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NATURAL RADIOACTIVITY MEASUREMENTS IN SOME SIWALIK VERTEBRATES USING FISSION TRACK TECHNIQUE

B.S. Bajwa and H.S. Virk
Department of Physics
Guru Nanak Dev University, Amritsar - 143005, India

ABSTRACT

Uranium, thorium and their daughter products are significant sources of natural radioactivity in the environment. They may constitute health hazard effects if their concentrations are considerably high enough. Uranium and thorium concentrations in the geological samples are helpful for study of environmental pollution, geochemical exploration and for establishing a correlation between uranium and elemental composition of vertebrates. The results of uranium content of some fossil bone samples collected from Siwalik Himalayas are reported in this paper. Uranium concentration of Siwalik vertebrates are estimated by the fission track technique, using solid state nuclear track detectors (SSNTDs). The uranium concentration in these samples has been found to be varying from 20-55 ppm, which is quite low as compared to uranium contents observed in the fossil bones from the uranium mineralised zones.

1. INTRODUCTION

Fission track technique using solid state nuclear track detector (SSNTD) because of its simplicity and applicability has attracted many users in diverse fields such as anthropology, archeology, biology, medical sciences and industrial technology (Fleischer et al., 1975). The heaviest naturally occuring trace element, uranium plays an important role in these investigations. The technique has already been well exploited by various authors (Fleischer and Lovett, 1968; Ramola et al., 1988; Fischer, 1970; Singh et., al., 1986, 92) for trace determination of uranium in water, rocks and fossil-bones etc.

In India the Siwalik system of deposits is known to enclose a rich collection of petrified remains of animals of the vertebrates sub-kingdom. The secondary enriched uranium in the Siwaliks of Himachal Pradesh, Cretaceous-Eocene sediments of Maghalaya and the Gondwanas of Satpura basin has been observed (Udas et. al., 1977; Pyddoke, 1963). These Siwalik vertebrate fossils from Himalaya are known to contain uranium varying from a few ppb to as high as few thousand ppm, (Lahoud et al., 1966; Szabo et al., 1970). Dar (1972) has reported the presence of Uranium in Siwalik fossil remains of Elephas, Mastodon, Stegodon and Bos with U_3O_8 percentage varying from 0.003 to 0.005%. Later Udas and Mahadevan (1974) reported that vertebrate fossils from upper Siwalik contain uranium as high as 0.34%, with no thorium and also have

reported that the uranium is fixed in these bones from circulating ground water. These uranium enriched water solutions, besides fixing up uranium in fossil bones during fossilzation possibly deposited their uranium in Siwalik sandstones wherever the reducing environment for precipitation was available.

Various authors (Sahni et al., 1983; Sharma et al., 1983) have suggested the possible mechanism for uranium enrichment and it has been suggested that studies on spatial distribution and concentration of uranium in fossil bones from different stratigraphic levels of Siwalik rocks and bones might help in the discovery of new uranium occurences, better enriched in uranium.

In the present investigations the fossil-bone samples from the Siwalik system deposits of the NW Himalaya, has been collected from Nadha Sahib, Haryana and have been analysed for uranium concentration using the homogenised fission track method.

2. EXPERIMENTAL

For uranium estimation in these samples, the homogenised fission-track technique suggested by Fisher (1970) has been utilised. In this method accurately weighted sample powder of the material was homogeneously mixed with methyl cellulose powder used as a binding material, free from uranium, in the ratio of 1:2 by weight. From 150 mg of this mixture a thin pellet of about 1mm thickness and 1.3 cm diameter was made by using a pellet making machine. Pellets of standard glass of known uranium conc. were also made in exactly similar manner, each of these pellets was sandwitched between a pair of plastic track detector (Lexan). All these pellets of samples of the standard were enclosed in an aluminium can and irradiated with thermal neutron from a reactor at BARC, Bombay. After irradiation the detector disks having latent fission track were separated from the pellets and were etched under appropriate etching conditions to reveal the fission tracks. The tracks were scanned and the densities measured using the Olympus binocular microscope. A comparison of the induced fission track densities recorded in Lexan, covering the unknown and standard pellts gives the uranium content in the sample, obtained by the following equation (Fisher, 1977) :

$$U_x = U_s (\rho x/\rho s)$$

where the subscript x and s stands for unknown sample and the standard respectively and ρ is the induced fission track density.

3. RESULTS AND DISCUSSION

Results of the fission track analysis for uranium content of fifteen vertebrate fossil bone samples collected from the Nadha Sahib location, Haryana are reported in Table 1. As can be seen from the table, that the uranium content of these sample is varying from 20-55 ppm, showing the natural radioactivity in the fossil bones.

This concentration observed in these samples is much below the values of the uranium content of the fossil bones from the locality of Nalagarh, Himachal Pradesh where they are reported to have uranium content varying from 130-418 ppm (Singh et

al., 1986), and these values are considered as anomalous uranium content. Sahni et al., 1983 have indicated that the uranium content in fossil calcified tissues, irrespective of

Table 1. U concentration by fission track analysis in the fossil bone samples of Nadha Sahib, Haryana.

Sample No.	Location	U_f(ppm)
N1		30.3
N2		19.5
N3		20.8
N4		23.8
N5		28.6
N6		25.3
N7		22.4
N8		51.0
N9		27.9
N10		35.2
N11		24.8
N13		45.7
N14		29.8
N15	Nadha Sahib Area	24.9
N24		31.1
N25		29.5
N26		28.2
N29		26.7
N30		37.9
N31		24.9
N32		31.4
N33		43.0
N34		32.1
N35		53.2
N37		54.9
N38		40.5
N39		49.4

the age is controlled by availability of uranium in contemporary environment in which the vertebrate lived and the nature of mineralizing solution acting as the carrier of uranium and further that the vertebrate fossil bones with anomalous uranium content can be used as indicator for the uranium mineralisation. But observed uranium content in the fossil bones is even much below the background-threshold level in the bones which is around 54 ppm (Singh et al., 1986). Therefore the Nadha Sahib in particular is not a radioactivity rich or anomalous zone, but in order to have more authenticity of the results, the investigations of the radio activity of soil, rocks and water samples of this location are also suggested.

GEOLOGICAL CONSIDERATIONS

Siwalik of NW Himalayas are a thick sequence of fluvial, lacustrine and floodpain type of sediments, deposited in a foredeep to the south of rapidally rising Himalayas. The detritus is apparently brought from the Himalayas, where the Precambrian crystallines are known to contain uraniferous zones. The Siwalik sediments contain in general. 3-10 ppm uranium which is much higher than the world averages of 2.1 ppm in greywacks an 1.5 ppm in arkoses (Wedepohl, 1978). Uranium occurrences (0.02-0.6% U_3O_8) are found at several localities close to lower-middle and middle upper Siwalik interfaces over a 70 km stretch in Asthota-Ramera-Nalagarh track (Himachal Pradesh), Udas et al., 1977. Thus this high uranium content in the sedimentaries of this zone might be reason for very high value of the uranium in the fossils from the Nalagarh area, which has been reported as high as 400 pm (Singh et al., 1986).

Even the value of uranium content in fossils bone samples from the Nadha Sahib, Haryana corroborates the results reported by Udas as Mahadevan (1974), that the upper Siwalik sandstones hosting the fossil are poorer in Uranium and considering their high porosity and permeability, it seems possible that the Uranium from them may have leached away by ground water action, and in the event of its having migrated to subsurface zones favourable for precipitation of uranium, such zones would be of interest for exploration.

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