Isotopic Differentiation (^{13}C) of Dissolved Organic Carbon and CO_2 During Organic Matter Degradation in Forest Soils: Influence of Vegetation.

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At the interface between soil and water, dissolved organic matter is a dynamic component of ecosystem functioning and aquatic environment quality. The amount and nature of dissolved organic matter in soils results from biological and chemical mechanisms of production and degradation. These processes are largely carried out by soil microflora, and are greatly influenced by environmental conditions such as climate and primary productivity.

The aim of this study was to better understand the effects of microbiological activity and vegetative cover on the production of dissolved organic matter in forest soils. This production was monitored during a 98 day incubation of forested soil samples by measuring concentration and isotopic composition of the soil organic carbon (SOC), DOC and CO_2.
Soil samples were collected from the Breuil-Chenue forest in the Morvan Natural Regional Park, in Burgundy, France. This forest had been clear-cut and planted in blocks of deciduous (native oak and beech) or coniferous (Douglas fir) trees in 1976. Soils under the two forest types were sampled in 4 places to account for spatial variability, at 0-5 cm and 5-10 cm depths. They were homogenised and sieved (< 5 mm) before analysis and 75 g of field-moist soils were incubated in 565 ml flasks for 98 days at different temperatures (8, 12, 20 and 28°C) to obtain a gradient of mineralisation rates. Total SOC content was measured at the beginning and at the end of the incubation period, using a Carlo Erba Elementary Analyser. The DOC fraction was obtained by water extraction, using a 1:5 w/v soil-to-pure water ratio, 16 hrs of mixing, centrifuged for 40 min at 7 500 rpm and filtered (<0.45µm) to recover solution for DOC analysis on a Shimadzu TOC 5000 and DOC $\delta^{13}C$ measurements on a Micromass Isochron EA. The soil DOC content, as well as the $\delta^{13}C$ of the DOC pool, were determined at days 0, 7, 21, 42, 63 and 98 on sacrificed samples. We analysed periodically the flasks' CO_2 concentration and $\delta^{13}C$ on a MTI micro-gas-chromatograph and on a Micromass Isochron EA.

Soils under deciduous forest produced 2 to 3 times more DOC and CO_2 than soils under coniferous trees. Forest type also influenced the isotopic composition of the DOC, SOC and CO_2. DOC and SOC isotopic composition evolved for samples under deciduous trees (depletion of about 0.7‰ to 0.3‰ of the DOC $\delta^{13}C$ depending on depths, and depletion of 0.2‰ of the SOC $\delta^{13}C$). This depletion was established after 21 days of incubation, whereas under coniferous trees no significant isotopic variations were observed. This suggested that production processes are different between the two vegetative covers. Incubation temperature did not have any effect on DOC and SOC isotopic compositions but the emitted CO_2 was increasingly depleted in ^{13}C at higher temperatures (0.8‰ at 8°C and 2‰ at 28°C). This suggested that soil C dynamics are different between the native forest and Douglas fir plantation. A more rapid mineralisation of C in the native forest soil accompanied a greater decrease in DOC and SOC $\delta^{13}C$.