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SOM quality and phosphorus fractionation to evaluate degradation organic matter: implications for the restoration of soils after fire

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The design of emergency treatment for the rehabilitation of fire-affected soils requires a quick diagnosis to assess the degree of degradation. For its implication in the erosion and subsequent evolution, the quality of soil organic matter (OM) plays a particularly important role. This paper presents a methodology that combines the visual recognition of the severity of soil burning with the use of simple analytical techniques to assess the degree of degradation of OM. The content and quality of the OM was evaluated in litter and mineral soils using thermogravimetry-differential scanning calorimetry (DSC-TG) spectroscopy, and the results were contrasted with 13C CP-MAS NMR. The types of methodologies were texted to assess the thermal analysis: a) the direct calculation of the Q areas related to three degrees of thermal stabilities: Q1 (200-375 ºC; labil OM); Q2 (375-475 ºC, recalcitrant OM); and Q3 (475-550 ºC). b) deconvolution of DSC curves and calculation of each peak was expressed as a fraction of the total DSC curve area. Additionally, a P fractionation was done following the Hedley sequential extraction method.

The severity levels visually showed different degrees of SOM degradation. Although the fire caused important SOM losses in moderate severities, changes in the quality of OM only occurred at higher severities. Besides, the labile organic P fraction decreased and the occluded inorganic P fraction increased in the high severity soils. These changes affect the OM processes such as hydrophobicity and erosion largely responsible for soil degradation post-fire. The strong correlations between the thermal parameters and NMR regions and derived measurements such as hydrophobicity and aromaticity show the usefulness of this technique as rapid diagnosis to assess the soil degradation.The marked loss of polysaccharide and transition to highly thermic-resistant compounds, visible in deconvoluted thermograms, which would explain the changes in microbial activity and soil nutrients availability (basal respiration, microbial biomass, qCO_2, and enzymatic activity). And also it would have implications in hydrophobicity and stability of soil aggregates, leading to the extreme erosion rates that occur usually are found in soils affected by higher severities.