

GENERAL PAPERS

Air Session

Organized by

A.M. Ford

(Pages 4-6 in *Preprints of Extended Abstracts*, Vol. 39 No. 1)

Symposia Papers Presented Before the Division of Environmental Chemistry
American Chemical Society
Anaheim, CA March 21-25, 1999

A STUDY OF INDOOR RADON IN POLAND

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ABSTRACT

In the northern and central parts of Poland, thick layers of glacial deposits contain low uranium concentrations and low indoor radon concentrations (most < 1 pCi/l). In southern Poland, in the Sudety Mountains, crystalline rocks are known to contain enrichments of uranium. Soil developed on this terrane has relatively high soil-gas radon concentrations, and more than 50% of the indoor radon measurements exceed 4 pCi/L, the U.S. EPA recommended maximum. In the southern Poland Coal Basin, known to have radon enrichments in mines and enrichments of radium in groundwater, the soil-gas radon concentrations are low, as are the indoor radon measurements (95% < 4 pCi/L).

INTRODUCTION

It is generally recognized that radon potential, defined as the tendency of radon concentrations in homes to be higher than average, can be correlated to the uranium, radium and/or radon content of the soil under the home, to the permeability of the soil (more permeable soils produce higher radon homes), and to home construction factors (Mose, et al., 1996; Gundersen et al., 1996). Scientists at the Polish Geological Institute, in association with USA scientists, have studied the radon potential of southern Poland for several years. Based on hundreds of soil-gas radon data and hundreds of indoor radon data, it now appears that some areas, notably in the Sudety Mountains, carry significant risk of lung cancer due to indoor radon.

DISCUSSION

The granites, gneisses and schists of the Sudety Mountains in southern Poland are Late Precambrian and Early Paleozoic in age (1000-400 million years old), and contain numerous sites of uranium mineralization, some of which were extensively mined 50 years ago. Most of the mineralization occurs as small veins of uranium minerals, mineralized fault zones, and zones of hydrothermal enrichment around the perimeter of formerly molten chambers of granite. Quite different evidence of high radon potential occurs in the Coal Basin of southern Poland, the Late Paleozoic and Early Mesozoic strata (@300-200 m.y. old) from which most of the Polish coal is extracted. In the Coal Basin, collapse of now-unused mine tunnels have caused surface subsidence along near-vertical cracks, through which gas such as radon could move. Also, mine tunnels sometimes contain elevated concentrations of airborne radon, and elevated radium-226 concentrations have been reported during mine dewatering operations.

The measurements of soil radon, Table 1, above the Sudety Mountain granites, gneisses, and schists have a geometric mean of @2000 pCi/L. The highest measurement in the crystalline rocks is, to date, @ 40,000 pCi/L. Over 50% of the homes have indoor radon concentrations in excess of 4 pCi/L.

Table 1. Geometric means of radon measurements from the Sudety Mountains.

Geological Unit of Radon Measurement	Soil Gas Measurements		Indoor Radon Measurements	
	Sample Size	pCi/L	Sample Size	pCi/L
Izera Gneiss	182	2100	74	4.2
Precambrian Granite	25	6960	5	7.4
Quartz-Graphite Schist	30	4350	9	2.9
Mica Schist	102	1240	17	5.9
Karkonosze Granite	238	1920	45	4.1
Glacial Deposits	409	1130	29	5.0

Parts of the Sudety Mountains are covered by debris that accumulated during the episodic melting of glaciers that advanced over Poland during the past 2 million years. It is generally thought that radon which enters homes built on the glacial deposits comes primarily from the glacial material and not from the underlying rocks (Gates, et al., 1990). The geometric mean of soil-gas radon from this material is @ 1130 pCi/L, but the geometric mean of the indoor radon measurements is similar to that of homes on the Sudety Mountain granites.

The measurements of soil-gas radon in the Coal Basin, Table 2, were unexpectedly low, with a geometric mean of less than 500 pCi/L. Less than 5% of the indoor radon measurements in the Coal Basin homes exceeded 4 pCi/L.

Table 2. Geometric means of radon measurements from the Coal Basin.

Geological Unit of	Soil Gas Measurements	Indoor Radon Measurements
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<u>Radon Measurement</u>	<u>Sample Size</u>	<u>pCi/L</u>	<u>Sample Size</u>	<u>pCi/L</u>
Florowskie Beds	98	330	21	2.9
Rudzkie Beds	138	390	33	0.5
Orzesze Beds	267	200	23	2.1
Limestones/Dolomites	100	540	32	3.6
Gogolin Beds	239	470	17	3.7

CONCLUSIONS

In Poland, the area with the highest radon potential is in the Sudety Mountains in southern Poland. In this area, 50% of the homes exceed the US/EPA recommended maximum, the soil gas commonly contains in excess of 2000 pCi/L radon, and the bedrock contains localized uranium deposits. Although the southern Poland Coal Basin contains geological evidence of elevated radon (elevated airborne radon and elevated waterborne radium in mines), the Coal Basin is an area of low radon potential. Most soil-gas radon measurements are <500 pCi/L and only 5% of the homes exceed 4 pCi/L. Based on the preliminary study, it appears that geological information, along with compilations of soil-gas radon and airborne indoor radon, can be used to characterize radon potential. In this country, where a large portion of the population lives in the same area for most of their lives, radon potential may be successfully compared to the incidence of radon-induced lung cancer.

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