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Vertical transport of fire-derived carbon in soils

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Fire-derived carbon, also known as pyrogenic carbon (PyC), is formed during wildfires as a result of incomplete combustion and represents one of the largest identified component in the organic carbon (C) pool on Earth. With residence times over 1000 years in soils, it is the most persistent form of organic C and thus plays an important role in the global C cycle. Several field and laboratory experiments suggest that PyC can be transported vertically through the soil to a significant extent in dissolved and particulate forms. However, the mobility of dissolved PyC in soils has not been traced yet and thus our understanding is still limited regarding the quantities and factors controlling the vertical transport. In this study, we use highly 13C-labelled ryegrass charcoal (produced at 450°C) in water saturated soil columns to trace the mobility of fire-derived C. Fresh and artificially oxidised charcoal, obtained from chemical oxidation with H_2O_2 to accelerate aging, are applied on top of a sandy loam in the column and percolated with 1 ml min-1 of 0.01 M CaCl2 solution. The dissolved and particulate fractions are collected after a percolation equivalent to 1, 5, 10, 15 and 20 years of continuous rain infiltration. We calculate the recovery of 13C to determine proportion of fire-derived C in each fraction and soils. We test our hypothesis that: i) Significant proportions of fire-derived C are transported through the soil column over the whole experiment period but decrease with time, ii) oxidised fire is more mobile than fresh charcoal and iii) fire-derived C can be retained and stabilized within the soil column during the vertical transport.