

## URANIUM AND RADON ESTIMATION IN SOME WATER SAMPLES FROM HIMALAYAS

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**Abstract** - The uranium content of water samples collected from Kumaun (Uttar Pradesh) and Siwalik (Himachal Pradesh) Himalayas has been estimated using the technique of fission track registration in lexan plastic. The uranium content has been found vary from  $1.08 \pm 0.02$  to  $35.83 \pm 0.09$  ppb. The radon estimation has also been made in the same water samples using LR-115, type II plastic track detector. The radon content has been found to vary from  $2.68 \pm 0.23$  to  $12.55 \pm 0.93$  pCi/l. No direct correlation has been found between uranium and radon contents. However, the high values of uranium in the mineralized areas confirm that the fission track method can successfully be employed for uranium exploration.

### 1. INTRODUCTION

Uranium can be measured by various techniques viz. activation analysis, mass spectrometry, fluorescence and delayed neutron counting. Since the discovery of solid state nuclear track detectors, an additional method is available to determine the uranium concentration in rocks and minerals of both the terrestrial and extra-terrestrial origin<sup>1-3</sup>. The track etch technique which is finding many technological applications<sup>6,7</sup>, can be easily used to find uranium content in water. The radon detection in water indicates the high potential for detection of structural features as well as uranium occurrence<sup>8</sup>. Rao et al.<sup>9</sup> carried out the radon measurements in the hot springs for investigation of geothermal energy sources. In present study, a simple apparatus employing LR-115, type II plastic as alpha track recorder is used to detect the alpha activity of water samples collected from Kumaun (Uttar Pradesh) and Siwalik (Himachal Pradesh) Himalayas due to radon. Uranium estimation is made in water using fission track technique to study its correlation with radon.

### 2. EXPERIMENTS

The experimental procedure for uranium estimation in water is same as reported elsewhere<sup>10-13</sup>. The uranium concentration in water is determined using the formula:

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

where symbols have their usual meanings. The method provides a detection limit of 0.01 ppb and a precision is stated to be  $\pm 10-15\%$  and  $\pm 5\%$  (Ref.14 and 15).

The apparatus used to detect alpha activity due to radon is same as reported elsewhere<sup>13</sup>. 200 ml of each sample is taken in radon tight reagent bottle of one litre capacity connected with a conical flask through a hand operated rubber pump and the glass bulb containing  $\text{CaCl}_2$  to absorb moisture. LR-115, type II plastic track detectors each  $1 \text{ cm}^2$  in area are suspended in the conical flask for a period of 15 days. The radon gas is transferred from the reagent bottle to the conical flask by bubbling water and sucking the gas with the help of a hand operated rubber pump. All the detectors are etched in 2.5N NaOH solution at  $60^\circ\text{C}$  for 2 hrs and are scanned under an optical microscope for track density measurements. Track density is converted into radon activity in pCi/l by using a calibration constant ( $1 \text{ pCi/l}$  of radon corresponds to  $16.8 \text{ tracks/cm}^2$  for 15 days

exposure period) determined by Singh *et al.*<sup>16</sup> in this laboratory. Detection limit of radon determination was found to be 0.5 pCi/l by this track etch method, with a precision of 5-10 %. The detection limit can further be lowered by increasing the exposure period.

### 3. RESULTS AND DISCUSSION

The results for uranium and radon content in water samples are given in Table 1. The uranium content in the water samples is determined by using

Table 1. Radon and Uranium concentration in water samples

Sample location	Alpha Track Analysis		F.T. Analysis	
	Track density (tracks/cm <sup>2</sup> )	Radon activity (pCi/l)	Total No. of tracks	U content (ppb)
<u>UTTAR PRADESH</u>				
Nanak Mata	83	4.94±0.36	11616	5.46±0.04
Bhimtal	146	8.69±0.48	3520	1.66±0.02
Nainital	45	2.68±0.23	3872	1.82±0.02
Linglot	143	8.51±0.79	2304	1.08±0.02
Kanchi Mandir	211	12.55±0.93	4928	2.32±0.02
Rati Ghat	45	2.68±0.23	5856	2.75±0.03
Kharana	50	2.98±0.25	9312	4.38±0.03
Panyali	158	9.40±0.59	6432	3.03±0.03
Kalarmal	144	8.57±0.55	4992	2.35±0.02
Gurali	45	2.68±0.24	20560	9.68±0.07
<u>HIMACHAL PRADESH</u>				
Samur Kalan	166	9.88±0.89	38688	18.20±0.07
Rameda	181	10.77±0.86	76164	35.83±0.09

equation 1. The uranium values in Samurkalan and Rameda areas of H.P. and Gurali area of U.P. are found comparatively higher than in other areas. Atomic Minerals Division, Department of Atomic Energy, India has already reported the presence of uranium in Samur Kalan and Rameda areas. The presence of uranium in water samples can be due to the following two possibilities:

- (1) Uranium present in suspended or colloidal impurities.
- (2) Uranium derived by the leaching of rocks through which the water traverses.

The suspended impurities, if present in large size, are easy to filter, but when the size is very small, they will give rise to cluster of tracks whereas they are deposited in thin film. The number of clusters found in our study was negligible and if any, the number of tracks in a cluster did not exceed 100. It rules out the contribution of uranium due to suspended impurities.

The radon values in water samples are found to vary from 2.68±0.23 to 12.55±0.93 pCi/l. The water samples from Kanchi Mandir, Bhimtal, Linglot, Panyali and Kalarmal areas have yielded exceptionally high values of radon content irrespective of their low U content values. The high values of radon in these areas may be due to radium separated from uranium and precipitating for a long time on the walls of fractured rocks<sup>17</sup>. No direct correlation was found between radon activity and uranium content. However, both the radon and uranium values are found higher in Samur Kalan and Rameda areas, which may be due to the presence of uranium in these areas.

### 4. CONCLUSIONS

The high values of uranium in mineralized areas confirm that the fission track method could be successfully employed in the uranium exploration. Radon estimation method can be used as an additional technique. However, this technique may give some spurious anomalies due to the presence of



radium. The present study also highlights the anomalous uranium content of  $9.68 \pm 0.07$  ppb in water samples collected from Gurali area, indicating need for further investigation of U mineralization in this area.

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