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Molecular and isotopic composition of organic compounds from higher plants: a useful tool for forensic provenancing?

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Soil is a common trace evidential material recovered during forensic casework, and is therefore a vital source of investigative information. Previous research has shown that relative distributions of well-preserved long-chain n-alkanes in soils, originating from the epicuticular waxes of higher plants, can be related to overlying vegetation (Lichtfouse *et al.,* 1994) and thus may provide a method for linking a soil sample to a location of interest (Dawson *et al.,* 2004). In addition, wax marker profiles can be useful for the identification of vegetation fragments on questioned items. However, such molecular distribution patterns have limited discriminatory potential between individual plant species, as most distributions of n-alkanes show a considerable degree of overlap in the range of n-C_{25} to C_{33}(Buggle *et al.,* 2010).

Despite the potential for organic compounds to assist in the discrimination of soils, compound specific isotopic analysis of biomarkers remains unexploited. D/H ratios of plant n-alkanes are related regional environmental water via leaf water from which they are biosynthesised (Sachse *et al.,* 2010). This relationship allows for allocation of geographical locations through the use of predictable isotopic ratios of global precipitation (Bowen *et al.,* 2007). Examination of $^{13}C/^{12}C$ signatures reflects factors such as soil moisture availability (Pedentchouk *et al.,* 2008) and photosynthetic pathway. In conjunction, these isotopic signatures display a degree of species-specific discrimination (Pedentchouk *et al.,* 2008).

This project combines analysis of molecular structure with $^{13}C/^{12}C$ and D/H signatures of *Triticum spp* (wheat), *Sorghum bicolour* (Sorghum), *Zea mays* (maize) and *Oryza sativa* (rice) and their host soils at a range of specific locations. These grass species have been selected on the basis of their environmental importance as a natural groundcover and their widespread global use in agriculture. To ensure that study sites cover a wide range of climatic zones, soils sampled from Europe as part of the TRACE project (http://www.trace.eu.org), supplemented by study sites in Scotland (in association with the Macaulay Institute) and Portugal(in association with the University of Porto), will be analysed. Differential preservation rates of n-alkanes among soil particle-size fractions (Cayet and Lichtfouse, 2001), and the influence of soil types and climate on $n-$alkane soil profiles will also be evaluated.

The results of isotopic analysis of n-alkanes in combination with their molecular distributions will provide crucial information for determining the discriminatory potential of these biomarkers in soil for forensic applications.

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