Indoor Radon
in
Eastern Ohio

by

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Introduction

A detailed study for indoor radon was conducted in eastern Ohio (Ashtabula, Trumbull, Mahoning and Columbiana counties). This study was conducted because: 1. The EPA has determined that indoor radon poses a health risk,

2. Very few measurements had previously been made in the study area,

3. It would be possible to evaluate various geologic factors as determinents, and to assess their use as predictive tools.

Radon-222 is an odorless, colorless, tasteless radioactive gas that occurs in the air, soil, bedrock, and groundwater. It is produced in a series of radioactive decays that originate with Uranium-238, found commonly in rocks and sediment. As a gas, radon moves freely through soil and bedrock and can collect in homes. The amount of uranium and radon found in the ground will vary considerably from site to site, and therefore, necessitates a house-by-house assessment. It is a potential problem where uranium is concentrated in the ground, and where radon gas accumulates in elevated amounts in homes and other structures.

Indoor radon was measured using alpha-track detectors (ATD) placed in more than 800 single-family homes for approximately three-months during the time between November 1988 and June, 1989. Alpha-track detectors were used in order to minimize the daily and weekly variations that can occur in indoor radon concentrations. The use of ATDs in this manner constitutes a long-term screening test.

The geologic factors evaluated included bedrock lithology, glacial stratigraphy, overburden thickness, and soil permeability.

This study was given support and cooperation by the Ohio Air Quality Development Authority, the Health Commissioners of Ashtabula, Columbiana, and Mahoning counties, the Ohio Department of Natural Resources, and Youngstown State University Department of Urban Studies.

FOUR COUNTY STUDY AREA

FIG. 2

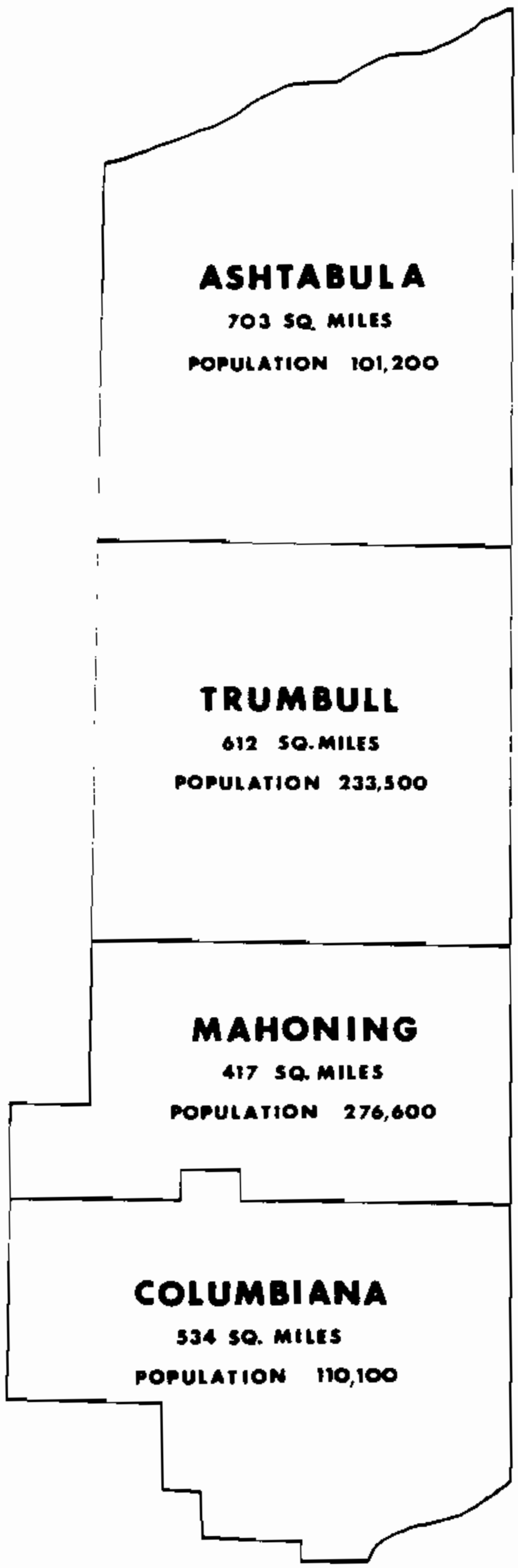
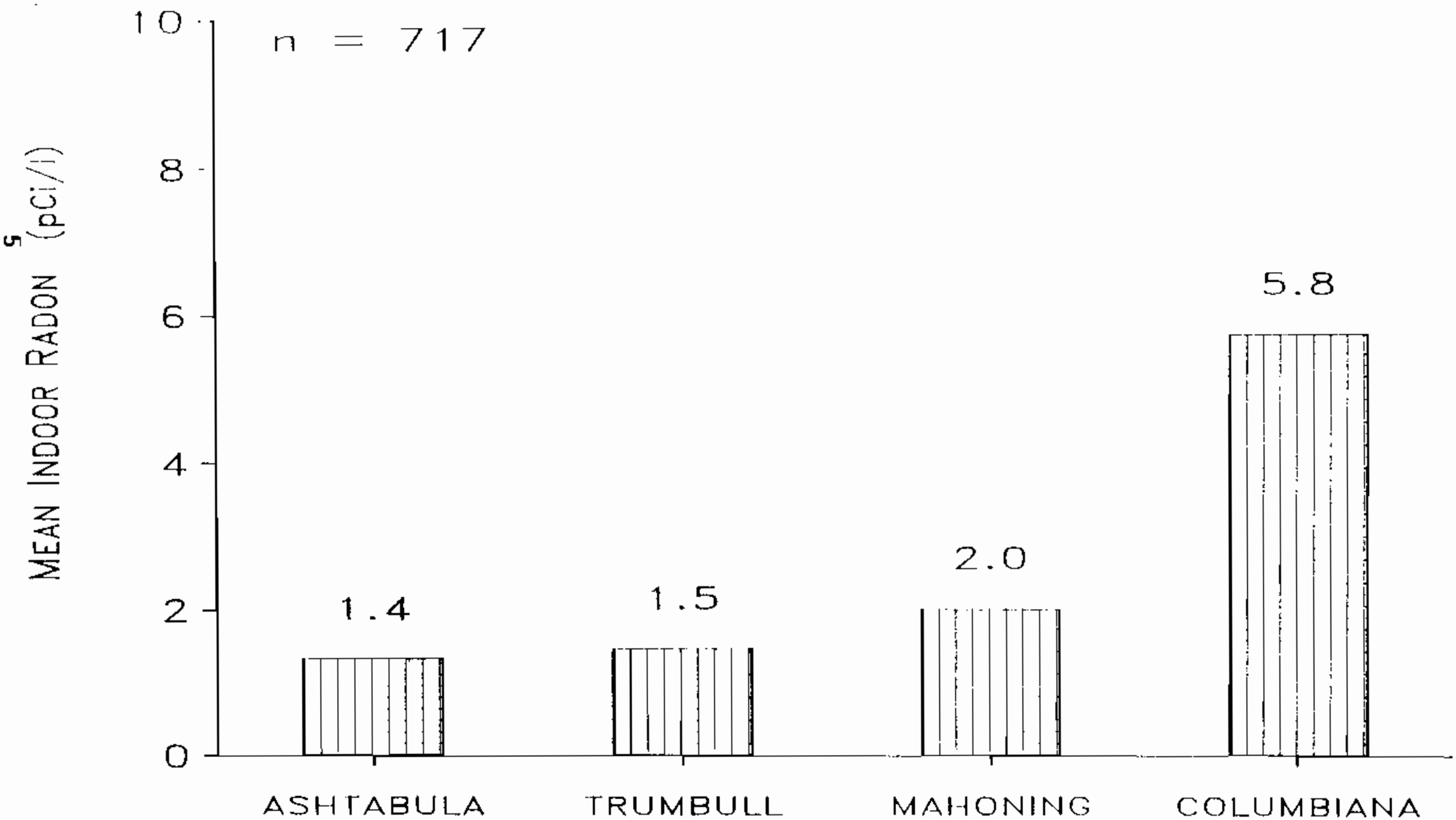


Table 3. Summary of indoor radon levels in eastern Ohio.

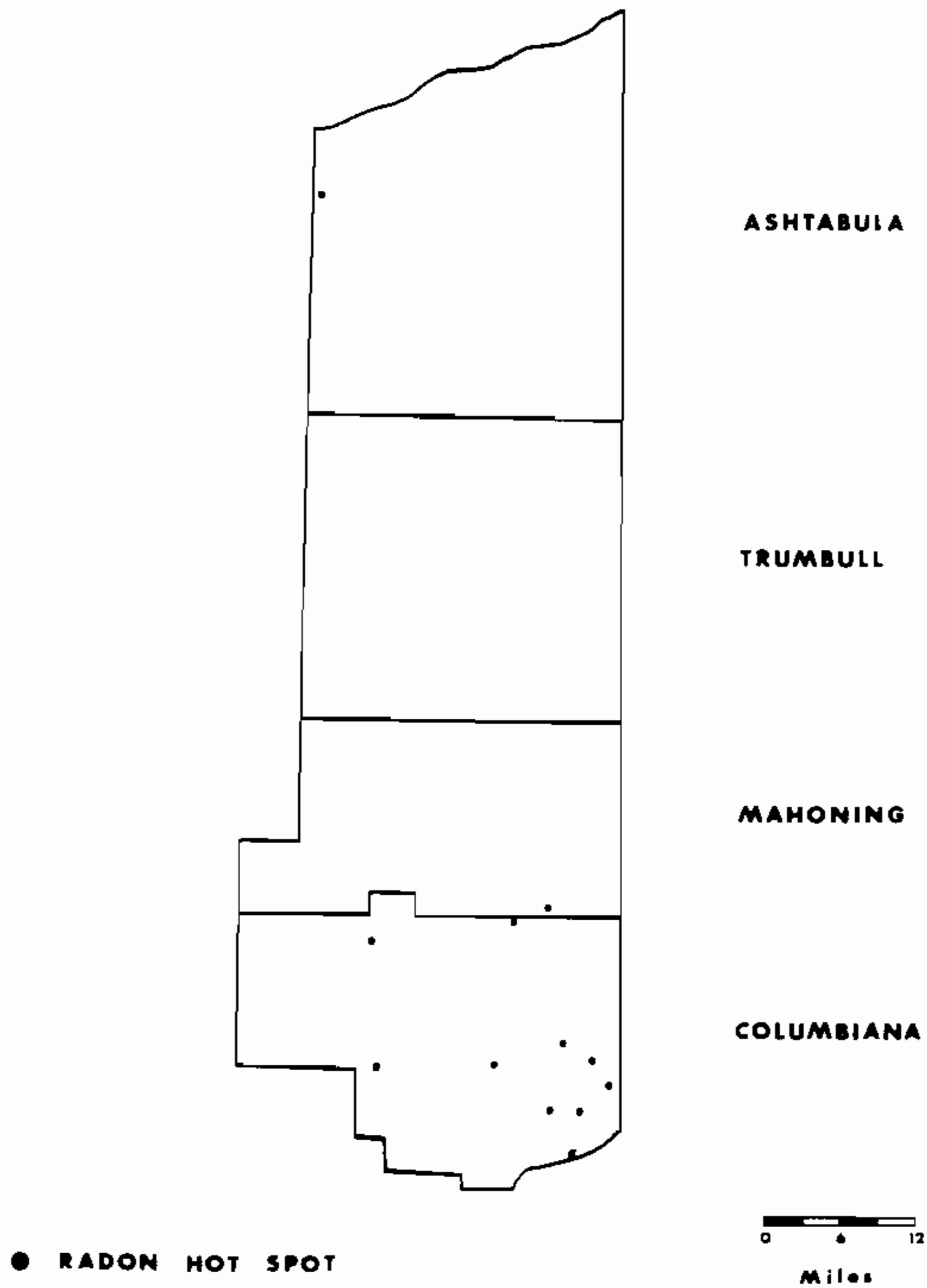
	Number	Mean (pCi/l)	Highest (pCi/l)	% above 4 pCi/l	% above 20 pCi/l
Ashtabula County	268	1.4	28.3	3.7	0.6
Trumbull County	107	1.5	6.8	3.7	0.0
Mahoning County	171	2.0	20.1	8.8	0.6
Columbiana County	171	5.8	103.9	33.9	5.8

FIG. 11
SUMMARY OF INDOOR RADON LEVELS
IN EASTERN OHIO



RADON HOT SPOTS IN EASTERN OHIO

FIG. 12



Conclusions

Across the eastern four counties of Ohio, indoor radon levels in single family homes averaged 2.6 pCi/l, based on 717 ATD measurements taken during a three-month interval between November, 1988 and May, 1989. Radon value generally increased in a north-to-south direction between a mean of 1.4 pCi/l in Ashtabula County and 5.8 pCi/l in Columbiana County. The highest individual readings and a significantly elevated mean occurred in the southernmost part of the study area, that is, in the area of Columbiana County.

Hot spots, defined as sites with indoor radon measurements exceeding 20 pCi/l, were found at 12 locations across the study area. Ten of the 12 measurements occurred in Columbiana County, and in particular, in the southeastern part of the county. This cluster has been geologically mapped as underlain by Pennsylvanian age sandstones and shales and generally lacking a glacial cover. Measurements as high as 103.9 and 92.2 were recorded here.

Statistical analyses comparing indoor radon levels with bedrock type indicate that the occurrence of sandstone correlates with elevated radon levels. Dwellings built over shales and limestones exhibit lower radon levels. In the study area, it is believed that the bedrock is a principal source of radon and that particular attention should be given to sites underlain by sandstone.

There are two significances to the occurrence of overburden materials in the study area. The primary one relates to the presence or absence of overburden materials of glacial origin. Radon levels are significantly greater where glacial materials were absent. The mean radon values for the unglaciated area is 8.9 pCi/l, but only 2.1 pCi/l in the glaciated area.

The second significance correlates with the type of overburden material in the glaciated region. Where kame deposits are found, indoor radon levels are higher than the levels observed in homes over till and lacustrine deposits. This probably occurs because kame deposits are more permeable than the others, and thus provide a means for radon transport.

Thickness of overburden is another geologic parameter that affects radon levels. With an increase in thickness, there is a decrease in indoor radon. Elevated radon readings occur where thicknesses are less than two meters, although an envelope of up to 5 meters thickness was significant in contributing to higher readings.

It can be concluded that the bedrock (especially sandstone) is the main source of the radon in the study area. The nature (texture) of the overburden and the thickness of overburden affect radon migration. Overburden with characteristically higher permeabilities exhibited higher radon levels in the associated dwellings.

An examination of the radon data relative to soil permeabilities in Mahoning County indicates that there is a significant correlation between elevated radon levels and rapid soil permeabilities. Soils of slow permeabilities show low indoor radon concentrations.

Recommendations

a) The cause(s) for the considerably elevated radon levels in Columbiana County should be fully investigated.

b) Unglaciated areas in the region (Carroll and Jefferson Counties) should be systematically surveyed to establish the magnitude of indoor radon in such areas.

c) Where data are available, an examination should be conducted to compare the indoor radon values in glaciated against unglaciated terrain.

d) Hot spots indicated in Columbiana County should be further investigated to delineate their boundaries.

e) Public buildings should be screened for radon, especially in Columbiana County.

f) Use of soil permeability as a predictive tool for indoor radon should be further investigated.

g) Additional research is needed to determine the relationships which may exist between indoor and soil gas radon values.

Radon Risk Evaluation Chart

pCi/l	WL	Estimated number of lung cancer deaths due to radon exposure (out of 1000)	Comparable exposure levels	Comparable risk
200	1	440—770	1000 times average outdoor level	More than 60 times non-smoker risk
				4 pack-a-day smoker
100	0.5	270—630	100 times average indoor level	20,000 chest x-rays per year
40	0.2	120—380		
20	0.1	60—210	100 times average outdoor level	2 pack-a-day smoker
10	0.05	30—120	10 times average indoor level	1 pack-a-day smoker
4	0.02	13—50		5 times non-smoker risk
2	0.01	7—30	10 times average outdoor level	200 chest x-rays per year
1	0.005	3—13	Average indoor level	Non-smoker risk of dying from lung cancer
0.2	0.001	1—3	Average outdoor level	20 chest x-rays per year

Source: The Environmental Protection Agency