U.S. Department of the Interior
U.S. Geological Survey

Radon in Ground Water in Idaho, 1989–95

WHAT IS RADON AND HOW DOES IT OCCUR?

Radon is a naturally occurring, odorless, tasteless, inert gas. Radon-222 is formed by the natural radioactive decay of uranium, which is present to some extent in nearly all rocks and soils. Uranium-238 decays through a series of daughter products to radium-226, which in turn decays to radon-222 with a half-life of 3.82 days. Radon-222 (referred to as radon in this report) can enter pore spaces in rocks and soils, where it can be dissolved into ground water, trapped in the rocks and soils, or released to the atmosphere. Radon can enter buildings through cracks, vents, joints, or other openings in basement floors and walls or by degassing from well water used for household purposes. A simplified version of the uranium-238 decay series and some of the possible migration paths of radon are shown in figure 1.

Radon concentrations in the United States are measured in picocuries (pCi) per liter (L) of air or water. Radon concentrations in ground water range from less than 100 to nearly 3,000,000 pCi/L and average less than 1,000 pCi/L in most areas. Most soils in the United States contain between 200 and 2,000 pCi of radon per liter of soil air. Radon concentrations in the atmosphere range from less than 0.1 to about 30 pCi/L and average between 0.2 and 0.4 pCi/L. Concentrations in indoor air range from less than 1 to about 3,000 pCi/L and average between 1 and 2 pCi/L. Households or public supply systems that use surface-water sources generally do not have a problem with radon in water because radon dissolved in surface water rapidly escapes to the atmosphere.

WHY IS RADON A PROBLEM?

The U.S. Environmental Protection Agency (EPA) estimates radon to be the second leading cause of lung cancer in the United States (smoking is the leading cause). The EPA recommends that the average radon concentration in indoor air not exceed 4 pCi/L, a value established on the basis of lung-cancer risks and remedial actions that can readily and economically decrease the concentration in indoor air.

Ingesting water containing radon is considered to be a minor health risk compared with the risk from breathing air containing radon. Activities that heat, aerate, or expose ground water to air, such as washing dishes or taking showers, release dissolved radon and increase the radon concentration in indoor air. The EPA estimates that, as a general rule, the radon concentration in indoor air will increase by 1 pCi/L for every 10,000 pCi/L of radon in household water, and that household water accounts for about 2 to 5 percent of the radon in a house. Percentages will fluctuate, depending on radon concentration in the water and in the air, quantity of water used, how much the water is heated or aerated, and type of house construction. In severe situations, household water may contribute as much as 75 percent of the radon in indoor air.

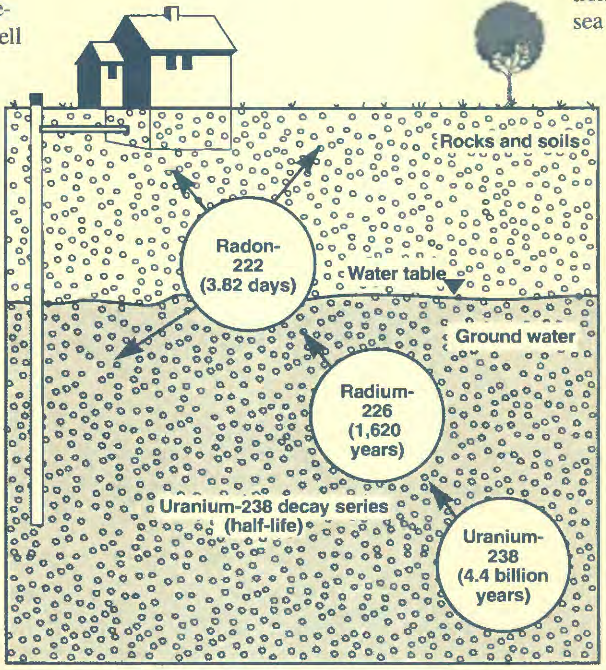

Figure 1. Uranium-238 decay series and possible migration paths of radon.

To keep radon concentrations in indoor air to a minimum, the EPA has proposed that the radon concentration in public water supplies not exceed 300 pCi/L. However, this proposed limit currently is under review. In 1993, the American Water Works Association petitioned the EPA to set a maximum limit of no lower than 1,000 pCi/L, with a possible range of between 2,500 and 5,000 pCi/L.

WHAT IS KNOWN ABOUT RADON IN GROUND WATER IN IDAHO?

From 1989 through 1995, the U.S. Geological Survey collected water samples from 1,434 wells and springs in Idaho for radon analyses. The number of wells and springs with radon analyses, by county and ranges of radon concentrations, are shown in table 1. Median (50th percentile) and range of concentrations for these radon analyses are 470±29 pCi/L and -58±30 to 8,000±74 pCi/L, respectively. Locations of counties and major uranium deposits in the State are shown in figure 2.

Idaho radon analyses represent a wide variety of ground-water conditions: water temperatures range from 4.5 to 88 degrees Celsius (40 to 190 degrees Fahrenheit); specific conductances range from 23 to 5,520 microsiemens per centimeter; total well depths range from about 10 to 3,400 feet; land-surface elevations range from about 720 to 8,320 feet above sea level; and wells are completed in sedimentary, igneous, or metamorphic rocks. No correlation has been observed between Idaho radon concentrations and physical properties of water (for example, temperature, specific conductance, or pH) or major ion concentrations. Radon concentrations in ground-water supplies are determined by mineral content of water-bearing rocks and soils and by well location and construction.

Uranium is moderately soluble in ground water and mobile under most conditions. Uranium is a component of a large number of minerals and many different kinds of rocks, and uranium-bearing rocks and soils are common throughout Idaho. The occurrence and quantity of radon in ground water primarily are related to the quantity of uranium or uranium-decay products in rocks and soils, physical properties of the rocks and soils, proximity of a well or spring to a source or sources of uranium, proximity of a well to fault zones, flow rate of ground water, and well construction.

Samples with consistently large radon concentrations were collected from wells in mountain valleys near uranium-bearing bedrock. Samples with consistently small radon concentrations were collected from areas in southern Idaho where most wells are completed in thick basalt deposits rather than in sediments.

WHAT CAN BE DONE ABOUT RADON IN WATER?

Most households in Idaho rely on ground water as the principal source of supply. If a homeowner tests for radon in indoor air and the concentration is small, there generally is no need to test for radon in water. If the indoor air concentration is large, the homeowner can test for radon in the ground-water supply. When tests show large radon concentrations in water, the homeowner has several choices: take no action; remove radon from indoor air but do not treat the water supply; or remove radon from indoor air and the water supply. Water can be treated before or after it enters the home. Efficient treatment methods for removal of radon are water aeration and a granular activated-carbon system. Aeration requires agitating the water and exposing it to air before use, but this treatment cannot be done inside the home and can be costly. A granular activated-carbon system is similar in appearance and function to a water-softener tank—dissolved radon and other radioactive particles adhere to carbon grains in the filter. Although this treatment method is efficient and cost effective, disposal of the carbon grains can be a problem.

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Figure 2. Major uranium deposits in Idaho.

—D.J. Parliman

Table 1. Number of wells and springs with water analyses for radon, 1989–95, by county and ranges of radon values

[pCi/L, picocuries per liter; ≤, less than or equal to; —, no data available]

County	Ranges of concentrations, in pCi/L				
	≤ 300	301 to 999	1,000 to 2,499	2,500 to 5,000	Greater than 5,000
Ada	31	218	78	8	—
Adams	1	7	1	—	—
Bannock	4	17	6	1	—
Bear Lake	—	2	—	—	—
Benewah	2	11	1	—	—
Bingham	27	27	—	—	—
Blaine	3	19	7	1	—
Boise	2	11	5	1	—
Bonner	6	27	7	1	—
Bonneville	5	9	1	—	—
Boundary	—	6	5	—	—
Butte	43	11	2	—	—
Camas	1	3	4	—	—
Canyon	10	84	6	1	—
Caribou	8	8	3	—	—
Cassia	7	16	3	1	—
Clark	7	6	—	—	—
Clearwater	1	6	—	—	—
Custer	2	12	28	7	2
Elmore	7	23	2	—	—
Franklin	2	2	1	—	—
Fremont	5	5	6	3	—
Gem	4	11	—	—	—
Gooding	32	6	—	—	—
Idaho	1	7	1	—	—
Jefferson	22	14	1	—	—
Jerome	51	3	1	—	—
Kootenai	2	13	2	1	—
Latah	6	12	3	—	1
Lemhi	4	12	11	1	—
Lewis	—	4	2	—	—
Lincoln	23	—	—	—	—
Madison	1	9	2	1	—
Minidoka	36	36	2	—	—
Nez Perce	6	8	—	—	—
Oneida	—	4	—	—	—
Owyhee	6	17	4	—	—
Payette	6	12	3	—	—
Power	7	19	—	—	—
Shoshone	—	2	2	—	—
Teton	1	4	4	1	—
Twin Falls	25	20	12	1	—
Valley	9	14	—	—	—
Washington	3	10	—	—	—
Number of sites per range (1,434 total)	419	767	216	29	3
Percentage of total sites	29%	54%	15%	2%	<1%

For more information contact any of the following:

Radon, household testing for radon, and radon removal from air and water:

Idaho Department of Health and Welfare
Division of Environmental Health
Boise, Idaho 83707
(208) 334-6584 or
1-800-44-LUNGS (Idaho Radon Hotline)
(445-8647)

National EPA Radon Hotline:

1-800-SOS-RADON
(767-7236)

Water Information:

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