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Discerning the biochemical stability of pyrogenic C in soils

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The soil organic matter (SOM) constitutes approximately 2/3 of the global terrestrial C pool, which corresponds to estimated 4000 Pg to a depth of 3 m [1] and therefore, the dynamics of organic carbon (OC) in soils control a large part of the terrestrial C cycle.
The term Pyrogenic Carbon (PyC) comprises the whole range of pyrogenic organic materials, from partly charred material through charcoal to soot produced during fire, as well as technical chars (biochars) produced by pyrolysis of biomass. The previously common assumption of PyC being inert has long been proven wrong [2]. In theory, the pyrogenic process confers these materials a longer mean residence time in the soils than their precursors, thus the application of PyC in general and particularly biochar to soil is proposed as a valid approach to establish a significant, long-term sink for atmospheric carbon dioxide in terrestrial ecosystems [3]. Nevertheless, the knowledge concerning the biochemical recalcitrance of PyOM in soils is still limited. This study combines the analysis by 13C solid state Nuclear Magnetic Resonance Spectroscopy (13C NMR), Field Emission Scanning Electron Microscopy (FESEM), analytical pyrolysis (Py-GC/MS) and CO_2 emissions in incubated pots of burned and unburned soils as well as in biochar amended and un-amended soils.
By using this integrated approach we achieved a more complete understanding of the stability of different forms of PyC in the soil and the chemical changes occurring during aging. Significant differences are found between the stability of PyC. They depend on the nature of the source material, surficial properties of PyC, the pyrolysis process and the soil conditions during aging.

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