C17 Determining the Primary Source and Time Period of Trichloroethylene Contamination in Groundwater — An Unusual Case History in Which TCE Apparently Moved Faster Than Its Degradation Compounds

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The goal of this presentation is to show that some of the conventional thinking about the relative mobility of trichloroethylene and its degradation products in groundwater does not always apply.

This presentation will impact the forensic science community by showing how investigators sometimes need to think "out of the box" to determine relative timing and locations of groundwater contamination sources.

A large area of trichloroethylene (TCE) contamination was discovered in groundwater in 1989 at a former industrial facility rural Kansas. The facility served as an Army Air Base during World War II (WWII) where heavy bombers were prepared for final deployment to European and Pacific war theaters. After the War, the facility was turned over to a local municipality and converted to a municipal airport and industrial park. A major aircraft manufacturing company then leased much of the property and conducted various manufacturing and assembly operations at the site from 1950 to the early 1960s.

After the discovery of groundwater contamination at the site in 1989, regulatory authorities determined that the aircraft manufacturing company was responsible, at least in part, for the contamination and ordered the company to characterize the extent of contamination and to implement appropriate remedial actions. The primary contaminant is the industrial chlorinated solvent TCE, but its chemical biodegradation products, 1,2-dichloroethene (DCE) and vinyl chloride (VC) are also significant contaminants. The groundwater contamination plume extends several miles down-gradient from the source areas. The contaminated aquifers are composed of three, relatively thin, flat-lying limestone strata.

During the course of conducting remedial investigations and cleanup actions, the aircraft manufacturing company filed a law suit against the federal government under the terms of Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), claiming that the U.S. Army caused a significant portion of the contamination during its activities at the base during WWII. Serving as an expert for the government to determine what portion, if any, of the contamination could be reasonably attributed to the Army's activities.

An unusual aspect of the groundwater contamination plume was the fact that in the most distant, down-gradient portion of the plume, TCE is the dominant contaminant, with very little of the degradation products, DCE and VC. In contrast, near one of the two primary source areas, the degradation products are the dominant contaminants. This is unusual because in many aquifers, DCE and VC are more mobile than TCE and move faster because TCE is more retarded by adsorption to solid organic carbon matter in the aquifer matrix.

There were two primary source areas where TCE was initially released: a large hanger area called Hangar A and another larger hangar area, Hangar B. The plaintiff's expert in this case argued that the explanation for the TCE-dominant contamination at the leading edge of the plume was caused by early releases of clean TCE during the Army's activities at one of the two source areas (Hangar A) and that the DCE/VC dominance at that source area was due to the later releases of non-chlorinated solvents, fuels, and paint strippers probably during the aircraft manufacturing company's activities. The aircraft company conducted TCE vapor degreasing operations at both hangar sites. No credible evidence could be found that the Army ever conducted TCE degreasing operations or other significant use of TCE at the site during its WWII operations.

After careful analysis it was shown that the unusual distribution of TCE, DCE and VC was due to the release of relatively clean TCE at Hangar B by the aircraft company and that undegraded TCE constituted the contamination at the leading edged of the plume. Later releases of TCE mingled with petroleum hydrocarbons by the aircraft company at Hangar A caused the DCE/VC-dominated contamination near that source area. Another factor effecting the contaminant distributions is the fact that matrix diffusion in the fractured limestone aquifers favor greater mobility of TCE over DCE and VC (the opposite effect of adsorptive retardation).

At trial, the court concurred with my analysis and concluded that the federal government had no liability for the contamination.

Groundwater, Contamination, Trichloroethylene

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