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Hint of prehistoric fire uses: Step 1. Characterization of experimental fire residues

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Micro-morphological analysis of prehistoric deposits from ancient fires may allow identifying different anthropogenic features. Vegetal fuels produce specific micro-particles of charcoal. Animal fuels, such as bones and fat, lead to dark soil impregnation. The analysis of organic matter, collected on pottery or in soil from archaeological sites, is also a powerful tool to investigate anthropic activities and the status of the archaeological sites (Oudemans and Boon, 1991; Hjulström and Isaksson, 2009). According to their function, two types of fires can be defined: heating fire and cooking fire (March et al. 2000). The aim of our work was to identify fuel biomarkers in ancient fires through organic residues characterization. Our approach included two steps: in a first one, we tested our ability to discriminate the fire type. We characterized experimental fires residues. In a second step, archaeological fires will be studied and interpreted considering results previously obtained.

Three experimental fires were realised and samples collected by the archaeologist researchers; then blind analyses were realised by geochemists in another laboratory (i.e. exp1, exp2, exp3). Two experimental fires were fuelled with wood and one of them was used to cook meat peaces and fat. The third fire was fuelled only with animal bones. The soil just behind the fire was collected. The brown or black surface layer of soil sample was visually identified and manually scratched. Subsamples were ground and analysed for their C and N contents and δ13C, using an elemental analyser coupled to an isotope ratio mass spectrometer. The organic matter was characterized by Curie-point pyrolysis coupled to gas chromatography and mass spectrometry (py-GC-MS). Lipids from other subsamples were extracted and characterized by GC-MS.

The carbon contents of soil black layer in exp1, exp 2 and exp3 were 3 mg g-1, 3.3 mg g-1, and 2.4 mg g-1, respectively. The δ13C of soil black layer in exp1, exp 2 and exp3 were -30‰ -30‰ and -25‰ respectively. The nitrogen content was 0.1% in the three samples. Pyrochromatograms showed that similar compounds are present in the three samples. However, exp1 is dominated by alkene / alkane (C11 to C16) and acids (C14 to C18), whereas exp2 and exp3 are dominated by acids (C7 to C18). Acids with carbon chains >C12 are especially dominant in exp2. The high alkene / alkane contribution in pyrolysates was previously noticed by different authors (Oudemans and Boon, 1991 and references therein). The high contribution of long chain acids recorded in exp 2 could be attributed to a higher plant biomass contribution. This work showed that global characterization of fire residues by a non-selective technique alone is able to give some clues to identify organic matter but not clearly distinguish them. Ongoing work on the composition of the lipid fraction is expected to help to refine our hypothesis.