INVESTIGATION 1

HOW IS RADON RELATED TO ROCKS, SOILS, AND URANIUM?

INTRODUCTION

Rocks are classed into three groups (igneous, sedimentary, and metamorphic) based upon how they form. *Igneous rocks* (from "fire") form when molten rock, called *magma*, hardens. They include many different minerals, such as silica, aluminum, and iron. Molten rock forms when rocks are melted by heat inside the earth. The molten rock is less dense than solid rock, and tends to move up towards the earth's surface. When magma erupts to the surface of the earth in a volcano, it is called *lava*. *Sedimentary rocks* (from "sediment"), such as sandstone and shale, are formed by the pressing together of sedimented materials, which might include plant and animal remains and small pieces of rock materials and soil particles. *Metamorphic rocks* ("change"), such as slate, originated as igneous or sedimentary rock materials, but have been physically changed by intense heat or pressure.

To understand where uranium is found in rock materials, you have to understand the basic features of igneous rock formation. As magma solidifies, various minerals are incorporated into the crystals and rock material in an orderly pattern. Uranium is not easily incorporated into the mineral structures that develop into igneous rock. It is often incorporated into the rock in combination with some of the minor accessory minerals that form at the end of the crystallization (hardening) process. Uranium represents .00016% of the earth's crust. It is found mostly as urannite. Uranium is a heavy element, but its combination with oxygen makes it less dense than the magma and it tends to rise to the surface. Uranium deposits are therefore often found on the outer rock surfaces and along cracks in the rock material. Much of the uranium present during igneous rock formation does not enter at all into the crystal structure of any of the minerals, but is deposited on the outer rock surfaces at the end of the crystallization process.

Radon is a gas formed from the breakdown of uranium (and several intermediate products). Movement of radon gas out of rocks and soil is influenced by the amount and location of the uranium underground, and passageways for radon movement to the surface. Permeability of the rocks and soils is important because both dissolved uranium in groundwater and radon gas move readily through materials that have the greatest permeability. Sandstones are much more permeable than granites or shales. Sandy soils are more permeable than silt or clay soils. **In this exercise you will explore the movement of radon underground and into four hypothetical New Jersey homes.**

OBJECTIVE

To explore the interrelationships among rock types, rock formation, soil structure, and the production and release of radon underground.

PROCEDURE

1. Examine the illustration in Figure 1 and complete the analyses and questions that follow.

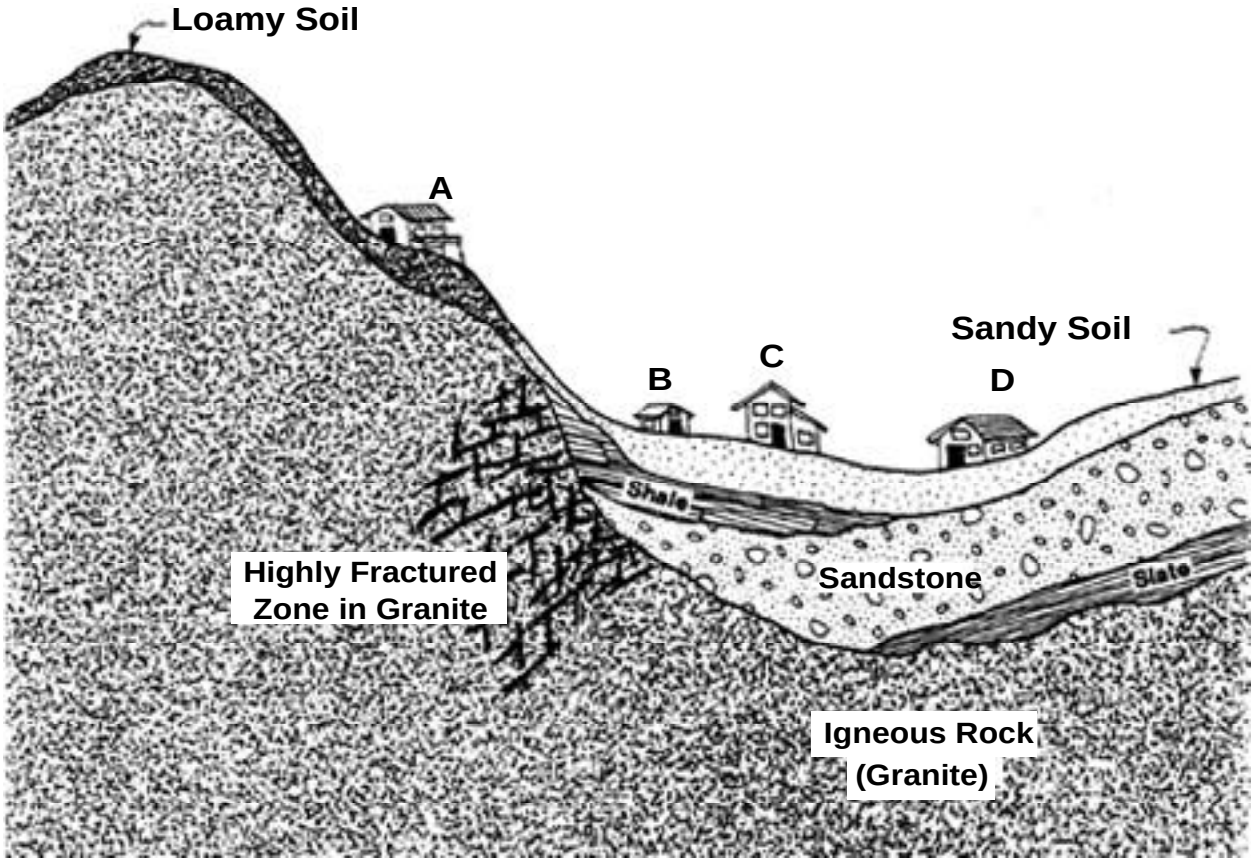

Figure 1. Illustration of a hypothetical region in New Jersey containing some igneous, metamorphic, and sedimentary rocks. The granite is high in uranium, whereas the concentrations of uranium in the other rock materials are lower. Four houses are situated in the region (A through D). Loamy soil is found on the main hill, and contains a mixture of sand, silt, and clay. Sandy soil covers the valley bottom. The sandstone contains an abundance of shell fossils from marine organisms.

ANALYSIS

2. Describe the geologic processes that might have resulted in the formation of the rocks in the region shown in Figure 1.

Hint: remains of sea shells are quite abundant in the sandstone layer.

3. Rock and soil permeability are most important in determining the rate of radon movement in the rocks and soil underground. Discuss how soil and rock permeability might influence radon movement to the surface in Figure 1.

4. Which of the homes illustrated in Figure 1 would you expect to have the greatest amounts of radon gas? Why?

5. Radon measurements have revealed that House D has 20 times more radon in the household air than does House C. Explain why this might be the case.

CONCLUSIONS

6. Homes underlain by granite that is high in uranium may or may not have high concentrations of radon in the soil air spaces under the home. Describe at least three factors, in addition to uranium concentration, that might influence radon build-up under a home.

NOTES