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العدد الثالث

والأربعون

قياس تراكيز اليورانيوم في عينات التربة جنوب محافظة ذي قار باستخدام تقنية مطياف الكتلة (ICP-MS) بالبلازما المقترنة حديثاً

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## المستخلص:

استُخدم مطياف الكتلة بالبلازما المقترنة حديثاً (ICP-MS) لتحديد تراكيز اليورانيوم في عينات التربة السطحية المأخوذة من ثلاثة وعشرين موقعاً في الجزء الجنوبي من محافظة ذي قار، جنوب العراق. تراوحت تراكيز اليورانيوم المقاسة في مناطق الطار وكرمة بني سعيد وسوق الشيوخ والفهود بين ١,١ و ٣,٤ جزء في المليون. في جميع المواقع المدروسة، كانت مستويات اليورانيوم أقل بكثير من ١٠٠ جزء في المليون، مما يشير إلى أن اليورانيوم المكتشف يرتبط على الأرجح بمصادر خلفية متفرقة أو تلوث متبقٍ، وليس برواسب معدنية قابلة للاستغلال. علاوة على ذلك، أظهرت جميع العينات المأخوذة تراكيز يورانيوم أقل من عتبات الكشف والسلامة الموصى بها دولياً. ووفقاً للجنة الأمم المتحدة العلمية المعنية بآثار الإشعاع الذري (UNSCEAR)، فإن التركيز المسموح به لليورانيوم في التربة هو ١١,٧ جزء في المليون. تُظهر نتائج هذه الدراسة أن تراكيز اليورانيوم في التربة السطحية لمنطقة الدراسة أقل بكثير من هذا الحد، مما يشير إلى الحد الأدنى من المخاطر البيئية والصحية المرتبطة بوجود اليورانيوم في المنطقة التي تم التحقيق فيها.

الكلمات المفتاحية: اليورانيوم، التربة، البلازما (ICP-MS)



## Measurement of Uranium Concentration in the Soil Samples South of Thi-Qar Governorate Using ICP-MS Technique

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### Abstract:

Inductively coupled plasma mass spectrometry (ICP-MS) was used to determine uranium concentrations in surface soil samples taken from twenty-three sites in the southern part of Dhi Qar Governorate, southern Iraq. Measured uranium concentrations in the Al-Tar, Karmat Bani Saeid, Suq Al-Shuyuk and Al-Fuhud areas ranged from 1.1 to 3.4 parts per million (ppm). At all studied sites, uranium levels were well below 100 ppm, indicating that the detected uranium is most likely associated with sporadic background sources or residual contamination rather than exploitable mineral deposits. Furthermore, all analyzed samples showed uranium concentrations below internationally recommended detection and safety thresholds. According to the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the permissible concentration for uranium in soil is 11.7 ppm. The results of this study show that uranium concentrations in the topsoil of the study area are significantly below this limit, indicating minimal environmental and health risks associated with uranium in the area.

**Keywords:** Uranium, Soil, Plasma (ICP-MS)



## INTRODUCTION:

One of the most dangerous types of environmental pollutants is naturally occurring radioactive material, which has a direct and indirect impact on human health and the environment. Uranium is an element found on Earth and is therefore present in significant quantities in the environment, particularly in soil, rocks, and sediments. It is found in varying concentrations across a wide range of environments, depending on several factors, including local geology, the mineral and elemental composition of the soil and its weathering products, as well as various geochemical processes. Uranium (U) is a massive metal with a density of  $18.95 \text{ g/cm}^3$  and an atomic radius close to that of gold. Uranium has the highest atomic weight among the primordial elements, yet it is relatively weakly radioactive. Its density is higher than that of lead but lower than that of gold or tungsten. (Salman et al., 2022)

There are three major isotopes of natural uranium,  $^{238}\text{U}$ ,  $^{235}\text{U}$ , and  $^{234}\text{U}$ , with relative abundances of approximately 99.27%, 0.72%, and 0.005%, respectively. (Efficiency and Speed, 2023) (Al-Hamzawi et al., 2015) The average uranium content in the Earth's crust is about 2 mg/kg. (Ahmed et al., 2024) However, reported values can range from 0.1 to 20 mg/kg, depending on the regional geology. High uranium content is often associated with specific mineralized areas, i.e., regions rich in gold and silver ores. (Ducry et al., 1993) (D.K. et al., 2001)

From an environmental and public health perspective, uranium is primarily harmful due to its toxic chemical effects, not its radioactive ones. Uranium, like most other heavy metals, can pose a health risk if ingested or inhaled, primarily through nephrotoxicity (Ahmed et al., 2024; Clareaux et al., 2019). Due to its wide distribution, specific isotopic properties, and sensitivity to geochemical processes, uranium has become widely used in earth and environmental sciences (Salman et al., 2022; Chan et al., 2013), such as in geochemical mapping (Baykara et al., 2006; Todorov et al., 2005), environmental pollution studies, and radiological risk assessment. Therefore,



accurate soil uranium analysis is essential for supporting environmental monitoring, regulatory compliance, and the assessment of potential human-caused contributions (Salman et al., 2022; Chan et al., 2013). This research contributes to environmental assessment for the protection of both the environment and human health and supports national efforts.

### **EXPERIMENTAL TECHNIQUE:**

Collection of samples Soil (Top): The samples were gathered from twenty-three areas located in the southern region of Thi Qar Governorate, Southern Iraq. The concentrations of the major and trace elements in collected sediments were determined by inductively coupled plasma mass spectrometry (ICP-MS). (Ahmed, et al., 2024) ICP-MS is an extremely sensitive instrument for the detection and accurate quantification of several elements. This technique, introduced into commercial practice in 1983, has found widespread application in analytical facilities owing to its availability for multielemental analysis of elements and particularly rare earths with high sensitivity. (Algrifi, et al., 2023) The most important superiority of ICP-MS is the capability for simultaneous multi-element analysis with high precision. However, this technique has limitations, because it cannot be used to evaluate all elements at once. It is usual that current ICP-MS analysis techniques are capable of accurately determining only a few elements, normally from seven to twenty, depending on the isotopic nature and the dynamic range and concentration ranges for such elements.

### **Collection of soil samples:**

Twenty-three soil samples were collected from the southern region of Thi-Qar Governorate. Sampling was carried out at twenty-three different locations selected based on specific criteria, including former or active military areas, agricultural sites, and residential areas. The collected samples were oven-dried at 70°C, then mechanically ground and sieved through a 75- $\mu\text{m}$  sieve to ensure homogeneity. (Baykara, et al., 2006; Todorov, et al., 2005)

As portrayed in Fig.1, the research was designed to evaluate the uranium hazard and compare its level specifically in collected soil samples of varying sites from southern Thi- Qar Governorate-Iraq.



**Fig(1):** South of Thi-Qar Governorate, the points represent the sampling locations from the numbering at the station number (S)

## RESULTS AND DISCUSSION:

Table 1: The results of uranium concentration accepted temperatures measured in this work at different locations, within southern Thi Qar Governorate and the south of Iraq. Three types of substitutions were tabulated (from S1 to S23). The highest level of uranium was recorded in the southern Thi-Qar Governorate town of Suq al-Shuyuk at 3.4 parts per million, while the lowest level of uranium was found in the Karma Banished district, the south-western part of Basra province, with 1.1 parts per million,



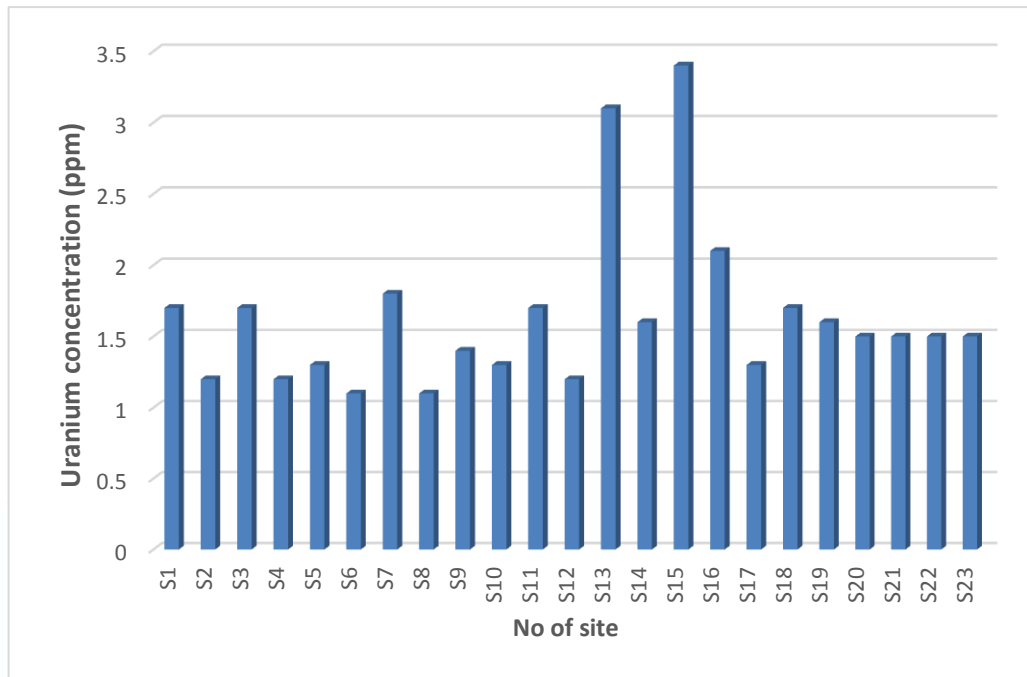
according to scientists involved in the survey. Based on 21 concentrations  $>1$  ppm, the concentration varied between 1.1 and 3.1 ppm. The US Environmental Protection Agency (EPA) has set the maximum allowable amount of uranium in drinking water as hard to be about 30 mg/L, so surveillance on U levels in different parts of the environment is important because of its potential effects. Inductively coupled plasma atomic emission spectrometry (ICP-AES) works for this, but small and outport companies have depended for years on uranium to make their bulk assays with continually poor results. In addition, since levels of uranium are estimated, the precision of the alpha spectroscopy method is used.

**Table (1):** Measurements of Uranium concentration in soil samples from different areas of South of Thi-Qar Governorate by using ICP-Mass

| No | No of site | Location of samples (Area name) | Location type of samples (Area type) | Concentration of uranium in Soil by (ppm) |
|----|------------|---------------------------------|--------------------------------------|---|
| 1  | S1         | Al-Tar                          | Agricultural area                    | 1.7                                       |
| 2  | S2         | Al-Tar                          | Agricultural area                    | 1.2                                       |
| 3  | S3         | Karmat Bani Saeid               | Residential and agricultural area    | 1.7                                       |
| 4  | S4         | Karmat Bani Saeid               | Residential and agricultural area    | 1.2                                       |
| 5  | S5         | Karmat Bani Saeid               | Residential and agricultural area    | 1.3                                       |
| 6  | S6         | Karmat Bani Saeid               | Residential and agricultural area    | 1.1                                       |
| 7  | S7         | Karmat Bani Saeid               | Residential and agricultural area    | 1.8                                       |
| 8  | S8         | Karmat Bani Saeid               | Residential and agricultural area    | 1.1                                       |



|    |     |                   |                                   |     |
|----|-----|-------------------|-----------------------------------|-----|
| 9  | S9  | Karmat Bani Saeid | Residential and agricultural area | 1.4 |
| 10 | S10 | Karmat Bani Saeid | Residential and agricultural area | 1.3 |
| 11 | S11 | Karmat Bani Saeid | Residential and agricultural area | 1.7 |
| 12 | S12 | Karmat Bani Saeid | Residential and agricultural area | 1.2 |
| 13 | S13 | Suq Al-Shuyuk     | Residential and agricultural area | 3.1 |
| 14 | S14 | Suq Al-Shuyuk     | Residential and agricultural area | 1.6 |
| 15 | S15 | Suq Al-Shuyuk     | Agricultural area                 | 3.4 |
| 16 | S16 | Suq Al-Shuyuk     | Residential area                  | 2.1 |
| 17 | S17 | Suq Al-Shuyuk     | Agricultural area                 | 1.3 |
| 18 | S18 | Suq Al-Shuyuk     | Residential and agricultural area | 1.7 |
| 19 | S19 | Suq Al-Shuyuk     | Residential area                  | 1.6 |
| 20 | S20 | Suq Al-Shuyuk     | Residential area                  | 1.5 |
| 21 | S21 | Suq Al-Shuyuk     | Residential area                  | 1.5 |
| 22 | S22 | Suq Al-Shuyuk     | Residential area                  | 1.5 |
| 23 | S23 | Al-Fuhud          | Residential area                  | 1.5 |



**Fig(2):** Uranium Concentration in soil samples from different areas of South of Thi-Qar Governorate analysis by ICP- Ms

## CONCLUSION:

This study is the first to record uranium concentrations in soil sources in Thi-Qar Governorate, Iraq. Analysis revealed that soil samples collected from the study area often had high visible uranium content. The results showed a strong correlation between uranium and certain chemical elements in the soil. The well-being of humanity closely relies on healthy soil, which makes this a relevant issue in the public health context. The preservation of non-polluted soil and the filtration of water may also have an effect on soil quality. Efficient management of the watersheds and pollution prevention methods that avoid soil-polluting substances being added are important to protect the soil resources. Samples S15 recorded the highest U concentration of 3.4 ppm while other samples were below. Analyte Sidwa338



Plant p (ppu Ag49 sIDIMeLsED Measurement Colour depth CC814  
Remarks Lower Additional eRedpHe Fuel stain b14 A Rev, Surge, Ki), Cw  
Movie Light blue comtun(sad, Patwi, Gtimi)t:, THHLED DlarImagineproxie  
and BrGammaFilmtransferforObserv Red DBLT IN-  
1/mYIIIE/MIIIAN/TAY/PALPAE/201 The /17tarLediggrude mSalLibind  
Celesta trope(Kakati, et al., 2013)the population living in Suq Al-Shuyuk is  
considered the most uranium-contaminated compared to other areas because  
of the high concentration of uranium that is found within their soil. While  
uranium levels elsewhere seem fine, every care should be taken.  
(UNSCEARSources, 1993)

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