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# Pyrogenic carbon loss pathways under natural and increased N deposition and its priming effect on soil organic matter

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Pyrogenic carbon (PyC) plays an important role in the terrestrial C cycle, in fact it can comprise up to 40% of soil organic carbon(1), but the relative importance of processes that lead to its disappearance from the soil remain a mystery (2).

Most experiments on PyC mineralization have been laboratory incubations (3; 4); very few studies have been carried out in situ (5; 6). Several studies have found relevant quantities of PyC in marine (7) and riverine (8) dissolved organic carbon. However, since PyC is not thought to contain easily soluble compounds (9), it is still unknown how such large quantities of PyC can be transported from soil to water bodies. Moreover, some studies find that PyC can promote soil organic matter decomposition (10; 11), although other studies do not find this result (9; 4). Moreover, nitrogen deposition might affect PyC losses from the soil, as it has been shown to reduce the mineralization of old soil organic matter (12). We set up a field experiment to measure PyC decomposition and stabilization in soil using stable isotopes ($^{13}C/^{15}N$) as tracer. The experiment was conducted under ambient and added mineral nitrogen. The equivalent of 3.8 gC $kg^{-1}$ of soil of $^{13}C$- labelled (840 per mil), powdered (<2 mm) PyC has been added to the topsoil within mesocosms located in a mixed temperate forest. We measured soil $CO_2$ and dissolved organic carbon fluxes and their isotopic C values to partition between the two main processes leading to PyC losses.

After one year we found that: 1)PyC decomposed at a rate of 0.7 % $year^{-1}$; 2)the presence of PyC primed native soil organic C mineralization by 48% compared with no PyC addition 3) N additions depressed PyC mineralization and the priming effect from PyC ; and 4)PyC losses as dissolved organic carbon were three orders of magnitude smaller compared to losses due to $CO_2$ efflux. Therefore, we conclude that mineralization is the main process leading to PyC losses. Moreover we conclude that both the global trend of increasing atmospheric N deposition and the priming effect need to be taken into account when evaluating PyC as a C sink. Finally, we need to understand the mechanisms underlying PyC solubilisation, since in the long term it remains unclear how the observed large quantities of water-borne PyC get transferred from soil to rivers and oceans.

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