

## **NATIONAL AND NEW JERSEY STATEWIDE SURVEYS OF THE OCCURRENCE OF SHORT-LIVED RADIOISOTOPES IN GROUND-WATER SUPPLIES AND IMPLICATIONS FOR MONITORING PROGRAMS**

Zoltan Szabo  
U.S. Geological Survey  
810 Bear Tavern Rd., Suite 206  
W. Trenton, NJ 08628

### **ABSTRACT**

Ingestion of alpha-particle-emitting radionuclides, which are carcinogenic, may pose health risks. Measurements to characterize gross alpha-particle radioactivity in ground water from the New Jersey Coastal Plain were conducted. Gross alpha-particle activity within the first 3 to 7 days after sample collection was greater than expected based on the concentration of long-lived radium-226, a commonly occurring natural contaminant in these waters. The previously undetermined radionuclide radium-224 (Ra-224, half-life 3.64 days) accounted for the additional radioactivity. The U.S. Geological Survey in cooperation with many agencies and organizations (U.S. Environmental Protection Agency, New Jersey Department of Environmental Protection, Richard Stockton College of New Jersey, Rutgers University, New Jersey American Water Company, American Water Works Association, and American Water Works Service Company), conducted reconnaissance surveys of the occurrence of Ra-224, both statewide in New Jersey and nationwide.

In New Jersey, concentrations of Ra-224 (maximum, 6.8 pCi/L, picocuries per liter) exceeded 1 pCi/L in 34 percent and 5 pCi/L in 3 percent of the 61 samples collected in 1999-2000. Concentrations of Ra-224 were greatest in acidic waters from unconfined quartzose Coastal Plain aquifers, where anthropogenic nitrogen-bearing leachates increased acidification. In the targeted national reconnaissance of radionuclides in public ground-water supplies, concentrations of Ra-224 (maximum, 73.6 pCi/L) exceeded 1 pCi/L in 30 percent and 5 pCi/L in 15 percent of the 99 samples collected in 1998-99, and were greater than any other radium radionuclide in 29 percent of the samples. Concentrations of Ra-224 were greatest in waters from aquifers in the Atlantic Coastal Plain and Midwestern Interior Lowlands Physiographic Provinces.

Elevated gross alpha-particle activities observed within distribution systems in the New Jersey Coastal Plain resulted in part from decay of high concentrations of lead-212 (half-life, 10.64 hours). Field assessments with portable instruments (alpha scintillometer, alpha spectrometer) confirmed the presence of radon-220 (half-life, 56 seconds), the decay product of Ra-224. Radium may be concentrated in distribution pipelines by adsorption onto corrosion products or scale, where it decays, forming these progeny. The wide array of naturally occurring short-lived radionuclides presents challenges for monitoring programs; they will need to incorporate new technologies and analytical methods to adequately characterize radioactivity.

**KEY WORDS:** radioactivity, gross alpha-particle activity, radium-224, lead-212, radon-220, ground water, Atlantic Coastal Plain, New Jersey