Compound-specific isotope analysis of 1,2-dibromoethane: characterization of biotic and abiotic degradation pathways and analytical methodology considerations

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1,2-Dibromoethane (ethylene dibromide; EDB) was a commonly used component of leaded gasolines. While the use of leaded gasoline has been restricted in most countries, EDB persists at concentrations significantly above drinking water regulatory threshold at a large percentage of groundwater sites that were historically subject to leaded gasoline spills. EDB is potentially biodegradable under aerobic and anaerobic conditions and may also undergo abiotic degradation in the presence of reduced iron species and/or strong nucleophiles. However, the assessment of EDB degradation based on concentration data alone can be difficult. Similarly to the classical applications of compound-specific isotope analysis (CSIA), e.g., in the assessment of the fate of chlorinated ethenes or MtBE, the same approach may be potentially very informative in EDB studies.

This presentation will summarize the work on definition of isotope effects in biodegradation of EDB by anaerobic sediment cultures, by *Mycobacterium spaghni*, a novel cometabolic (aerobic) organism recently isolated from an EDB-contaminated site and by abiotic degradation pathways, conducted as a prerequisite to future applications in contaminated site assessment.

In comparison with typical VOC-class contaminants, remedial action of may be required for EDB occurring at significantly lower concentrations (drinking water MCL = 0.05 µg/L) that are inaccessible to typical CSIA methods. Moreover, EDB is likely to co-occur with a complex mixture of gasoline hydrocarbons, which poses an analytical challenge in applications of CSIA to actual environmental samples. To address this issue, novel analytical solutions were developed to permit a dramatic increase of CSIA detection limits and to overcome the limitations of chromatographic resolution.