Distinguishing between Multiple Dry Cleaner Sources in a Commingled Chlorinated Solvent Groundwater Plume

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Background/Objectives. Perchloroethylene (PCE) is a chlorinated organic compound that has been widely used as a dry cleaning solvent since the 1950s. PCE can, under anaerobic conditions, biologically degrade to the "daughter" products of trichloroethylene (TCE), cis-1,2-dichlorethylene (cDCE), vinyl chloride (VC), and ethene. Applying an understanding of this degradation process to groundwater data from a commingled groundwater plume of PCE in a small northern California city allowed us to establish that all three dry cleaners contributed to the commingled plume and delineate the sources of PCE releases, as part of an allocation of responsibility between the potentially responsible parties (PRPs).

Approach/Activities. We utilized the biodegradation patterns of PCE by comparing plots of the molar ratios of PCE and its daughter products at and down gradient from each of the three former dry cleaners to demonstrate that distinct releases had occurred at each former dry cleaner. The plume originated at Dry Cleaner A and extended 1,700 feet to the southeast in two separate groundwater zones, passing beneath Dry Cleaner B and Dry Cleaner C, which are located across a street from each other, approximately 400 feet downgradient from Dry Cleaner A. While the releases from Dry Cleaner A are evident, as the plume approaches the downgradient dry Cleaners B and C, the evidence of contributions is not as clear, based on concentrations of PCE alone. Dry Cleaner C denied any releases and claimed that PCE had migrated via a sewer lateral from Dry Cleaner B.

Results/Lessons Learned. Plots of total molar ratios of PCE and its daughter products for all groundwater samples within the plume revealed distinct degradation fingerprints for each dry cleaner. Dry Cleaner A had two distinct degradation fingerprints for each of the two release points: a pure PCE fingerprint behind the back door of the former dry cleaner and a biodegraded fingerprint, containing TCE, cDCE, and VC, along a fracture in the sanitary sewer behind the dry cleaner, where sanitary wastewater had caused anaerobic conditions. Dry Cleaner A's fingerprints became heavily biodegraded with much higher proportions of cDCE and VC due to the presence of separate and unrelated petroleum contamination as the groundwater travelled downgradient towards Dry Cleaners B and C. As the plume migrated beneath Dry Cleaners B and C, the fingerprint pattern became much less biodegraded, indicating releases of PCE from both dry cleaners. The claim of releases via the sewer at Dry Cleaner C was disproven given the fairly non-biodegraded fingerprint directly adjacent to the sewer, contrary to a heavily biodegraded fingerprint expected at a sewer release. Therefore, analysis of the molar ratio plots demonstrated that all three dry cleaners had contributed to the commingled groundwater plume. In addition, based on the degradation fingerprints, we were able to delineate the PCE releases from each dry cleaner for allocating responsibility between the PRPs.