Radon in mining exploration of the deposits of the Shaba Copperbelt (République du Congo, Africa) (*)

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Summary. — Radon in soils has been tested for the exploration of copper-cobalt deposits of the Shaba crescent where uranium is often a pathfinder element. A very simple technique has been developed using a charcoal detector and a reading by a portable scintillator.

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1. – Introduction

Uranium is often associated with the copper-cobalt deposits of the Southern Shaba (see fig. 1) of the «Republique du Congo» (Gauthier *et al.*, 1989). It can constitute a useful indicator of the hidden or buried mineralizations in consideration of the behaviour of the gas products by disintegration (radon, helium).

However, radiometric anomalies can also be related to lateritic soils well known in Africa (Samama, 1984). The discovery of U-occurrences in ferralitic environment of the Lubumbashi area (Makabu *et al.*, 1990) leads to a question:

These anomalies can represent secondary dispersion patterns above high-grade primary occurrences or result from processes of concentration on ordinary source rocks?

To discuss this problem we have undertook a radon and radiometric exploration on a Cu-Co deposit situated near the mining town of Lubumbashi (Luiswishi deposit).

The Luiswishi deposit has been the subject of a complete study in the thesis of Loris (Loris *et al.*, 1997; Charlet *et al.*, 1997).

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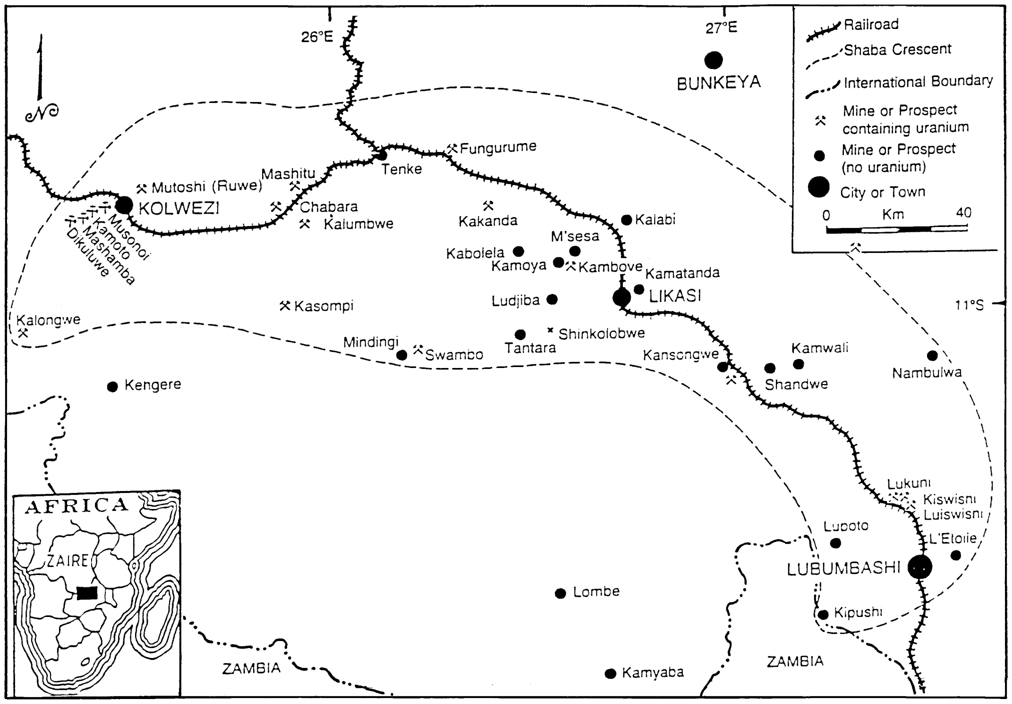

Fig. 1. – Distribution of uranium deposits or occurrences in the Shaba Crescent (after Gauthier *et al.*, 1989).

A typical profile of radioactivity (fig. 2) in a quarry shows a high U concentration in the «RAT grey» formation (REDOX front) where mineralizations are developed.

2. – Application of the radon method

Application of gas methods in developing countries requires a low-cost, efficient and not complex method. We have developed a charcoal detector allowing reading by a portable scintillator that many mining companies use for the radiometric prospection by foot. In 1995 a first test has allowed to compare the measures of radon concentration on field with a portable system (a total-count scintillator and some lead pieces to reduce the background) and in the Mons laboratory with a gamma-ray spectrometer. The day after the recovery of the detectors, the return by plane allowed to count the detectors at Mons. Correlation between both the systems of measurement was excellent ($r^2 =$ 0.990) and support the generalization of *in situ* reading in Shaba (Charlet and Makabu, 1996).

Two traverses and some sites at the bottom of the quarry (points 23-24) have been studied in 1995 and 1996.

A typical radon profile in soils (fig. 3) shows a very high anomaly at the top of the «RAT grey» and a general shape similar to the radiometric profile (fig. 2).

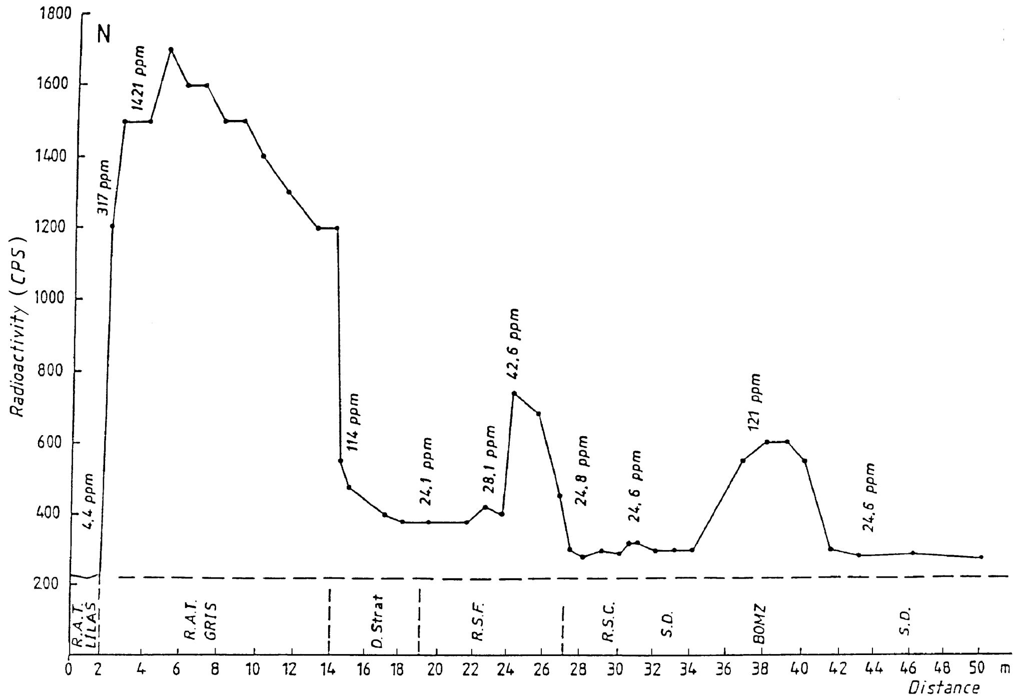

Fig. 2. – A typical radioactivity traverse in the Luiswishi deposit (RAT lilas: dolomitic, chloritic siltstones with hematite, RAT gris: dolomitic, chloritic siltstones with organic matter and sulfides, RSF-RSCA: siliceous dolostones, SD: dolomitic shales).

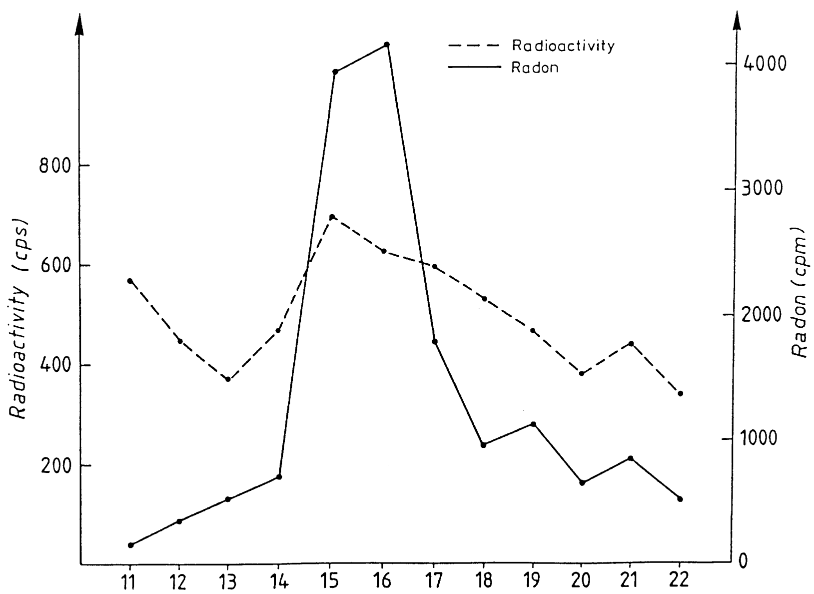

Fig. 3. – Radon and radiometric traverse.

3. – Comparison between radon and radioactivity in soils

During the field survey, radioactivity has been measured at the bottom of the holes where the charcoal detectors have been put down. Besides soils were sampled and a γ-ray spectrometry was performed at Mons.

From the traverse 1 (see fig. 3) a comparison between radon and hole-radioactivity shows some correlation but lower than with the radiometric profile of the deposit (fig. 2).

For example, the high radioactivity of points 11-12 is linked with «colluvium» of «RAT grey» covering the «RAT lilas» formation.

A statistical study of the results shows (table I) three different behaviours:

– A good correlation between radon-U concentration and total count of the superficial formations. In this first case the radon source is close. The application of the radon technique accentuates the geochemistry anomalies in soils (traverse 1).

– A bad correlation between radon and radioelements content of the superficial formations where the radon source is distant (traverse 2).

– A breaking of the correlation of traverse 1 when some sites at the bottom of the quarry (points 23-24) are added. In that zone wastes with high grade of U cover a non-uraniferous formation (similar to a pedology anomaly).

TABLE I. – *Correlation radon-radioactivity in soils and γ-ray spectrometry of soils samples.*

			Correlation coefficient (r^2)
Traverse 1	radon	radoactivity in holes	0.789
	radon	eU (ppm)	0.617
	radon	Th (ppm)	− 0.723
Traverse 1 + pts23-24	radon	radoactivity in holes	0.382
	radon	eU (ppm)	0.277
Traverse 2	radon	radoactivity in holes	0.270
	radon	eU (ppm)	0.278
	radon	Th (ppm)	0.0133

4. – Conclusions

The results show a possibility to distinguish superficial uraniferous concentrations linked with pedology and deeper concentrations linked with copper-cobalt-uranium mineralizations. They suggest the use of radon methods to prospect deposits of the Shaba copperbelt in a tropical environment where the difficulty is that anomalies can be present in the lateritic terrains, in the absence of deposits.

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