INVESTIGATION 8

IS THERE RADON IN NEW JERSEY?

INTRODUCTION

It is difficult to predict where radon is apt to accumulate to high concentrations in indoor air and thus constitute a potential health problem. Scientists at the U.S. Environmental Protection Agency (EPA) have attempted to do just that by constructing a map of the United States that shows areas with "potentially high radon levels" (Figure 1). It was based on geologic data and indicates those areas where there are known deposits of granite, phosphate, shale, and uranium - all likely sources of radon. EPA scientists are not satisfied that the map represents an accurate picture of radon concentration, and caution that it should not be used for predicting high radon levels in individual homes. If you live in one of the darkened areas, you don't necessarily have a radon problem. Similarly, if you live outside the darkened areas, you could still have high radon levels in your home. There is no way to predict for individual homes. No one should use his or her neighbor's test results as an indicator of his or her own radon levels.

Areas of high radon levels have been found in just about every state, and new areas of contamination are being discovered as more people test their homes. Testing of homes has not been uniform in all states. Several states, including Pennsylvania, Washington, and New Jersey, have revealed more than 1000 homes with radon concentrations higher than EPA's "action level"[1].

Geographers and geologists have divided the State of New Jersey into a number of discrete units, called physiographic provinces, based largely on the processes responsible for the formation of rocks and land features in the region (Figure 2). Granite rocks in the Highlands area, also called the Reading Prong, are very old (almost one billion years), and contain high concentrations of uranium. Rocks in the Piedmont area are younger (less than 1/4 billion years) and include shale and other sedimentary rocks that are high in uranium. The Valley and Ridge Province also contains high quantities of uranium, although glacial debris tends to be very thick, which prevents radon gas from reaching the surface prior to its breakdown into a non-gaseous element.

Because of the uncertainties in identifying areas of high radon and the difficulties in predicting the location of individual homes with elevated levels of radon, the New Jersey Department of Environmental Protection (DEP) recommends that *all* homes in the state be tested for radon.

[1]EPA's action level (4 pCi/L) is the level above which EPA recommends that some remedial action be taken.

Radon is a geologic phenomenon and houses that accumulate very high concentrations of radon tend to occur in clusters. If a house is identified with high radon concentrations, there is a good chance that other houses within a one mile radius may also have elevated radon concentrations. The DEP has found that when a house has radon levels of 200 pCi/L or more, 75% of the surrounding homes (within a one mile radius) will have radon levels at or above 4 pCi/L.

In this exercise you will explore the geographic aspects of radon in New Jersey. In the last ten years both the US Environmental Protection Agency (EPA)and the New Jersey Dept. of Environmental Protection (NJ-DEP) have developed other radon potential maps based upon the results of radon tests done in actual homes. The EPA divides the country into three "zones" based upon the potential for indoor radon levels exceeding the action level of 4 pCiAL (Figure 3).

In 1988, NJ-DEP conducted a state-wide radon survey to map out areas of potential for elevated radon levels by municipality. The resulting "tier" map (figure 4) shows the potential for indoor radon levels in excess of 4 pCi/L. Since 1988 this map has been updated several times. Part of the reporting requirements for NJ-DEP certified radon service providers is to provide NJ-DEP with measurement data. These test results are used to periodically update the tier designations when additional data moves municipalities from one tier to another.

Areas with Potentially High Radon Levels

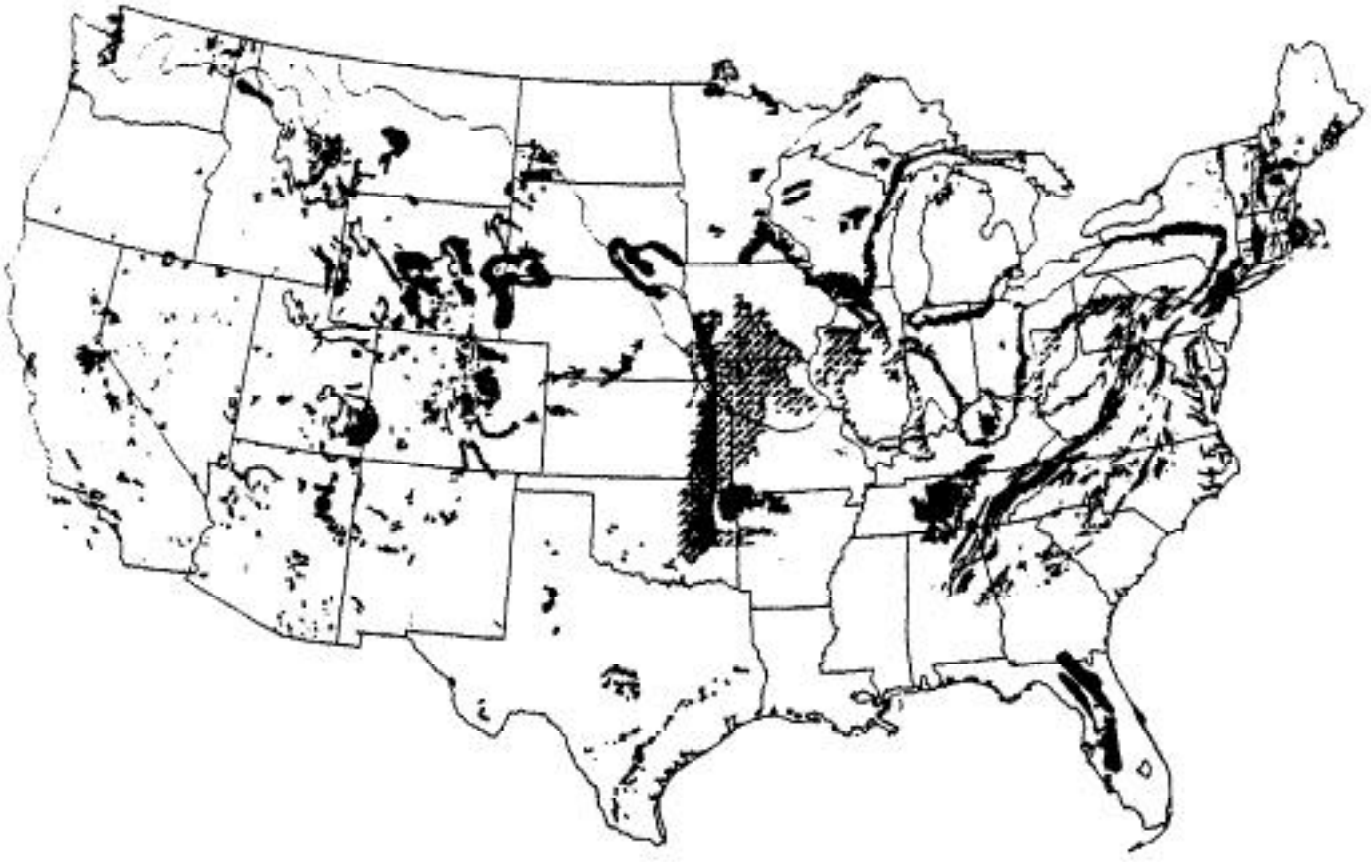

Figure 1. Major areas of the United States that have "potentially high concentrations of radon" in indoor air. This map was constructed by the U.S. Environmental Protection Agency from geologic information on the distribution of certain rock types known to be associated with radon release.

OBJECTIVE

To explore the geographical aspects of the radon issue in New Jersey.

PROCEDURE

1. Review the maps in Figures 1 and 2, and the inset boxes on the Watras story and the Clinton story.

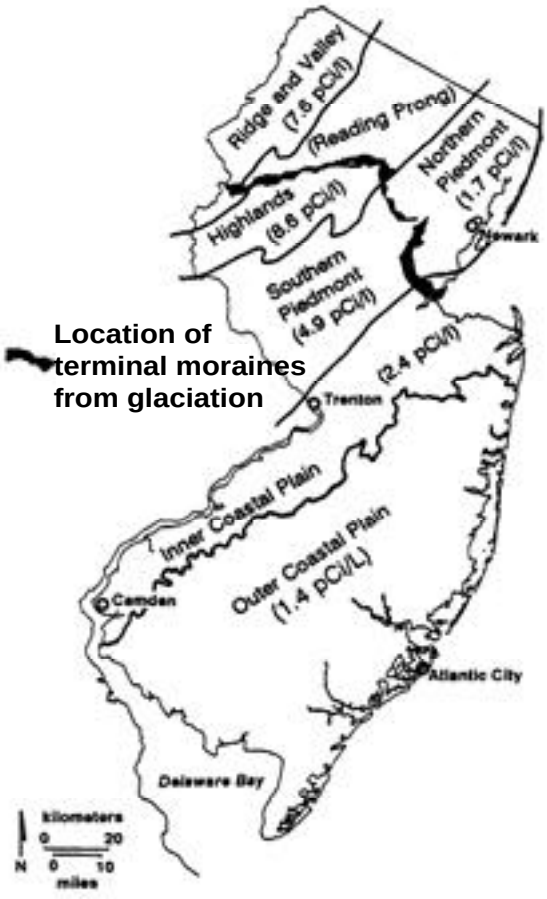

Figure 2. Physiographic provinces of New Jersey and the average concentration of radon measured in homes in each province. The highest concentrations of radon in the state have been found in homes located in the Highlands, Valley and Ridge, and southern Piedmont areas.

The Watras Story

Radon was generally unknown to most citizens of New Jersey 10 years ago. The event that triggered the widespread publicity that radon has received in recent years occurred across the border in Pennsylvania in 1984. Stanley Watras worked at that time at the Limerick Nuclear Power Plant in Pottstown, near Reading. A monitor was installed at the plant to check workers to make sure they did not accidently accumulate an unsafe dose of radiation at work. Watras repeatedly triggered the alarms on the detector going into work, and spent hours in decontamination rooms trying to get rid of the radiation on his clothes and body. Eventually,he discovered that he was not picking up the radiation at work, but rather was bringing it to work from home!

A team of specialists was sent to the Watras home to investigate. There they measured radiation levels about 700 times higher than the maximum level considered safe for human exposure. The source of this enormous amount of radiation turned out to be radon, a naturally-occurring gas that made its way into the Watras home from underground. It had nothing to do with Watras' job. The entire family was living in an environment roughly equivalent to smoking a couple of hundred packs of cigarettes per day. They moved out of the house immediately, while the problem was being fixed.

Further study revealed a vein of uranium ore directly under the house. It was continually releasing radon gas directly into the house, thereby producing the most radioactive home anyone had ever seen. After about $30,000 worth of clean-up and construction work that involved sealing off the house from the underlying bedrock, radon levels in the Watras home were reduced to reasonable levels. Although the Watras home is undoubtedly an extreme case, there may be millions of other homes in the United States that also contain high levels of radon.

The Clinton Story

Dozens of families in a Clinton, New Jersey neighborhood learned in the spring of 1986 that their homes were contaminated with the naturally occurring radioactive gas called radon, in some cases with remarkably high levels. The findings stunned state and federal researchers, who until then had never encountered a cluster of homes with such high levels of radon, which researchers say causes lung cancer. In the months that followed, the Clinton Knoll neighborhood was turned topsy-turvy by fear of radon, and by an onslaught of environmental scientists and reporters. The neighborhood became a laboratory of sorts, with the homes used as models that became the basis of federal research on construction techniques to purge contaminated homes of radon.

Clinton Mayor Robert Nulman recalls that particular spring when he steered his community through the scare of 1986. Nulman almost proudly tells you he had a radon problem, if only to emphasize how he got rid of it and to show that radon did not deflate the value of his house. When he purchased the house it registered a level of 130 picocuries (a measurement of radiation per liter of air). The federal government recommends remedial action be taken when the level goes beyond 4 picocuries per liter. Nulman said that after a $900 system of plastic piping and a fan were installed in the basement by a contractor, at the seller's expense, the radon level dropped to below 2 picocuries per liter.

Clinton resident Robert Timko remembers the initial fear of radon he and his neighbors experienced. He said they worried about their health and the health of their children, and about the value of their properties. "The worst part was the fear, the word 'cancer'. I still occasionally think about it, but it's not in my mind all the time," Timko said. Timko had initial readings of 690 picocuries per liter in his basement and 127 in his family room. After a contractor installed remediation equipment, the levels dropped to 3.1 picocuries per liter in the basement and 1.2 in the living area.

ANALYSIS AND CONCLUSIONS

2. You have been appointed the new acting director of the New Jersey Radon Program.Your immediate priority is to identify as many homes as possible that contain more than 20 pCi/L of radon. Your budget for this task is $200,000, and you estimate it will cost about $500 per house to obtain the desired radon measurements. Using the map in Figure 2, design and describe your strategy for tackling this problem.

   Hint: You have access to all existing data on radon measurements taken so far, and soils and geology maps for New Jersey.

3. Based on data collected in New Jersey so far, about twice as many homes have radon concentrations greater than EPA's action level of 4 pCi/L if you use data collected in basements as compared to the ground floors. Why do you think this occurs?

How will you take this knowledge into consideration in designing your sampling strategy for identifying homes with very high radon levels?

4. What is the best way to show the results of radon surveys so that people can understand the sampling data?

5. What kinds of data would you like to have mapped in order to help you design your strategy for Step 2?