

Hexavalent Chromium in Drinking Water Wells from North Carolina: Where is it coming from and how widespread is it?



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Hexavalent Chromium

- Chromium occurs in two different forms when dissolved in water
 - Cr(III), thought to be primary type in groundwater, non-toxic
 - Cr(VI), thought to primarily from industrial (man-made) sources, potential carcinogen
- EPA has a total Cr standard (MCL) of 100 ppb, and the WHO has an upper limit of 50 ppb
- California has state limit for Cr(VI) of 10 ppb
- and a public health goal of 0.02 ppb.



Hexavalent Chromium

- Occurrence in drinking water has primarily be associated with industrial contamination
 - Used for electroplating or chrome-plating, can be formed when welding chromate-painted metals
- Recent studies have suggested naturally occurring Cr(VI) in ultra-mafic aquifers in California, Arizona, Mexico, Argentina, Brazil, Italy and Greece

The North Carolina Case



Hexavalent chromium results for drinking water wells tested within 1500 feet of Duke Energy coal ash sites:

Allen Steam Station, Belmont
 Mean: 1.55 µg/L (123 samples)
 Highest: 8.30 µg/L (78 times the health screening level)

Buck Steam Station, Salisbury
 Mean: 0.56 µg/L (64 samples)
 Highest: 22.30 µg/L (319 times the health screening level)

Roxboro Steam Station
 Mean: 0.55 µg/L (19 samples)
 Highest value: 2.7 µg/L (38 times the health screening level)

Hexavalent chromium results reported under EPA's unregulated contaminant monitoring program by nearby municipal systems, 2013-2015:

Charlotte Water
 Mean: 0.07 µg/L (23 samples)
 Highest: 0.12 µg/L

Salisbury-Rowan Utilities
 Mean: 0.08 µg/L (7 samples)
 Highest: 0.13 µg/L

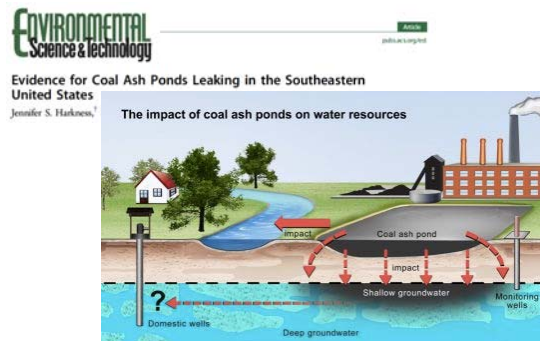
City of Roxboro
 Mean: 0.05 µg/L (9 samples)
 Highest value: 0.13 µg/L

Table compiled by Clean Water for North Carolina on March 13, 2016, comparing Cr(VI) in wells water near three coal ash sites vs. nearby public drinking water systems. For all three sites, mean Cr(VI) values for well water test results were significantly higher than mean Cr(VI) values detected in the nearby municipal drinking water supply. N.C. DHS's original health screening level for Cr(VI) was 0.07 micrograms per liter.
 Sources: N.C. DHEC well water test data downloaded in Dec. 2015 <http://www.ncwater.org/?page=007>, EPA Unregulated Contaminant Monitoring Rule data downloaded Jan. 20, 2016, <http://www.epa.gov/605/cmrm/monitoring-data/unregulated-contaminant-monitoring-rule/>.

- In 2015, NC-Department of Environmental Quality detected Cr(VI) in drinking water wells near coal ash ponds

The North Carolina Case

- There is evidence for leaking of coal ash ponds to shallow groundwater near ponds, but not to drinking water sources

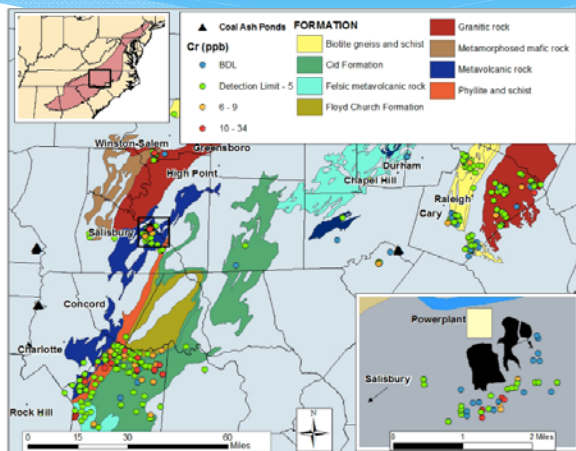


Objectives

1. To assess the distribution and occurrence of hexavalent Cr in drinking water wells in North Carolina and the Piedmont region
1. To determine the source of hexavalent Cr in groundwater in North Carolina

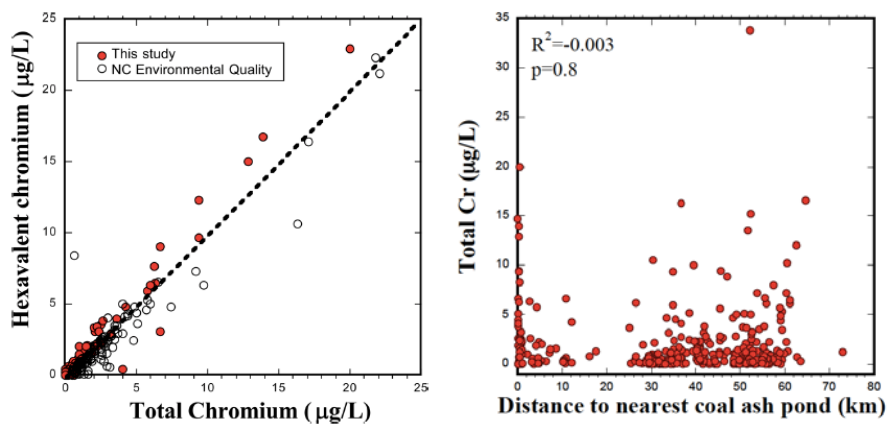
Objectives

- Dataset of 376 groundwater wells in NC
- 77 tested for Cr(VI) and isotope ratios
- Between 0 and 75 km from a coal ash pond



Vengosh et al. 2016, ES&T Letters

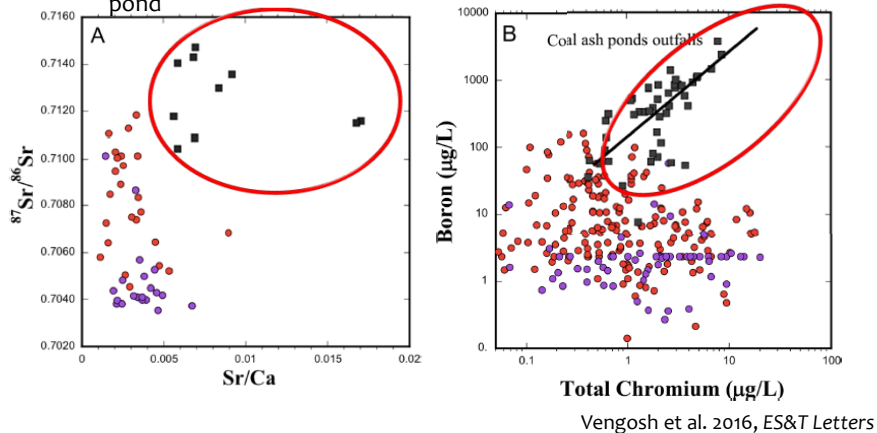
Results



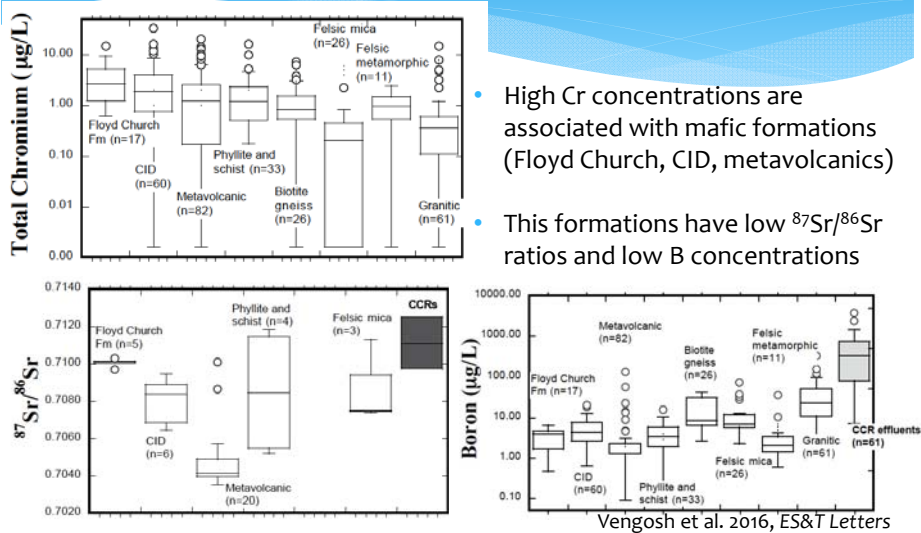
Vengosh et al. 2016, ES&T Letters

Results

Black squares – coal ash pond water from NC
 Purple squares – groundwater <0.5 km from an ash pond

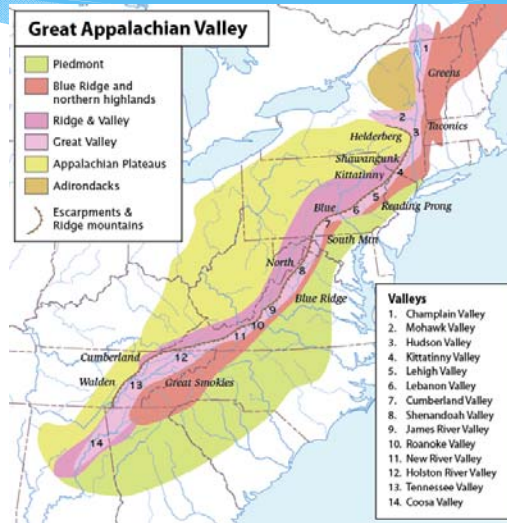


Results



Implications

- The Piedmont geology extends from SE Pennsylvania to NE Alabama
- Mafic formations are found throughout the world



Summary

- Hexavalent Cr is ubiquitous in groundwater throughout the NC Piedmont
- Related to surface geology, not proximity to coal ash ponds
- Water chemistry may play a role in the magnitude detected in drinking water wells

What can you do?



HEXAVALENT CHROMIUM IN DRINKING WATER WELLS IN NORTH CAROLINA

Would you like us to measure your water for hexavalent chromium?

We have identified areas with higher probability for elevated levels of hexavalent chromium in drinking water wells. Check on the link below to see where you are living and see if you likely have higher probability of getting hexavalent chromium in your drinking water.



Here is the link to the interactive map to find where you are with respect to rocks with higher probability of chromium.

If you are interested in sampling your well water, please write us: rachel.coyte@duke.edu

Free well testing!

<http://sites.nicholas.duke.edu/avnerengosh/hexavalent-chromium-in-north-carolina/>

Email: rachel.coyte@duke.edu

Thank you!

WRII
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Duke Nicholas School of the Environment
Southern Environmental Law Center

Rachel Coyte
Jon Karr
A.J. Kondash
Gary Dwyer

<http://sites.nicholas.duke.edu/avnerengosh/hexavalent-chromium-in-north-carolina/>