Supplementary Information

Priming mechanisms with additions of pyrogenic organic matter additions to soil

Silene DeCiucies[1], Thea Whitman[2], Dominic Woolf[1], Akio Enders[1], Johannes Lehmann[1,3]*

[1]Soil and Crop Sciences, School of Integrative Plant Science, Cornell University, Ithaca, NY 14850, USA

[2]Department of Soil Science, University of Wisconsin, Madison, WI 53706, USA

[3]Atkinson Center for a Sustainable Future, Cornell University, Ithaca, NY 149850

*Corresponding author, email: CL273@cornell.edu

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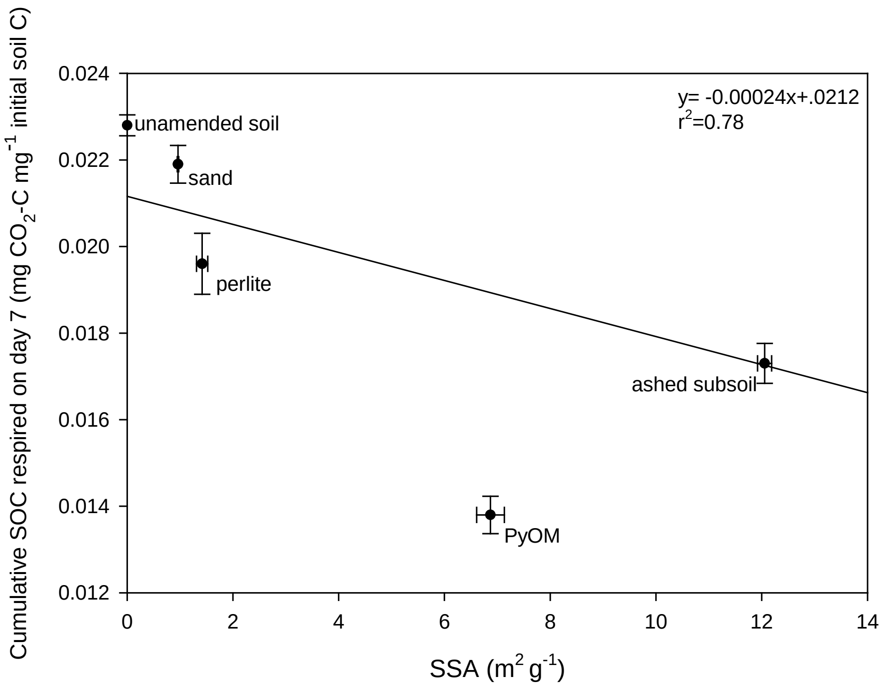

Fig. S1. Cumulative nSOC mineralization up to day 7 as related to the specific surface area (SSA) of the added materials, except for unamended soil which was placed on the y axis for comparison (means and standard errors, n=5; for respiration, n=1 for SSA (error calculated from 5-point regression line of a transformed BET equation); regression includes only sand, perlite and ashed subsoil, not the PyOM, as we expect PyOM surfaces to be more adsorptive per unit SSA than the inorganic substances (see adsorption experiment shown in Fig. 5 of the main manuscript); see Supplementary Discussion for explanation of the approach).

1. Supplementary discussion

Surface area of PyOM and additional dilution amendments were assayed using both CO_2 and N_2 BET analysis. CO_2 is considered to most accurately measure the nano-porosity of PyOM (Kwon and Pignatello, 2005) and to obtain total surface area that includes very small nanometer-sized pores (<1.5 nm; Zimmerman, 2010). We propose that the SSA obtained with N_2 is a more appropriate assessment of the SSA available for DOC adsorption within the scope of this experiment, because the micropores accessed using the CO_2 assay are most likely inaccessible to DOC particles sized up to 0.45 µm and therefore larger than the majority of those sub-nanopores <1.5 nm captured by CO_2.

The SSA obtained for some of the materials are very low (0.9-1.4 m^2 g^{-1}) and those results must therefore be regarded with caution. We therefore do not recommend that these be utilized individually. However, in aggregate with the other SSA shown here, they provide a way forward to improve estimates of the contribution of dilution to negative priming as outlined below.

Figure S1 uses N_2-SSA data combined with cumulative nSOC mineralization after 7 days to determine a regression, whereby the contribution of dilution on nSOC mineralization was quantified using the y-intercept as a theoretical amendment with no contribution from surface area. Only nSOC mineralization of soil amended with ashed subsoil, perlite, and quartz sand was used in the regression. PyOM was not included in this regression as we expect PyOM surfaces to be more adsorptive per unit SSA than the inorganic substances (as confirmed by the adsorption experiment shown in Fig. 5 of the main manuscript). The first 7 days were used to calculate cumulative nSOC mineralization, as this was the day when daily mineralization of nSOC from soil amended with the different inorganic and PyOM materials ceased to be significantly different from each other; and we therefore assume that the dilution process ceased to have a significant effect on nSOC mineralization. The nSOC mineralization results obtained from the unamended soil in Fig. S1 were placed on the y axis for comparison to the nSOC mineralization results of the same soil amended with either ashed subsoil, perlite, quartz sand, or PyOM produced at 450°C. Despite the uncertainties involved in obtaining SSA for some of the materials, ignoring possible interactions between nSOC and the inorganic diluents (ashed subsoil, perlite, quartz sand) and likely adsorption of DOC from nSOC (as unambiguously shown by the adsorption studies, see Fig. 5 in the main manuscript) would have increased any error in our quantification.

References

Kwon S. and Pignatello J. J. (2005) Effect of natural organic substances on the surface and adsorptive properties of environmental black carbon (char): pseudo pore blockage by model lipid components and its implications for N_2-probed surface properties of natural sorbents. *Environ. Sci. Techn.* **39**, 7932-7939.

Zimmerman A. R. (2010) Abiotic and microbial oxidation of laboratory-produced black carbon (biochar). *Environ. Sci. Techn.* **44**, 1295-1301.

Table S1.
Properties of amendments and proportion of SOC respired on day 7 (means, n=5) for incubation Experiment 1: Volumetric dilution.

Amendment	Bulk density	Mass added	SSA N_2	SSA CO_2	Proportion SOC respired, Day 7
	($Mg\ m^{-3}$)	(g)	($m^2\ g^{-1}$)	($m^2\ g^{-1}$)	(mg CO_2-C mg^{-1} initial SOC)
450°C PyOM	0.175	0.238	6.8705	192.61	0.0138
Ashed temperate subsoil	1.15	1.564	12.054	11.46	0.0173
Perlite	0.15	0.204	1.4173	-0.177	0.0196
Quartz sand	4.59	6.24	0.963	-0.19	0.0219
Control treatment	n/a	0.0	n/a	n/a	0.0228

n/a not applicable

Table S2.

Microbial biomass and microbial quotient (n=4) measured at the end of Experiment 2: Pyrolysis temperature.

Treatment	Microbial biomass (mg MB-C g^{-1} soil)	Microbial biomass from amendment (mg MB-C g^{-1} soil)	Total CO_2 respired (mg CO_2-C g^{-1} soil)	Metabolic quotient (mg CO_2-C mg^{-1} MB-C day^{-1})
Topsoil, unamended	0.86	n/a	0.0028	0.0032
Topsoil, 750PyOM	1.28	0.0009	0.0024	0.0018
Topsoil, 450PyOM	1.07	0.0008	0.0026	0.0024
Topsoil, 300PyOM	1.25	0.0040	0.0025	0.0020

n/a not applicable

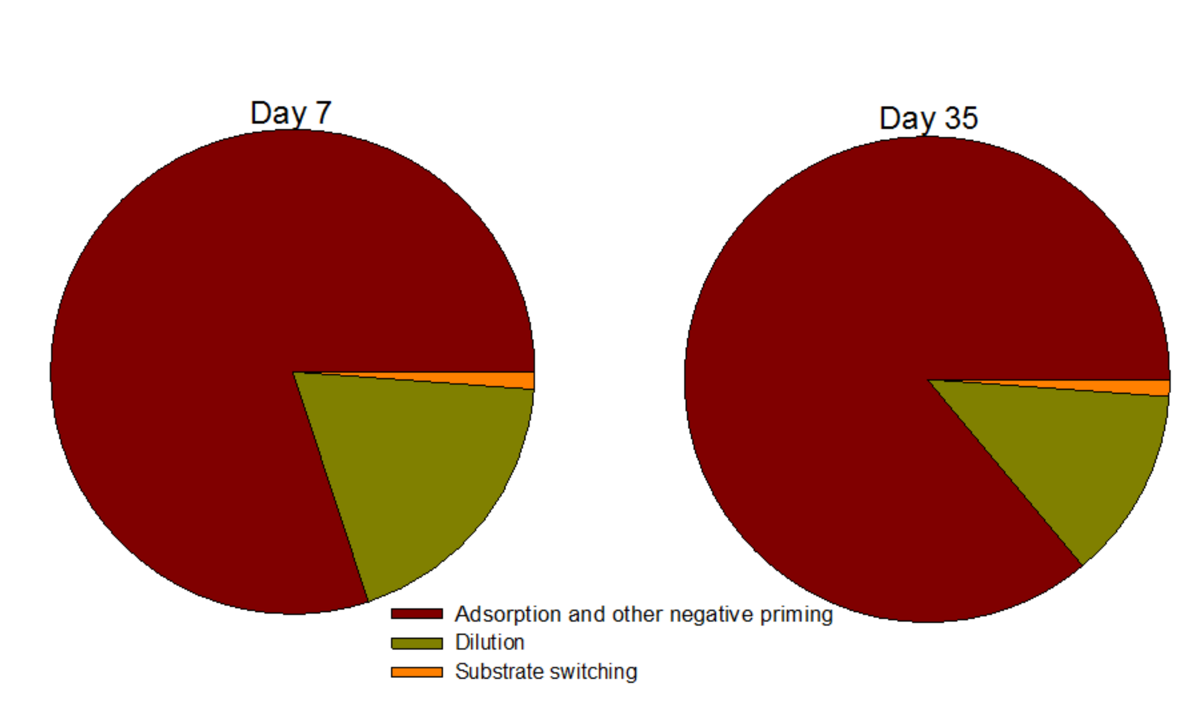

Fig. S2. Proportion of negative priming of nSOC by PyOM (shown for PyOM produced at 450°C and added at 10 mg g^{-1}) attributed to adsorption, dilution and substrate switching for day 7 and 35 (dilution and substrate switching were quantified directly, adsorption was determined by difference; this is an underestimate because co-metabolism induced some positive priming, see Fig. 7 in the main manuscript).