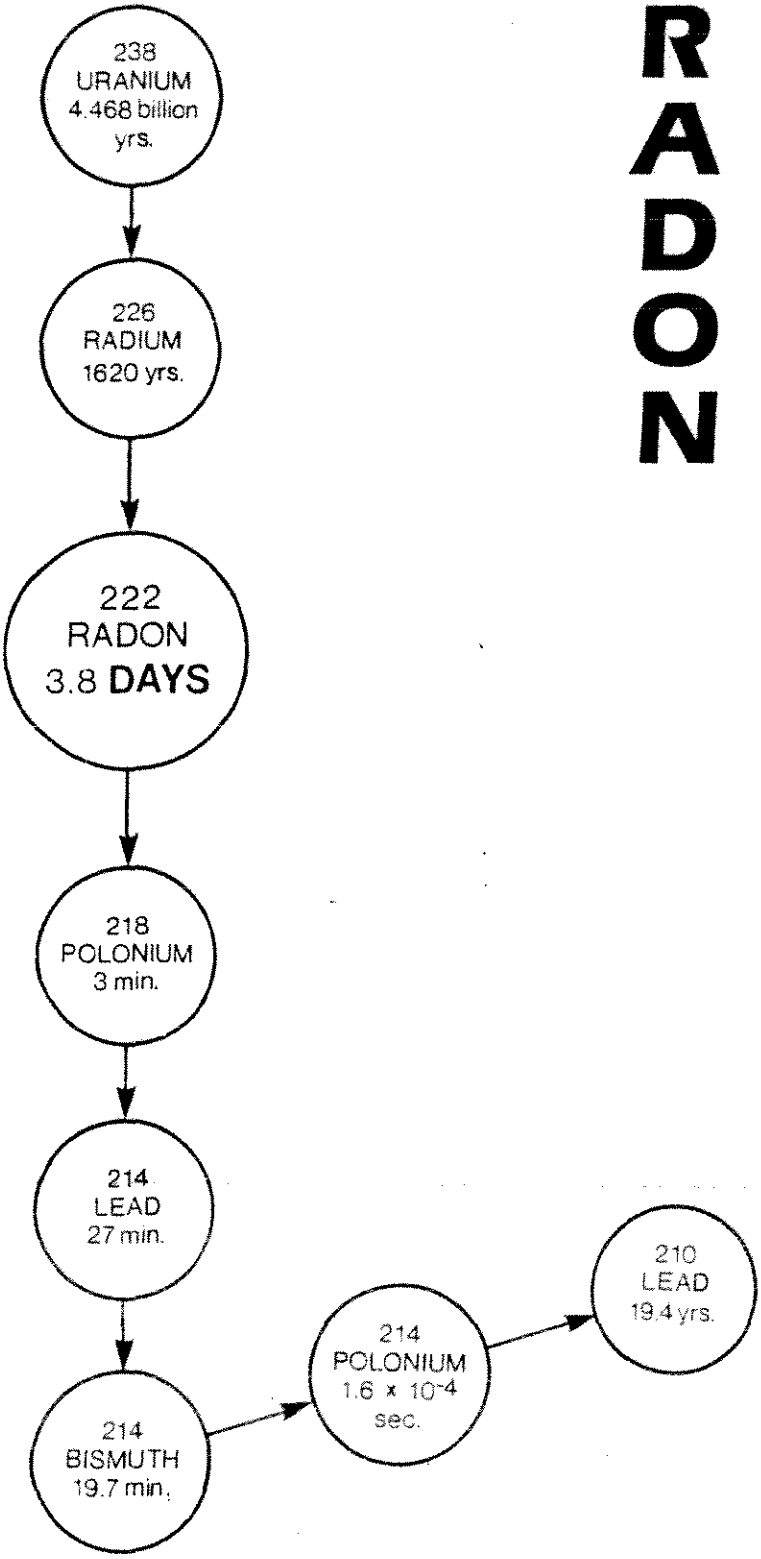
Information Series 24



RADON ISSUES AND ANSWERS

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Denver, Colorado / 1986

RADON GAS

ISSUES AND ANSWERS

DOI: https://doi.org/10.58783/cgs.is24.xcgo6605

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1986

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Radon Gas - Issues and Answers is being distributed to local governments, school districts, and others to assist in their understanding of the radon issue. We believe that all local governments, developers, school districts, architects, builders, and the public in general, need to be aware of this environmental health problem. We hope that a better understanding of the relationship of Colorado geology to radon will emerge as research into this problem progresses in the future.

I want to thank Mark Davis, Candace Jochim, Pat Rogers, and John Rold of the Colorado Geological Survey, and Al Hazle of the Colorado Department of Health, for their assistance in preparation of this paper.

L. R. Ladwig

RADON GAS - ISSUES AND ANSWERS

RADON - WHAT IT IS

Radon, a naturally occurring radioactive gas and its radon daughters (decay products), is the result of the breakdown of certain radioactive minerals, and has been known for 86 years. (See Attachment I) The possibility of radon decay products causing certain health problems was identified during the fifties in conjunction with uranium mining and the use of uranium mill tailings as construction fill. It wasn't until about 1983 that a possible connection between radon in homes located on natural soil and rock, and lung cancer was recognized by workers in public health. The U.S. Environmental Protection Agency has estimated that up to 20,000 deaths a year by cancer can be attributed to radon. The Pennsylvania "Reading Prong" situation in 1983 set in motion a national concern for radon in the home that has now reached all of the United States.

This radioactive radon gas, is odorless, tasteless and chemically inert. It is generated by the decay of radium, which is present in small amounts in nearly all soils and bedrock and many common building materials. Where there are higher concentrations of radium, or where the soil, or bedrock, is fairly porous, the concentrations of radon gas are usually higher. It is rarely a problem outdoors because of the large unconfined air space available for dilution and dispersion, however, it is often trapped indoors by structures and may attain levels judged critical to human health. Measures taken to make houses, schools and public buildings more energy efficient can increase radon concentration and exacerbate the problem.

WHERE RADON OCCURS

"Normal" variations and concentrations.

The entire crust of the earth is radioactive to some measurable degree. However, processes within, and at the surface of the earth, tend to

deplete or concentrate the radioactive minerals from place to place. This results in vast areas of "normal" terrain varying from very low to moderate radioactivity and in a relatively few areas, high concentrations that may even contain economic deposits of radioactive minerals. Areas of very low natural radioactivity are of lesser concern as a source of radon gas. At the other extreme, those areas having high concentrations are of concern, but can be detected by conventional instruments and many of these occurrences have been located and are indicated on existing resource maps of the State. Unfortunately, much of Colorado's geologic terrain appears to be in an intermediate classification of somewhat elevated "normal" concentrations of radioactive minerals. These intermediate areas are of concern because they encompass large areas of the State and are capable of generating hazardous concentrations of radon gas under certain conditions. Much of our future effort will be in evaluating the radon potential of such areas.

HOW RADON IS MEASURED

The measurement of the quantity of radon gas differs from the measurement of solid radioactive minerals, both by what is measured and by how it is measured.

Radioactive minerals, uranium and radium, that ultimately break down to radon gas and its daughter products usually are detected and measured by instruments that mainly detect gamma radiation. These instruments are typically geiger-counters or scintillometers. They, however, are not used to detect radon gas, or measure its concentration. Radon, being a gas, can migrate and concentrate in areas that may be too distant from the parent uranium and radium to allow gamma counts to necessarily be a valid indicator.

Radon gas is detected by instruments or devices that detect the alpha particles being given off continuously by the decay of radon and its daughter products. Radon detection or monitoring devices include time integrated techniques such as activated carbon, alpha track detectors, and the alpha scintillation cell, which can be used either for a short time sample, or for continuous monitoring.

The most common approach used today for measuring radon levels is the Charcoal Canister. This device is placed in a structure that has been closed for 12 hours and left at a location of interest for a 48 hour period, sealed, and then mailed to a laboratory for measurement of the radon gas and its decay products. Equally as convenient to place (both items are 2-5 inches in diameter) is the Track Etch Film, however, it is usually left in place for at least one month to as long as a year before being sealed and mailed to a lab for reading. The use of an alpha scintillation cell requires a greater level of knowledge, but can give an almost instant reading. All three provide useful information, but correct interpretation of the results is dependent upon a number of variable factors.

The U.S. Environmental Protection Agency has set, as a guideline, 4 picocuries radon per liter of air on a yearly average, or 0.02 working levels radon daughters (WL), as the highest recommended, acceptable level of radon in a home.

A curie is a measure of the number of radioactive decays per unit of time. One picocurie is one-trillionth of a curie. The WL is a measure of how much alpha particle energy will eventually be released in air by the short-lived radon decay products.

HOW RADON CONCENTRATES

Variations in the characteristics of bedrock and alluvial soils are a basic factor in how much radon gas is generated and how much reaches the atmosphere, or enters a house. These characteristics include uranium and radium content, how porous or fractured the soil or bedrock is, and its water content (degree of saturation). Water saturation tends to inhibit movement of the gas. These are important since the radon gas has to be able to migrate out of the soil or rock and into living space to become a potential health problem.

The four basic rock types that most often have a higher than average uranium-radium content are granites, some black shales, phosphatic rocks and certain sands and gravels derived from granites or other

uranium-radium source rocks. Thus, nearly all geologic settings have a measurable gamma-ray background count, and many of them can have a potential for radon gas.

The amount of radon in a structure is not only the result of underlying geology and building materials, but also the construction details of the building, ventilation practices and outside air pressure, time of day, and time of year.

Generally, in those structures that do not have a tightly sealed floor and foundation, radon moves out of the soils and into the interior spaces. Vented heating devices set-up a negative pressure (suction) in a structure during their use. Ventilation fans, vented dryers, and wind moving past the outside of the walls, do the same. Radon concentration can therefore be altered by the seasonal or daily heating demands, as well as by daily changes in air pressure. Recirculation of the same "air package" as in certain energy conserving systems can lead to concentration of radon within the home environment.

RADON TESTING

Structures

Testing for radon in structures usually is done through the use of Charcoal Canisters in the first stage, and if necessary, followed with Track Etch and/or scintillation cells. Placement of the devices is critical and should be done only after a thorough analysis of the structure for total air movement. It is important that a yearly average radon level be obtained. This precludes the potential for measuring radon highs or lows. The Track Etch device is best suited for this test because its measurements accumulate for the entire period it is in place.

Lands

Testing of undeveloped land is a more complex situation, and not as well defined as home testing. Preliminary results on correlation of in-home measurements to soil and rock radon potential at this time is

inconclusive. Both the Colorado Geological Survey and U.S. Geological Survey, along with private firms are, or will be, involved in testing and correlation programs focusing on this problem.

Regulation

No State agency licenses or controls the testing for radon gas. The U.S. Environmental Protection Agency has set certain protocol standards for this testing. Commercial testing firms that currently meet or exceed this protocol are listed on Attachment II. This list can be expected to change with time. The U.S. Environmental Protection Agency (Denver Office, (303) 293-1625) or the Colorado Department of Health (303-331-4800) can furnish a current updated list.

Information Sources

General information as to corrective measures for the reduction of radon levels in existing structures with a high radon content is available from the U.S. Environmental Protection Agency, various home building associations, and private contractors. This type of information has to be adapted for each individual structure and not all measures will work on all structures.

Attention to detail by both the architect and contractor, along with a good understanding of how radon enters a structure, can effectively prevent radon buildup in most new structures.

THE STATE'S APPROACH TO THE RADON PROBLEM

The State of Colorado at the request of the Governor has formed a Radon Task Force to assess the issue and recommend a State Plan of action to address these issues. A work plan has been presented to the Governor.

This plan will guide and direct the various state agencies, i.e., Colorado Department of Health, Colorado Geological Survey, Attorney General's Office, Department of Local Affairs, and Department of Regulatory Agencies. It is the intent of the Task Force to make the

public aware of the problem, perform certain field investigations and testing involving geology and structures, inform the public and school districts of proper testing procedures and issue reports on the subject as new information becomes available. The Task Force is being assisted by the EPA in the area of testing.

The private sector of the state is also involved in the testing, analysis, and mitigation of the radon gas problem. A number of firms have become involved in the testing of both structures and undeveloped lands. If radon levels are found to exceed safe limits, an analysis of the structure, with subsequent changes being made, often can correct the problem.

The Colorado Home Builders Association is playing an active role in informing its members of the problem and through its national organization is involved in research in the areas of design, materials, and construction, with the ultimate goal of decreasing the radon level in homes.

At this time the Colorado Geological Survey is advising the local governments and school districts that there may be problems with high radon levels in existing and future structures. These concerns may affect land development, home sales, the building industry, and the liveability of existing homes. In the area of undeveloped land, there are presently no precise methods or standards for determining what the radon potential will be for future construction.

Until more definitive test methods and data can be developed, we advise all entities of government, developers, homeowners and builders to be prudent in their actions, using the best knowledge, information and technology available at the time.

The staff at the Colorado Geological Survey is available for consultation on this problem.

REFERENCES

1. "Standards, Regulations and other Technical Criteria Related to Indoor Air Quality", National Institute of Building Sciences, 1986. Order from NIBS, Pub. Dept., 1015 Fifteenth St. N.W., Ste. 700, Washington, DC 20005; cost $20.00 (compilation of existing documents).

2. "A Citizens Guide to Radon; What it is and what to do about it", and "Radon Reduction Methods; A Homeowner's Guide", EPA, 1986. Can obtain free copies by calling (800) 332-3321.

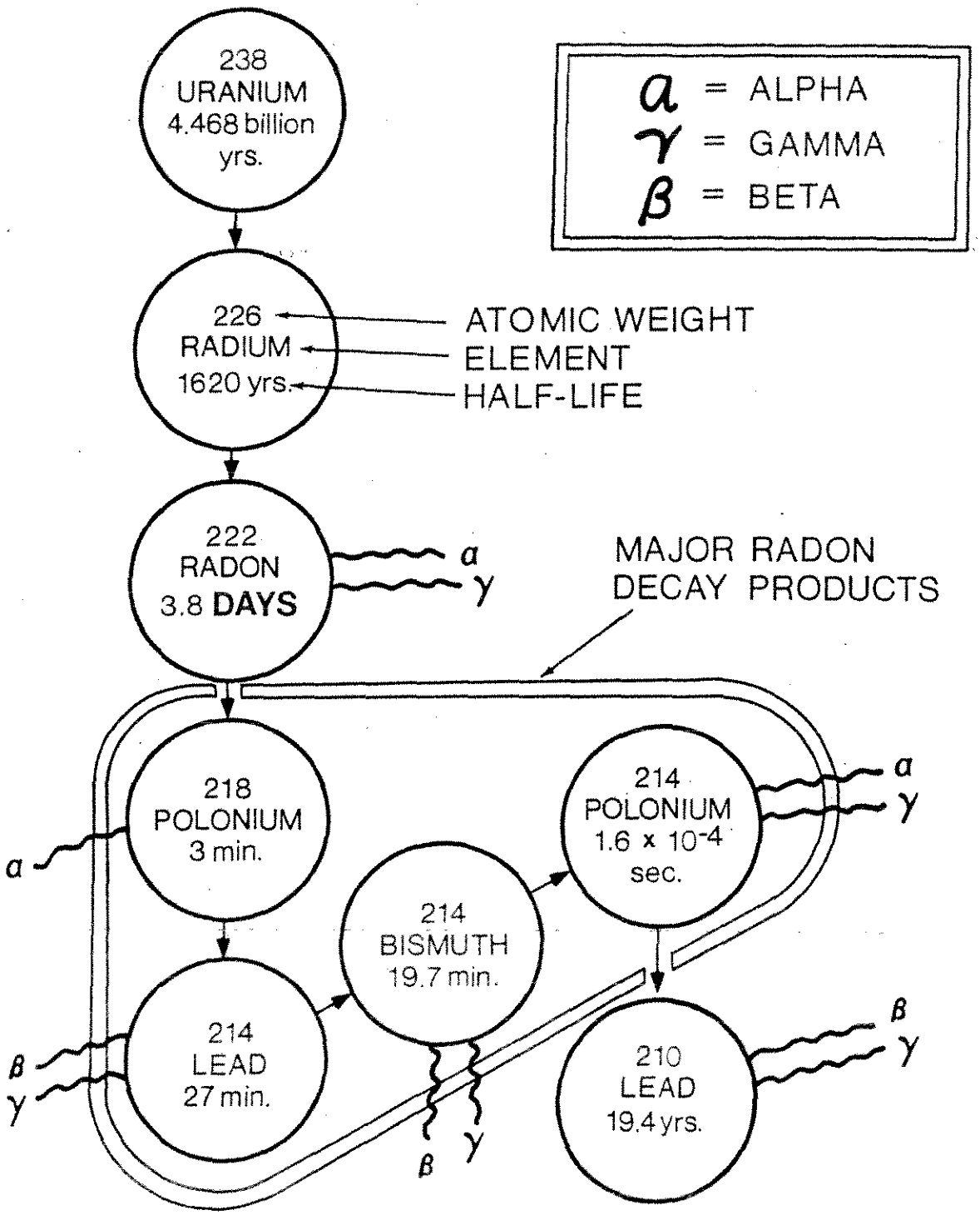
3. "Hazards of Indoor Radon Could Pose a National Health Problem, 1986, GAO/RCED-86-170", United States General Accounting Office, Washington, DC 20548.

4. "Map of Colorado Uranium and Vanadium Mining and Milling Activities", 1978, Collins, Hornbaker, and Chenoweth, Colorado Geological Survey Map Series 11, Colorado Geological Survey, 1313 Sherman St., Room 715, Denver, CO 80203, (303-866-2611).

5. "Swedish Limitation Schemes To Decrease Rn Daughters In Indoor Air", 1986, Gun Astri Swedjemark, Health Physics, Vol. 51. No. 5 (November), p.p. 569-578.

ATTACHMENT I

RADIUM DECAY CHART



ATTACHMENT II

There are a number of companies in this area who have the capability for making radon, or radon daughter measurements in homes. Also, there are private companies that can provide radon detectors and readout services to the general public. In each case, the homeowner must order the detectors by mail, install them in his, or her house, according to the directions provided and then return them to the supplier for readout after the prescribed monitoring periods. The supplier will send back the results with some minimal interpretation. Neither the Colorado Geological Survey, Colorado Department of Health, nor the Environmental Protection Agency endorses nor recommends these companies, but only offers them as an information service. The U.S. Environmental Protection Agency has, on a national basis, initiated a voluntary Radon Measurement Proficiency Program for companies who may wish to demonstrate their ability to make these measurements, and a homeowner may wish to ask if a particular company has successfully participated in the program.

Vendors

Air Check
P.O. Box 100
Penrose, NC 28766
(704) 862-4037,
1-800-257-2366 (Orders only)

Environmental Chemistry
1233 Ogden #504
Denver, CO 80218
(303) 831-0437

Colorado Home Protection
6318 S. Gallup Court
Littleton, Colorado 80120
(303) 798-5507

Geo-Chek, Inc.
Phil Herrington
2270 Stony Hill Rd.
Boulder, CO 80303
(303) 494-0576

EDA Instruments, Inc.
5151 Ward Road
Wheat Ridge, CO 80033
(303) 422-9112
1-800-654-0506

Glenwood Laboratories, Inc.
3 Science Road
Glenwood, IL 60425-1586
1-800-528-8327

Health Physics Assoc., Ltd.
3304 Commercial Avenue
Northbrook, IL 60062
(312) 564-3330

House Doctors, Inc.
David Kittinger
P.O. Box 10070
Colorado Springs, CO 80909
(303) 574-6960

Intrasearch
5351 S. Roslyn
Greenwood Village
Denver, CO 80111
(303) 741-2020

Metro Services
6268 S. Kearney Street
Englewood, CO 80111
(303) 741-2617

MVE Inc.
Charles C. Crum
1911 Lelaray Street
Colorado Springs, CO 80909
(303) 635-5736

Natural Energy Consultants
9575 Pross
Conifer, CO 80433

RA Consultants, Inc.
1236 N. 7th Street
Grand Junction, CO 81501
(303) 245-5237

Radon Detection Systems
2300 Central Avenue, Suite B-1
Boulder, CO 80301
(303) 444-5253

Radon Detection Systems
1918 W. Nevada
Colorado Springs, CO 80907
(303) 630-1920

Radon Measurements and Services
13131 West Cedar Drive
Lakewood, CO 80228
(303) 980-5086

Radon Research Group
P.O. Box 1143
Germantown, MD 20874
(303) 972-3309

Radon Screening Service, Inc.
Tom Staley
P.O. Box 37007
Denver, CO 80237
(303) 680-0169

Radon Testers, Inc.
1225 17th, Suite 2200
Denver, CO 80201
(303) 296-2277

Rocky Mtn. Real Estate Inspection Co
Andy Murray
5349 Fiesta Lane
Colorado Springs, CO 80918
(303) 528-1616

Scientific Analysis, Inc.
6012 E. Shirley Lane
P.O. Box 3112
Montgomery, AL 36117
(205) 271-0643

John B. Taylor
Environmental Chemist
1233 Ogden #504
Denver, CO 80218
(303) 831-0437

Tek Engineering
6780 E. Hampden Ave.
Denver, CO 80224
(303) 758-3173

Teledyne Isotopes
50 Van Buren Avenue
Westwood, NJ 97675
(201) 664-7070

3267

Terradex Corporation
A Subsidiary of Tech/Ops, Inc.
(Regional Office)
460 North Wiget Lane
Walnut Creek, CA 94598
(415) 938-2545

Western Radiation Consultants
1306 Winfield Dr.
Fort Collins, CO 80526
(303) 221-4118

University of Pittsburgh
Physics Dept./Radon Project
3941 O'Hara Street
Pittsburg, PA 15260
(412) 624-4290