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A study of the concentration of uranium in soil samples was evaluated using the CR_39 detector in the south of Amara Governorate

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Abstract The quantity of uranium in soil samples taken from various residential, industrial, and agricultural areas in southern Iraq's Southern Omara governorate was evaluated using the neutron activation technique for solid-state nuclear track detectors CR-39. Uranium values in soil samples varied from 0.77 ppm to 1.94 ppm, according to the findings. Soil samples were collected at a depth of 10 cm. The outcomes were compared to publicly available data and found to be within acceptable ranges.

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Keywords: *Uranium; soil samples; neutron activation technique; CR-39; ppm*

1. INTRODUCTION

Uranium is a silvery, shiny metal with a lengthy half-life as a natural radionuclide. Uranium is the world's heaviest element. It is one of the most significant environmental dangers due to its radioactivity. Uranium and its compounds are very toxic, posing a threat to both human health and the environment [1-3]. Uranium is a common element that may exist as a solid, liquid, or gas. Food, water, soil, rocks, natural materials, and the environment may all contain it. When uranium combines with other elements, it easily creates uranium oxide, silicates, hydroxides, and carbonates [2,4]. The physiological action of uranium compounds is determined by their solubility. The chemical toxicity of soluble uranium is regulated, but the radiological properties of insoluble (less soluble) uranium are not. However, because of its slow absorption via the lungs and long retention time in human tissues, it will do the greatest harm to internal organs through radiological damage (cancer mortality risk) rather than a large chemical hazard to the kidneys [6]. Uranium may enter the human body through a variety of pathways. It enters the body directly either breathing uranium-containing dust particles or drinking uranium-contaminated water, or indirectly through the food chain from the fertile soil layer [1,7]. It is more effective to utilize a CR-39 detector for detecting uranium trace levels in geological and biological materials [1, 2, 8]. Because of the problem's importance and influence on the environment and human health, researchers looked at the concentration of uranium in soil samples [9-12]. The goal of this study is to use the neutron activation technique for nuclear track detectors CR-39 to assess the uranium content in chosen soil samples acquired from various residential, industrial, and agricultural sectors in Southern Omara governorate in southern Iraq. Due to a lack of prior research and the construction of a database on the number of uranium concentrations in soil samples, this study was conducted in the governorate of Southern Omara.

2. MATERIAL AND PROCEDURE

2.1. The Collecting Of Samples

In this study, 25 soil samples were obtained from 25 distinct places in southern Iraq's Southern Omara governorate, one from each (see Fig.1). earth samples were taken at a depth of 10cm into the earth. The research areas, which included residential, agricultural, and industrial zones, are depicted in Table 1. The required quantity for the fission-track analysis technique was acquired after cleaning 25 soil samples and removing stones, pebbles, and root parts. Polypropylene containers labeled with sample codes were used to store the samples.

2.2. Experimental Method

A solid state nuclear track detector (CR-39, Pershore Moulding Ltd, UK) was used to determine the uranium content of soil

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samples. After drying in an electric oven at 70°C for 6 hours, the soil samples were pulverized with a grinder. As a binder, (0.5 g) powder soil was mixed with (0.1 g) methylcellulose. The mixture was crushed into a pellet using a manual piston with a diameter of 1 cm and a thickness of 1.5 mm. A (1.5*1.5 cm) CR-39 track detector was covered on both sides of the pellets. The pellets were then irradiated for 7 days in a paraffin wax dish at a distance of 5 cm from the neutron source (Am-Be) with a thermal flounce of (3.024105 n.cm-2.s-1) to create latent damage on the detector caused by the 235U reaction (n,f). Following irradiation, the detectors were chemically etched in (NaOH) solution under controlled circumstances, as previously described [1,13]. The density of induced fission tracks were measured using a 400 magnification optical microscope, and the tracks were seen using an optical camera. As demonstrated in Equation 1, the density of fission tracks (ρ) was estimated by dividing the average of tracks by the area of field view.

Track density (ρ×) = average of track / area of field view ……(1)

2.3. Calculation

The uranium content of soil samples was estimated using the previously stated equation [1,2] by comparing track densities observed on the detector of soil samples to those discovered on the detector of reference samples.

$$Cx = Cs\ \rho x / \rho s \quad \ldots\ldots\ldots\ldots(2)$$

Where ρx and ρs are the induced fission track densities in (tracks/mm2) for unknown and standard samples, respectively, and Cx and CS are the uranium concentrations in (ppm) for unknown and standard samples, respectively.

Figure1*:shows the locations where samples were obtained in the Southern Omara Governorate*

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***Table 1**: Using ICP-MS, to determine the concentration of uranium in soil samples from Southern Omara Governorate regions.*

Sites numbers	Sites	Tracks density(tracks/mm^2)	Uranium Concentration in ppm
S1	Aluzair1	415.31	1.01±0.36
S2	Qaleuh Salih1	481.10	1.17±0.32
S3	Qaleuh Salih2	419.42	1.02±0.37
S4	Qaleuh Salih3	341.29	0.83±0.23
S5	Qaleuh Salih4	529.12	1.44±0.38
S6	Qaleuh Salih5	637.36	1.55±0.39
S7	Qaleuh Salih6	649.69	1.58±0.42
S8	Alsalam1	386.52	0.94±0.27
S9	Alsalam2	375.01	0.912±0.24
S10	Alsalam3	666.14	1.62±0.44
S11	Alsalam4	355.27	0.864±0.23
S12	Alsalam5	797.72	1.94±0.54
S13	Alsalam6	326.90	0.79±0.25
S14	Alkhayr1	464.65	1.13±0.44
S15	Alkhayr2	382.82	0.931±0.42
S16	Alkhayr3	670.25	1.63±0.42
S17	Alkhayr4	439.98	1.07±0.36
S18	Alkhayr5	355.68	0.865±0.32
S19	Alkhayr6	526.33	1.28±0.58
S20	Sayed Ahmed Alrifai1	575.68	1.4±0.45
S21	Sayed Ahmed Alrifai2	740.16	1.8±0.50
S22	Sayed Ahmed Alrifai3	509.88	1.24±0.51
S23	Sayed Ahmed Alrifai4	423.53	1.03±0.30
S24	Sayed Ahmed Alrifai5	316.62	0.77±0.16
S25	Sayed Ahmed Alrifai6	756.60	1.84±0.49

3. DISCUSSION OF THE FINDINGS

Table 1 shows the analytical data acquired from the soil samples, which are used in this investigation. The greatest uranium content in a surface soil sample was 1.94 ppm in sample S12 fromAlsalam, while the lowest was 0.77 ppm in sample S24 fromSayed Ahmed Alrifai, to have uranium concentrations in soil samples taken from the surface . The mean uranium concentration in Southern Omara governorate surface soil samples is below the permissible threshold indicated by [14]. The findings reveal that as soil depth increases, the amount of uranium in the soil decreases. The cause of such outcomes may be traced back to erosion processes and the washing away of soil surface layers. The highest amount of radioactivity is seen near the soil surface during the first months following soil contamination, where winds and rains can remove up to 90% of radioactive material [15]. In addition to the mineral composition of Iraqi soil, which contains a considerable amount of calcium carbonate, iron

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oxides, and aluminum, the interaction of these components with the solid component of the soil exposes the soil's capacity to retain radioactive contaminants and hinder their mobility.

Figure 2 *depicts the overall average uranium concentration in Southern Omara governorate soil samples as a function of location.*

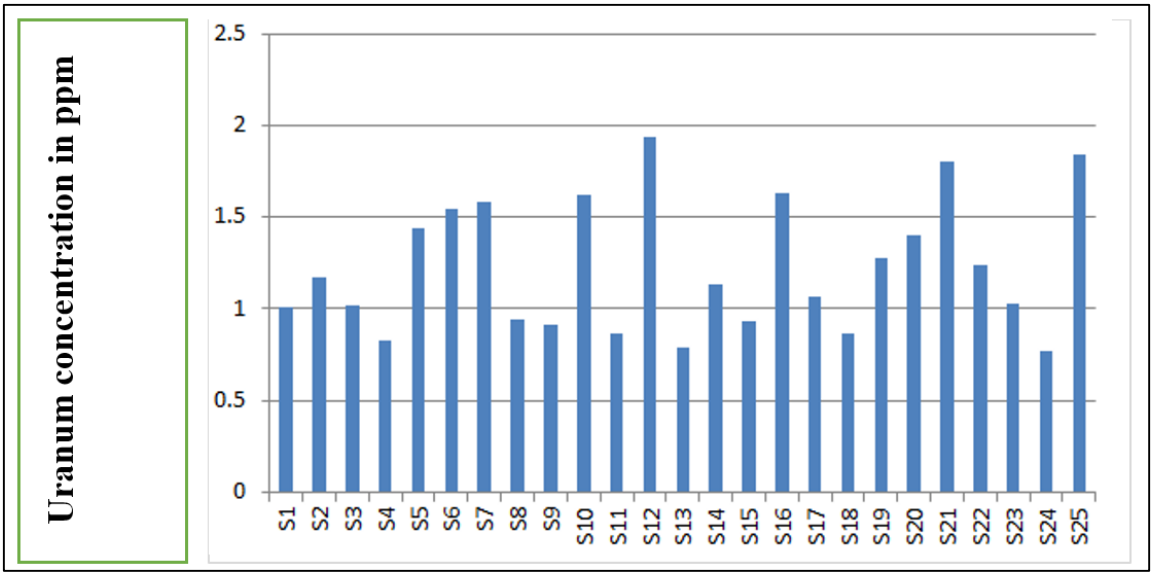

Fig. 2 *shows the average uranium content in soil samples as a function of geographic location*

Human activities and the exposure of some industrial zones to uranium contamination during the Gulf wars resulted in such results. The presence of uranium in agricultural soil samples may be linked to agricultural fertilizer use; the presence of uranium in soil samples is classed as industrial > agricultural > residential.

4. CONCLUSION

The uranium content of soil samples was determined using solid state nuclear track detectors (SSNTDs). The findings of this study revealed that the concentration of uranium increases in industrial regions more than in residential areas, although the results were within acceptable levels and do not cause worry at this time

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