



Chemical Changes of soil organic matter following burning

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Soil organic matter (SOM) represents an active and interconnecting environmental compartment in which biogeochemical processes have a direct impact on primary production and biodiversity. Both, quality and quantity of SOM are expected to be severely affected by fires. However, reports on fire-induced SOM alteration often lead to divergent conclusions which make it difficult to postulate a generalized model about the lasting effects. One key factor to elucidate the impact of fire on SOM composition and stability is a better understanding of chemical alterations occurring during charring. Therefore fire-affected and control soils from Mediterranean forests were characterized by ^{13}C and ^{15}N NMR spectroscopy.

Charring experiments indicated that furans or benzofurans are important components of the aromatic skeleton of lignocellulotic chars. Nitrogen is incorporated as pyridine and pyrrole-type N. Some peptides survive charring, possibly by protection via encapsulation or as structural element of Maillard products. In contrast to soot, the aromatic skeleton of pyrogenic SOM was found to have only minor contributions of graphitic domains with clusters of more than 6 aromatic rings. Atomic N/C ratios of horizons containing char demonstrated further that pyrogenic N plays an important but often neglected role within the SOM dynamic.

The short-term effect of burning on SOM can be highly variable depending on numerous factors such as fire intensity and duration, amount and flammability of the vegetation and the litter. For our samples it ranged from a dramatic loss of SOM in the topsoil to an increase of SOM by up to a factor of 3. The lowest fire intensity

resulted in the highest local accumulation of char, although its charring degree, expressed as the aromatic C to alkyl C, was low. Combustion and volatilization at higher fire intensities yielded in a decrease of the amount of char but increase of its charring degree. Irrespective of the fire severity, oxidation of char occurred already during the early post-fire period. The observed difference in aromaticity of charred residues is expected to affect its recalcitrance and degradability. Consequently, after incorporation into the soil, the long-term impact of the pyrogenic necromass on the chemical composition and stability of SOM will also vary with respect to type and intensity of the forest fire. Because char in soil is commonly considered as an efficient C sink within the global C cycle, potential variation in its recalcitrance has to receive more consideration if the role of black carbon in C sequestration in soils is elucidated.