



C59 Field Evidence for Abiotic Degradation of Trichloroethylene in a Thick, Weathered, Surficial Aquitard

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Upon completion of this workshop, participants will gain knowledge about the fate and distribution of TCE in a complex geological medium and how to use multiple data sets, including geologic, soil contaminants, aqueous geochemistry, water quality, and environmental isotopes together to determine chlorinated solvent fate and distribution. The focus will be on gaining an understanding of the abiotic process of TCE degradation to 1,1-DCE in the subsurface from field data, rather than laboratory experiments.

The forensic science community will gain further understanding and insight into the abiotic process by which TCE, a commonly encountered contaminant in soil and groundwater, degrades in the environment. This will enable forensic scientists to better evaluate the impact of TCE contamination on the environment and to support evidence for site characterization, source and extent of contamination, risk assessment, remediation technology development, and litigation issues. These evaluations and evidentiary support will result in better protection of human and environmental health and well being.

Abiotic reductive dechlorination of TCE to 1,1-DCE appears to have occurred at a former chemical landfill (the Site). The Site is situated on a fractured, surficial, clay aquitard, approximately 130 ft thick. The upper 3 to 4 m of the aquitard is highly weathered, beneath which the subsurface transitions into an unweathered zone. Chemical waste containing VOCs was deposited at the Site from the mid-1950s through the early 1970s. The disposed chemical waste was a large volume of PCE-dominant, multi-component DNAPL, containing neither 1,1-DCE nor 1,1,1-TCA.

Although biotic reductive dechlorination of TCE may produce *cis*-1,2-DCE, *trans*-1,2-DCE, and 1,1-DCE, the predominant biotic degradation product of TCE is *cis*-1,2-DCE. When TCE undergoes abiotic reductive dechlorination, the primary degradation product is 1,1-DCE. The results of the investigation conducted at the Site indicate that the production of 1,1-DCE in the unweathered zone of the aquitard is the result of abiotic degradation of TCE.

Subsurface conditions at the Site support the abiotic degradation of TCE. Laboratory studies by Klecka et al. (1990) and Kastner (1991) indicate that 1,1-DCE in groundwater can occur as a product from the abiotic degradation of TCE in the presence of sulfide. Kriegman-King and Reinhard (1992) observed in a laboratory study that abiotic degradation of another chlorinated solvent, carbon tetrachloride, was enhanced by the presence of pyrite (iron sulfide) and vermiculite. The clay soil at this site contains both pyrite and vermiculite (Abbott 1987, Quigley and Ogunbadejo 1976).

Abiotic degradation of 1,1,1-TCA may also produce 1,1-DCE, but it does not appear to be a source of the 1,1-DCE in the unweathered zone at the Site. Attributable to the degradation of 1,1,2,2-TECA, which was a component of the DNAPL, low concentrations of 1,1,1-TCA were detected in soil cores in the weathered zone, with no apparent relation to 1,1-DCE. In contrast to 1,1,1-TCA, TCE occurs in nearly all soil samples where 1,1-DCE was detected, and, in the unweathered zone, the mole fraction of 1,1-DCE increased as that of TCE decreased. The mole fraction shifts between TCE and 1,1-DCE indicate that TCE is the source of the 1,1-DCE in the unweathered zone.

TCE, Abiotic, 1,1-DCE