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Type of litter determines the formation and properties of charred material during wildfires

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Wildfire is one of the most important disturbances all over the World, affecting both the amount and composition of forest floor and mineral soils. In comparison with unburnt areas, wildfire-affected forest floor usually shows lower contents of labile C compounds and higher concentrations of recalcitrant aromatic forms. These changes in composition can have important impact on biogeochemical cycles and therefore ecosystem functions. Although burning of different types of litter can lead to different amount and types of pyrogenic compounds, this aspect has not been evaluated yet.

The effect of wildfire on SOM composition and stability were evaluated in five major types of non-wood litter in Mediterranean ecosystems: Pinus nigra, E. arborea, P. pinaster, U. europaeus and Eucalyptus globulus. In each of these ecosystems, forest floor samples from different soil burn severities were sampled. Soil burnt severities were based on visual signs of changes in forest floor and deposition of ash. Pyrogenic carbon quality were analysed using elementary analysis, solid-state 13 C nuclear magnetic resonance spectroscopy, Reflectance Infrared Fourier Transform (FTIR) and thermal analysis (simultaneous DSC-TG).

The study showed that the different types of litter influenced the formation and characteristics of charred material. They differed in the temperature at which they start to be formed, the amounts of charred compounds and in their chemical composition. The resulting charred materials from the different litter, showed an important variability in the degree of carbonitation/aromatization. Unlike the biochar obtained through pyrolysis of woody sources, which contains exclusively aromatic structures, in the charred material produced in some litter, lignin, cellulose and even cellulose persist even in the high soil burnt severity. Coinciding with increases in aromatic contents, important decreases in atomic H/C and O/C ratios were recorded. However, the values found in some litters, were higher than 0.5, suggesting that low degree of carbonization/aromatization. Although burning also led to compounds of higher thermal recalcitrance (increases in T50 values), values recorded in some litters were lower than those measured in highly polycondensed aromatic compounds.

The differences found among the different forest floor cannot be only attributable to the initial SOM composition of the litter. Other aspects, such as the different thermal sensitivity, flammability and different conditions during wildfire (temperatures, combustion duration, oxygen concentrations) could also have contributed.