Preliminary Identification of Ground-water Nitrate Sources Using Nitrogen and Carbon Stable Isotopes, Kansas

M. A. Townsend, Kansas Geological Survey, 1930 Constant Avenue, Lawrence, KS 66047,
and
S. A. Macko, University of Virginia, Department of Environmental Sciences, Clark Hall, Charlottesville, VA 22903

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Abstract

Increasing nitrate-N in ground water is a problem in many areas with limited ground-water supplies, such as west-central Kansas. However, potential sources of nitrate-N are not known. Nitrate-N concentrations in ground water in the Hays study area in Ellis County, west-central Kansas, range from 0.9 to 26 mg/L. The $\delta^{15}N$ signatures of the ground waters are more enriched (+16.8 to +28.7‰) than those of the soils (+8.4 to +13.7‰), strongly suggesting that nitrogen sources are not f mineralized and labile nitrogen present in the unsaturated zone. In this study, nitrate-N values greater than the U.S. EPA drinking water limit of 10 mg/L occur with $\delta^{15}N$ values of greater than +10‰. This relationship between high nitrate-N concentrations and enriched $\delta^{15}N$ values (greater than +10‰) in ground water has been observed in other studies in Kansas and is usually related to a human- and/or animal-waste source.

Soil cores collected near municipal wells had mean total nitrogen values of 1.2-15 mg/kg. Increased $\delta^{15}N$ with depth in several of the cores suggests that microbial mineralization, denitrification, or volatilization processes caused the enriched $\delta^{15}N$ signatures. Decreasing total nitrogen and nitrate-N values with depth also help support the idea of microbial processes.

Stable carbon isotopes provide supporting evidence that soils are not a major contributor to the observed nitrate-N concentration in the ground water. $\delta^{13}C$ values of the dissolved organic carbon (DOC) in soils generally were more enriched (-11.6 to -18.8‰) while corresponding groundwater $\delta^{13}C$ values were more depleted (-19.9 to -22.2‰), suggesting that the source of the DOC in ground water is not from the soils.
