



Conserve O Gram

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Fossil Vertebrates As Radon Sources: Health Update

Radon is a radioactive gas formed during the natural decay of uranium. It is odorless, colorless, tasteless, and undetectable by human senses. Radon occurs naturally in soil and water, as well as in rocks, such as granite and shales, and in phosphates containing radioactive minerals, such as carnotite, uraninite, and pitchblende. Chemical similarities between the radon precursor radium and the calcium component of bone cause radium to be concentrated in vertebrate fossils.¹

Radioactive fossil bones are common in some formations, such as the Morrison Formation (Dinosaur National Park) and the Glenns Ferry Formation (Hagerman Fossil Beds National Monument), and specimens from those formations now reside in several park museum collections. Consequently, radon from these specimens may be present indoors in collection areas where park and museum staff may be exposed to unsafe levels. It is important to note that the amounts of radon emitted by fossil bones may vary from locality to locality. Therefore, all museum cabinets housing such specimens need to be monitored for radon. This *Conserve O Gram* provides guidance on how to minimize the radon-related health risk associated with these types of collections.

Radon Health Risk

Radon gas itself is not a major health concern. The health hazard is associated with the products of radon decay called *radon daughters*. These daughter products are solids that are attracted to dust particles that can be inhaled and then trapped on the soft tissues of the lungs. (**NOTE:** Radon daughters do not pose an

external health risk because the skin acts as an excellent barrier.) Studies show that long-term exposure to elevated radon levels results in an increased risk of lung cancer. Not everyone exposed to elevated levels of radon will develop health problems, and the length of time between exposure and the onset of disease may be many years. The risk is cumulative and is dependent on both the radon concentration and length of exposure.¹ The risk of lung cancer increases significantly when radon exposure is combined with smoking. (See the *NPS Museum Handbook*, Part I (Rev 9/90), Chapter 11, for additional guidance on the health risks of radon.)

Monitoring and Mitigating Actions

Test all suspect fossil specimens housed in museum collections for radon. Radon monitors should be installed not only in the collections area but also inside cabinets where this type of specimen is stored. A cabinet housing radioactive specimens can build up a radon concentration substantially higher than what is present in the surrounding environment.

Before establishing a radon monitoring program, consult the Park Safety Officer or the Regional Public Health Officer, and the Regional Curator. A number of factors can make measuring indoor radon levels somewhat difficult. Monitoring should be conducted for a sufficient length of time to offset the variable effects of the facility, the ventilation system, seasonal climatic changes, and current weather conditions on the amount of radon in the air. Stable environmental conditions, with no ventilation, air conditioning, or heating, are required for accurate measurements.

When a radon level of above 4 picocuries/liter is detected, an action program for ongoing monitoring must be implemented. When levels exceed this amount, contact the Park Safety Officer for occupational exposure levels and for guidance on implementing the required monitoring program. Ventilation from outdoor air should be used to increase air flow. Recirculating indoor air or the use of a heat recovery ventilator are not sufficient. Only the *exchange* of air will satisfactorily dilute the radon concentration. In addition, air should be as dust-free as possible, because without dust the radon daughters will cling to walls and other surfaces where they pose little or no hazard.¹

Professional advice concerning monitoring and mitigation methods can be obtained from the Park Safety Officer and the Regional Public Health Officer. The U.S. Environmental Protection Agency provides free literature^{2,3} on radon and radon testing.

Preparation of Radioactive Fossil Specimens

The preparation of radon-bearing fossil specimens should be undertaken only in an area equipped with an adequate dust evacuation system that can pull dust away from the preparation site. Individuals should avoid inhaling or ingesting particulate material during the preparation and handling of specimens. Appropriate protection includes wearing a high-efficiency particulate air (HEPA) filter respirator, disposable latex gloves, goggles, and an apron. Staff need to wash hands after handling specimens. All workspace surfaces need to be wiped down with damp cloths that are discarded after use.

Storage of Radioactive Fossil Specimens

Once identified, radon-emitting fossil specimens should be stored on shelves in a well-ventilated space or in cabinets fitted with an exhaust

system. A large collection of radon-bearing specimens should be housed in a dedicated space. Isolating a collection of radon-emitting fossil specimens in a dedicated space minimizes unnecessary staff exposure and facilitates the use of ventilation to mitigate the problem. General guidance on storing this type of material is as follows:

1. Doors to storage spaces, museum storage cabinet doors, and containers (e.g., boxes, bags) that house radon-bearing specimens should be labeled with a warning sign. The sign should read ***Radon Daughter Area***. The standard Atomic Energy Commission magenta symbol on a yellow background is recommended.
2. Where possible, specimens should be housed in resealable polyethylene bags (e.g., Ziploc,[®] Baggies,[®] Whirl-pak[®]), or polypropylene boxes with tight-fitting lids.
3. Smaller specimens should be stored in tightly sealed museum storage cabinets. Cabinets should be located in an area as far away from staff/visitor activity as possible.⁴

NOTE: Museum storage cabinets housing radon-bearing specimens will build up a concentration of radon-daughters that poses a threat to staff. These cabinets will need to be modified to allow venting before each opening.

The modification involves fitting the cabinet door with two commercially available vacuum wall inlet valves to serve as a hose connector at the bottom of the door and as a pressure release valve at the top of the door. The hose connector will allow a HEPA vacuum that is designed for asbestos removal to be connected to the cabinet to draw out contaminated air. Drawers in the storage cabinet need to be positioned above the level of the hose connector, or plastic mesh needs to be installed on the interior side of the inlet valve to prevent the possibility of drawing out small specimens or specimen fragments with the contaminated air. The pressure release valve

at the top of the door is activated by installing a short section (3"-5") of plastic pipe into the upper inlet valve. *Cabinets containing radon-bearing specimens need to be ventilated for two minutes before being opened.* Contact the Curatorial Services Division, Harpers Ferry Office, (304) 535-6072, for technical guidance on modifying museum storage cabinets as described above.

Notes

1. Mary R. Carman and Jeffrey D. Carman, "Health Considerations of Radon Source Fossil Vertebrate Specimens," *Collections Forum* (Pittsburgh: Society for the Preservation of Natural History Collections, 1988).
2. U.S. Environmental Protection Agency, *A Citizen's Guide to Radon* (Washington, D.C.: U.S. Government Printing Office, 1987).
3. U.S. Environmental Protection Agency, *Radon Reduction Methods* (Washington, D.C.: U.S. Government Printing Office, 1987).
4. Ellen Warren Faller and Kenneth W. Price, "Storage of Radioactive Minerals," in *Storage of Natural History Collections: Ideas and Practical Solutions*, eds. Carolyn Rose and Amparo R. de Torres (Pittsburgh: Society for the Preservation of Natural History Collections, 1992).

Sources

Radon monitoring equipment is available from several sources, including Sun Nuclear Corporation, 415-C Pineda Court, Melbourne, FL 32940, (407) 259-6862.

Radioactive warning signs are available from a variety of sources, including Lab Safety Supply Company, P.O. Box 1368, Janesville, WI 53547, (800) 356-0783.

HEPA vacuum cleaners are available from Lab Safety Supply Company and from Nilfisk of America, 300 Technology Drive, Malvern, PA 19355, (215) 647-6420.

Polyethylene bags in several sizes are available from General Services Administration (GSA) and local grocery stores. High-density polyethylene boxes in several sizes (e.g., Rubbermaid®) are available from local housewares stores.

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