55

Nuclear Tracks and Radiation Measurements, Vol. 8, Nos. 1-4, pp. 415-418, 1984.
Printed in Great Britain.

0191-278X/84 $3.00 + .00

RADON-THORON ESTIMATION USING LR-115 PLASTIC TRACK DETECTOR

Manwinder Singh, N.P. Singh, Surinder Singh and H.S. Virk

SSNTD Laboratory, Department of Physics,
Guru Nanak Dev University, Amritsar(India).

ABSTRACT

LR-115 plastic track detector and a Radon-Thoron discriminator has been used to estimate the radon (Rn) and thoron (Tn) contents in the soil of Guru Nanak Dev University Campus area. Track production rates in the soil at different depths have been studied. Uranium estimation in the soil samples from the experimental site have also been made to establish some correlation with Rn emission. Rn-emanation rates from the plants growing around the experimental site have also been studied using LR-115 plastic track detector. Plant leaves have been found to emanate more Rn than stems.

KEYWORDS

Radon; thoron; uranium; tracks; plastic detector.

INTRODUCTION

Radon isotopes are the daughter products of radium in the naturally occurring uranium and thorium series. These belong to the group of nobel gases, can diffuse through the soil and enter the atmosphere. Because of their short half lives and being natural alpha emitter, these isotopes can be detected by an alpha sensitive detector.

The measurement of Rn in the soil gas is a well established method of prospecting for uranium (Gingrich, 1975; Fleischer, Price and Walker, 1975; McCorkell, Porrit and Brameld, 1981; Ghosh and Bhalla, 1981). Thoron because of its very short half life of 54.4 sec. could not be detected and discriminated properly from Rn. As such in radioactive surveys there used to be difficulties in interpretation of anomalies in thoriferrous areas. In the present investigations Rn-Tn discriminator fabricated by the department of Atomic Mineral Division, Hyderabad has been used for discriminating Rn from Tn in the soil. Alpha track detector have also been employed to measure the Rn emanation rate in plants (McCorkell, Porrit and Brameld, 1981).

EXPERIMENTAL PROCEDURE

Rn-Tn estimation in the soil of Guru Nanak Dev University area was made using aluminium (Al) can with a plastic film holder (Fig.1). The cans are hollow Al-cylinders with height 25 cm, internal diameter 4.5 cm, and sealed at the upper end. The lower detector in the film holder records alpha tracks due to Rn and Tn both whereas the upper detector records the tracks due to Rn alone. Eight such cylinders were kept in the grid pattern of auger holes one meter apart and at depths of 0.5, 1.0 and 1.5 meter for the 3 weeks period successively. LR-115 detector films were etched in 2.5N NaOH solution at 60°C for 90 minutes and were scanned under Olympus microscope at 600X magnification for track density measurements. The efficiency of the method for complete discrimination of Rn from Tn was checked by suspending the plastic detector films at

various heights inside the cylinder burried in the auger hole for 3 weeks period. Homogenised fission track method (Fisher, 1970) was used for uranium estimation in the soil samples of various depths.

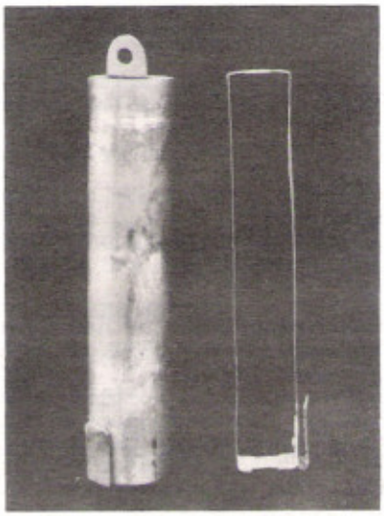

Fig. 1. Radon-Thoron discriminator.

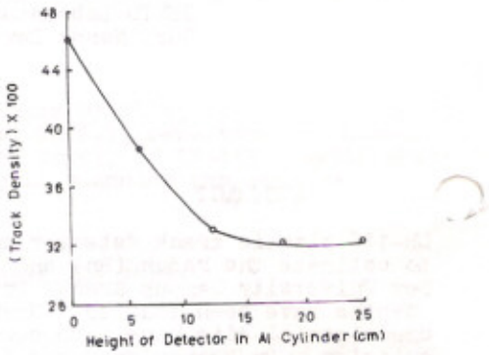

Fig.2. Plot of track density vs height of detector in the Al-cylinder.

In order to study the variations of Rn in the environs of campus area, LR-115 plastic sheets 1 cm^2 each were suspended in open space at altitude of 0.2, 6.5, 10.5, and 16.5 meter respectively above the ground surface for a period of 3 weeks. Time variation of Rn content in air was also studied by exposing detector sheets at a constant height of 10.5 meters for a period of 4 days to 3 weeks.

To study the emanation rate in the plants growing around the experimental site, LR-115 plastic detector sheets were attached to the stem and leaves for a period of 2 weeks. The detectors were covered with an insulating tape to protect them from heat and other background effects.

RESULTS AND DISCUSSION

The complete discrimination of Rn from Tn, which is the purpose of this experiment, has been achieved by the use of discriminator which is evident from the plateau in the track production rate beyond a height of 12 cm (Fig.2). It is the Rn content that first increases upto a depth of 1.0 meter and then decreases subsequently at 1.5 meter. Tn content is almost constant at all depths. The U concentration in the soil samples with depth shows a slight variation from 3.34 to 3.68 ppm (Table 1). As the Rn content in the soil at all depths is more than the Tn content, it proves the uraniferrous nature of the soil.

Various authors (Moses, Stebney and Lucas, 1970; Bradley and Pearson, 1970; Harley,1973) have studied the altitude effect on Rn diffusion in air. Our investigations proves that radon diffusion follows an exponential decrease with height (Fig.3) as observed by other authors. The Rn content in atmosphere with time shows a linear variation (Fig.4).

Rn emanation rate from plants varies from 5.16×10^{-2} to 20.6×10^{-2}

tracks $cm^{-2}hr^{-1}$ (Table 2). Different plants of the same species yield the same Rn emanation rate. Leaves have been found to emanate more radon than stem. The errors shown in the results are based on the track counting statistics.

TABLE 1. U, Rn and Tn estimation in the soil.

Depth (meter)	Mean track production rate* (tracks $cm^{-2}hr^{-1}$) due to			Uranium content
	Rn + Tn	Rn	Tn	(ppm)
0.5	17.18± 0.49	12.56± 0.42	4.56± 0.37	3.34± 0.09
1.0	37.82± 0.73	33.33± 0.73	4.49± 0.25	3.60± 0.10
1.5	18.02± 0.62	14.64± 0.56	3.38± 0.22	3.86± 0.09

* Exposure period 21 days.

TABLE 2. Rn emanation from the plants.

S. No.	Name and Family of plants	Track density(cm^{-2})	Track production rate* due to Rn ($cm^{-2}hr^{-1}$) x 10^{-2}
1	Tectona Grandis(Berbenaceae)	22.26	6.18± 0.01
2	Tectona Grandis(Berbeneceae)	21.10	5.86± 0.01
3	Tectona Grandis(Berbenaceae)	22.94	6.37± 0.01
4	Hamelia Patens(Rubiaceae)	74.30	20.60± 0.02
5	Jasminium(Oleaceae)	54.81	15.22± 0.02
6	Nerium Odorumsyn(Apocynaceae)	18.58	5.16± 0.01
7	Alsotonia Scholaris	46.08	12.80± 0.02

* Exposure period 15 days.

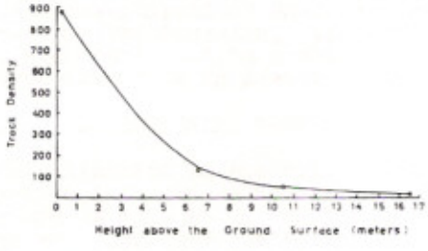

Fig.3. Variation of track density vs height of detector above the ground surface.

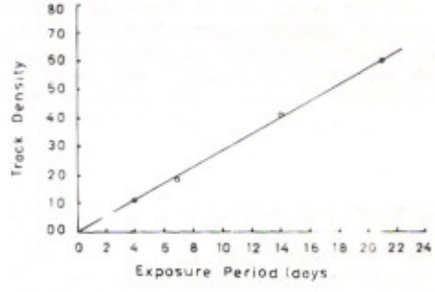

Fig.4. Variation of track density vs time at fixed height.

CONCLUSION

1 Rn and Tn can be effectively discriminated by using this technique.

2 Nature of the soil at the experimental site (Guru Nanak Dev University campus area) is uraniferrous.

3 Environmental Rn shows an exponential decrease with height.

4. Rn emanation rate from plants of the same species is constant.

5. There seems no correlation between uranium content of the soil and the radon emanation rate.

ACKNOWLEDGEMENT

The authors acknowledge the financial assistance by CSIR, New Delhi. They are thankful to Dr. P.C.Ghosh, Scientific Officer (S.F.), Department of Atomic Energy, Hyderabad for helpful discussions and supply of LR-115 plastic sheets. The thanks are due to Mr. V.P.Gupta for help in scanning the samples.

REFERENCES

Bradley, W.E., and J.E. Pearson (1970). J.G.R., 75, 5890.

Fisher, D.E.(1970). Anal. Chem., 42, 414-416.

Fleischer, R.L., P.B. Price, and R.M.Walker (1975). Nuclear Tracks in Solids Principles and Applications, University of California Press, Berkley.

Gingrich, J.E. (1975). AIME Trans. 258, 61-64.

Ghosh, P.C., and N.S. Bhalla (1981). Ind. J.Earth Sci., 8, 1-9.

Harley, J.H. (1973). Proc. of a Symp. on Nobel Gases, Los Vegas Naveda, 109-114.

McCorkell, R.H., J.W.M. Porrit and M.P. Brameld (1981). CIM Bulletin, 74, 93-98.

Moses, H., A.F. Stebney and H.F. Lucas (1970). J.G.R., 65, 1223.