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Isotopic Composition of Natural Nitrate in Groundwater in Los Alamos, New Mexico, USA

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American Geophysical Union, Fall Meeting 2009, abstract #H31E-0831

Los Alamos National Laboratory (LANL) has established background concentrations for various dissolved constituents in local groundwater from perched-intermediate and regional aquifers in the vicinity of Los Alamos in north-central New Mexico. Typical background concentrations of nitrate (NO3-) are on the order of 0.31 mg/L as N (0.02 mM/L). In addition to natural sources, anthropogenic sources of NO3- in local groundwaters include industrial and treated sewage discharges released from LANL facilities, and treated sewage effluent discharges from Los Alamos County. We are using stable isotopes of nitrogen and oxygen in NO3- to distinguish among these sources, define groundwater flow paths, and evaluate groundwater mixing. Following the approach of McMahon and Böhlke (2006), we have explored the δ18O[NO3-] of water samples taken from background wells and springs in the Los Alamos area. NO3- from a spring and a well located in the Valles caldera, upgradient and upwind (relative to prevailing winds) of Los Alamos has δ15N and δ18O values of approximately 4.8 ‰ and -2.6 ‰, respectively. Tritium and unadjusted radiocarbon analyses indicate that these caldera waters predate LANL operations commencing in 1943. NO3- from groundwater locations in Los Alamos that exhibit background conditions has isotopic values similar to those of the caldera groundwater. Because local groundwater is relatively oxidizing, denitrification is not expected to be a factor in altering isotopic compositions of NO3-. Results indicate that there is little direct atmospheric contribution to dissolved NO3-, and that most NO3- is derived from bacterial nitrification in which one oxygen atom comes from atmospheric oxygen and two oxygen atoms come from soil porewater. Oxygen isotope values plot slightly below the expected isotopic trend for a 1:2 mix of these two sources, indicating either slight fractionation of oxygen isotopes during nitrification, or potential mixing with geological sources of NO3-. Development of a robust isotopic data set for natural background

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NO3- improves our ability to distinguish between natural and anthropogenic sources of NO3-, allowing for better characterization of groundwater contamination and improved remediation decisions. P. B. McMahon and J. K. Böhlke (2006) Regional Patterns in the Isotopic Composition of Natural and Anthropogenic Nitrate in Groundwater, High Plains, U.S.A. Environmental Science & Technology, Vol 40, No. 9, 2965-2970

Keywords: [1041] GEOCHEMISTRY / Stable isotope geochemistry, [1829] HYDROLOGY / Groundwater hydrology, [1831] HYDROLOGY / Groundwater quality

The ADS is Operated by the Smithsonian Astrophysical Observatory under NASA Grant NNX09AB39G