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Isotope Tracking of Contaminant Movement in the Hanford Vadose Zone

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A suite of isotopic measurements of vadose zone soil samples and groundwater has been successfully used to identify the sources of groundwater contamination at the Hanford site in south-central Washington. The isotopic composition of nitrate can be used to distinguish high-level tank waste (high d15N) and low-level process wastes (high d18O) from the relatively high background concentrations of nitrate in the groundwater at the site. The 87Sr/86Sr of strontium is typically elevated above background in areas where large volumes of water have been flushed through the vadose zone. Conversely, interaction between high-level caustic waste and feldspars in the vadose zone sediments releases low 87Sr/86Sr. Uranium isotope ratios (234U/238U, 235U/238U, 236U/238U) have been particularly useful for distinguishing different generations of nuclear fuel processing, allowing identification of waste in the vadose zone and groundwater derived from known or suspected leaks or spills. Data will be presented from a site adjacent to one of the high-level tank farms where multiple possible sources of contamination are suspected of causing high (and increasing) concentrations of 99Tc and nitrate in groundwater. The isotopic composition of nitrate from a multi-level well shows a clear example of vertical mixing of high nitrate, low-level waste with concentrated high-level waste. Sr and U isotope data are helping to define the possible source of the high-level and low-level waste components in the groundwater.