## C51 Whose Contamination Is It? Distinguishing Groundwater Contamination Sources Using Chemical Signatures Combined With Hydrologic Evidence

*John B. Robertson, GE, BS*, 40107 North 3rd Street, Desert Hills, AZ 85086*

The goal of this presentation is to show how multiple lines of independent evidence can be used to identify sources of groundwater contamination and distinguish between possible sources of co-mingled or adjacent plumes.

This presentation will impact the forensic community and/or humanity by demonstrating chemical signatures, or "fingerprints," that can frequently be combined with other independent evidence, such as hydrologic data, to distinguish relative responsibilities of different potential sources of groundwater contamination. If developed early, this evidence can be used to help avoid litigation and to assist in negotiated settlements. At trial, such evidence can be vital to the judge or jury in reaching the correct conclusion.

Outcome: The audience will see how these techniques have been successfully applied to resolve disputed contamination responsibilities in at least three real-world cases.

Many complicated groundwater contamination cases end up in litigation because of disputes among potentially responsible parties (PRPs) over who is responsible for the contamination when two or more parties or sources may have caused the releases. A typical situation is a site with several known or likely sources of chlorinated solvent contaminants, such as trichloroethylene (TCE), tetrachloroethylene (PCE), and trichloroethane (TCA). PRPs often take the denial position of "Its not mine! It must be his!", pointing the finger at other PRPs. Or frequently, "A small portion might be mine, but most of it has to be his!" Forensic environmental scientists and hydrogeologists are then hired to try to sort out the relative responsibilities. In many, of not most, cases, the chemical compositions of the waste discharges from different facilities, from different times, or from different parties, have unique chemical signatures or "finger prints," even if the key contaminants of concern are the same for all. An experienced expert can often decipher these signatures. There are several types of chemical signatures that can be useful. These include: 1) the suite of chemical compounds associated with each party's waste stream; 2) ratios of different chemical constituent concentrations to one-another; 3) presence and relative abundance of degradation products from parent chemical contaminants; (4) isotopic composition of a given chemical from different production facilities or times. The history and configuration of individual contamination plumes is determined by the hydrologic factors that control the flow direction and velocity of groundwater and dissolved contaminants over time. The configuration of contamination plumes must be consistent with the position and timing of the alleged source(s) for each plume. Combining hydrologic analysis with chemical signature analysis can provide a powerful tool in proving or disproving an alleged source. The success of this approach is demonstrated on at least three case histories: 1) The principal source of wide-spread ethyhlene dibromide (EDB) contamination in a major water supply aquifer could have originated from land applications of EDB as a crop nematocide or from leaks and spills of leaded gasoline (which contained EDB as a lead-scavenger additive) from fuel pipelines and storage tanks. Evidence developed with this combined approach resolved the issue. 2) TCE, PCE, TCA, carbon tetrachloride and related chlorinated volatile organic compounds (VOCs) from multiple sources contaminated a major public water supply aquifer in the Midwest. Individual contributions to commingled plumes containing many of the same compounds were distinguishable using this technique. 3) At a wellknown site in the northeast, a public well field became contaminated with chlorinated VOCs and a nearby commercial facility was blamed. Analysis of chemical signatures and groundwater flow pattern history proved that the alleged facility could not have been the source. Furthermore, the analysis identified the true source at a different location.

**Groundwater, Contamination, Hydrology**

 ** Presenting Author*