B163 Discrimination of Soil Organic Matter Via Nuclear Magnetic Resonance (NMR) Spectroscopy Combined With Interval Extended Canonical Variate Analysis (iECVA)

Victoria Hsieh, 140 W 69th Street, Apt 85B, New York, NY 10023; Nicholas D. Petraco, PhD, John Jay College of Criminal Justice, Dept of Science, 524 W 59th Street, New York, NY 10019-1007; and Elise Champeil, PhD, 7855 E Boulevard, Apt I, North Bergen, NJ 10040*

After attending this presentation, attendees will be able to apply the techniques presented. Attendees will be able to extract the organic matter from soil samples, prepare samples for NMR analysis, and understand how iECVA can be combined with NMR to pinpoint the exact location of a soil sample.

This presentation will impact the forensic science community by disseminating new methods for soil analysis. The new methods developed will provide both guidance to practitioners for soil sample collection and arguments to establish convincing corroborative evidence in court between a suspect and a crime scene, between a victim and a crime scene, or between a victim and a suspect when soil evidence is found.

A new method for the analysis of Soil Organic Matter (SOM) is described. Modern detection and identification methods for soil evidence at crime scenes suffer from some drawbacks. In particular, most techniques of identification are destructive and rely primarily on the inorganic fraction of soil. Forensic scientists have not given much consideration to the analysis of SOM. Forensic geoscientists also face the following problem: if a soil sample is found on a potential suspect, what is the probability that this soil sample comes from one particular area versus another? (i.e., is there a way to assess how common the observed points of similarity or difference between soils are?). Another issue is the small amount of published guidance regarding the small-scale spatial variability of the soil considered. Assessing this variability is important in determining where samples should be collected in order to adequately represent an area of forensic interest. In view of these current shortcomings, the work presented here seeks to: (1) identify the SOM at nine different locations in New York City by Nuclear Magnetic Resonance (NMR) spectroscopy; (2) combine iECVA with NMR to pinpoint the exact location of a soil sample; and, (3) produce a method (i.e., empirical base match probability estimate) to determine the probability of finding similar soil samples from a particular park in the wider environment.

Soil samples from New York City Central Park were collected in nine different locations. The organic matter of the soil samples was analyzed by liquid state ^{1}H NMR and solid state ^{13}C NMR using spectrometers JEOL 300 MHz instrument for liquid NMR experiments and AVIII 400 MHz instrument for solid NMR experiments. The iECVA was combined with NMR results using computers to discriminate the nine different locations of interest. The ability to correctly assign the origin of the soils was assessed. It is expected that the method developed in this presentation (i.e., NMR spectroscopy combined with iECVA) will produce superior results (i.e., better ability to correctly assign the origin of the soil sample) than the traditional techniques. Finally, statistical analyses (iECVA and Wilks' lambda statistic) were used to assess the degree of small spatial variability in the soil properties observed by NMR.

Soil, NMR, Statistics