

# Study of radioactive tracer in soil sample of Yamuna Bank at Delhi, India

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**Abstract :** The earth's crust since its genesis has contained radionuclides with long half-lives, such as nuclei of uranium thorium series and <sup>40</sup>K. Radioactivity of these nuclei causes natural radiation. Delhi is the capital of India located in the Northern part of India. Due to industrial affluent natural radioactivity rises in the river while it passes through the metro city. Therefore, measurements of radioactivity are necessary to keep tab on the industrial effluents as the Yamuna water is being used for irrigation purposes also. This affects the human habitants as well since radionuclides in soil contribute towards

a significant component of the background radiation exposure to the population. The present study focusses on activity measurements i.e., concentrations of naturally occurring <sup>40</sup>K, <sup>238</sup>U, and <sup>232</sup>Th radionuclides, in soil samples collected from Yamuna bank near Sadar Bazar Delhi, India. For carrying out experiments we have taken help of Nuclear Security Education Laboratory at Amity Institute of Nuclear Science & Technology (AINST) setup in collaboration with the Centre for Nuclear Security Science and Policy Initiatives (NSSPI) at Texas A & M University (TAMU), and Oak Ridge National Laboratory (ORNL). The activity of radionuclides in soil from different location from the study area were measured by means of gamma spectrometry with Radioidentifinder (RIID) having a NaI(Tl) detector where the dimension of NaI(Tl) crystal is 1.2"x1". The activity in soil samples showed variation, which led to measurement of specific activity and gamma ray absorbed doses of the naturally occurring radionuclides, taking the efficiency of detector into consideration

## 1. INTRODUCTION:

Amity Institute of Nuclear Science & Technology (AINST), Amity University Uttar Pradesh (AUUP) in collaboration with the Center for Nuclear Security Science and Policy Initiatives (NSSPI) at Texas A & M University (TAMU), Oak Ridge National Laboratory (ORNL) and supported by Defense Threat Reduction Agency (DTRA), are jointly established the Nuclear Security & Educational Laboratory.

Environmental radiation measurements aim to determine the dose of radiation exposure from environmental sources and to evaluate the health risks posed by radiation. Similar studies has been conducted in the region periodically in the region in order to update the previous studies and to update any changes[1]. It is important to determine natural radioactivity of  $^{40}\text{K}$ ,  $^{238}\text{U}$  and  $^{232}\text{Th}$  radionuclides.

**Study Area:**

Delhi is capital of India located in northern region of Indian Ocean between  $28.7041^\circ$  N of latitude, and  $77.1025^\circ$  E longitude. The population of Delhi is 32,941,000, [1] the surface area being,  $1483 \text{ Km}^2$  and  $783\text{Km}^2$  designated rural and  $700\text{km}^2$  urban. Yamuna river flows through the capital region, which is one of the sources of drinking water, hence the study.

Sample Name	District	N	E
Ganesh Ghat	DELHI	$20.4603^\circ$	$85.86211^\circ$
Old Iron Bridge	DELHI	$26.61381^\circ$	$92.84764^\circ$
Kalindi Kunj	DELHI	$28.54338^\circ$	$77.3103^\circ$

Table 1: Location of the study area from where the sample were collected.

**2.Sampling:**

The samples were collected by conventional methods from the afore mentioned places, were left to dry for seven days under laboratory condition, the dried and clumped soil sample was sieved to obtain homogenous and fine sized particles. The net weight of the samples were around 500g. The samples were transferred into beaker and sealed to prevent the escape of radon gas. The soil samples were rested for seven days to allow the radon gas in the soil to reach equilibrium.

**3. Analysis:**

A  $1.2" \times 1"$  NaI(Tl) detector with Radioidentifinder (RIID) was utilized in gamma ray spectrometry, connected to an 2048-channel Multichannel Analyser (MCA). The resulting spectrum was analyzed using CANDLER software [3]. Data was acquired in tool kit format and subsequently converted into a

two-column format before being converted into the RADWARE format. Energy and channel numbers were identified, and the experimental data was calibrated using  $^{133}\text{Ba}$ ,  $^{137}\text{Cs}$  and  $^{60}\text{Co}$  radioactive source. The resolution of the detector being 6% at 661.7keV. The data were collected for 72000 seconds for all the samples and background, to ensure sufficient statistics.

The background spectrum is shown in Fig. 1.

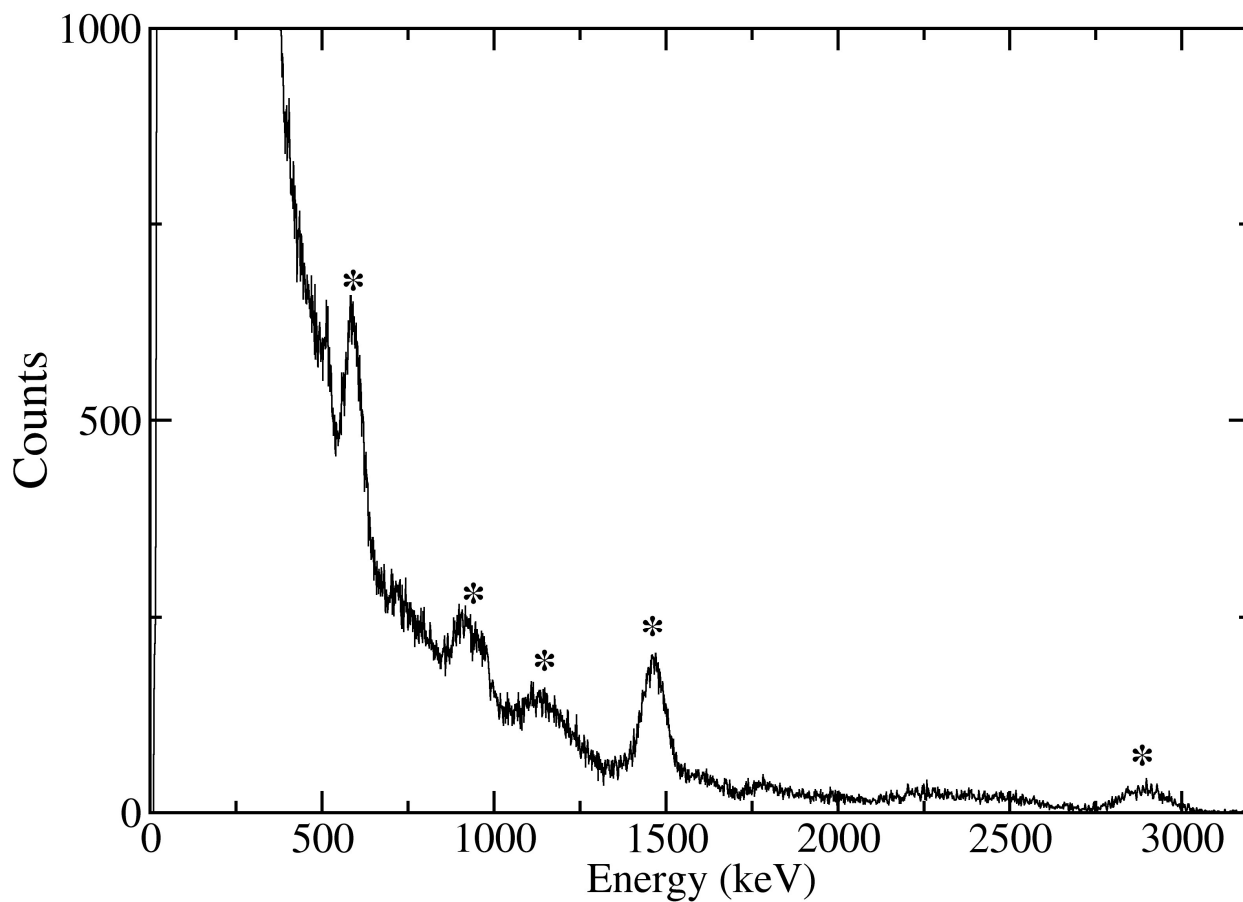


Fig 1: The background spectrum collected for 72000 seconds.

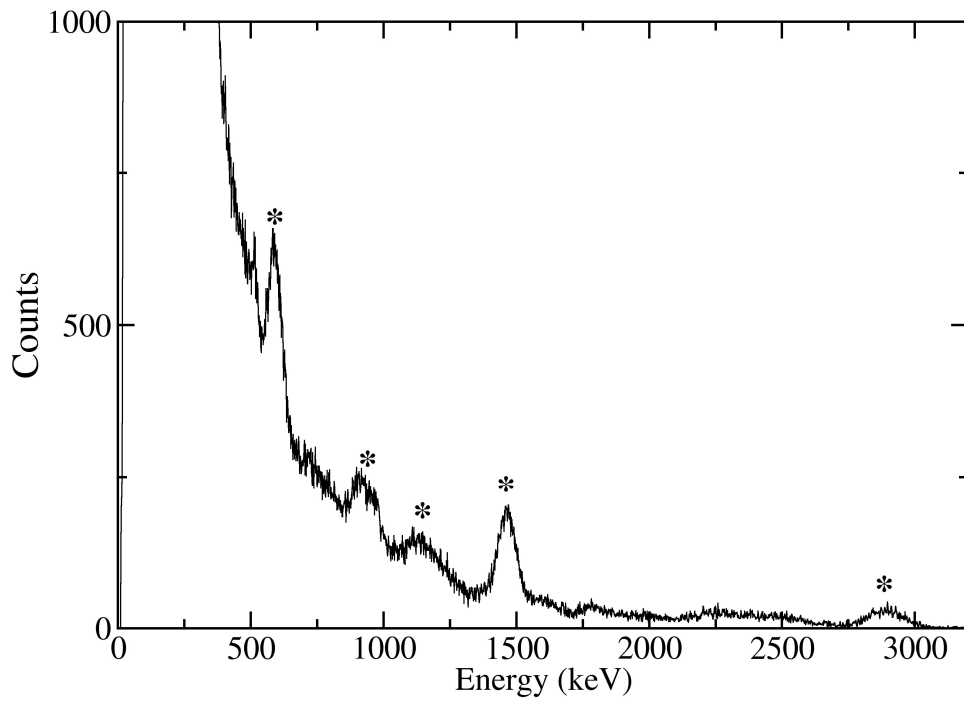


Fig 2: Spectrum from the sample collected from Ganesh Ghat.

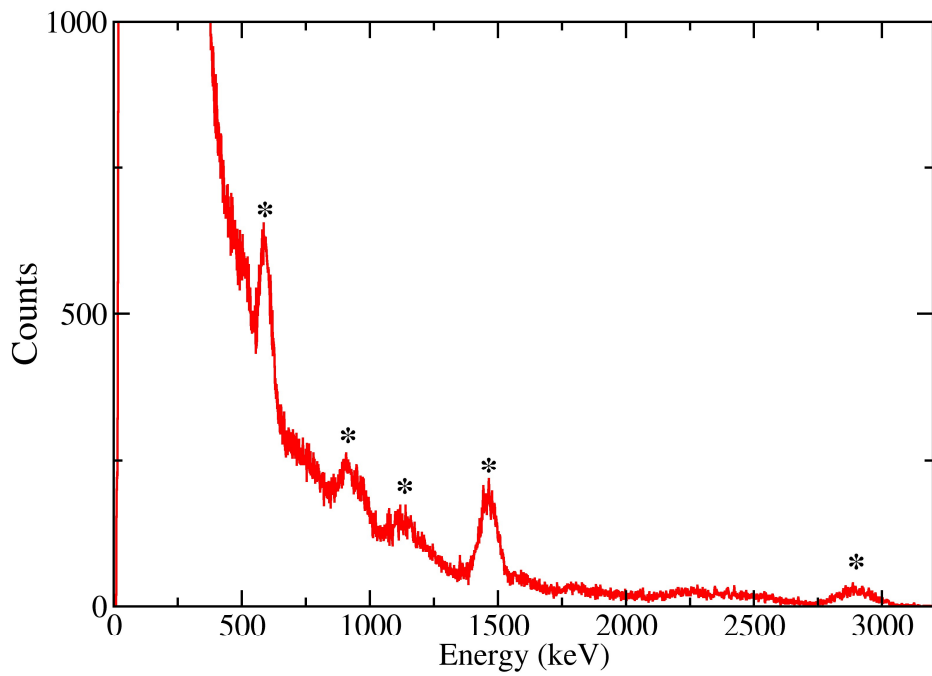


Fig 3: Spectrum from the sample collected from Kalindi Kunj.

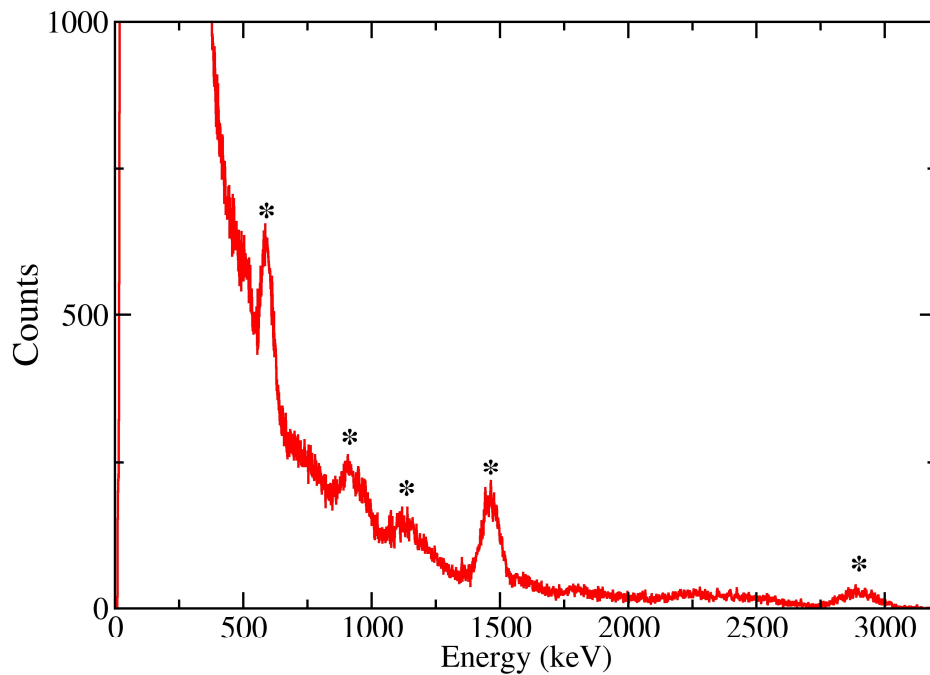


Fig 4: Spectrum from the sample collected from old iron bridge

### 3. Results and Discussions:

As can be seen from the figures the activity of  $^{40}\text{K}$  was determined using only the 1460.8 keV peak. Likewise, the activity of  $^{238}\text{U}$  and  $^{232}\text{Th}$  radionuclides were determined using the energy of their daughter products that occurred during the decay series. The prominence of 911.07 keV and 968.9 keV ( $^{228}\text{Ac}$ ) for  $^{232}\text{Th}$  is seen. When the spectrum of background is compared with that of the sample no extra activity is noticed there. As no extra radioactivity is found in the soil of bank of river Yamuna it is deemed as safe to be used for general purpose too.

### Acknowledgement:

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### Summary:

In this study, we conducted measurements to determine the radioactivity concentration of soil sample along the bank of river Yamuna with the help of Radioactive identifier (RIID) consisting of  $1.2'' \times 1''$  NaI(Tl) detector. Yamuna river being one of the sources of drinking water for the people of Delhi,

which being the Capital of India. As the background spectra was compared with that of the sample spectrum, no extra activity was found.

***Referenses:***

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[3] Ajith Kumar B. P. DAE conference, Vol 44B, 390 2001.