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# Naturally occurring contaminants in North Carolina private wells: The role of geology and water chemistry on radium mobilization in a granitic area

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## Abstract Text:

Naturally occurring arsenic, radium, and radon have emerged as widespread contaminants in groundwater resources in many areas of the USA. The objectives of this interdisciplinary research are to (1) document the occurrence of natural contaminants in North Carolina (NC) private wells, (2) develop improved geochemical models for key processes that control contaminant levels, (3) examine perceptions of natural contaminants across socioeconomic groups, (4) present reasonable treatment strategies to residents and communities in NC, and (5) examine different states' strategies for dealing with natural contaminants in private wells. Here we present preliminary chemical results from the fractured crystalline rock aquifer of Wake County, NC. We observed a wide range of pH (5.0-8.5), dissolved oxygen (0.2-8.6 mg/L), bicarbonate (9-229 mg/L), radon (up to 30,070 pCi/L), combined radium (0.04-15.7 pCi/L), uranium (up to 141 µg/L), and arsenic (up to 7 µg/L). Elevated radionuclides were especially prevalent in the extensive Rolesville granite. There, 72% of 32 wells exceeded the EPA alternate maximum contaminant level (MCL) for radon, 9% exceeded the MCL for uranium, and 3% exceeded the MCL for radium. Also, the ratio of radon-222 to its parent radium-226 decreases with decreasing dissolved oxygen. This suggests that reduced conditions are capable of mobilizing small quantities of radium from adsorption sites (such as manganese oxides and iron oxides) to partially explain the observed radionuclide activities. Thus, both bedrock geology and water chemistry are important factors for the assessment of radionuclide occurrence. In particular, the redox state of water can be used as a preliminary proxy for the occurrence of radium relative to the overall radionuclide content of aquifer rocks.

## Impact Statement:

In this research, we introduce geochemical tools based on simple field measurements (e.g. dissolved oxygen) to monitor potential occurrence of natural contaminants in groundwater.