משרד התשתיות הלאומיות
המכון הגיאולוגי

Ministry of National Infrastructures
Geological Survey of Israel

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לכבוד
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משרד התשתיות הלאומיות
ירושלים

שלום רב,

דר' זאב ב. בגין, מנהל המכון הגיאולוגי, העביר לעיוני את מכתבך בנושא סיכוני גז רדון לערד ואת חוות הדעת של ד"ר ברחנא וד"ר דובנוב בנושא ההשפעות הבריאותיות של מכרה פוספטים מתוכנן בשדה בריר.

על אף שבעמודים 1 ו-2 מביאים הכותבים מידע ספרותי עדכני אודות ההשפעות הבריאותיות של החשיפה לגז רדון, ומציינים תרחישים אפשריים של חשיפת האוכלוסיה בערד ובמכרה לרדון, כל חישובי העלייה בשיעור התחלואה והתמותה (עמודים 3,4) מבוססים על הצפי לכמויות האבק וגודל חלקיקיו, ללא כל קשר לרדון (ראה גם הערתם בסיכום, במרכז עמוד 5). לחישובים אלו אינני יכול להתייחס בהיותם מחוץ לתחום התמחותי.

לגבי האפשרות של פליטות רדון בעת פיצוצים או תהליכי הכרייה, אם תהיינה כאלו, אלו תימהלנה באופן מיידי באויר. על פי הידע הקיים וזה שהתפרסם בעתונות המדעית, אין לצפות לעליה ברמת הרדון באויר בתחום העיר ערד, הנמצאת במרחק של כ-4 ק"מ מקצהו הצפוני של שדה בריר, בגין נדידת מסות אויר. בעבודה שעסקה בהשפעת אזורי כרייה של פחם עשיר באורניום בגרמניה [1], בתנאי מזג אויר קיצוניים נרשמה עליה מזערית של רמת הרדון באויר במרחק של מספר מאות מטרים מאזור הכרייה. בנתונים שפורסמו על ידי המשרד לאיכות הסביבה באוסטרליה בדבר רמות רדון בשני יישובים הנמצאים באזור מכרות אורניום [2], לא נרשמו כל חריגות ברמות הרדון באויר עקב הקירבה לאתרי הכרייה. יש לציין כי בשני המקרים מדובר באתרים שבהם מצוי חומר המכיל ריכוזי אורניום גבוהים בהרבה מאלו שבפוספטים הישראליים.

אשמח לעמוד לרשותך באם תדרשנה הבהרות.

ב ב ר כ ה,

דר' משה שירב-שורץ

[1] Dushe, Ch., Kummel, K. Long-term outdoor levels in mining regions of Germany. 5th Int. Conf. on High Levels of Natural Radiation and Radon Areas. Munich, 2000.

[2] Explanatory notes on radon and radon progeny in air at the Mudginberri station and at Jaribu. Australian Government, Department of the Environment, Water, Heritage and the Arts.

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Long-term Outdoor Radon in Mining Regions of Germany

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ABSTRACT

Mining residues can contribute to the increased outdoor-radon concentration in the mining regions. Surveillance was carried out to determine the long-term average values of outdoor-radon concentration at many sites.
The results of the measurements are investigated. The natural concentration level for most mining regions is assessed. Average values of radon concentrations in residential areas exceed 80Bq/m³ only in four mining regions.
In addition the influence of remedial actions carried out by Wismut in the mining region „Ronneburg“ is analyzed. Only values of radon concentrations near mining relics are correlated with decomissioning and remediation activities.

INTRODUCTION

About 8000 residues and sites of both uranium mining and milling and traditional mining and processing of certain types of non-ferrous ores or hard coal exist in the Federal states Saxony, Thuringia and Saxony-Anhalt. To justify remediation a radiological assessment in the form of a site-specific analysis has to be made for each site of interest. Among others, the inhalation of radon and its decay products has to be considered as a major exposure pathway. To evaluate this pathway the Commission on Radiological Protection (SSK) recommends a two-step approach (1). If the outdoor radon concentration exceeds the level of 80Bq/m³ in the residental areas nearest to a mining residue a site specific analysis should be made to calculate the contribution to the outdoor concentration due to the emission of mining residues. If this contribution exceeds the level of 50Bq/m³ remediation is justified.
In order to determine outdoor radon concentrations the Federal Office for Radiation Protection installed a network of passive radon detectors.
In the paper the measurements are presented and statistically analyzed.

MEASUREMENT METHOD

In order to determine outdoor-radon concentration diffusion chambers were used equipped with solid state nuclear track detectors. The overall accuracy of the measurement system is estimated up to 20% for a radon exposition > 80kBqh/m³. The exposure time of the detectors was about half a year (spring and summer resp. autumn and winter). The detectors were positioned about 1.5m above the ground.

About 500 measuring points were established on or adjacent to mining sites or affected grounds as well as in greater distances from them. The network was subdivided into 15 regions affected by mining activities.

NATURAL OUTDOOR-RADON CONCENTRATION

The natural outdoor-radon concentration level is determined by the radon exhalation from the ground (and therefore on the type of rock, permeability etc.) and on the dispersion in the atmosphere. However, the mining regions differ in types of rock and in the orography and the estimation of the natural background has to be carried out in each mining region.

For the estimation of the natural outdoor-radon level the measuring points were selected in the following manner: For each measuring point the distance to the periphery of the nearest mining residue was estimated. However, measuring points with a distance < 500 m are considered as influenced by mining residues. In mining regions with a sufficient number of measuring points near and far from mining residues a statistical test (Friedman‘s test to compare related populations) was carried out to separate a group of measuring points with no significant change of values of radon concentration. This values were used to calculate the radon background.

The natural outdoor-radon concentration corresponds approximately to a log-normal distribution. The median of the natural radon concentration vary in a range from 10Bq/m³ (region with clay schist as main type of rock, range of single values: 5 – 35Bq/m³) up to 20Bq/m³ (granite region, range of single values: 8 – 58Bq/m³).

OUTDOOR-RADON FROM MINING RESIDUES

Investigations have been carried out for all measuring points in the residential areas in order to estimate the influence of the radon exhalation from mining residues on the long-term outdoor-radon concentration. We have determined the cases with average annual values of radon concentration greater than 80Bq/m³. The results are presented in Table 1.

Mining region	Total number of measuring points	Number of measuring points with C≥80Bq/m³	Range of measured radon in Bq/m³
Aue	31	5	80 – 240
Johann-georgenstadt	63	14	82 – 620
Lengenfeld	30	2	80 – 195
Ronneburg	38	1	88 – 215

Table 1: Mining regions with measured outdoor radon concentration ≥80Bq/m³

The maximum value of outdoor radon concentration was measured in the mining region „Johanngeorgenstadt". It refers to a very small anomaly adjacent to a combination of a waste rock pile and a tailings pond. At present the reason for this extremely high radon concentration is being investigated.
In the other mining regions (except „Lengenfeld") decommissioning and remediation of the Wismut facilities were carried out during the investigation period.
The measuring points with radon concentrations greater than 80Bq/m³ have different distances to the mining residues in the several mining regions. In „Johanngeorgenstadt" and in „Aue" the minimum distance is less than about 200m and in the other mining regions mentioned in Table 1 it is less than about 50m.

INFLUENCE OF REMEDIAL ACTIONS

In order to investigate the influence of remedial actions of Wismut for example the values of long-term outdoor radon concentrations in the mining region „Ronneburg" were analyzed with regard to temporal changes of radon releases (from 1992 to 1999).
Generally we have found decreasing radon concentrations with time in residential areas (see Fig. 1).

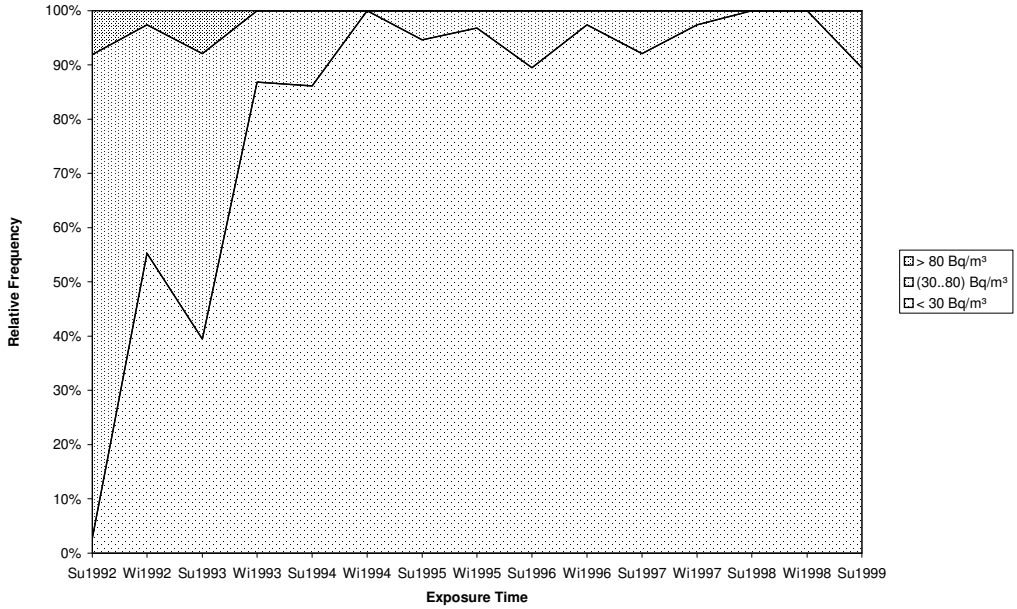

Figure 1: Relative frequency of observed radon concentrations in residential areas in Ronneburg 1992 - 1999

Closing up of shafts is the main reason for this effect. In the special case of shaft 379 we have compared the annual average outdoor radon concentrations in different distances from the shaft with the radon emission:

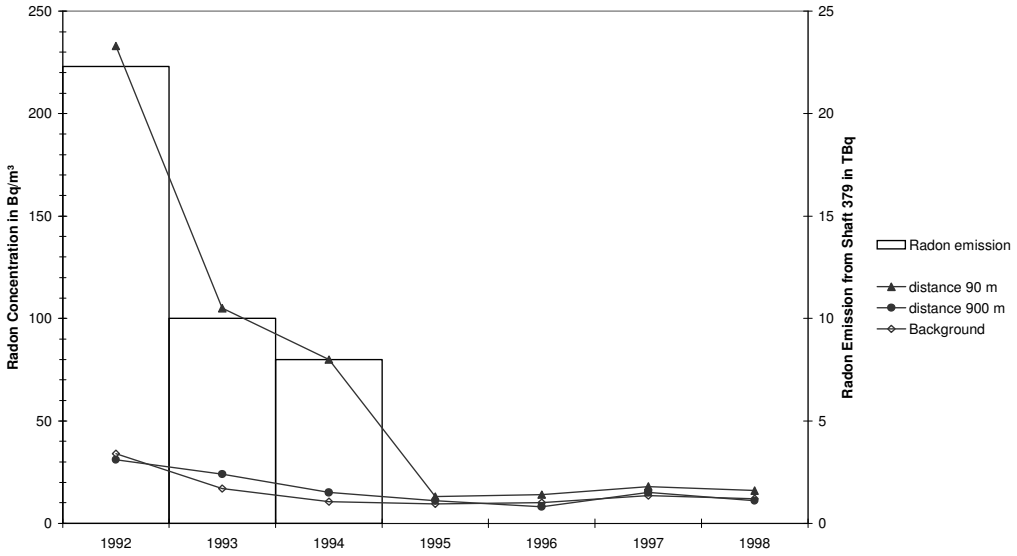

Figure 2: Long-term outdoor radon in the vicinity of shaft 379

As seen in Fig. 2 there is a strong correlation between the radon emission and the radon concentration measured near the shaft. All along we have measured radon concentrations in a distance of 900m from the shaft only in the range of the background.
Statistical analyses of all observed radon concentrations in the mining region „Ronneburg“ led to the result that values of radon concentration measured after 1996 and in a minimum distance of 500m from mining residues are not significantly distinguishable.

CONCLUSION

A large-extended radon contamination of the atmosphere has not been observed. With the exception of mining regions with remediation activities of the Wismut in two regions only outdoor-radon concentrations above 80Bq/m³ could be identified. Site specific analysis to determine the source-related contribution to the outdoor concentration has to be carried out there.

REFERENCES

1. Principles for the assessment of radiation exposure as a result of radon emissions from mining residues in the uranium mining areas of Saxony and Thuringia. Recommendations and Statements of the Commission on Radiological Protection, 1994, Veroeffentlichungen der Strahlenschutzkommission. Band 36, Gustav Fischer Verlag