

# The Quantity of Uranium in Soil Samples Collected from Particular Sites Within the North Maysan Governorate Using ICP-MS

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## ABSTRACT

In this particular investigation, 30 surface soil samples taken from various locations across North Maysan governorate were analyzed using ICP-MS (inductively coupled plasma mass spectrometry), several of which the researchers know, have been analyzed for an initial time. Uranium was investigated in soils in concentrations ranging from 0.52  $\mu\text{g.mL}^{-1}$  (Almajar Alkabeer 4) to 1.91  $\mu\text{g.mL}^{-1}$  (Almajar Alkabeer5). The results are presented and compared with the ones from a different study. The soil samples that were studied had less than 100  $\mu\text{g.mL}^{-1}$  of uranium, which shows that they are composed of overloads and garbage rather than mineable stocks. This article describes and assesses the uranium content in the North Maysan Governorates. Additionally, all 30 exposed earth samples had uranium below the detection threshold. The results show that the samples of surface soils under investigation have uranium concentrations below the allowable limit (11.7  $\mu\text{g.mL}^{-1}$ ) established by UNSCEAR in 1993.

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## INTRODUCTION

The earth's crust contains uranium, which may also be found in varying amounts in the soil, sand, and rocks in various regions of the planet. Uranium, a heavy metal with a density of 18.95  $\text{g/cm}^3$  (1.7 times more than lead's density of 11.35  $\text{g/cm}^3$ ), is represented by the letter (U). Uranium is both a chemical and a radioactive element. Metallic uranium has a high melting point (1132 °C) and boiling point (4131 °C), is chemically extremely reactive, and has a strength that is comparable to most steels [1]. There are three isotopes of uranium in nature. The percentages of

$^{238}\text{U}$ ,  $^{235}\text{U}$ , and  $^{234}\text{U}$  in the bulk are 99.276 percent, 0.718%, and 0.0056 percent, respectively [2-4]. The earth's crust contains between 0.1 to 20 mg from the organic metal uranium each kg. It happens far more often than gold or silver. Human health will be harmed consequently. The greatest threat to health is not radiation exposure but rather uranium's chemical toxicity [5-8]. The substance's toxicity was contrasted with that of lead. Numerous earth science disciplines have made extensive use of chemical and isotopic uranium abundances to investigate both physical and biogeochemical processes [9].

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Low uranium concentrations and the predominance of  $^{234}\text{U}$  in most natural samples, however, limit many uses due to measuring difficulties. For measuring uranium radionuclides, alpha specimen techniques have been employed for five decades [10, 11], but enormous sample needs and the introduction of equipment with noticeably improved performance and precision have rendered alpha counting methodologies outdated. To measure the concentration of uranium, inductively coupled plasma atomic emission spectrometry (ICP-AES) is widely utilized. However, several samples and extended testing times frequently produce trustworthy findings since uranium is extremely sensitive to these methods. Furthermore, alpha spectrometry's precision only allows for an approximate calculation of uranium levels. Mass spectrometry provides one of the greatest alternatives to the prior techniques due to its outstanding sensitivity and accuracy [12, 13]. Its major goal is to investigate all the many relationships, dealings, and risks related to soil samples. The research area is situated in North Maysan Governorate of Iraq.

## PROCEDURE & MATERIALS

### Soil Sample Collection

Thirty samples of soil distributed in: Maysan University1; Maysan University2; Maysan University3 ; Hay Aljameea 1; Hay Aljameea 2; Hay Aljameea 3; Hay Aljameea 4; Control of Baghdad1; Control of Baghdad2; Control of Baghdad3; Control of Baghdad4; Control of Baghdad5; Control of Baghdad6 ;Control of Baghdad7;Control of Baghdad8; Control of Baghdad9; Military airport1; Military airport2; Military airport3; Military airport4; Military airport5; Military airport6; Military airport7; Military airport8; Military airport9; Almajr Alkabeer1; Almajr Alkabeer2; Almajr Alkabeer3; Almajr Alkabeer4; Almajr Alkabeer5. (5–15cm) deep when tests were cleaned in Omara Governorate, a study location in the North. The materials were subsequently ground into a powder, filtered using a mesh with a particular size of  $75\mu\text{m}$  [7], and dry for a few hours in a furnace set to  $70^\circ$ .

### Plasma-Source MS

The ICP-MS approach combines two technologies: high-sensitivity ion sensor technology (MS) and ion source technology (ICP). Ionizing source input systems and ICP are the same for ICP-OES and ICP-MS. Plasma-generated ions are transferred to a highly vacuumed MS region through a sampler and a skimmer cone in the case of ICP-MS. An ion optic system is used

to concentrate on the ions in the MS and measure the mass-to-charge ratios of the ion(s) of interest. A traditional quadrupole mass spectrometer (MS) can only pass ions with a specified mass-to-charge ratio via its mass filter. Ions flowing through the MS are converted into an ion detector, which converts the ionic power into a power source and allows the analyzed amount to be measured. During multi-element study, the settings may be modified to make space for new ions with varying mass-to-charge ratios to flow through the detector. A single-element sequential analysis is used in ICP-MS multi-functional analysis. The ICP-MS offers benefits over other approaches in terms of sensitivity, detection, and simultaneous U-concentration and U-isotope ratios. The most exact ICP-MS measurement is U, which employs a method known as the analytical isotopes diluting approach. Several studies have employed the FI technique for U preconcentration and determination by isotope dilution method to increase sensitivity, accuracy, and detection capabilities [12, 13].

## OUTCOMES & DISCUSSION

The findings for the uranium content in soil samples taken for this inquiry from numerous sites in the north Maysan Governorate, South Iraq, are shown in Table 1. Table 1 and Figure 1 reveal that the uranium levels in these soil samples were lower than those reported by the United States Environmental Protection Agency (EPA) in the United States. The findings for these 30 samples were classified into 30 categories ranging from S1 to S30. had the Almajr Alkabeer5 greatest uranium level ( $1.91\ \mu\text{g}\cdot\text{mL}^{-1}$ ), whereas beyond 10 m (Almajr Alkabeer4) had the lowest ( $0.52\ \mu\text{g}\cdot\text{mL}^{-1}$ ). The US Environmental Protection Agency (EPA) determined the maximum contamination limit (MCL) for uranium, which is roughly  $30\ \mu\text{g}\cdot\text{mL}^{-1}$ . Environmental samples must be tested for uranium levels on a regular basis.

Uranium content is commonly determined using plasma atomic emission spectrometry (ICP-AES) and inductively linked alpha spectrometry. However, due of how sensitive to uranium these technologies are, it typically requires a significant number of objects and measurements durations to provide accurate findings. Furthermore, only an approximate assessment of the uranium quantity is possible due to the alpha spectrometric accuracy. Specific mass spectrometry is one of the finest alternatives to these techniques, having good sensitivity and precision [12, 13]. Hashim and Najam (2015) conducted research in which they compared the results of the investigation [11]. Testing

was done on the uranium, radium, and radon content of construction materials from Iraq. Uranium levels in these samples ranged from 0.074 to 5.055  $\mu\text{g.mL}^{-1}$ , with a mean of 0.755  $\mu\text{g.mL}^{-1}$ . It is vital to determine

the uranium ratio based on a variety of various factors. Nuclear weapons are still present in certain locations bordering the Middle Maysan Governorate because of the ongoing conflict [11].

**Table 1**

Using ICP-MS, to determine the concentration of uranium in soil samples from Middle Maysan Governorate regions

Sites numbers	Sites	Uranium Concentration in $\mu\text{g.mL}^{-1}$
S1	Maysan University 1	0.63
S2	Maysan University 2	0.75
S3	Maysan University 3	0.69
S4	Hay Aljameea 1	0.68
S5	Hay Aljameea 2	0.54
S6	Hay Aljameea 3	0.6
S7	Hay Aljameea 4	0.66
S8	Control of Baghdad 1	0.66
S9	Control of Baghdad 2	0.68
S10	Control of Baghdad 3	0.6
S11	Control of Baghdad 4	0.59
S12	Control of Baghdad 5	0.55
S13	Control of Baghdad 6	0.6
S14	Control of Baghdad 7	0.59
S15	Control of Baghdad 8	0.8
S16	Control of Baghdad 9	0.62
S17	Military airport 1	0.61
S18	Military airport 2	0.76
S19	Military airport 3	0.56
S20	Military airport 4	0.79
S21	Military airport 5	0.68
S22	Military airport 6	0.63
S23	Military airport 7	0.54
S24	Military airport 8	0.62
S25	Military airport 9	0.63
S26	Almajr Alkabeer 1	0.55
S27	Almajr Alkabeer 2	0.7
S28	Almajr Alkabeer 3	0.6
S29	Almajr Alkabeer 4	0.52
S30	Almajr Alkabeer 5	1.91



Fig. 1. Uranium concentrations in soil samples collected from several sites in north Maysan as determined by ICP-MS analysis

## CONCLUSION

The North Maysan region of Iraq has never had soil sources with amounts of uranium before, according to this study. Oftentimes, soil specimens from the investigating area are heavily mineralized. The test reveals a strong positive association between uranium and certain chemical components in soil samples. Healthy people depend on safe land samples, which is a serious public health concern. By safeguarding the supply of raw soil samples and purifying soil water, high-quality soil samples might be preserved. The availability of unprocessed soil samples can be safeguarded by effective watershed management

approaches and pollution control measures that limit the introduction of unwanted materials into soil samples. The sample with the highest concentration of uranium, S 30, contained less than the maximum allowed in soil samples ( $1.91 \mu\text{g}\cdot\text{mL}^{-1}$ ). Almajar Alkabeer5 region, in contrast to other areas, has the greatest prevalence of uranium contamination, making nearby local residents there more susceptible to uranium exposure. Due to its higher contamination ratio compared to other areas, residents of this region (Almajar Alkabeer5) are more exposed to uranium from other locations.

### Competing Interest

The authors had no competing interests.

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