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A PREDICTIVE MODEL FOR DETERMINING INDOOR RADON LEVELS IN NORTHEASTERN OHIO

C.R. Singler, E.C. Abram, and I.U. Khawaja
Department of Geology, Youngstown State University
Youngstown, OH

An indoor radon measurement program deployed 717 alpha-track detectors (ATD) in homes across an area of approximately 2266 square miles in eastern Ohio. The distribution of results along a north-to-south profile of 145 km distance is summarized as table 1.

Table 1: Distribution of indoor radon in homes in eastern Ohio

County	No. Measurements	Highest pCi/l Reading	% > 4 pCi/l	% > 20 pCi/l
Ashtabula (most northerly)	268	28.3	3.7	0.4
Trumbull	107	6.8	3.7	0.0
Mahoning	171	20.1	8.8	0.6
Columbiana	171	103.9	33.9	5.8

In the same area, a geologic study was conducted to determine the lithology of bedrock, nature of the glacial cover, and thickness of glacial overburden. The bedrock was mainly sandstone and shale with lesser amounts of limestone. The overburden cover was dominantly of glacial origin, except for the southern half of Columbiana County (the most southerly county) where mostly non-glacial soils and alluvium occurred.

The glacial cover was chiefly till, with lesser amounts of lacustrine, kame and outwash materials. Kame and outwash were treated as similar lithologies because of textural similarities.

Thickness of overburden was defined as the thickness of loosened material (soil, glacial) of any composition or texture that lies between the surface and the bedrock at depth. Categories were divided as: I (0-2 m.); II (2-5 m.); III (5-15 m.); IV (15-30 m.) and V (> 30 m).

For the study area, the following conclusions were made:

1) In eastern Ohio, higher radon levels occur in a southerly direction,
2) Where there is not a glacial cover, radon levels are significantly higher,
3) Elevated radon levels occur in homes over kame and outwash deposits; lower values occur over till and lacustrine deposits, and
4) Radon levels are higher over sandstone than over shale or limestone.

If radon were derived from the glacial debris, we would expect higher indoor radon values in the glaciated area and a distribution independent of overburden thickness. The data indicate that these did not occur. It is our conclusion that indoor radon in the study area is derived from the bedrock. South of the glacial terminus, indoor radon levels are highest.

The geologic factors identified above can be extrapolated beyond the original study boundaries. In particular, rock formations as mapped on the Geologic Map of Ohio (reprint of 1965) are occurring in adjacent Ohio counties. The presence or absence of glacial cover is defined by the glacial boundary line (same map). It is proposed here that the geologic factors reported for the original study area can be used to identify areas where higher radon levels would be expected. We propose that, based on the geology, lower indoor radon levels would occur on the north, and higher levels on the south. The highest values would occur south of the glacial boundary line.

A second indoor radon measurement project using charcoal detectors (AC) was conducted across northeastern Ohio (approximately 10,000 square miles). The distribution of results is reported in tables 2, 3, 4 and 5.

Table 2. Indoor radon in northeastern Ohio: northern area

County	No. Measurements	Highest Readings (pCi/l)	% > 4 (pCi/l)	% > 20 (pCi/l)
Ashtabula	54	9.2	11.1	0.0
Lake	35	3.8	0.0	0.0
Geauga	14	3.2	0.0	0.0
Cuyahoga	51	8.1	5.9	0.0
Lorain	33	14.1	27.3	0.0

Table 3. Indoor radon in northeastern Ohio: central area

County	No. Measurements	Highest Readings (pCi/l)	% > 4 (pCi/l)	% > 20 (pCi/l)
Trumbull	39	4.4	5.1	0.0
Portage	11	3.3	0.0	0.0
Summit	29	12.1	20.7	0.0
Medina	15	2.3	0.0	0.0

Table 4. Indoor radon in northeastern Ohio: Southern area (glaciated)

County	No. Measurements	Highest Readings (pCi/l)	% > 4 (pCi/l)	% > 20 (pCi/l)
Mahoning	29	22.5	20.7	6.9
Columbiana	8	4.3	25.0	0.0
Stark	16	6.6	43.8	0.0
Holmes	32	24.8	31.3	6.3

Table 5. Indoor radon in northeastern Ohio: southern area (unglaciated)

County	No. Measurements	Highest Reading (pCi/l)	% > 4 (pCi/l)	% > 20 (pCi/l)
Jefferson	34	12.7	26.5	0.0
Carroll	41	76.2	48.8	12.2
Harrison	14	272.8	42.9	21.4
Tuscarawas	36	103.6	41.9	16.7

Tables 2, 3, 4 and 5 indicate results consistent with those of the earlier study. Indoor radon level generally are lower where glacial overburden occurs, significantly higher south of the glacial boundary line, and correlative to bedrock trends. These conclusions have implications for predicting correlations between bedrock characteristics and indoor radon levels, and may have application in other areas.