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Quantifying pyrogenic carbon: don't miss the big bits?

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Pyrogenic carbon (PyC; also known as black carbon or biochar), is viewed as an important carbon form that may contribute substantially to C sequestration in soils. However, big uncertainties arise when trying estimate PyC stocks in the environment. One of the main hurdles is the use of a wide range of methodologies used for PyC quantification, which can lead to variations in estimates of PyC quantities of several orders of magnitude. Another problem is that, as PyC is a continuum of compounds affected by different degrees of charring, the window of this continuum that is considered in a given study determines the amount of PyC quantified.

When quantifying PyC in soils, two main approaches are currently taken: (i) estimation of charcoal content by visual detection, and (ii) estimation of PyC content in the bulk soil by various chemical, spectroscopic and/or thermal methods. The second approach is usually carried out for soil samples after sieving to < 2 mm. The aim of this contribution is to explore the consequences for PyC estimation in this second approach when only the soil fraction < 2mm is used for analysis.

Soils from four sites affected by an extremely severe wildfire ('2009 Black Saturday' fires, Melbourne, Australia) and two control sites (last burnt in 1939) were sampled. Samples were taken at 0-2.5 and 2.5-5 cm depth and then passed through a 2 mm sieve. For the < 2mm fraction PyC was quantified by acid dichromate oxidation. In the > 2 mm fraction, organic fragments were picked by hand under a low-magnification binocular microscope and the charred and uncharred pieces separated. The charred fragments were also subjected to acid dichromate oxidation and the remaining PyC quantified.

On average, soil fractions < 2 mm and > 2 mm comprised around 80% and 20% of the soil total weight respectively, with only small variations between samples, but a slight increase of the coarser fraction for samples taken at 2.5-5 cm. Charred fragments > 2 mm were found in most of the samples, including those taken at the control sites which had not been affected by fires for more than 60 years. The outcomes of the PyC content estimation in the two soil fractions and its respective chemical recalcitrance will be discussed.