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Radon in Drinking Water and Arizona Domestic Wells

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Introduction

Radon is an odorless gas usually found in water that comes into contact with uranium bearing minerals. Radon is a radioactive gas that can cause cancer when it is breathed into the lungs or absorbed in the stomach from water. Home owners can be exposed to radon gas if it seeps into basements or through concrete pads and when it is released from the water supply. If high levels of radon are present in the well water, well owners will be exposed to radon gas as they shower, clean, and flush toilets and when they drink the well water. In addition to testing for radioactive chemicals such as gross-alpha radiation and uranium, private well owners should also test their indoor air and their well water for radon.

The Uranium-Radon Connection

Uranium is a natural element that breaks down into other elements such as thorium, radium, and other elements, ultimately becoming lead. This process known as radioactive decay, produces harmful radiation in the forms of particles and light. One of the elements produced during the decay of uranium is radon, which is a gas that dissolves in water and can travel long distances in the air. As radon decays, on its way to becoming lead, it emits alpha particles that can damage living cells in our bodies.

Uranium is everywhere in soil and rocks as there are more than a dozen uranium minerals (Geology.com 2019), see Fig. 1. There are areas of Arizona with abnormally high concentrations of uranium (Spencer et al. 1993), which can produce high concentrations of radon gas in soils, sediments, and groundwater.

Figure 1. Uraninite Crystals: The most common uranium mineral. Formerly known as pitchblende, this mineral has radioactive uranium that decays to form radon gas and other radioactive elements . Source: Geology.com

Radon and your Health

Radon is a radioactive gas that is naturally present in most soils. Common exposure to radon is through gas seepage into homes through small cracks in foundations, see Fig. 2. When radon is inhaled and comes into contact with the lungs it can damage the lungs, which can cause cancer. According to the US Environmental Protection Agency (EPA), radon is the second leading cause of lung cancer in the United States. (CDC 2019).

Radon can also dissolve into your water supply. While most radon related deaths are due to radon gas accumulated in houses from seepage cracks in the foundation, 30 to 1,800 deaths per year are attributed to radon from household water (CDC 2015). If you live in an area with high radon in groundwater it can get into your private well. Exposure to radon from a water supply can also come through showering, washing dishes, and laundering. This can disturb the water and release radon gas into the air you breathe (CDC 2015).

Radon in Drinking Water Guidelines

There are no National Drinking Water Standards for Radon in drinking water. The EPA in 1999 proposed a rule for maximum contaminant levels (MCLs) in public water systems in the range of 300 to 4,000 picoCuries per liter (pCi/L). The proposed lower MCL would be for states that do not have programs that monitor and reduce indoor air radon exposure.

This rule is not enforced in the drinking water supplies of public water utilities or private well owners (USEPA 2018a,b). This proposed rule remains controversial among state agencies and water providers. This is because of the added costs of treating water sources and because radon in indoor air is considered "...a greater public risk..." than radon in drinking water (USEPA 2012).

Radon in Arizona's Groundwater

Well water data from a 20-year survey of Arizona's groundwater quality by the Arizona Department of Environmental Quality (ADEQ) showed that 2% of 356 private wells sampled for radon had concentrations above 4,000 pCi/L and 65% of the wells had levels above 300 pCi/L (Towne & Jones 2016). The radon water quality data was obtained by sampling private wells from 27 of 38 of Arizona's major watersheds and did not include Native American Lands. A water quality survey of 77 private wells in Arizona by the US Geologic Survey (USGS) (USGS 2004) measured radon levels in 22 wells. Radon levels above 300 pCi/L were detected in 18 (86%) of the wells sampled for radon and one well (4%) had a level above 4,000 pCi/L.

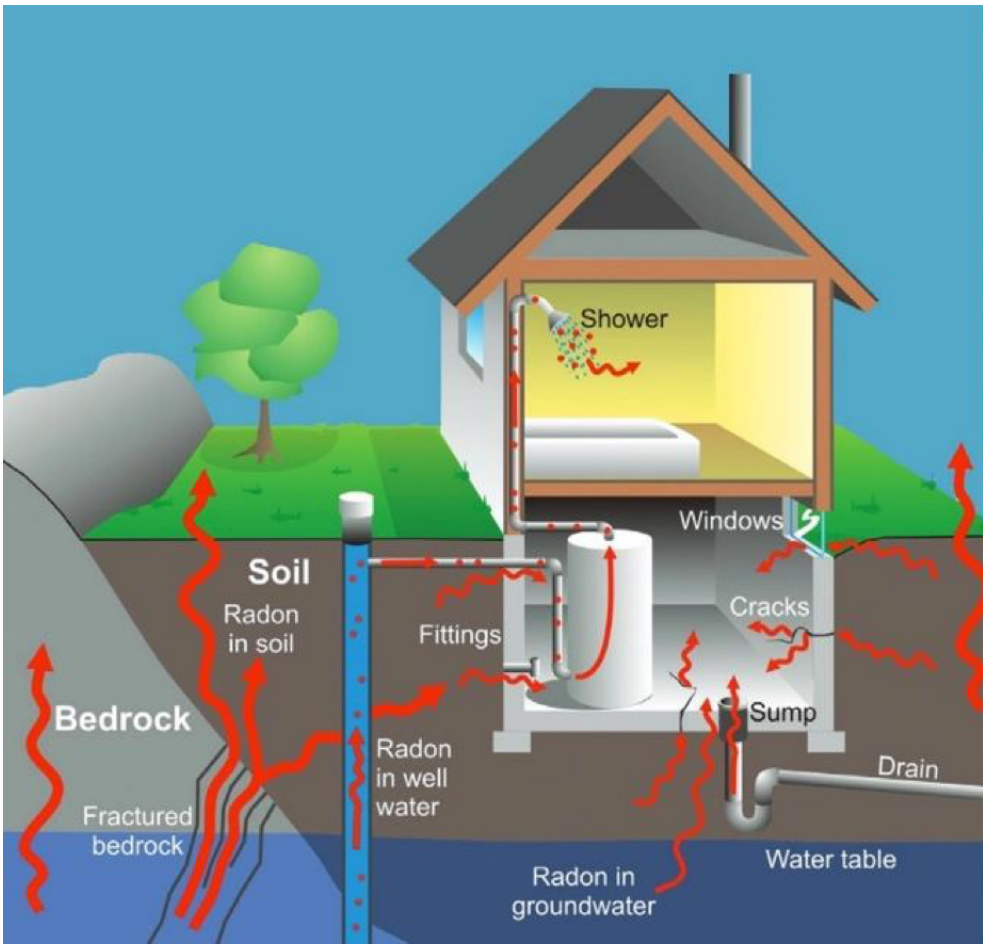

Figure 2. How Radon enters your home: air and water. Note that homes without basements are also at risk of radon gas intrusion. Source: Geological Survey of Canada.

Public Water Utilities

Radon is not regulated in drinking water but is sometimes mentioned in annual drinking water quality reports of Arizona public water utilities. Public water utilities often monitor radon in groundwater but not in aerated surface water sources. Public water utilities may provide information on radon in groundwater if consumers request it.

How to Test for Radon in Water

If you have a private well, the USEPA recommends that you test the water for radon (1-800-426-4791 hotline). Arizona residents also can contact the Arizona Department of Health Services (ADHS) for information on state certified laboratories that can test radon in drinking water.

Since radon gas can easily escape from water, it is very important to follow the instructions that the laboratory provides. The water sample should be collected close to the well after it has been pumped for a long time. Sampling is best done at the end of the day after doing the laundry and watering the yard or garden. Collect the sample from a faucet without an aerator with a slow trickle into a glass bottle and quickly cap it with no air space left on top (Kitto 2016). Repeat the process if necessary, until no air bubbles are left in the bottle. Other water sample collection methods may use a syringe, which should be provided by the laboratory with instructions.

Gross-Alpha Radiation and Uranium in Water

There are National Primary Drinking Water Standards (NPDWS) for gross-alpha radiation, uranium, and other radioactive elements, see USEPA references. Public water utilities must regularly test their water supplies for these radioactive elements. These two tests are also recommended for all Arizona well owners, **but they do not replace the radon test in water.** Radon comes from the breakdown (decay) of uranium. But, because radon is a gas, it may or may not be found in groundwater near uranium-rich minerals as it can quickly travel far away.

How to Lower Radon Levels in Water

Well owners concerned about radon in their water may an install activated carbon filters or aeration devices on their tap water faucets. Although activated carbon is known to react with radon gas, use carbon filters that are NSF (NSF 2019) certified to reduce radon in tap water. These filters should be replaced regularly to prevent the accumulation of other radioactive chemicals produced by radon decay. Faucet aerators may be less efficient than activated carbon filters and will introduce radon gas in the indoor air. They should be used in well ventilated spaces only.

Summary

Arizona well owners that live in areas known to have uranium-rich minerals, including granite, should test their well water at least once for uranium and gross-alpha radiation (and radium if gross-alpha radiation is above 15 pCi/L) to make sure that their well water meets safe drinking water standards, these are : Uranium 30 micrograms per liter (ug/L) or less and gross-alpha radiation 15 pCi/L or less.

It is important that home owners test their indoor air for radon and if necessary, take steps to reduce their exposure to radon. See the ADHS (ADHS 2018) website for information on radon testing and indoor air radon mitigation.

No drinking water standards exist for radon in water, but the USEPA also recommends that well owners test their well water for radon and treat it if necessary, to lower their exposure to this cancer-inducing gas.

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