Co-occurring contaminants may increase NC groundwater risks

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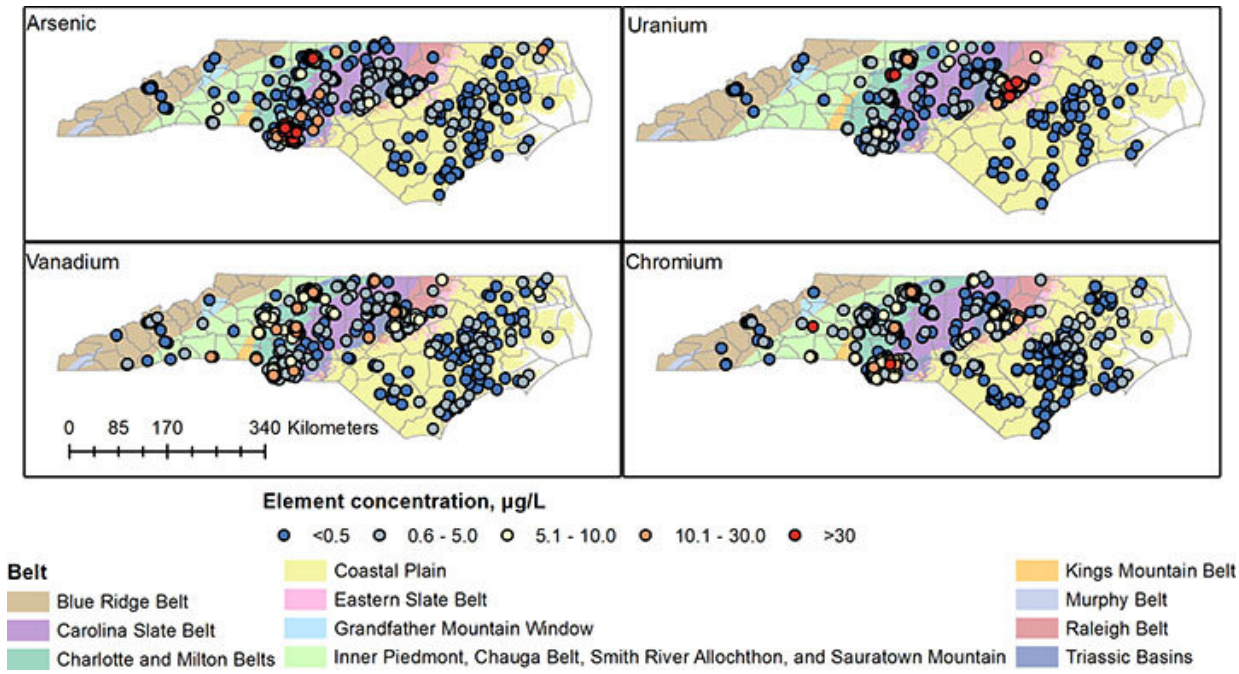

Naturally occurring concentrations of four environmental contaminants are mapped across the state of North Carolina. Credit: Vengosh Lab, Duke University

Contaminants that occur together naturally in groundwater under certain geological conditions may heighten health risks for millions of North Carolinians whose drinking water comes from private wells, and current safety regulations don't address the problem, a new Duke University

study finds.

"Guidelines for safe drinking water are normally based on one element or contaminant," said Avner Vengosh, professor of geochemistry and water quality at Duke's Nicholas School of the Environment. "They tell us how much arsenic is okay to have in our water or the maximum amount of chromium that's safe. But what if arsenic and chromium occur together? That's something the guidelines aren't equipped to address, even though recent research suggests exposure to multiple contaminants may increase toxicity."

The Vengosh lab's new study of four naturally occurring elements—arsenic, chromium, vanadium and uranium—in North Carolina groundwater wells highlights this disconnect, Vengosh said.

"Around 84% of the wells sampled in the Kings Mountain Belt and the Charlotte and Milton Belts of the Piedmont region contained concentrations of vanadium and chromium, in its more toxic hexavalent form, that exceeded health recommendations from the North Carolina Department of Health and Human Services," said Rachel Coyte, a doctoral student at Duke University, who led the study. Of the four elements studied, vanadium and chromium were found to co-occur most frequently, she noted.

The Kings Mountain Belt and the adjacent Charlotte and Milton Belts are geological formations underlying the western Piedmont. They cover a combined area that extends northward from Charlotte and its suburbs to the Virginia border.

The fact that 84% of the nearly 1,500 wells sampled in this area contained levels of both vanadium and hexavalent chromium in excess of state health recommendations is reason for concern, Vengosh said, especially since these recommendations are based on epidemiological

studies of risk factors. Yet none of the wells violate the Environmental Protection Agency's current maximum contaminant level (MCL) regulations. This sends a mixed message, he said.

"People with private wells—they don't know who to follow. The state says their water exceeds guidelines, but the EPA says they have no problem," Vengosh said.

The EPA has a maximum contaminant level for total chromium in drinking water of 100 micrograms per liter, but it has no separate MCL for hexavalent chromium, a known carcinogen, he noted. It likewise has no MCL for vanadium. By contrast, the NC Department of Health and Human Service has a much lower health advisory level for hexavalent chromium of 0.07 micrograms per liter to protect against a one-in-one-million risk of cancer over a 70-year life span. The state has a 0.3 microgram per liter health advisory level for vanadium, which some studies suggest may affect reproductive health and fetal development, though its risks are still not well-documented.

There are no guidelines, at either the federal or state levels, that address human safety of chromium and vanadium, or any other combination of elements, occur together.

Coyte and Vengosh published their peer-reviewed paper March 13 in the journal *Environmental Science & Technology*.

To conduct the research, they analyzed groundwater samples from 1494 private drinking water wells across North Carolina to determine the concentrations of arsenic, chromium, vanadium and uranium in each of the wells.

The highest concentrations of the four naturally occurring elements were found mostly in wells overlying fractured igneous and metamorphic

geologic formations in the state'sPiedmont region. Similar geological conditions underlie the Piedmont regions in South Carolina, Georgia and Virginia, as well as other regions worldwide.

"As climate change and population growth continue to stress our water resources, North Carolina and many other communities all over the world are relying more and more on groundwater to meet their growing water needs," Coyte said. "It is important that we systematically, continually and comprehensively monitor this vital resource. We also need more research to better understand the health impacts of geogenic contaminants and mixtures of geogenic contaminants. Only then can we understand who is being exposed, and what increased health risks, if any, they may face. It's an answer we don't have now."

More information: Rachel M. Coyte et al, Factors Controlling the Risks of Co-occurrence of the Redox-Sensitive Elements of Arsenic, Chromium, Vanadium, and Uranium in Groundwater from the Eastern United States, *Environmental Science & Technology* (2020). DOI: 10.1021/acs.est.9b06471

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