An Overview of the Geochemistry of Edwards Aquifer Ground Water in South-Central Texas

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Abstract

The U.S. Geological Survey collected 249 ground-water samples from 136 sites in the San Antonio segment of the Edwards aquifer during June 1996 through December 2006 as part of the National Water-Quality Assessment Program. The Edwards aquifer is a highly-productive, fractured, karst aquifer developed in Cretaceous-age carbonate rocks and is well-suited for examination of ground-water evolution processes as well as urban influences on ground-water quality. Samples were analyzed for a broad range of geochemical and isotopic constituents, including some anthropogenic contaminants. The resulting geochemical dataset was evaluated to assess regional-scale geochemistry, processes controlling ground-water evolution, natural and anthropogenic factors affecting water quality, spatial and temporal trends in ground-water geochemistry, and the interaction between hydrologic conditions and ground-water geochemistry.

Edwards aquifer ground water is dominantly fresh, Ca-Mg-HNO_3, oxygenated water (median specific conductance is 550 microsiemens per centimeter). Carbonate mineral-solution reactions and ground-water residence time can account for most of the observed range of regional-scale geochemical and isotopic variability. A few samples are influenced by downdip saline water or water from the underlying Trinity aquifer. Variations in Mg/Ca ratios, which are indicators of residence time and water-rock interaction in carbonate aquifers, and Sr isotope compositions, provide insight into sources of dissolved constituents in ground water, water-rock interaction pathways, and ground-water residence time. Hydrologic conditions exert strong control on both regional- and local-scale geochemistry. Data for a small number of sites sampled relatively frequently indicate close links between surface water and ground water in this aquifer, particularly with respect to ground-water quality.

Some organic contaminants were frequently detected in Edwards aquifer samples at very low (less than 1 microgram per liter) concentrations: atrazine, deethylatrazine (a degradate of atrazine), and chloroform (a byproduct of drinking-water treatment) were detected in more than 50 percent of the samples and were more frequently detected (in more than 75% of the samples) from shallow, unconfined, recharge-zone wells in the urban San Antonio area. The variation in concentration of frequently detected organic compounds, such as atrazine, and nitrate with respect to hydrologic conditions provides insight into their sources and transport into the aquifer. Nitrate concentrations range from less than 0.05 to 8.2 milligrams per liter with a median concentration of 1.7 milligrams per liter; nitrate concentrations greater than 3 were restricted to a few samples and might indicate anthropogenic influences. Mg/Ca ratios vary inversely with concentrations of some of the frequently detected organic contaminants, which indicate that these compounds likely are entering the aquifer with recharging surface water.