C4 High-Throughput Environmental Forensic Investigation to Identify Contamination Sources of Polycyclic Aromatic Hydrocarbons in a Stream

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After attending this presentation, attendees will understand how to prepare and clean up various samples prior to Gas Chromatography/Mass Spectrometry (GC/MS) analysis for environmental forensic needs. The sample clean-up procedure to be discussed is based on USEPA 3640A, but the procedure has been modified into an automated method using J2 Scientific's automated sample preparation instrument, PrepLinc. Attendees will also learn how to identify contaminants in a complex ecosystem through a discovery analysis. Lastly, attendees will learn a technique on how to identify possible sources of contamination via receptor model called Positive Matrix Factorization (PMF).

This presentation will impact the forensic science community by demonstrating an alternative automated sample clean-up method that would require less manual labor and an increase in sample throughput. The sample clean-up method will employ Gel Permeation Chromatography (GPC) and automatic concentration via an AccuVap. The forensic community will also learn how to identify sources of contamination and the contribution of those sources in sediment samples. This will be beneficial for differentiating natural and anthropological contamination sources.

Modern society has increased the usage and varieties of organic compounds for various benefits; however, there can be a negative side of the use of these same chemicals—environmental exposure. The "contaminant" may be transported great distances through the ecosystem before detection. In addition, once detected, the compounds may undergo significant degradation, metabolism, or other processes termed "weathering." This may make the identification of the original source of the pollution more difficult. It is the identification, quantification, and determination of the source or sources of environmental pollution that largely comprise the science of environmental forensics, and the subject of this presentation. The organic contaminants of interest in this study are Persistent Organic Pollutants (POPs) like Polycyclic Aromatic Hydrocarbons (PAHs).

PAHs are organic, atmospheric pollutants created through the incomplete combustion of fossil fuels like coal and petroleum. These airborne pollutants can travel a great distance before depositing onto surfaces via wet and dry deposition. For this presentation, PAHs deposited into and around a nationally recognized fishing stream, Spring Creek, are investigated. PAHs are of environmental concern because of their persistent, bioaccumulative, and carcinogenic properties, thus, identifying and monitoring the contributions of PAH sources becomes important.

The PAH emission sources have distinct signatures, but the complex environmental matrix interferes with the analysis. To eliminate interfering compounds in the sediment samples prior to analysis, the automated sample clean-up procedure will be presented. The cleaned samples are then analyzed via GC/MS for identification and quantification.

Besides matrix complexity, sediment samples contain a collection of PAHs from natural and anthropological sources. Thus, differentiating between the two will be beneficial for environmental forensics application. Field sediment samples from Spring Creek are analyzed to identify PAH sources and their apportionment. The PAH emission sources and their contributions are identified using a receptor model called PMF. PMF is a multivariate statistical tool used to identify contamination sources and the contribution of each source in a given sample. PMF was chosen for this investigation because of the ability to assign experimental uncertainties to individual data points. Secondly, solutions are constrained to non-negative values, thus, overcoming limitations found in other, current receptor models like Principle Components Analysis (PCA). This work specifically discussed in this presentation may be applied to numerous other forensically relevant samples, and this will also be discussed.

PAHs, Forensic, PrepLinc

 ** Presenting Author*