



The uncertain future of pyrogenic carbon in terrestrial system

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Since last decade there is an increased interest in pyrogenic C (PyC), a chemically heterogeneous class of compounds produced by the incomplete combustion of biomass. It is considered as C sink with potential for partly offsetting carbon emissions as it the most stable C form identified in soil. However, there are evidences that charcoal is susceptible to degradation, especially over longer time scales. We intend to integrate information on what is known about degradability of PyC and investigate from published evidence how the inherent chemistry of initial PyC is responsible for its fate and role in the biogeochemical cycles. We summarized recent progress in understanding pyrogenic carbon degradation and losses, and provide a first estimate of the potential degradation rate (literature meta-analysis). We observed maximum scatter in data for field-based study due to high spatial and temporal variation. For short-term studies, pyrolysis temperature is important variable in deciding the rate of PyC, however, initial substrate had little effect in the variation of the degradation rates. This communication also aims to report the plausible mechanisms and possible actors for the degradation of PyC in the soil. To assess and understand degradation mechanism with time, we separate different causative agents involved (oxidation, microbial co-metabolism, physical breakdown among others) and changes in the quality of PyC itself with time (surface and core chemistry). Various literatures reported oxidative degradation pathway (abiotic and/or biotic) leading to surface and core chemistry changes in PyC. These changes in PyC may exert a key influence on the future trajectory of its further decomposition. Therefore, we finally address the question of whether the changes and/or ageing of PyC change the decomposition dynamics and/or loss of PyC as soluble fraction. The outcome of this work would facilitate in better understanding of soil PyC dynamics in soil and the gaps in knowledge that need to be addressed for future research.