 (0.19) | 0.030 (0.005) | 13.4 (1.7) | 1.0 (0.2) |
| 18,000                   | 4.51 (0.01) | 2.26 (0.01) | 0.90 (0.10) | 0.030 (0.002) | 9.4 (1.2) | 1.1 (0.1) |
| **Sandy subsoil**        |        |                  |                             |              |                 |                     |
| Control                  |        |                  |                             |              |                 |                     |
| 1,000                    | 4.38 (0.02) | 2.35 (0.02) | 3.28 (0.18) |
| 3,000                    | 4.63 (0.04) | 2.32 (0.01) | 0.61 (0.04) |
| 8,000                    | 4.88 (0.04) | 2.24 (0.01) | 0.74 (0.06) |
| 13,000                   | 5.20 (0.05) | 2.25 (0.01) | 0.65 (0.21) |
| 18,000                   | 5.40 (0.03) | 2.23 (0.01) | 1.08 (0.13) |
| Fresh PyOM              |        |                  |                             |              |                 |                     |
| 1,000                    | 4.98 (0.07) | 2.52 (0.02) | 13.31 (1.55) | 0.183 (0.008) | 1,114.7 (169.5) | 6.8 (0.3) |
| 3,000                    | 5.06 (0.03) | 2.25 (0.01) | 1.57 (0.04) | 0.073 (0.003) | 50.1 (3.4) | 2.7 (0.1) |
| 8,000                    | 5.41 (0.04) | 2.26 (0.01) | 0.57 (0.06) | 0.045 (0.002) | 10.8 (0.4) | 1.7 (0.1) |
| 13,000                   | 5.43 (0.04) | 2.24 (0.01) | 1.61 (0.21) | 0.030 (0.001) | 20.6 (2.1) | 1.1 (0.1) |
| 18,000                   | 5.74 (0.03) | 2.20 (0.01) | 1.14 (0.19) | 0.008 (0.003) | 3.6 (1.2) | 0.3 (0.1) |
| Oxidized PyOM           |        |                  |                             |              |                 |                     |
| 1,000                    | 4.96 (0.07) | 2.58 (0.02) | 11.88 (0.51) | 0.463 (0.018) | 2,836.9 (166.1) | 17.2 (1.0) |
| 3,000                    | 4.96 (0.05) | 2.29 (0.01) | 1.42 (0.14) | 0.162 (0.006) | 105.8 (8.6) | 6.0 (0.3) |
| 8,000                    | 5.19 (0.04) | 2.23 (0.01) | 0.86 (0.13) | 0.082 (0.009) | 31.6 (6.4) | 3.0 (0.4) |
| 13,000                   | 5.36 (0.03) | 2.25 (0.01) | 0.73 (0.08) | 0.056 (0.003) | 18.3 (2.9) | 2.1 (0.1) |
| 18,000                   | 5.58 (0.01) | 2.23 (0.01) | 0.67 (0.09) | 0.056 (0.005) | 16.3 (1.9) | 2.0 (0.2) |
Table S2: Continued

|                     | Percolation | pH     | EC     | Percolated nSOC | $xE^{13}$C | PyOM-C | PyOM-C: perc. TOC |
|---------------------|-------------|--------|--------|-----------------|------------|--------|------------------|
|                     | [1 m$^{-2}$] | [-]    | [mS cm$^{-1}$] | [mg l$^{-1}$] | [%] | [µg l$^{-1}$] | [%] |
| Loamy topsoil       |             |        |        |                 |            |        |                  |
| Control             |             |        |        |                 |            |        |                  |
| 1,000               | 5.99 (0.08) | 2.25 (0.01) | 9.65 (1.07) | | | | |
| 3,000               | 5.76 (0.21) | 2.25 (0.01) | 4.30 (1.22) | | | | |
| 8,000               | 5.99 (0.10) | 2.17 (0.01) | 1.56 (0.36) | | | | |
| 13,000              | 6.11 (0.02) | 2.12 (0.01) | 1.57 (0.22) | | | | |
| 18,000              | 6.11 (0.07) | 2.19 (0.02) | 0.63 (0.11) | | | | |
| Fresh PyOM          |             |        |        |                 |            |        |                  |
| 1,000               | 6.75 (0.06) | 2.36 (0.03) | 21.14 (1.96) | 0.106 (0.002) | 596.4 (46.6) | 2.9 (0.1) | |
| 3,000               | 6.26 (0.12) | 2.16 (0.01) | 2.50 (0.16) | 0.070 (0.009) | 45.3 (4.2) | 1.9 (0.2) | |
| 8,000               | 6.21 (0.08) | 2.15 (0.01) | 1.21 (0.14) | 0.031 (0.001) | 9.8 (1.2) | 0.8 (0.1) | |
| 13,000              | 6.06 (0.12) | 2.19 (0.01) | 2.01 (0.61) | 0.008 (0.005) | 61 (4.4) | 0.2 (0.1) | |
| 18,000              | 6.21 (0.07) | 2.19 (0.01) | 1.25 (0.25) | ND | ND | - | |
| Oxidized PyOM       |             |        |        |                 |            |        |                  |
| 1,000               | 6.45 (0.09) | 2.47 (0.03) | 15.89 (2.08) | 0.295 (0.033) | 1,411.4 (439.8) | 7.7 (1.3) | |
| 3,000               | 6.44 (0.07) | 2.20 (0.01) | 1.76 (0.24) | 0.182 (0.024) | 87.9 (18.2) | 4.8 (0.9) | |
| 8,000               | 6.31 (0.04) | 2.16 (0.01) | 1.35 (0.15) | 0.065 (0.005) | 22.8 (2.3) | 1.7 (0.2) | |
| 13,000              | 6.01 (0.07) | 2.15 (0.01) | 2.96 (1.00) | 0.024 (0.001) | 18.5 (6.8) | 0.6 (0.1) | |
| 18,000              | 6.14 (0.10) | 2.19 (0.01) | 1.17 (0.19) | ND | ND | - | |
| Loamy subsoil       |             |        |        |                 |            |        |                  |
| Control             |             |        |        |                 |            |        |                  |
| 1,000               | 4.29 (0.03) | 2.22 (0.01) | 7.86 (0.49) | | | | |
| 3,000               | 4.35 (0.04) | 2.23 (0.01) | 1.22 (0.16) | | | | |
| 8,000               | 4.49 (0.03) | 2.22 (0.01) | 1.33 (0.11) | | | | |
| 13,000              | 4.64 (0.07) | 2.23 (0.01) | 0.74 (0.07) | | | | |
| 18,000              | 5.04 (0.06) | 2.20 (0.01) | 0.85 (0.07) | | | | |
| Fresh PyOM          |             |        |        |                 |            |        |                  |
| 1,000               | 4.39 (0.03) | 2.49 (0.05) | 12.23 (1.55) | 0.071 (0.005) | 357.5 (49.5) | 2.6 (0.2) | |
| 3,000               | 4.55 (0.09) | 2.29 (0.01) | 1.62 (0.11) | 0.043 (0.005) | 28.6 (3.7) | 1.6 (0.1) | |
| 8,000               | 4.69 (0.07) | 2.27 (0.01) | 0.90 (0.06) | 0.053 (0.007) | 19.6 (3.1) | 1.9 (0.2) | |
| 13,000              | 4.65 (0.01) | 2.24 (0.01) | 0.70 (0.04) | 0.038 (0.005) | 10.8 (1.1) | 1.4 (0.2) | |
| 18,000              | 4.87 (0.11) | 2.27 (0.01) | 0.66 (0.09) | 0.033 (0.003) | 9.0 (1.4) | 1.2 (0.1) | |
| Oxidized PyOM       |             |        |        |                 |            |        |                  |
| 1,000               | 4.32 (0.02) | 3.42 (0.03) | 10.92 (0.79) | 0.165 (0.008) | 724.2 (67.5) | 5.7 (0.3) | |
| 3,000               | 4.50 (0.01) | 3.03 (0.01) | 1.41 (0.08) | 0.168 (0.019) | 93.8 (7.1) | 5.8 (0.6) | |
| 8,000               | 4.72 (0.09) | 2.70 (0.01) | 0.98 (0.08) | 0.163 (0.012) | 63.5 (4.6) | 5.6 (0.3) | |
| 13,000              | 4.63 (0.04) | 2.29 (0.01) | 0.60 (0.05) | 0.140 (0.012) | 34.0 (5.3) | 4.8 (0.3) | |
| 18,000              | 4.82 (0.04) | 2.33 (0.01) | 0.83 (0.04) | 0.081 (0.003) | 26.3 (0.4) | 2.8 (0.1) | |
Figure S3: pH values of percolates from controls columns and columns with addition of fresh and oxidized PyOM percolated from topsoils and subsoils of the sandy and loamy soil (± 1 SE). Significant differences in pH of the first flush (1,000 l m⁻²) are shown by lettering (p<0.05). The grey dotted line shows the background value (pH=5.5) of the 0.01 M CaCl₂ solution used for the percolation.
Figure S4: EC values of percolates from controls columns and columns with addition of fresh and oxidized PyOM percolated from topsoils and subsoils of the sandy and loamy soil (± 1 SE). Significant differences in EC of the first flush (1,000 l m⁻²) are shown by lettering (p<0.05). The grey dotted line shows the background value (EC=2.2 mS cm⁻¹) of the 0.01 M CaCl₂ solution used for the percolation.