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An integrative study of the sources and effects of naturally occurring contaminants in private wells in North Carolina: A water quality prospective

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Abstract:

Drinking water from private wells is currently unregulated in the United States. While the federal Safe Drinking Water Act and North Carolina's drinking water standards protect consumers of public water systems, there are no similar protections for the safety of private wells. Currently about two million residents in North Carolina are served by private wells and this number is rapidly growing. The purpose of this USDA-funded project is to evaluate the exposure of private well users to natural contaminants of arsenic, radon, and radium. Our data show that in western and central parts of North Carolina, ground water is tapped from shallow aquifers that are located along the contact between the underlying fractured bedrock and overlying weathered profiles, leading to high levels of naturally occurring contaminants. Occurrences of contaminants are directly related to the local geology; Elevated radon levels were encountered in many wells located in the granitic rocks in the Blue Ridge Mountains and the Piedmont areas; high radium activities were identified in several wells in the Rolesville granite near Raleigh; and high arsenic concentrations exceeding the new EPA MCL of 10 ppb are associated with meta-volcanic rocks of the Carolina Belt. Our results show that a large fraction of the groundwater in the Piedmont area is in a reducing state, which is also associated with higher dissolved constituents. The combined redox state-salt content affects the distribution of radium and radon contaminants (e.g., higher radon/radium ratio in oxic and low salt water) and also arsenic species distribution. Hence, groundwater chemistry, in addition to rock types, plays an important role for the distribution of naturally occurring contaminants in North Carolina.

Impact Statement:

The purpose of this project is to evaluate the exposure of private well users to natural contaminants of arsenic, radon, and radium. The project investigates the mechanisms in which these natural contaminants are leached into groundwater, the available treatment techniques for removal of natural contaminants, the role of information as an environmental health policy tool that examines how households respond to information regarding inorganic contaminants, and the policy implications for an increasing population that uses groundwater with contaminant levels exceeding EPA regulations. After two years of research, the project provides several important outputs for the exposure of rural communities to naturally occurring contaminants: (1) the water quality, in addition to local geology, plays an important role on the distribution of radon, radium, and arsenic in private wells. Nonetheless, predictions for the occurrence of these contaminants for individual wells are at high risk, give the heterogeneity of fracture network that characterize the local aquifers. Thus actual sampling and measurements are essential for protecting the health of rural communities that are using private wells; (2) level of awareness of private homeowners for the occurrence of naturally occurring contaminants is very low in rural areas, even in zones of higher frequency of contaminants occurrences; and (3) revision in Safe Drinking Water Act (SDWA) for arsenic levels in public wells (new MCL of 10 ppb) does not apply for private wells. Analysis of Congress's treatment of naturally occurring arsenic, we identify a case where Congress had, in fact, created sufficient tools to detect the severe potential affects of arsenic in drinking water but, nevertheless, failed to apply it also to rural water systems of private wells.

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