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The role of ash in carbon fluxes in fire-affected environments

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During wildfires, a fraction of the biomass consumed is directly emitted to the atmosphere as carbon dioxide, aerosols and water vapour. Another component is deposited on the ground containing both organic (e.g. charcoal) and inorganic (e.g. alkali and alkaline earth oxides) material. In the wildfire context, this deposit is often referred to as 'ash', although a more precise definition would be warranted. Investigations of black (i.e. carbon-rich) ash from conifer forest fires in various regions have reported organic C contents in the region of 50 % and ash bulk densities of 0.5. In forest or shrub environments with substantial pre-fire fuel loads close to the ground, ash deposits following a severe burn can be 2-10 cm thick. These equate to ash loads of 1-5 kg/m2 and with a C storage of 0.5-2.5 kg of C/m2 (=5-25 t/ha). Some of the C contained in ash (charcoal, back carbon) is highly resilient to breakdown, and likely to remain stored in soils, sediments and aquifers for longer than the period needed for full biomass recovery. This could result in a net sequestration of C during a fire-regrowth cycle. However, the role of ash is rarely considered in detail in studies examining C fluxes from wildfires. One reason for this neglect may be the often rapid rate of ash redistribution within, and removal from, burnt sites by wind and water erosion. As field studies are often initiated some time after a fire, the potential importance of this C deposit may not always be obvious.

Emissions of C from, for example, Canadian conifer forests are estimated to be 2-100 t/ha. The C deposited in ash (5-25 t/ha) may therefore represent a significant fraction (of up to ˜25 %) of these emissions. Furthermore, it is often overlooked that alkali and alkaline earth mineral components in ash react with aqueous CO2 (in rainwater) and

atmospheric CO2 to form bicarbonates and carbonates leading to additional C accumulation in ash following burning. This presentation aims to highlight and evaluate the importance of ash in carbon flux assessments associated with past, current and expected future wildfire regimes.