The use of magnetic susceptibility in forensic soils analyses

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Magnetic parameters such as magnetic susceptibility (MS) are important in characterizing materials, and detectable quantities of magnetic and paramagnetic minerals are almost always found in soils, the magnetic susceptibility being the sum of all contributions from the forming minerals, and varying due to concentration and composition of those minerals. The MS measurements of soils at room temperature are non-destructive. Therefore, the same material is available for further analysis with any other technique. Additionally, does not require sample preparation, and can be used as a simple and fast method which may be operable in small samples. So, MS is an excellent tool for studies of soils being used as trace evidence in forensic investigations.

Magnetic susceptibility measurement methodology, discriminatory power, reproducibility and accuracy in analysis were tested on soil samples for its use in forensic applications. Seventeen soil samples were collected on several Portuguese sites surrounded by different lithologies. At each site, samples were manually collected from the surface soil with a plastic spade. The magnetic susceptibility was measured applying an external magnetic field of 300 A/m to the sample, and a Kappabridge, model KLY-4S of Agico balance equipped with the Sumean software was used. Tests were performed on each sample to establish the discriminatory power between similar and different geological and geographical origins; the measurement reproducibility within samples and along the time; the variation with sample quantity, size fractions and presentation method. Before each measurement, the equipment was calibrated, and regularly calibrated along the measurement period due to the repeated nature of the measurements carried out. Magnetic susceptibility was calculated in m^3/kg. It was observed that magnetic susceptibility can enable discrimination between soil samples, measured values are reproducible over time, and the analysis can be carried out in samples as small as 0.5 g.

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Chemical and isotopic properties of airborne particles in industrial, urban and rural areas of the Rhine Valley

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In order to evaluate the past and actual air pollution, tree barks (biomonitoring) and airborne particulate matter (dp >2.5 μm) were collected around and within the industrial area of the cities of Strasbourg (France) and Kehl (Germany) situated on both sides of the river Rhine. Theses cities suffer from emissions of traffic and industries (steel plant, thermal power plant and waste incinerators) located in the industrial harbour.

Sr, Nd and Pb isotopic ratios measured on barks allowed to distinguish between various sources of pollution. Traffic emissions are the main contaminants in the urban areas of the cities, whereas local industrial emission plumes are distinguishable around and within the industrial harbour.

Organic and inorganic emissions were monitored during 9 months by Sigma-2 passive samplers as well as by passive air samplers with XAD-2 resin for PCB collection for actual air quality measurement in these environments. Sample sites were located in remote, rural and in urban areas, where different industrial emission plumes have been detected by tree bark biomonitoring.

Ambient aerosol collected in these different environments have similar trace element concentrations but the mass deposition rate is highest in the industrial zone. Enrichment factors (EF) $((X/Nd)/(X/Nd)_{UCC})$ are particularly high in Mn, Cr, Zn, Mo, Cd, and similar to EF measured in tree barks.

Isotopic ratios of the collected particles from different sampling sites allowed to distinguish between anthropogenic and natural sources. The dominating emission source in the industrial area is the steel plant as also demonstrated by the aerosols trace metal concentrations. Both organic and trace metal emissions are correlated, which allows the Sr and Nd isotopes to be a powerfull tool to trace the polluting sources.