July 2015

Fact Sheet
Series on Ohio's Ground Water Quality

Radionuclides in Ohio's Ground Water

What are radionuclides?

Radionuclides are elements with unstable atoms. When these unstable atoms decay, they release energy (radiation) in alpha or beta particles and gamma rays . Energy is continually released until a stable, non-radioactive substance is formed. Most radionuclides occur naturally, but some come from man-made sources. The most common radionuclides found in ground water are decay products of uranium and thorium and include radium and radon.

How do radionuclides get into Ohio's ground water?

Most of the radionuclides found in Ohio's ground water occur naturally from the weathering and dissolution of rocks and minerals. The amount and type of radiation released during the decay process depends on the radionuclides present.

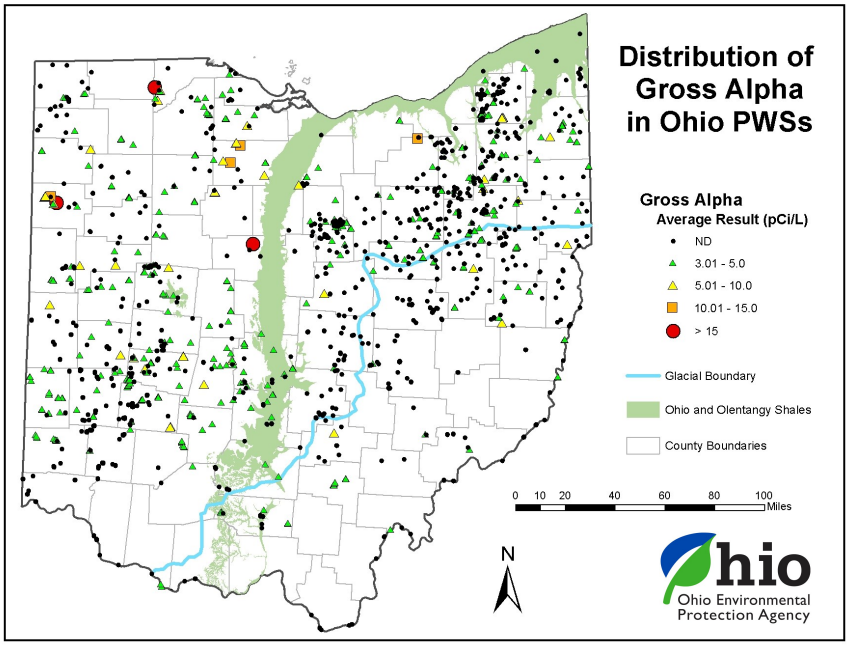
Radioactive materials are also used in medical diagnostics and treatments, electricity production, commercial products, research and nuclear weapons. Human activities, such as disposal of radioactive wastes, may increase the levels of radioactive materials found locally in ground water.

How are radionuclides measured?

Gross alpha and gross beta particle activity are measures of the total radioactivity produced during decay, and are measured in picocuries per liter (pCi/L). If a sample shows high gross alpha or gross beta, additional analysis is required to identify the specific radiation source. Analysis is also completed for individual radionuclides like radium-228, which is a decay product of thorium.

Where will you find elevated radionuclides in Ohio's ground water?

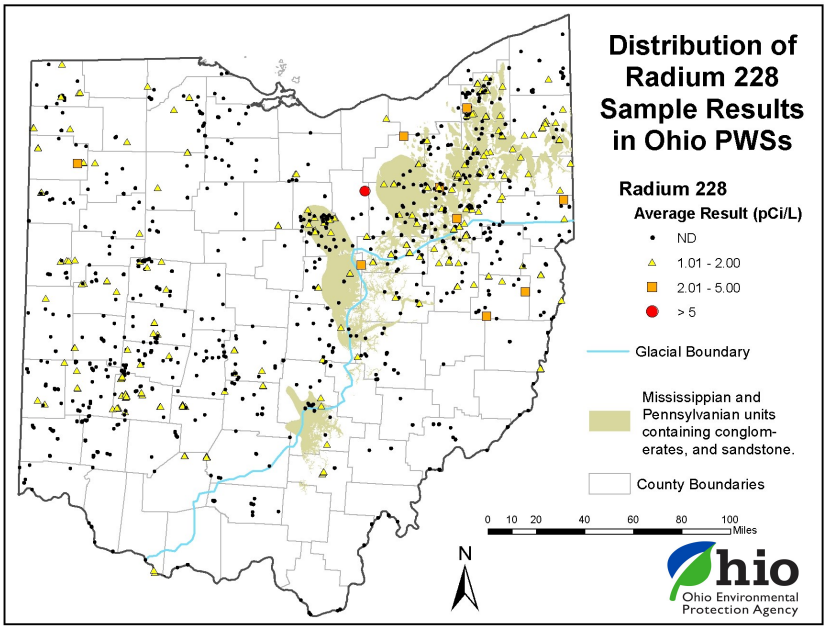
Ohio's public water systems are required to sample for radionuclides in ground water. The figure on the right shows that gross alpha in ground water is generally low across Ohio. This is expected because uranium and thorium, typically found in igneous (volcanic or plutonic) rocks, are found at low levels in Ohio's major aquifers.



The highest levels of gross alpha can be found in the carbonate bedrock of northwestern Ohio. Because organic matter was abundant in some areas of the carbonate sediments when the bedrock was being formed, the uranium was concentrated and incorporated into the bedrock. These levels are still relatively low and not of concern. Radium-226 follows the same general pattern as gross alpha because its source material is also uranium.

Radionuclides in Ohio's Ground Water

Black shales, such as the Ohio and Olentangy shales, have higher concentrations of uranium, but they typically do not yield much water. Consequently, little public water system radionuclide data is available from shale aquifers. A low yield well in a shale rich aquifer may exhibit elevated radium 226 concentrations. Thus, homeowners with wells in shale rich aquifers, like the Devonian, Ohio and Olentangy shales, may want to test their wells for radium 226.



The figure on the left displays the average distribution of radium-228 (decay product of thorium) detected in drinking water at community public water systems. Although radium-228 is generally low, areas of northeastern Ohio with aquifers containing sandstones and conglomerates appear to exhibit more frequent detections. In igneous processes, such as during the formation of the Appalachian Mountains, thorium is concentrated in small, heavy minerals that are resistant to weathering. Streams transport and concentrate these heavy minerals. Thus, the area of elevated detections of radium-228 in Northeast Ohio is probably the result of these thorium-rich minerals being concentrated in Mississippian- and Pennsylvanian-age sandstones and conglomerates (olive green overlay). The main point, however, is that the data document the low levels of radionuclides in public drinking waters.

What are safe levels of radionuclides in drinking water?

The U.S. Environmental Protection Agency (U.S. EPA) has set standards, or Maximum Contaminant Levels (MCLs), for radioactive substances in public drinking water supplies. U.S. EPA defines an MCL as the maximum allowable level of a contaminant that may be present in drinking water without a high risk of causing health problems. Ohio EPA and the Ohio Department of Health (ODH) use these standards for both public and privately owned water systems. The MCL for gross alpha is 15 pCi/L, and the MCL for radium-226 and radium-228 combined is 5 pCi/L.

What are the health effects of radionuclides in drinking water?

Exposure to radionuclides in drinking water at levels above the MCLs may significantly increase one's lifetime risk of developing certain types of cancer. In addition, uranium may also cause kidney damage.

Is radon a problem in drinking water?

Radon is natural a breakdown product of uranium. Radon gas easily escapes from water once the water is exposed to air, such as by running a faucet or shower. The greatest risk from radon in drinking water is

from the radon that escapes to the indoor air; however, most of the radon found in indoor air comes from the soil beneath the foundation, not from drinking water. To date, U.S. EPA has not established a drinking water standard for radon, although standards have been proposed.

How do you know if there are radionuclides in your well water?

Even though studies show the levels of radioactivity in Ohio's drinking water is relatively low, testing your water for its presence is proactive, especially if your well produces water from shale. The recommended approach is to request that the laboratory first test for gross alpha. If gross alpha is less than 5 pCi/L, then no testing for radium-226, radium-228, or uranium is needed because the results will be below the public drinking water standards. If the gross alpha result is equal to or greater than 5 pCi/L, then testing for radium-226 and radium-228 should be requested. If gross alpha is equal to or greater than 15 pCi/L, then testing for uranium should also be requested. A list of certified laboratories that can perform these tests is available on the Web at: ***epa.ohio.gov/ddagw/labcert.aspx.*** Contact your local health department for help in determining sampling options.

What should you do if you have elevated radionuclides in your well water?

Reverse osmosis and ion exchange treatment units for faucets may remove radionuclides from tap water. The table below provides the safe levels for ground water and identifies treatment options for removal of specific radionuclides. Private well owners are required to use a registered private water system contractor to install water treatment equipment for radionuclides, and a permit is required from the local health department. The use of a registered contractor provides consumer protection through bonding, and review of the installation by the local health department will ensure that the system is properly sized, installed correctly and working effectively to reduce the radionuclides.

Public water systems considering installing treatment to reduce radionuclides should contact the appropriate Ohio EPA district office.

Radionuclide	Safe Levels in Ground Water	Treatment Options
Radium-228 and Radium-226	5 pCi/L (combined)	Ion Exchange (IE), Reverse Osmosis (RO)
Gross Alpha	15 pCi/L	Reverse Osmosis (RO)
Radon	No standard	Aeration, Granular Activated Carbon (GAC)
Uranium	30 ug/L	Ion Exchange (IE), Reverse Osmosis (RO)

Where can I get more information?

For more information about radionuclides in Ohio's ground water, contact Ohio EPA's Division of Drinking and Ground Waters at (614) 644-2752, or visit ***epa.ohio.gov/ddagw***. Information regarding private water systems, including water well testing and lists of registered contractors and certified labs, is available through the Ohio Department of Health's Environmental Health website at : ***odh.ohio.gov/odhprograms/eh/water/PrivateWaterSystems/treatment.aspx***.

This fact sheet is part of a series discussing the water quality of Ohio's aquifers. A companion report, available online at ***epa.ohio.gov/ddagw/gwqcp_pubs.aspx****, describes the distribution of radionuclides in Ohio's ground water in more detail.*