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# URANIUM ESTIMATION IN PLANTS OF THE SIWALIK HIMALAYAS, HIMACHAL PRADESH, INDIA


**H. S. Virk, P. S. Suri and S. Singh**

*Department of Physics, Guru Nanak Dev University, Amritsar, India*



## ABSTRACT

Fission track technique has been used to estimate uranium content in plants, water and rock samples collected from Siwalik Himalayas of Himachal Pradesh. The present study aims to propose a correlation hypothesis for uranium exploration based on uranium content anomalies.



## KEYWORDS

Fission track; uranium exploration; indicator plants; Siwalik Himalayas.


## INTRODUCTION

The migration of uranium in solution on weathering of primary ore suggests that geochemical techniques, involving quantitative chemical analysis for the metal in soils, vegetation and surface waters, may be of value in searching for new uranium ore bodies. The present study aims to find a correlation between uranium occurrences in plants, natural waters and rock samples of an area of Siwalik Himalayas using homogenised fission track technique (Fisher, 1970).

Prospecting by plant analysis is based on the uranium content of plants growing in the area to be prospecting. Plant ash normally contains 0.2 to 1.0 part per million (ppm) uranium. The uranium content of plants rooted in ore, however, may range from 1 to 100 ppm uranium. Therefore, the uranium content of plants rooted in ore may be used as an indication of mineralized ground.

It is an established fact that some plant species absorb much more uranium than others. Plants that readily absorb large amounts of sodium, sulphur, selenium and calcium but small amounts of potassium will also absorb uranium readily. For this reason, conifers and desert shrubs of the rose family can be used as indicator plants in sampling programs in uranium districts.

Hydrogeochemical prospecting for uranium deposits is based on the ability of uranium and its disintegration products - radium and radon- to dissolve in natural waters and migrate together with them. The uranium content varies over wide range in natural waters: 2 ppb in sea water; $10^{-2}$ ppb to 10 ppb in river water; ~ 10 ppb in some undrained basins.

Since the concentration of uranium is more in deposits as compared to rocks, and taking into consideration the relatively high solubility of its ore minerals, the solution washing the uranium deposits are enriched in uranium in comparison with the solutions which migrate in ordinary rocks.

The Siwaliks in the area under survey constitute a transition zone between middle and upper Siwaliks and the river Beas flows along their contact. The litho units exposed in the area are mostly sandstones, greenish pebbles and conglomeratic sandstones interbedded with shale bands.

Plant samples growing along tributaries and channels of river Beas were collected in the months of September-October, 1980 after the rainy season. Water samples from the channels flowing in the area and rock samples from different locations along the channels were also collected for correlation purposes.

## EXPERIMENTAL TECHNIQUE

Uranium estimation techniques for plant, water and rock samples have been reported by various authors (Fleischer and Lovett, 1968; Nagpal, Nagpal and Bhan, 1974; Virk and Koul, 1977; Virk and Harinder, 1979). A brief description follows.

Plant samples were dried in an oven till the material is completely charred. This residue is powdered and pulverized. 50 mgm of the plant powder was thoroughly mixed with 100 mgm of methyl cullulose which acts as a binder and the mixture was pressed into a pellet, 1.3 cm in diameter and 1 mm thickness, by a handpressing machine. Lexan discs of the same diameter as that of pellets were pressed against both sides of each pellet and were used as external detectors for recording fission tracks. The pellets were then packed in the aluminium capsule which was irradiated with a specified thermal neutron dose of $5 \times 10^{15}$ (nvt) in the thermal column of CIRUS Reactor at B.A.R.C., Trombay, Bombay.

After irradiation the lexan discs were removed from the pellets and were etched in 6.25 N NaOH at 70°C for 20 minutes using a reflux condenser assembly. The tracks recorded in the lexan discs were counted with a binocular microscope at a magnification of 600x. Uranium concentration was determined by matching the track densities recorded in the lexan discs covering the plant pellets with those covering the standard glass dosimeter pellet by using the formula (Virk and Koul, 1977).

$$\frac{C_w\ (\text{sample})}{C_w\ (\text{standard})} = \frac{\rho\,(\text{sample})}{\rho\,(\text{standard})} \qquad (1)$$

where Cw indicates uranium content and $\rho$, induced fission track density.

Experimental procedure for rock samples is almost similar but it is modified for preparation of water samples. A known volume of water (2 drops = 0.04 c.c.) of each sample is taken on lexan polycarbonate discs and allowed to evaporate in dust free atmosphere. The non-volatile constituents are left over the discs in the form of a thin film. The irradiation and etching procedure is the same as described in case of plant samples. Uranium concentration is determined by using the formula (Fleischer and Lovett, 1968).

$$C_w = \frac{TM}{V\,G\,N_A\,E\,\phi\sigma} \qquad (2)$$

Rock samples used in this study are conglomeratic sandstones which are particularly friable and porous and did not pose any problem for preparation of pellets with homogeneous distribution of grain size. Alpha particle auto-radiography and fission track registration as lexan plastic prints have made possible the precise location of all mineral phases containing uranium (Basham, 1980; Kleeman and Lovering, 1967).

## RESULTS AND DISCUSSION

It has generally been established that ecological habitat plays a dominant role in the absorption of uranium by various plant species. Hydrophytes absorb much more uranium as compared to xerophytes and mesophytes (Nagpal, Nagpal and Bhan, 1974; Virk and Harinder, 1979). From our experimental results (Table 1) it is observed that uranium content in Artemisia sp., a member of mesophyte group, is 28.31 $\pm$ 0.82 ppm which is higher than uranium content of hydrophyte group. Value of uranium content reported for this plant growing in Khillenmarg, Kashmir Himalayas is as low as 0.05 ppm (Koul and Chadderton, 1980). This anomaly is an evidence in favour of Artemisia sp. as an indicator plant for uranium prospecting in Siwalik Himalayas.

TABLE 1 Uranium Content in Plant Species

| Ecological Group | Plant | U Content(ppm) |
|---|---|---|
| Mesophytes | Artemisia sp. | 28.31 $\pm$ 0.82* |
| | Nicotiana tabacum sp. | 18.30 $\pm$ 0.66 |
| | Nasturtium sp. | 9.49 $\pm$ 0.47 |
| | Commelina sp. | 7.60 $\pm$ 0.42 |
| Hydrophytes | Vallisneria sp. | 18.87 $\pm$ 0.68 |
| | Polemogeton sp. | 10.54 $\pm$ 0.50 |

* Statistical counting error is 1 $\sigma$
U content of standard glass is 20 ppm

Uranium content in most of the water samples from the channels varies from 0.2 to 2 ppb. Again, a large anomaly is observed in two samples collected from a channel flowing through the mineralized zone with uranium content as high as 14 ppb and 74 ppb respectively. These results are further corroborated by rock samples analysis. Uranium content in conglomeratic sandstones varies from 0.009 % to a maximum of 0.06 % depending on the location of samples. Thus we conclude that the anomaly in uranium concentration of plants, water and rock samples supports our correlation hypothesis which can be exploited for uranium prospecting and exploration in developing countries.

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