Case Studies: Source Delineation Using CSIA

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Background/Objectives. In any field of forensic science, pieces of evidence are required to create a clear picture of what has taken place. The way that the evidence fits together allows for clarifications, contextualization and better resolution of the overall vantage point. As a form of environmental forensics, the process of distinguishing contaminant plume origins requires multiple lines of evidence and careful analysis. Because it is unaffected by physical processes like dilution and sorption, compound specific isotope analysis (CSIA) has the unique ability to bridge data gaps in environmental forensics that were previously impossible to fully resolve – an important addition to the puzzle. This study is designed as a navigational aid for employing CSIA as an added line of evidence for contaminant source delineation.

Approach/Activities. Two separate case studies are used as examples to highlight how contextualized CSIA data can play a vital role as evidence for contaminant source distinction. The importance of each stage of the analysis is covered in a step-wise fashion, from the sampling strategy to the data interpretation. Because all analyses have limitations, focus will also be given to circumstances in which historical treatments or environmental parameters may affect CSIA data, making it less practical for a specific situation. By removing common misconceptions and by clarifying the ways that CSIA data is best used in conjunction with chemical, geochemical, spatial and historical data, this work provides commentary on when and how best to use the analytical method for source distinction purposes.

Results/Lessons Learned. The first study that is discussed involves two possible parties that may have been at fault for a downgradient PCE plume. Surprisingly however, samples taken from the downgradient plume as well as upgradient of the possible sources were statistically isotopically similar with overlapping error bars (2σ). By contrast, samples taken from the source areas of the two parties involved were determined to contain PCE that was more ^{13}C enriched than the PCE collected from the downgradient plume, indicating that neither party in question was likely to be at fault. Currently, more samples are being collected from locations upgradient of the parties to determine if a third party might be responsible. The second study employed CSIA to determine if TCE on a property was originating offsite or from a past on-sight release. Again, by contextualizing the data with standard error, contaminant concentration, and spatial information, the TCE was determined to be originating off-site. Compound specific isotope analysis provides an added layer to environmental forensics that can be vital for refining a contaminant plume origin assessment. Understanding the basics of the analysis and recognizing the best, unbiased way to implement it at a contaminated site will ultimately enhance the narrative and aid in determining the responsible party.