Development of methodology for analysis of small soil samples for plant wax biomarkers enabling their use in forensic investigation

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Introduction

- Plant wax compounds (e.g. long-chain hydrocarbons, fatty alcohols and fatty acids) differ according to plant species.
- Plant wax compounds are long-lived in soil and reflect the present and past vegetation and applied organic fertilisers.
- The composition of wax biomarkers in soil offers new approach to soil characterisation of forensic samples.
- Forensic samples weighing only a few milligrams (e.g. a scraping from a shoe) may need to be compared to a particular garden or site.
- This project aims to modify the existing methodology (Dawson et al., 2004) to allow small samples to be analysed.

Tests of methodology

1. Reduction of contamination
- Use redistilled solvents at optimal volumes.
- Avoid contact with plastics (other than PTFE).
- Heat glassware to 450°C prior to use.
- Wash solid reagents with solvent (KOH and silica-gel).

2. Miniaturisation
- Different sample weights of a mineral soil and an organic soil (dried and ball milled) analysed for plant wax markers.
- Weights analysed:
  - Mineral soil – conventional weight 1000mg; reduced weight 100mg, 50mg and 35mg.
  - Organic soil – conventional weight 200mg; reduced weight 50mg, 25mg and 13mg.
- Amounts of solvents and other reagents, and size of equipment (vials and chromatography columns) reduced as sample size reduced.
- Positive pressure solid phase extraction (SPE) manifold used for extract clean-up with glass silica-gel columns.
- For reduced weight samples, extracts were manually injected on the gas chromatograph.

Results

- Estimates of alkane concentrations were generally consistent across different weights analysed for both soils.
- Patterns of alkanes were consistent across different weights of samples analysed.

Conclusions

- Analyses of soil alkanes were satisfactory for sample sizes as little as 35mg for mineral soil and 13mg for organic soil.
- Further investigations are underway to ascertain the reason for slight inconsistency in concentration estimates with sample weight.
- There is potential for further reductions in minimal acceptable sample size.
- Similar studies are underway for analysis of long-chain fatty alcohols and fatty acids in small soil samples.
- This work suggests that soil wax biomarkers can be used as a forensic tool when only small samples of soil are available.