

## CSIA of Challenging VOCs Sample Matrices Using 2-D Gas Chromatography: Principles and Applications of the Method

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**Background/Objectives.** While significant progress in analytical techniques has been made over the past decade, poor chromatographic resolution of target analytes remains a major challenge in the use of compound-specific isotope analysis (CSIA) in the studies of field sites with volatile organic compound (VOC) class contaminants. To obtain precise and accurate isotope ratio data, C and H CSIA require near-perfect chromatographic separation of the target compound(s) from other compounds present in the sample. Such separation can be difficult for samples with complex VOCs fingerprints, for example, for VOCs collected from indoor air or in the vicinity of gasoline LNAPL. Similarly, even in relatively “clean” samples, certain pairings of analytes can be inherently difficult to separate using conventional GC techniques, for example, 1,4-Dioxane occurring together with Trichloroethane. Poor chromatographic separation has significant implications for the end user of the data: 1) certain categories of samples are not possible to analyze by conventional methods, e.g., indoor air VOCs; 2) in certain data sets, the completeness of the data is decreased by local concentrations of interfering non-target VOCs, e.g., for portions of chlorinated solvent plumes commingled with hydrocarbon fuels; 3) the quality of the reported data may be negatively affected (the analytical uncertainty for field samples with various non-target VOCs may be worse than that determined for lab control samples where the target compounds are analyzed in simplified sample matrix). This presentation discusses a method that addresses said limitations of classic CSIA. The presentation will summarize novel developments from the CSIA laboratory of the University of Oklahoma, in regards to the design and applications of CSIA with an integrated element of two-dimensional gas chromatography.

**Approach/Activities.** Standard CSIA utilizes a single GC column. The 2-D gas chromatographic (GC) configuration presented herein utilizes a separate GC instrument to perform the first stage of GC separation, using a polar phase column. That GC is interfaced to a separate GC-IRMS instrument, with a non-polar phase GC column.

**Results/Lessons Learned.** The 2-D GC approach offers significant improvement of chromatographic resolution in comparison with standard GC. The method has been successfully tested by analysis of several classes of samples, including samples with high levels of gasoline hydrocarbons and air VOCs. While the disadvantage of the method is the extended time of single analytical cycle (thus, the cost of the analysis is larger than the cost of standard CSIA), the method opens the potential to apply CSIA at sites where standard CSIA methodology would be not feasible.