

## RADON LEVELS IN CENTRAL MINNESOTA

D. J. Steck (St. John's University, Collegeville, MN 56321)

Soil gas, waterborne, and airborne radon levels were monitored during the past year at 28 sites in Central Minnesota. These sites represent a cross-section of local surface soil, bedrock, and housing. Soil gas and airborne concentrations were measured by thermoset polycarbonate detectors. The wide range of soil gas concentrations, 20 pCi/l to 500 pCi/l, reflect the glacial origins of our surface soil. Airborne radon levels varied from .5 pCi/l to 8 pCi/l. Waterborne radon, measured by a liquid scintillation technique, ranged in concentration from 30 pCi/l to 2600 pCi/l.

### INTRODUCTION

IN ORDER to characterize radon ( $^{222}\text{Rn}$ ) behavior adequately or to test control measures, research needs to be conducted in existing dwellings that have significant radon concentrations. For a particular dwelling, it is difficult to predict radon levels as there are wide local variations in radon source strength, weather, and housing construction. Central Minnesota has the potential to contain dwellings with high radon levels since it has a geology somewhat similar to Maine where high radon levels have been observed ( $\text{He83}$ ), has regions where significant concentrations of uranium may occur ( $\text{Mo81}$ ), and has weather that encourages energy efficient housing.

### METHODS AND MATERIALS

To determine the magnitude and nature of local radon concentrations in existing houses, we surveyed airborne, waterborne, and soil gas radon at 28 sites within a 30 mile radius of Collegeville during the period 10/83 to 5/84. The sites were selected to sample all local soil, bedrock, and housing types.

Waterborne radon levels were measured using the liquid scintillation technique of Prichard and Gessel (Pr78). The detection efficiency of the window set on a Beckman LS100C was established with a  $\text{RaCl}$  standard solution. The sampling and counting procedure

showed a 10% reproducibility and a sensitivity of 10 pCi/l.

Airborne and soil gas radon concentrations were measured by thermoset polycarbonate (CR-39) detectors housed in a polymethylpentene jar (70 mm by 105 mm). The open end of each detector jar was covered by either a Celgard 4510 membrane (airborne) or by a GE MEM 213 plastic membrane (soil gas). After exposure, the detectors were etched in a 6N NaOH solution at 70°C for six hours. Track densities were measured with a haemocytometer at 400X magnification. Our detectors were calibrated relative to Track Etch<sup>®</sup> detectors and showed a reproducibility of approximately 30%.

### RESULTS

Radon concentrations and their typical uncertainties are listed in Table 1. Entries missing from Table 1 represent detectors that were damaged or lost. Airborne radon concentrations at Site 1, the most thoroughly studied site, represent an average of 11 detectors for the lower story and 5 detectors in the upper story. Variations in concentrations within a story were about the same size as the detectors' reproducibility. Variations in soil gas concentrations at site 1 reflect the range of soil types in that house's berm.

Table 1: Average Radon Concentrations (10/83 to 5/84) in pCi/l

SITE NUMBER	AIRBORNE		SOIL GAS	WATERBORNE
	LOWER STORY	UPPER STORY		
			50 ± 20	
			150	
1	2.1 ± 0.6	2.2 ± 0.6	180	140 ± 10
			500 ± 50	
2	4.0	6.5	70	50
3	-	3.0	50	100
4	4.2	3.0	60	270
5	4.8	6.5	-	90
6	0.8, 4.7	-	30	140
7	1.3	-	80	200
8	1.1	1.0	80	380
9	2.9	0.8	130	120
10	3.7	2.2	180	170
11	4.1	4.2	160	1700 ± 50
12	2.5	2.7	300	2600
14	-	6.2	-	260
15	4.2	4.2	20	310
16		1.5	450	690
17	6.9	3.5	200	110
18	7.6	3.8	120	80
19(a)	1.1	0.5	80	50(b)
	2.1	6.8		
	1.6	3.3		
	0.8	2.2		
		1.7		
		1.3		
		1.8		
21(c)	0.8	0.8	80	50(b)
23	4.7	-	-	1200(b)
24	1.7	1.4	-	20(b)
Average	3.1	2.9	150	420
Median	2.9	2.2	100	200

(a) University residence halls  
 (b) Tap water

(c) University classroom building

## DISCUSSION AND CONCLUSIONS

Generally, the radon levels in the region around Collegeville tend to be within the ranges observed elsewhere (Ne83) and have an average near the national average. Some dwellings do have airborne concentrations that exceed proposed environmental standards but no dwellings exceeded 10 pCi/l. It would be premature to draw more detailed conclusions from this survey in light of the limited sample size, the highly variable radon source environment, and the reproducibility of the airborne radon detectors.

## REFERENCES

- He83 Hess C.T., Weiffenbach C.V. and Norton S.A., 1983, "Environmental Radon and Cancer Correlations in Maine", Health Phys. 45, 339-348.
- Mo81 Morey G.B., 1981, "Geologic Terranes of Minnesota and Their Uranium Potential", Minnesota Geological Survey Information Circular 19.
- Ne83 Nero A.V., 1983, "Airborne Radionuclides and Radiation in Buildings: A Review", Health Phys. 45, 303-322.
- Pr78 Prichard H.M. and Gessel T.F., 1978, "Rapid Measurements of <sup>222</sup>Rn Concentrations in Water with a Commercial Liquid Scintillation Counter", Health Phys. 33, 577-581.