Naturally-Occurring Radionuclides in Drinking Water Wells and Indoor Air in Selected Areas within the Blue Ridge & Inner Piedmont Physiographic Provinces of Western North Carolina, 2005

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Background

The Blue Ridge and Inner Piedmont physiographic provinces of Western North Carolina contain rock types and geologic structures associated with elevated levels of radionuclides in ground water and indoor air (radon). Uranium-rich granitic rock is common across the region, as well as fault and shear zones that can increase the mobility, and thus the occurrence and concentrations, of radionuclides in drinking water wells and homes. Eight counties in western N.C. have predicted indoor radon levels above the EPA action level of 4 pCi/L. Moreover, some studies have documented elevated levels of radon and other radionuclides in ground water in this region.

To date, studies of radionuclides in ground water in western N.C. have been limited in scope. To address the need for additional information, the N.C. Department of Environment and Natural Resources, Division of Water Quality, is conducting a study to evaluate the extent to which rock type, structure, water chemistry, well construction, and other factors are associated with elevated radionuclide concentrations in ground water and indoor air. Findings from this investigation will allow the planning, regulating, and scientific communities to more fully understand the mechanisms and settings that contribute to elevated radionuclides in the region's ground water supplies and indoor air. The study is being funded by a U.S. Environmental Protection Agency grant awarded through the office of the N.C. Radiation Protection Division.

Purpose of Study

"The purpose of this study is to evaluate the extent to which geologic setting, geochemistry, and well characteristics are associated with elevated radionuclides in ground water and indoor air."

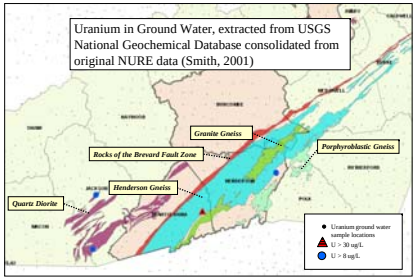
Factors to be evaluated include rock type, geologic structure (mylonitization, fault zones), ground water chemistry (pH, specific conductance, dissolved oxygen, iron, manganese, lead,…), depth to bedrock, total well depth, well yield, and others."

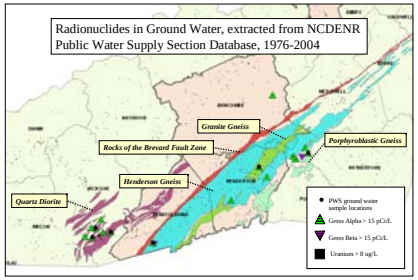
Problem Summary

- 8 counties in NC (all in Western NC) are classified as EPA "zone 1" for radon in air
- uranium-rich rocks - the source of radon - are common in Western NC
- of 277 private well samples in the Mountain region, 83% contained radon above EPA's recommended MCL of 300 pCi/L and the average value was 2000 pCi/L (UNC, 1993)
- extent of problem is unknown

EPA Guidelines

Gross Alpha MCL = 15 pCi/L	Combined Ra-226/228 MCL = 5 pCi/L
Radon proposed MCL = 300 pCi/L*	Uranium MCL = 30 ug/L
Radon proposed AMCL = 4000 pCi/L *	* Depends on system size and other factors





Study Approach

- Select 100 sample locations (home and associated private well) with the goal of observing areas of uranium-rich rocks, pronounced geologic structure, and (or) EPA Indoor Radon "Zone 1" counties.
- Sample private wells for total uranium, gross alpha + gross beta particle activity, radon-222, Pb, Fe, Mn, As, and field parameters. Also collect GPS coordinates, record well details from well tag, and note rock outcrops in vicinity. Water sample will be collected at the well head (preferred) or at the home's outdoor hose bib. Samples will be iced and shipped same day to a commercial lab for radionuclides and to the DWQ lab for metals.
- Sample homes for indoor radon. Homeowner will be given radon air kit to deploy, along with instructions on its use. Sampler will be placed in lowest-most "living area" of the home for 3 days, then sealed and shipped to a local lab.
- Evaluate water and air results and compare to existing datasets (NURE, Public Water Supply, indoor air data).
- Results will be published in late 2005.

Sampling Strategy

- Focus sampling in the counties of Henderson, Buncombe, and Transylvania; these areas are EPA Zone 1 counties, are underlain by uranium-rich rocks (Henderson gneiss, granitic gneiss), and have shown elevated levels of selected radionuclides. Moreover, the Brevard fault zone cuts through these areas allowing us to observe the effects of variably mylonitized rock.
- Select sampling transect(s) perpendicular to the strike of the Brevard fault to evaluate spatial distributions of radionuclides inside and outside of the fault zone.
- Use Statewide geologic map, detailed geologic maps (as available), and county road and parcel maps to target sample locations.