B39 Assessment of LA-ICP-MS for the Forensic Analysis of Soil and Sediments

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After attending this presentation, attendees will understand the applicability of laser ablation ICP/MS as an alternative methodology for the elemental profile in complex matrices like soils and sediments. Avoidance of digestion procedures is a clear advantage of the proposed technique.

This presentation will impact the forensic community and/or humanity by demonstrating the use of a non-destructive technique for the elemental characterization of possible contaminated sites or to conduct a rapid screening of background levels in protected areas. In addition, this technique can also be applied for paired-comparison of samples to determine likely sources of origin in homicides, kidnapping and other crimes.

Forensic examination of soil and sediments are an important part of the services provided by forensic science laboratories since they are matrices frequently encountered in crime scenes. T he investigation of these matrices has generated increasing attention within the environmental forensic arena. The value of the data obtained from such investigations will impact the legal processes and must be scientifically reliable and legally defendable. Several methodologies has been used for the evaluation of elemental profiles in this type of evidence such as X-Ray fluorescence (XRF), inductively coupled plasma mass spectrometry (ICP) and/or energy dispersive X-Ray (EDX).

The aim of this study is to develop, optimize, and validate a method for the analysis of soil and sediments by LA-ICP-MS in order to evaluate its utility to forensic analyses. As a primary goal, the proposed method can be applied to the analysis of environmental samples to monitor contaminated sites and/or to conduct rapid screening of background levels in protected areas. In addition, this technique can also be applied for paired-comparison of samples to determine likely sources of origin in homicides, kidnapping and other crimes.

The use of LA-ICP-MS for soil and sediments has several advantages over the conventional digestion methods, including direct characterization of solids with minimum handling and very low sample consumption (~ ng vs ~ mg of samples). Common multi-step dissolution procedures for these solid samples are avoided which represent a better alternative for faster analysis while still allowing the multi-elemental characterization of complex geological matrices. The key issue is to provide precision and accuracy comparable to traditional methods.

Three different ICP-MS instruments were used in standard operation modes in order to account for robustness of the method: HP- 4500 (Agilent Technologies, Palo Alto, USA), ELAN DRCII (PerkinElmer LAS, Shelton CT USA), Element 2 (Thermo Electron GmbH, Bremen, Germany). Two different laser units were used for this work: 1) a *New Wave UP- 213* operating at 213 nm (New Wave Research, USA) and 2) a *CETAC LSX 500* (CETAC, USA) operating at
266 nm. A Scanning Electron Microscope with EDX detector (SEM/EDX) JSM-5900LV Jeol (JEOL, Japan) was used for the imaging of craters on soil standards and the determination of particle size distribution of the internal standard.

A critical evaluation of parameters of forensic interest is discussed in detail, including the analytical performance of the technique, homogeneity of the samples at microscale, reproducibility, use of matrix matched standards and quantification strategies.

Of the parameters controlled in the experiments, spot size, ablation pattern, sample grain size after homogenization, and the choice of the internal standard were found to be the key factors to improve the analytical performance of the method. Analytical results obtained by LA-ICP-MS were compared versus solution work followed by ICP-MS in terms of accuracy, precision and time of analysis.

The application of this novel method to environmental samples, particularly soil and sediments is evaluated. Soil and sediment standards were used for the optimization and evaluation of the analytical performance of the method. Two proficiency test samples were analyzed to validate the method. Good agreement with the participant laboratories on this round robin (using solution methods) was achieved, demonstrating the ability of this method for elemental analysis of these matrices. In addition, this method was applied to a set of real samples and the results are compared to data obtained by typical dissolution ICP- MS method.

The novelty of the proposed method relies on the application of laser ablation for the elemental analysis of soil and sediment matrices by ICP-MS using a single solid matrix matched standard with internal standardization for the quantification. The developed method uses solid standards without the need of using binders or liquid standards.

Laser Ablation ICP MS, Soil/Sediments, Elemental Analysis

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