Studying the effects on soil organic matter of wildfires in central Portugal

[a,b]De la Rosa JM, [c]Faria S R, [c]Varela M E, [b]Knicker H, [b]González-Vila F J, [b]González-Pérez JA, [c]Keizer J J

In Mediterranean ecosystems, forest fires are a common phenomenon and widely considered to be the main factor of disturbance.

In the case of the Mediterranean Basin, the Iberian Peninsula has the highest risk of wildfire occurrence, and certainly in relative terms Portugal is affected most by wildfires, devastating on average 100,000 ha each year and dramatically larger areas in dry years like 2003 and 2005.

Wildfire result in the transformation of vegetation and litter, leaving charred residues, and thus influence the carbon cycle by changing: (i) the amounts of soil organic matter (SOM); and (ii) the proportions amongst the carbon pools with different degrees of stability. In addition to affecting the carbon cycle, fires also affect the amounts and availability of nitrogen within soil organic matter. Especially char and other highly stable soil carbon pools are dificult to determine with solvent-based methods, so that pyrolysis-based analysis methods offer several advantages.

The main objective of this study is testing the efficacy of pyrolysis–gas chromatography/mass spectrometry (Py–GC/MS) as a fast analytical technique to detect wildfire-induced molecular alterations of the SOM in Mediterranean Leptosols.

To this end, the topsoil of two slopes with adjacent patches of burnt and unburnt Maritime Pine (*Pinus pinaster*) and eucalypt plantations (*Eucalyptus globulus*) were sampled in the Serra de Lousã, central Portugal. Compounds released by analytical pyrolysis showed alterations in the SOM due to fire. At desorption step (300ºC), the marked presence of labile carbohydrate-derived compounds and of long chain *n*-alkanes distribution pointed to the incorporation of fresh plant material and/or low wildfire severity. Pyrolysis at 500ºC revealed an increase of low molecular weight molecules for certain homologous series in fire-affected soils, suggesting the occurrence of thermal breakdown and cracking of long-chain components. Also the presence of several thermolabile markers indicated that the wldfire severity had been low. Elemental analysis indicated marked fire-induced increases in total organic carbon (TOC) and total nitrogen (TN) for the pine stand as opposed to noticeable decreases for the eucalypt stands. The pH and CEC results were consistent with the contrast in fire-induced changes in TOC and TN. Probably, this contrast between the two sites was not due to differences in direct fire effects (especially fire severity) but to indirect fire effects i.e. in particular needle/leaf fall from partially combusted tree canopies.

[a] *Instituto Superior Técnico-Instituto Tecnologico e Nuclear (IST-ITN), Estrada nacional 10, 2686-953, Sacavém, Portugal (jmrosa@itn.pt) (josemasev@hotmail.com)*
[b] *Instituto de Recursos Naturales y Agrobiología de Sevilla (IRNAS-CSIC), Av. Reina Mercedes 10, 41012, Sevile, Spain. Tel. +34-954624711.*
[b] *Centro de Estudos do Ambiente e do Mar (CESAM), Departamento do Ambiente e Ordenamento, Universidade de Aveiro, 3810-193 Aveiro, Portugal. (jjkeizer@ua.pt)*