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Black carbon as isolated by chemical oxidation: characterization and contribution in litter and soil

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More than 400Mha of land surfaces are concerned by vegetation fire each year, in savannas, boreal forest and Mediterranean ecosystems (Lavorel *et al*., 2001). Biomass burning leads to a carbon loss to the atmosphere as gas and particles, and to the production of pyrogenic carbon that contains black carbon, considered as one of the most stable components of soil organic matter. Long term balance between these two processes is still unclear and Masiello (2004) highlighted the need to improve global carbon budget using new field measurements. The fire-induced conversion of aboveground biomass into black carbon and the use of soils with well-known fire history appear as essential data (Czimczik *et al*., 2003; Daï *et al*., 2005). The aim of this work was to link the quantity of black carbon produced during a fire event and the stocks remaining in soils after fire. We tested the capacity of chemical oxidation to isolate an aromatic, *a priori* stable fraction of the combustion continuum in litter as well as in soil organic carbon.

Litter samples were collected before and after the fire in a subtropical oak scrub. Post-fire material was visually divided into burned and unburned leaves. During the burning, temperature elevation was assessed with thermosensitive paints. Soils (0-30cm) were also sampled in four areas of the same ecosystem, protected from fire for 1 to 20 years. All samples were crushed and demineralised with a HF/HCl solution (10%/6M). The oxidation with $H_2SO_4/K_2Cr_2O_7$ solution was performed at a temperature of $80\pm5^{\circ}$C and during 24 hours. Black carbon quantification was obtained by

measurements of weigh and carbon content. Isolated carbon (OREC) was characterized with solid-state ^{13}C nuclear magnetic resonance spectroscopy.

In unburned litter samples, less than 1% of treated OC is resistant to the oxidation and repetition error represents about 0.4% treated OC. In litter charcoal, the oxidation allows concentrating aromatic carbon and the OREC content is correlated to the production of aromatic pyrogenic carbon by temperature elevation. When applied to soil organic matter, the oxidation concentrates aromatic carbon in soil surface samples, but some alkyl carbons are also preserved. The ^{13}C NMR analysis is necessary to convert OREC measurement into black carbon value. Black carbon content of visually-identified charcoal varied from 4 to 16% OC. As a result, a typical oak scrub fire could produce from 10 to 30 g BC m^{-2}. The first 25 cm of soil contain between 40 and 90 g m^{-2} of black carbon. But no black carbon (aromatic and resistant) is detected in deep soil horizon by oxidation. Results of this work indicate that black carbon can accumulate in soil surface for at least 100 years.

References:

Czimczik, C.I., Preston, C.M., Schmidt, M.W.I., Schulze, E.D., (2003) How surface fire in Siberian Scots pine forests affects soil organic carbon in the forest floor: Stocks, molecular structure, and conversion to black carbon (charcoal). Global Biogeochemical Cycles, 17(1), 1020.

Dai, X., Boutton, T.W., Glaser, B., Ansley, R.J., Zech, W., (2005) Black carbon in a temperate mixed-grass savanna. Soil Biology and Biogeochemistry, 37, 1879-1881.

Lavorel S, Lambin EF, Flannigan M, Scholes M, (2001) Fires in the earth system: the need for integrated research. IGBP Global Change Newsletter 48 : 7–10.

Masiello, C.A., (2004) New directions in black carbon organic geochemistry. Marine Chemistry, 92, 201-213.