

## Grave soils analysis by TD-GCxGC-ToFMS

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In recent year, an increasing number of studies are conducted to show the potential of soil analyses for crime solving. An important part of these investigations is the study of places where human remains are buried and decay. Certain conditions, like the environment, are known to have an influence on the decay process<sup>1</sup>. For example, archaeological study earlier highlighted the impact of lime on the rate of the decomposition process<sup>2</sup>.

This paper reports on a chemical investigation studying the production of volatile organic compounds (VOCs) from decomposition of remains in soil, and the impact of lime on the migration of compounds. The main analytical challenge is to be able to extract specific data despite the combined complexity of both the soil and the carcass matrices.

In that context, and based on a recent study we performed on soils<sup>3</sup>, we developed an analytical strategy relying on the trapping of VOCs from soil samples collected on fields using a simple pumping device and sorbent tubes. Thermal Desorption (TD) of sample tubes is then carried out on a comprehensive two-dimensional gas chromatography system coupled to a Time-of-Flight mass spectrometer (TD-GCxGC-TOFMS) (LECO, Monchenglabach, Germany).

The first step was the determination of the best separation parameters, including both chromatographic and mass spectral deconvolution aspects. In GCxGC, a reverse column set was implemented using a polar ionic liquid (SLB-IL-111, Sigma-Aldrich, Dorset, UK) first dimension phase (<sup>1</sup>D) and a nonpolar 100% méthylpolysiloxane (Restek Corp., Bellefonte, USA) second dimension phase (<sup>2</sup>D). This reverse configuration improved the dispersion of GC peaks inside the chromatographic plan.

Most efforts were dedicated to develop a data processing procedure that allowed to efficiently subtract the soil signature from the analytes related to body decay. Multivariate analyses were used to extract potentially important biomarkers and obtain statistical cross comparison of the different samples.

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<sup>1</sup> A.S. Wilson, et al., Modeling the buried human body environment in upland climes using three contrasting field sites, *Forensic Science International* 169 (2007) 6–18.

<sup>2</sup> E.M.J. Schotsmans, et al., Effects of hydrated lime and quicklime on the decay of buried human remains using pig cadavers as human body analogues, *Forensic Sci. Int.* (2011) in press.

<sup>3</sup> C Brasseur, et al., Comprehensive two dimensional gas chromatography-time-of-flight mass spectrometry for the forensic study of cadaveric volatile organic compounds released in soil by buried decaying pig carcasses, *J. Chromatogr. A* (2012) in press.