

# Use of Multiple Tracers and Geochemical Modeling to Assess Vulnerability of a Public Supply Well in the Karstic Upper Floridan Aquifer

Brian G. Katz<sup>1</sup>, Christy A. Crandall<sup>1</sup>, W. Scott McBride<sup>2</sup>, Marian P. Berndt<sup>1</sup>

<sup>1</sup> U.S. Geological Survey, 2010 Levy Avenue, Tallahassee, FL 32310

<sup>2</sup> U.S. Geological Survey, 10500 University Center Drive, Suite 210, Tampa, FL 33612

*2006 National Monitoring Conference: Concurrent Session F: F3-Assessing Ground Water Vulnerability Through Mechanistic Methods II, May 7-11, 2006, San Jose, CA.*

## Biographical Sketches of Authors

Brian G. Katz, PhD, is a research hydrologist with the U.S. Geological Survey in Tallahassee, Florida. During his career with the USGS, he has conducted numerous geochemical studies of processes that control the composition of natural and contaminated waters. His current research involves the use of isotopic and other chemical tracers to quantify hydrochemical interactions between ground water and surface water, determine sources and chronology of contamination in karst aquifers, and assess flow-system dynamics in complex aquifer systems.

Christy A. Crandall is a hydrologist with the U.S. Geological Survey's National Water Quality Assessment Program with training and experience in hydrology and water quality. Since 2002, she has served as project manager and ground-water modeler for the Transport of Anthropogenic and Natural Contaminants to Supply Wells project from its planning phase into full implementation. Christy moved to the U.S. Geological Survey in 1993 from the National Park Service and has worked in a variety of water programs over the last 20 years.

W. Scott McBride is a hydrologist with the U.S. Geological Survey in Tampa, Florida. He has 17 years of experience in surface and groundwater investigations, water quality sampling and analysis, technical equipment procurement and use, specialized sampling techniques, and project management. He has coordinated and implemented several groundwater studies for the Georgia-Florida Coastal Plain Study Unit of the National Water-Quality Assessment Program, and is currently project chief of a watershed study in central Florida.

Marian P. Berndt is a hydrologist with the U.S. Geological Survey in Tallahassee, Florida. She is currently the project chief for the Georgia-Florida Coastal Plain study of the National Water Quality Assessment program. She has worked on a variety of water quality and ground water geochemistry studies and is currently working on studies on the geochemistry and occurrence of contaminants in the surficial and Floridan aquifer systems in the southeastern U.S.

## Abstract

As part of a USGS national study of contaminants in public supply wells, multiple chemical indicators and geochemical modeling techniques were used to assess contaminant movement in a karstic groundwater system in Tampa, Florida. Six volatile organic compounds and four pesticides were detected in trace concentrations in water from a public supply well (PSW) tapping the carbonate Upper Floridan aquifer (UFA) with an open interval from 119-174 ft below land surface. These contaminants were detected more frequently in water samples from 11 monitoring wells in the overlying clastic surficial aquifer system (SAS) than in water from 13 monitoring wells in the UFA in the study area. Likewise, nitrate-N concentrations in the PSW (0.72-1.4 mg/L) were more similar to median concentrations in the oxic SAS (2.1 mg/L) than the anoxic

(sulfate-reducing) UFA (0.06 mg/L). Elevated concentrations of  $^{222}\text{Rn}$  and U in the PSW appear to originate from water moving downward through sands and discontinuous clay lenses that overlie the UFA.  $\text{SF}_6$  and  $^3\text{H}/^3\text{He}$  concentrations in water samples from the SAS were consistent with recent recharge (4-year median age), but water from the UFA indicated binary mixtures of recent recharge with tracer-free waters (>50 years). Tracer concentrations in the PSW also indicated the presence of some young water (< 7 years), and  $\text{SF}_6$  apparent ages for water from 140-160 ft depth in the PSW were slightly younger (1-2 years) than ages of water from shallower depths in samples collected during pumping and non-pumping conditions. Additional chemical and geophysical data indicated that movement of young water into the 140-160 ft zone is enhanced by solution features that likely are directly connected to the surface and SAS. Geochemical mass-balance models for the PSW indicate mixing scenarios that include 50-80% contribution of water from the SAS, along with dissolution of minor amounts of calcite, gypsum, and dolomite from the UFA.