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URANIUM AND RADON ESTIMATION IN WATER AND PLANTS USING SSNTD

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ABSTRACT

Lexan plastic track detector is used to estimate the uranium content of water and plant samples collected from the Dalhousie area, Chamba district, Himachal Pradesh, India. Uranium content has been found to vary from 0.26 ± 0.01 to 6.77 ± 0.06 ppb in water and from 0.65 ± 0.04 to 2.61 ± 0.08 ppm in plant samples. The track production rate due to radon in water has been found to vary from 1.44 ± 0.18 to 385.25 ± 0.70 tracks $cm^{-2} hr^{-1} litre^{-1}$ using LR-115 plastic as a solid state nuclear track detector.

KEYWORDS

Uranium; Radon; water; tracks; plastic detector.

INTRODUCTION

There are various methods for uranium estimation viz. Gamma ray spectrometry, Mass spectrometry, Flourimetry, Colorimetry, Autoradiography, Neutron activation analysis and Fission track technique. Uranium exploration by radon survey using alpha sensitive plastic track detector is recent addition to this field. It has become popular due to its simplicity, versatility and cheapness. Radon (Rn^{222}), a member of the uranium decay chain with a half life of 3.82 days, decays with the emission of alpha particles whose tracks can easily be recorded in alpha sensitive plastic track detector (Fleischer, Price and Walker, 1975; Iyer and Rao, 1976; McCorkell, Porritt and Bramald, 1979; Suri, Singh and Virk, 1981). Thus radon can be used as one of the prospecting guides indicative of the possible occurrence of uranium deposits in the region. Ghosh and Bhalla (1966) determined radon content of water by closed circuit technique using alpha counting scintillation assembly. In our laboratory, we have used LR-115 plastic films as a track recorder and have designed the apparatus to detect alpha activity of water due to radon alone.

EXPERIMENTAL METHOD

The experimental procedure for uranium estimation in water and plants is the same as reported elsewhere. (Fleischer and Lovett, 1968; Nagpal, Nagpal and Bhan, 1974; Virk and Harinder, 1979).

Uranium concentration in water was determined using the formula (Fleischer and Lovett, 1968):

$$C_w = \frac{TM}{VGN_A E \sigma \phi} \qquad (1)$$

Where the symbols have their usual meanings.

Uranium estimation in plants can be made by using the relation (Virk and Koul, 1977)

$$\frac{C_U(\text{Sample})}{C_U(\text{standard})} = \frac{\rho(\text{Sample})}{\rho(\text{standard})} \qquad (2)$$

Rn Estimation in water. The apparatus designed to detect alpha activity due to radon is shown in figure 1. 100 ml. of each water sample was taken in radon tight reagent bottles of one litre capacity connected with a conical flask through a hand operated rubber pump and a glass bulb containing $CaCl_2$ to absorb moisture. LR-115 plastic track detector films of 1 cm^2 in area were suspended in conical flasks for a period of fifteen days. Detector films were also suspended in water to record the alpha tracks due to other possible alpha emitters viz. U, Th, Ra etc.

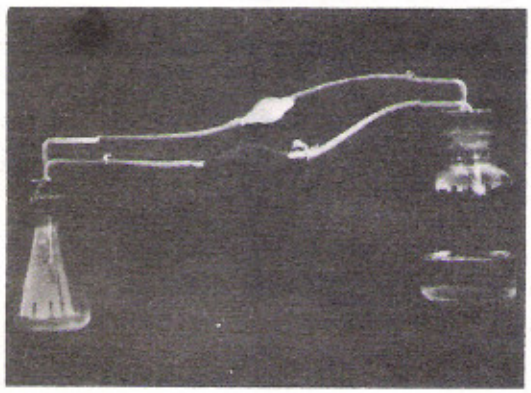

Fig. 1. The apparatus for radon detection in water.

The alpha activity of water due to radioactive elements other than radon gas was also checked by boiling off radon from water and suspending detector films in it. In order to study the effect of moisture on radon a detector was suspended in air above the water level. All the detectors were etched in 2.5N NaOH at 60°C for 90 minutes and were scanned under the Olympus microscope at a magnification of 600X for recording the alpha track density. The results for the track production rate due to radon in water samples are given in Table 1.

RESULTS AND DISCUSSION

Results of uranium content in water and plant samples are recorded in Tables 1 and 2. Uranium content in water varies from 0.26 ± 0.01 to 0.93 ± 0.02 ppb except in case of Kandu spring where the highest U content of 6.77 ± 0.06 ppm is recorded. In case of plant samples the U content lies in the range 0.65 ± 0.04 to 2.61 ± 0.08 ppm. Our results are quite low compared with reported U content in case of hydrophytes of other areas (Nagpaul, Nagpal and Bhan, 1974; Virk and Harinder, 1979). It is evident that U content in water and plants is not significant from prospecting and exploration angle.

The track production rate due to radon in water samples varies from 1.44 to 385.25 tracks $cm^{-2}hr^{-1}litre^{-1}$. Water sample from Khajiar have yielded maximum radon content. The alpha activity due to radioactive elements other than radon has been found only in water samples from Khajiar and satdhara (Panchpula). The presence of moisture in the air has been found to reduce the radon emanation rate from water.

TABLE 1. Uranium and Radon Content in Water Samples.

S.No.	Sample Location	Uranium Content (ppb)	Track production rate*($cm^{-2}hr^{-1}litre^{-1}$) recorded in the detector suspended in			
			Water	Moist air	Dry air	Boiled water
1	Satdhara (Panchpula)	0.93 ±0.02	0.41 ±0.09	0.50 ±0.06	12.83 ±1.50	0.55 ±0.14
2	Teendhara (Panchpula)	0.30 ±0.02	0.58 ±0.12	1.00 ±0.12	1.61 ±0.19	Nil
3	Khajiar Lake (Khajiar)	0.26 ±0.01	2.30 ±0.32	4.55 ±0.50	385.25 ±0.70	0.72 ±0.24
4	Well Water (Dunera)	0.80 ±0.02	0.72 ±0.24	1.05 ±0.14	1.44 ±0.18	Nil
5	Kanduspring	6.77 ±0.06	0.44 ±0.09	0.92 ±0.18	1.66 ±0.18	Nil

*Exposure time 15 days.

From the data (Table 1) of uranium and radon content it is evident that there is no direct correlation between uranium and radon in water. This absence of correlation seems to be due to the fact that the radium separated from uranium and precipitating for a long time on the walls of fractured rock may have become the source of radon in water. The errors shown in the results are statistical counting errors.

TABLE 2. Uranium Content in Plant Samples

S.No.	Name of Plant	Part of plant	No.of samples studied	Mean track density $10^4(cm^{-2})$	Uranium Content (ppm)
1	Desemodium	Leaves	2	1.78	1.22 ±0.06
		Roots	2	1.50	1.03 ±0.05
2	Furn	Leaves	2	1.80	1.24 ±0.06
		Roots	2	1.45	0.99 ±0.05
3	Malra	Leaves	2	1.16	0.80 ±0.04
		Roots	2	1.47	1.01 ±0.05
4	Cannabis	Leaves	2	1.31	0.90 ±0.05
		Roots	1	1.43	0.99 ±0.04
5	Athyrium	Leaves	1	0.94	0.65 ±0.04
		Roots	2	3.80	2.61 ±0.08

Uranium content of glass dosimeter = 20 ppm
Track density recorded due to glass dosimeter = $29.11 \times 10^4 cm^{-2}$

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