



The James
Hutton
Institute

Craigiebuckler
Aberdeen
AB15 8QH

Tel +44 (0) 1224 395103
Fax +44 (0) 844 928 5429

www.macaulayanalytical.com

Written by
Lorna Dawson
Head of Forensic Soil Science
(lorna.dawson@hutton.ac.uk)
July 2013



Soil Forensic Services

A leading forensic research and analysis centre with unparalleled experience
in analysis of soils, waters and other ecological/environmental materials

CASE STUDIES

Methods used in soil analysis



Inorganic Analysis (XRD, FTIR, XRF, ICP),
Organic Analysis (GC, GC-MS, FTIR, spectral colour, VOC's) and GIS
Plant identification (morphology, DNA), Organisms (bacteria, fungi, diatoms etc)

Soil, rocks, waters and unidentified materials analysed and characterised with precision.

Introduction

A range of methods are used for forensic investigation and analysis. Each case is initially reviewed with the police force, environmental agency or forensic provider to ensure the correct questions are being asked. We use a combination of both inorganic and organic analyses to compare samples and to provide discrimination of sample characteristics. The methods of analysis used are chosen to answer these questions. Depending on the outcome of the initial analysis further work may be requested to strengthen the evidence to be presented in court.

Initial work usually involves, for example, soil from a scene and soil from a suspect or vehicle. Further work may then involve wider sampling of the area round the crime scene to establish if soil characteristics found at the scene are comparable in a wider area. During the initial phase of examination soil is examined under a microscope where vegetation, hairs or other artefacts may be picked out, then sent for further analysis in another specialist laboratory.

This information may be used as part of an intelligence led investigation into environmental or criminal case work and can also be presented as evidence in court.

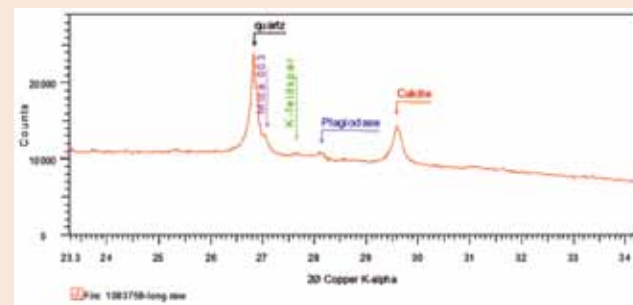
A team of experts in soil, mineralogy, organic chemistry, diatoms, fungi, bacteria and molecular biology, along with geographers and statisticians provide a range of complementary characterisations dependent on the individual issue.

Examples of cases where soil characterisation has been a major part of an investigation are outlined:

Inorganic Analysis

XRD analysis

- Comparison of soil from a carcass with a range of reference locations to see if the origin of the carcass could be determined.
- Identification of contaminants in a consignment and determination of point of origin.



Elemental analysis

- Identification of the provenance of food stuffs such as wine, garlic, olive oil etc.

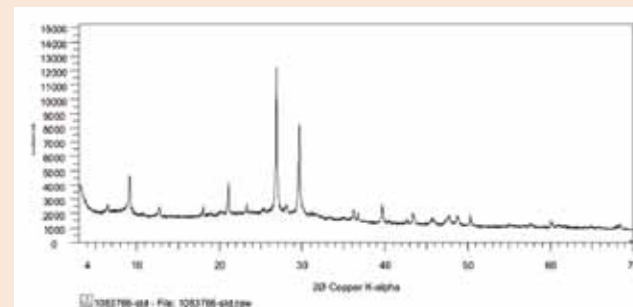
Particle size analysis

- Using lazer diffraction – characterisation of contrasting beach sands.

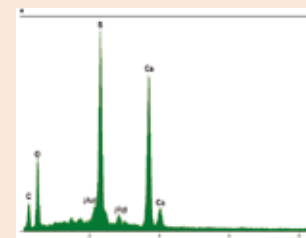
Trace particle identification –

SEM-EDS analysis

- Comparison of material on an article of clothing with identification of compound and linking with potential sources of contaminant.



Gypsum SEM



Gypsum EDS

Organic Analysis

GCMS showing sewage sludge concentrations

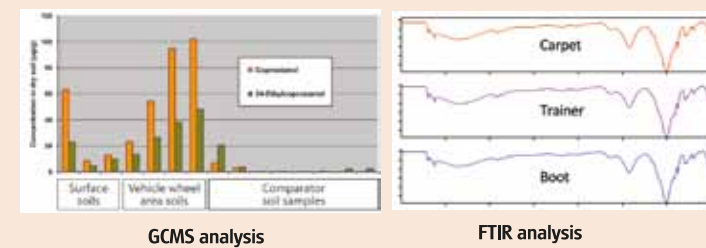
- Comparison of soil from a vehicle with crime scene and other locations in an area and assessing signature of markers within case context.

Stable isotope analysis

- Comparison of questioned clothing samples with deposition site and control soil. ^{13}C and ^{15}N results identified point of contact with murder scene.

Organo-mineral characterisation – FTIR analysis

- Comparison of soil on a carpet with soil from footwear along with samples from the entry and exit points at an aggravated burglary scene identified contact points of suspects.



Organo-mineral characterisation

- Soil colour – spectrophotometry; these characteristics are used in general for site exclusion.

Faeces - the source animal can be identified using molecular approaches.

Organisms

Microbial community – Bacterial analysis

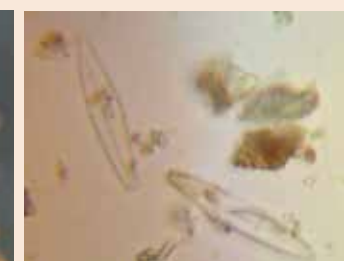
- Comparison of soil from a grave with soil from a spade.

Diatom analysis

- Characterization of diatom community to represent habitat.



Bacterial substrate analysis



Diatom analysis Navicula sp.

Plant Characterisation

Plant identification

- Comparison of vegetation fragments from a pair of shoes, with control vegetation using light microscopy.



Wych Elm (shoe)



Wych Elm (control)

Crop cereal identification

- Comparison of cereal grains from the front grill of a suspect vehicle with control samples taken from a field where a theft had taken place.



Barley (vehicle)



Barley (control)

Plant DNA analysis

- Identification of unknown fragment of vegetation can identify plant species.

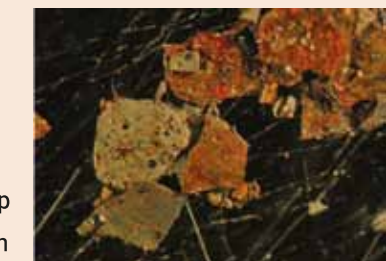
Other Methods

Geographical Information Systems

- Mapping of soil and vegetation characteristics in a geo-referenced model system, used to narrow areas of search.

Artefacts

- Paint, metal, glass, plastic, hairs, etc. have been found within the soil matrix. These can help to determine transfer from person or object of interest.



Metal flakes (spade)