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Pyrogenic carbon in wildfire ash: characteristics and potential as C sink

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Forest fires release substantial amounts of carbon (C). Much of this is emitted to the atmosphere, but some is deposited within an ash layer on the ground as pyrogenic C (PyC; also termed black carbon or biochar). PyC production is increasingly considered an important mechanism for C sequestration, but the current knowledge about its generation, mobilization and degradation is still limited. One area of limited knowledge is the quantity and characteristics of C deposited in ash from wildfires, which is crucial to understanding the fate of PyC in the environment and specifically its role as a C sink.

Here we analyze C stocks, forms and recalcitrance in the ash layer deposited after the extreme 2009 'Black Saturday' wildfires in Victoria, Australia. Sampling was carried out in three mixed-species eucalypt sites, where both canopy and understorey were almost completely consumed, and in five temperate rainforests sites, where the high canopy remained largely unaffected, but the understorey was consumed by fire.

On average, 5.9 t ha-1 of C were transferred from vegetation to the ash layer in the eucalypt forest. In the rainforest, despite lower ash loads, higher C contents in ash resulted in higher deposition of PyC (average: 8.1 t ha-1). As regards C forms, most of the PyC contained in ash was organic C (OC >97%). Of this OC, 6-26% was particulate, and, consequently, especially susceptible to be mobilized by water erosion. Water-soluble OC represented only the 0.2-0.4% of PyC in ash. This pool should not be neglected since it is likely to contain polyaromatic hydrocarbons; a potential threat to water quality.

Chemical oxidation of the organic component of the ash suggests that the pyrogenic nature of ash OC gives it a high resistance to degradation. After 400 h of chemical oxidation, 24-52% OC did remain. These findings suggest that PyC contained in wildfire ash, particularly when incorporated into soils or sediments, could make an important contribution to long-term C sequestration.