Using tritium-helium groundwater age to assess contamination vulnerability in California

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The California Water Resources Control Board, in collaboration with the US Geological Survey and Lawrence Livermore National Laboratory, has implemented a program to assess the susceptibility of groundwater resources. Advanced techniques such as groundwater age-dating using the tritium-helium method, extensive use of $\delta^{18}O$ for recharge water provenance, and analysis of common volatile organic compounds (VOCs) at ultra-low levels are applied with the goal of assessing the contamination vulnerability of deep aquifers, which are frequently used for public drinking water supply. Over 1200 public drinking water wells have been tested to date, resulting in a very large, tightly spaced collection of groundwater ages in some of the heavily exploited groundwater basins of California. When employed on a basin-scale, groundwater ages are an effective tool for identifying recharge areas, defining flowpaths, and determining the rate of transport of water and entrained contaminants. De-convolution of mixed ages, using ancillary dissolved noble gas data, gives insight into the water age distribution drawn at a well, and into the effective dilution of contaminants at long-screened production wells. In combination with groundwater ages, low-level VOCs are used to assess the significance of vertical transport.

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Fuel/hydrocarbon fingerprinting

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There are several different types of fuel/hydrocarbon fingerprinting techniques or approaches that can be used to answer specific site concerns. Generally, there is a need to identify the parties responsible for some type of environmental contamination. The knee-jerk reaction to such a situation is to try to "age date" the contamination that is present at the site. Here, a request is made to determine the age or date when a release occurred. This approach is usually problematic for a number of reasons. For example, a slow release that occurs over a period of several years will often have fuel of different ages at different locations within the contamination plume. The oldest material is often near the edge of the plume and the newest material located close to the release point. An "age date" analysis can then vary based on the locations from which one collects a sample for analysis. Likewise, the mixing of fuel of two different ages can also confound age dating techniques. Here, any "age date" is often guaranteed to yield an unreliable result, one that is neither as old as the oldest release nor as new as the most recent release. These limitations will be discussed using an "age date" model.

Alternatives to the knee-jerk "age dating" approach involve the development of various hypotheses which can then be evaluated in a scientific manner. This approach greatly expands the techniques that can be used to address the site issues, as well as the certainty of the findings. Examples of how such an approach can be used will be discussed.

When using analytical testing data in forensic evaluations, it is usually important to develop the context within which the data are to be used. The most common approach is a simple error analysis. Without such an evaluation, it may prove impossible to establish the significance of chemical testing results.