MEASUREMENTS OF RADON CONCENTRATIONS IN BUILDINGS - RESULTS OF INVESTIGATIONS IN MINING REGIONS OF SAXONY AND THURINGIA

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ABSTRACT

In the East German Federal States Saxony and Thuringia territories exist where rock formations with silver and cobalt ores and above-average uranium content are located and intensive mining has taken place. In these regions a series of measurements of radon concentrations in buildings is carried out to determine local mean values, local ranges and buildings with very high concentrations of radon.

INTRODUCTION

The radiological situation in certain regions of Saxony and Thuringia is characterized by above-average uranium concentrations in layers close to the surface and, in addition, by the mining influence. The local higher uranium concentrations determined by airborne gamma-ray spectrometry are shown in Figure 1.
By order of the Federal Minister for Environment, Nature Conservation and Nuclear Safety the "Project for the Registration, Investigation and Radiological Evaluation of the Mining Residues" has to be implemented by the Federal Office for Radiation Protection. The investigation of radon concentrations in buildings with the aim to estimate regional and local distribution patterns of radon concentrations as well as the identification of houses with very high concentrations and their reasons are essential parts of this project. Since November 1990, investigations have been carried out in houses located in mining regions with a high density of measuring points.
For the assessment of the results additional measurements are carried out in regions not influenced by mining, e.g. in the Fichtel Gebirge, in regions of Lusatian granite, in the Norddeutsche Tiefebene etc..

METHODOLOGY OF MEASUREMENTS

To get a rapid survey of the radiological situation, short-term measurements (screening measurements) with activated charcoal detectors analyzed by liquid scintillation counting are carried out. The exposure of the charcoal takes 24 hours under unfavourable ventilation conditions, i.e. closed doors and windows.
Dwellings, factories, schools, kindergarten and other buildings are investigated. Participation in measurements is optional and free of charge.
Results are compared with the recommendation of the German Radiation Protection Commission (Strahlenschutzkommission - SSK) who defined a "normal range" of the radon concentration in living rooms of Germany up to 250 Bq/m^3.

If the radon concentration measured by the screening method in lounges and living rooms is evidently higher than 250 Bq/m^3 it is probable that the annual mean value exceeds this limit, too; the higher the level is exceeded the greater this probability. Therefore, in addition to the verification of short-term results long-term investigations are necessary to establish remedial measures. For these long-term measurements already started diffusion chambers with track etch detectors are used.
Each citizen/institution involved in the measurements is informed about the results of the measurements and an assessment as demonstrated in Table 1 is given.
The investigations will be extended to measurements in up to 100,000 buildings in about 200 communities.

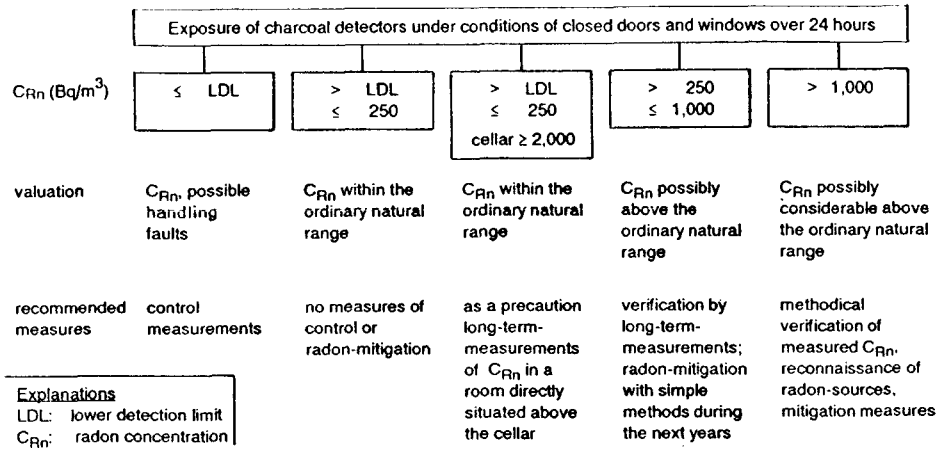
RESULTS AND CONCLUSIONS

The results of the investigations hitherto achieved show that there is a strong correlation between radon concentration in houses and geological subsoil. A relatively great number of houses with above-average radon concentration has been found in granite and certain Zechstein subdivision regions whereas buildings above glacial sediments have much lower concentrations. Figure 2 presents the results of measurements in different regions without any mining influence.
Figure 3 shows the results of screening measurements in about 15,000 buildings in regions where uranium mining and milling as well as former ore mining has taken place. In general, there is no striking difference in the frequency distribution compared with regions of similar geology. Only in cases where geological and mining influences are overlapping extreme values of the radon concentration in houses have been observed. An outstanding example is the old mining town Schneeberg where radon concentrations up to more than 100,000 Bq/m^3 have been measured by the screening procedure (see Table 2).
An influence of mining and milling residues on the radon concentration in buildings can be attributed to

- building on waste rocks
- use of waste rocks for building purposes
- shallow drivings partly immediately under, or nearby, or connected with houses
- building over of outcroppings of geological disturbances and ore-bearing lodes.

Moreover, the investigations have indicated that the underground ventilation has a great influence on the radon concentration in houses constructed on shallow drivings.
At Schlema, a centre of recent uranium mining, the mining facilities like ventilation installations are still in operation.
First experiments show that the radiological situation changes dramatically if the mining exhausters are switched off. An increase of the radon concentration two orders of magnitude higher can be observed in certain buildings after the ventilation has been stopped (see Figure 4).In this special case, it cannot be excluded that the results of screening measurements do not necessarily represent pessimistic information about the radiological situation.

Tab 1: Follow-up of the radon screening measurements in dwellings



Tab.2: Frequency of radon concentrations <250 Bq/m^3 in selected communities measured by screening method

Characterization of measured location	Geological remarks	EXAMPLE		
		community	relative frequency in % (< 250 Bq/m^3)	maximum concentration (Bq/m^3)
mainly old mining	contact area to granite	Schneeberg	48	115 000
uranium mining	carbon schist, diabases, phyllites, quartzitic rocks	Schlema	76	21 000
uranium mining	ochrons lime, diabases, clay schist	Ronneburg	85	3 100
uranium milling	lower permian	Crossen	76	2 300
without mining and milling	Fichtel Gebirge granite	Bad Brambach	25	8 700
without mining and milling	Erz Gebirge granite	Stangengrün	13	18 000
without mining and milling	Lusatian granite (glacially covered over)	Arnsdorf-Hilbersdorf	79	1 600
without mining and milling	glacial sediments (North German Lowland)	Körchow / Zühr	94	470

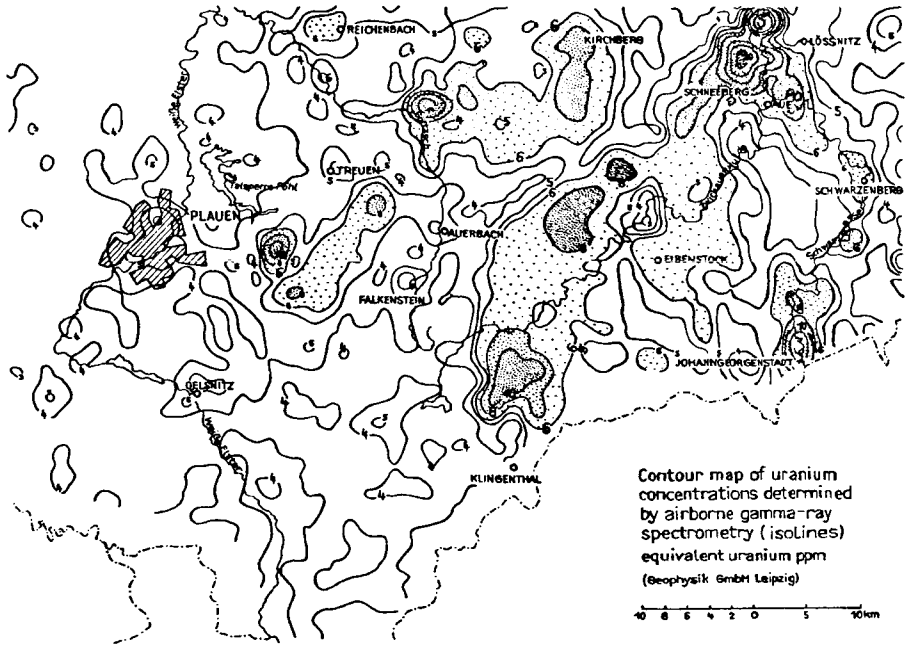


Fig.1: Aerogamma map of Westerzgebirge

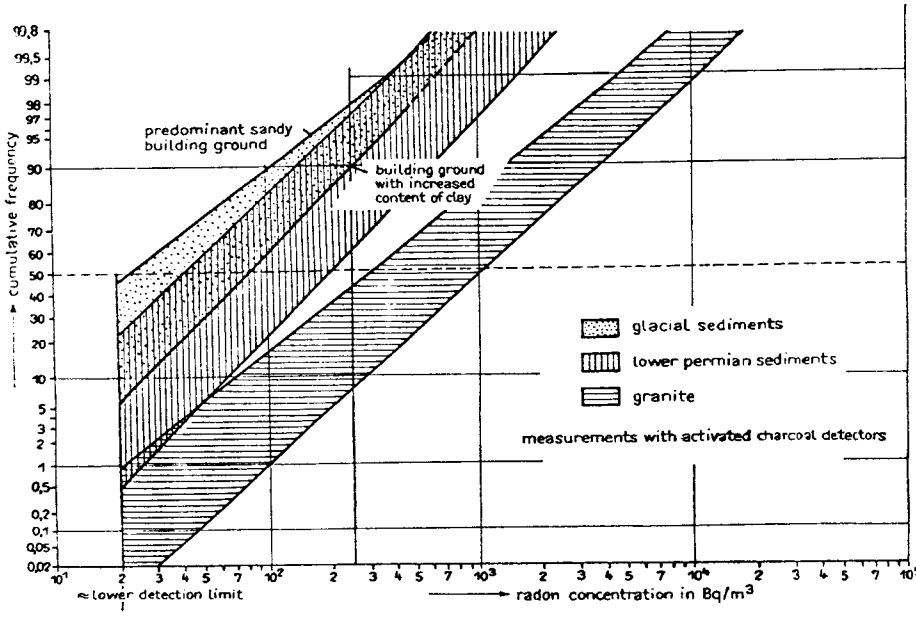


Fig.2: Radon concentration in dwellings located in special regions of Erzgebirge and Norddeutsche Tiefebene

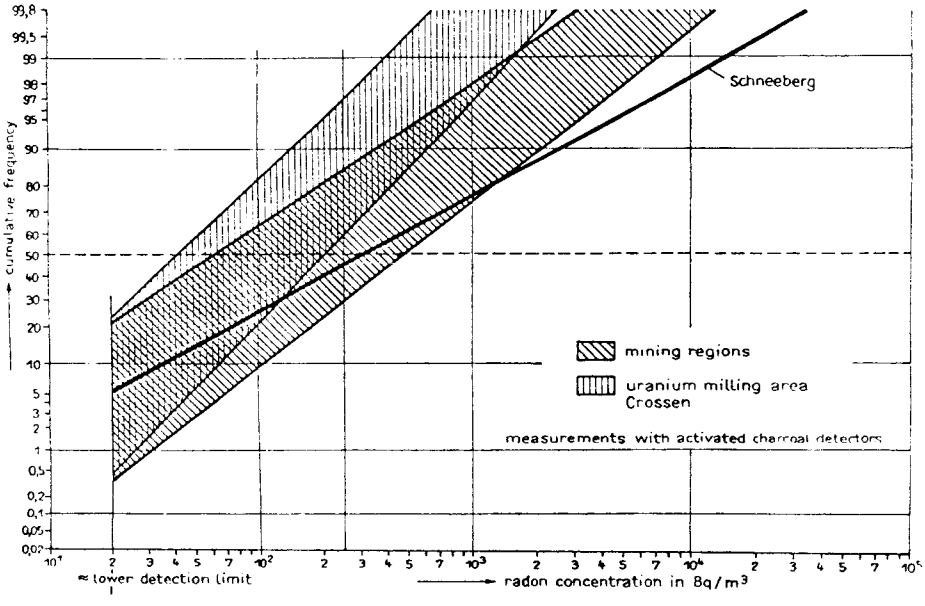


Fig.3: Radon concentration in dwellings located in mining regions of Westerzgebirge

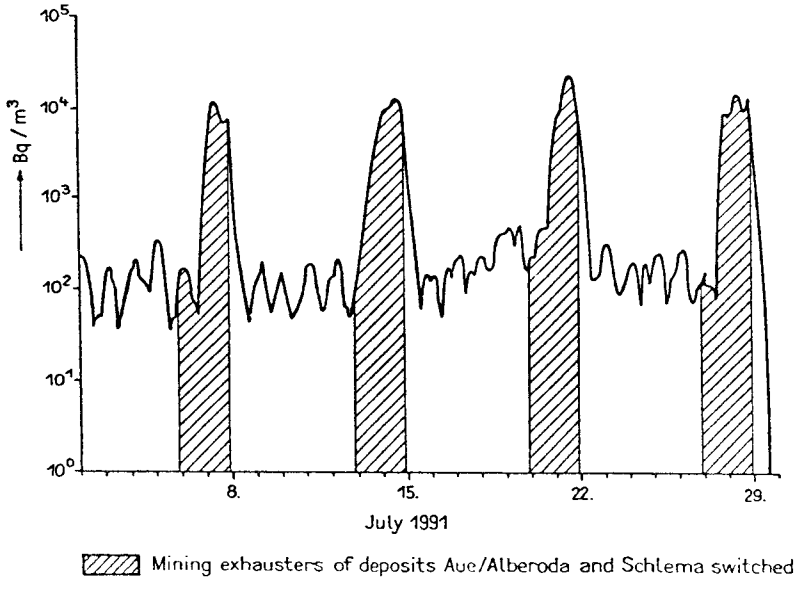


Fig.4: Radon concentration in a building depending on ventilation in shallow drivings