Journal of Basrah Researches (Sciences) **51**(1), 130 (2025)
DOIhttps://doi.org/10.56714/bjrs.51.1.11

Identifying the uranium concentration in soil samples from northern Basra Governorate using ICP-MS

Muslim J. Al-Baha'I *, Thaer M. Salman

Department of Physics, College of Education for Pure Science, University of Basrah, Basrah, Iraq

ARTICLE INFO

Received 13 November 2024
Revised 5 March 2025
Accepted 15 March 2025
Published 30 June 2025

Keywords:

Northern Of Basrah, Icp-Ms Method, Soil Samples, Oil Fields, Uranium Concentration.

Citation: M. J. Al-Baha'I , T. M. Salman , J.Basrah Res. (Sci.) **51**(1),130 (2025). DOI:https://doi.org/10.56714/bjrs.51.1.11

ABSTRACT

In this investigation, soil samples were taken from 25 locations in the northern Basra Governorate. The concentration of uranium was determined using the inductively coupled plasma mass spectrometry (ICP-MS) technique. Following impurity removal, they were crushed and sieved through a 75-micron sieve. The findings indicate that the uranium concentrations in the oil fields in North Rumaila and West Qurna range from 0.05 parts per million to 6 parts per million. The findings are examined and contrasted with those of earlier studies. Regarding the other regions, all of them were within this range of uranium concentration in the investigated samples. The findings are accompanied by comparisons with other research. The examined soil samples contained less than 100 parts per million (ppm) of uranium, indicating that the quality of the surface soil and fill is more significant than the mineable reserves. The uranium content in the northern Basra region was collected and evaluated, as detailed in this report. The investigation found that all surface soil samples had uranium levels below the hazardous threshold. the investigation found. According to the 1993 recommendation of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the uranium concentrations in the study's surface soil samples were below the allowable limit of 11.7 parts per million.

Introduction

Rocks, sand, and soil are natural sources of uranium; yet, the distribution of this widely distributed element varies considerably. The chemical and radioactive element uranium, represented by the symbol (U), has a density of (18.95 g/cm^3), which is (1.7) times greater than lead's density (11.35 g/cm^3). The properties of metallic uranium include a boiling point (4131 °C) that is extremely chemically reactive, a very high melting point (1132 °C), and a tensile strength that is similar to most steels [1]. The bulk uranium concentrations for (234U, 235U, and 238U are 0.0056%, 0.718%, and 99.276%), respectively [2-4]. The earth's crust contains about (2 milligrams) of naturally occurring uranium per kilogram (range: 0.1 to 20 mg per kilogram). There is also a

*Corresponding author email : Muslim123701@gmail.com

ISSN: 1817-2695 (Print); 2411-524X (Online)
Online at: https://jou.jobrs.edu.iq

greater concentration of silver and gold. Human health is negatively impacted by uranium. The primary health risk linked to uranium is chemical toxicity rather than radiation. The average concentration of the natural element uranium in the Earth's crust is marginally higher than that of silver or gold. It has an adverse effect on people's health. Radiation is not the main health hazard associated with uranium; rather, it is chemical toxicity [5-8]. It is believed that chemical toxicity and lead poisoning are comparable. An abundant supply of isotopes and uranium It has been widely used to study geochemical and physical processes in a variety of Earth science fields [9]. low abundance and minimal uranium concentrations 234 Nevertheless, in the majority of natural samples, measurement issues restrict many uses. For the past fifty years, radionuclides from uranium have been measured using alpha spectroscopy techniques [10,11], however the large sample size needs are The advent of analytical precision technology and far higher productivity have rendered alpha count techniques all but obsolete. The amount of uranium in environmental samples is commonly determined using alpha spectrometry and inductively coupled plasma atomic emission spectrometry (ICP-AES). Nevertheless, considering the relative decline Accurate results usually require a large number of samples and long testing times due to the uranium sensitivity of these methods. Additionally, because of the alpha spectrometer's precision, the uranium levels are only estimates. It has been demonstrated that mass spectrometry is an extremely sensitive and accurate substitute for the aforementioned methods in both situations [12, 13].

Experimental Technique

Twenty-five locations in the northern regions of the Basra governorate provided soil samples. The ICP/Mass technique was then used to measure the sediment sample [13]. Inductively coupled plasma mass spectrometry is the analytical technique used for component identification (ICP-MS). Long ago, in 1983 Following its commercial introduction, the approach was extensively adopted in a range of laboratory settings. Among the first labs to adopt ICP-MS technology were those doing geochemical analysis. This is because of its remarkable element identification powers, especially when it comes to rare-earth elements (REEs). Currently, many trace elements can be detected at once using (ICP-MS) [14]. Despite its powerful gear, inductively coupled plasma mass spectrometry's utility is limited by its intrinsic inability to cover all elements in a single analysis. Only a small number of elements, typically between seven and twenty [15–16], have been evaluated using the ICP-MS methods now in use. The dynamic range of isotopes and the amount of various elements in the human body are often responsible for this[17].

Collection Of Soil Samples

Following their utilization, the soil samples collected from the northern Basra Governorate were consumed. There were twenty-five different locations in the investigation, starting from location S1, which represents the Khourah area, to location S25, which represents the Majnoon field. The areas also include locations from Umm Qudr, the West Qurna (1) oil field, the North Rumaila oil field, and the Nahran Omar oil field. After being immersed in (75 micrometers), the samples were dried in an oven heated to (70 degrees Celsius). The assessment of uranium-related risks in the soil of northern Basra in southern Iraq is the objective of this study, which uses the map in Figure 1.

Fig.1. According to station number (S) numbering, dots represented the locations of sample collecting sites north of the Basra Governorate.

Results And Discussion

The measurement of uranium content in soil samples taken from northern Basra Province, southern Iraq, is presented in the Atomic Energy Laboratories at the University of Tehran in the Islamic Republic of Iran, as shown in Table 1. Groups (S1) through (S25) represent the results for each of the(25) locations. The table unquestionably demonstrates that the areas with the highest uranium concentrations are those in the North Rumaila and West Qurnah oil fields (6 ppm). The lowest concentration, (0.05 ppm), was also detected in an oil field location in North Rumaila. It was also reported that uranium concentrations in four samples ranged from (2.49 ppm to 6 ppm), or more than 1 part of a million, but in one sample, uranium concentrations were as low as 1 part of a million. Twenty samples had uranium concentrations between (0.05 and 0.99 parts per million), or less than one part per million. For uranium, the US Environmental Protection Agency (EPA) [18] states that the maximum threshold for contaminants (MCL) is roughly 30 mg/L. Uranium concentrations in different environmental zones need to be regularly monitored. Alpha and Inductive Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) are widely employed to quantify uranium content in environmental materials. However, long testing intervals and big sample numbers are typically required due to these technologies' extremely poor sensitivity to uranium. Furthermore, because of the alpha spectrometer's accuracy, the range of possible uranium levels is limited to a rough estimate. It is important to monitor uranium concentrations in many environmental situations. Alpha and Inductive Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) are the methods most frequently employed to determine the amount of uranium in environmental materials. However, because of these technologies' extremely low sensitivity to uranium, lengthy testing periods and a large number of samples are typically needed to acquire correct results. Moreover, the alpha spectrometer's precision limits the determination of the likely uranium levels to only an approximation.

Table 1. ICP-Mass analyses of soil samples from several northern Basra Governorate locales to determine the amount of uranium present

No of site	Location of samples (Area name)	Location type of samples (Area type)	Concentration of uranium in Soil by (ppm)
S1	Al-khora	Empty area	0.758
S2	Umm Jadir	Residential area	0.517
S3	Umm Jadir	Residential area	0.220
S4	West Qurna oil field (1)	Oil area	6.000
S5	West Qurna oil field (1)	Oil area	0.370

S6	West Qurna oil field (1)	Oil area	0.410
S7	West Qurna Oil field (1)	Oil area	0.090
S8	West Qurna Oil field (1)	Oil area	0.500
S9	North Rumaila oil field	Oil area	0.400
S10	North Rumaila oil field	Oil area	0.050
S11	North Rumaila oil field	Oil area	0.187
S12	North Rumaila oil field	Oil area	2.490
S13	North Rumaila oil field	Oil area	3.907
S14	North Rumaila oil field	Oil area	0.900
S15	North Rumaila oil field	Oil area	6.000
S16	Nahran Omar oil field	Residential and oil area	0.100
S17	Nahran Omar oil field	Residential and oil area	0.230
S18	Nahran Omar oil field	Residential and oil area	0.400
S19	Nahran Oma oil r field	Oil area	0.520
S20	Nahran Omar oil field	Oil area	0.600
S21	Nahran Omar oil field	Oil area	0.872
S22	Nahran Omar oil field	Oil area	0.110
S23	Majnoon oil field	Oil area	0.620
S24	Majnoon oil field	Oil area	1.000
S25	Majnoon oil field	Oil area	0.990

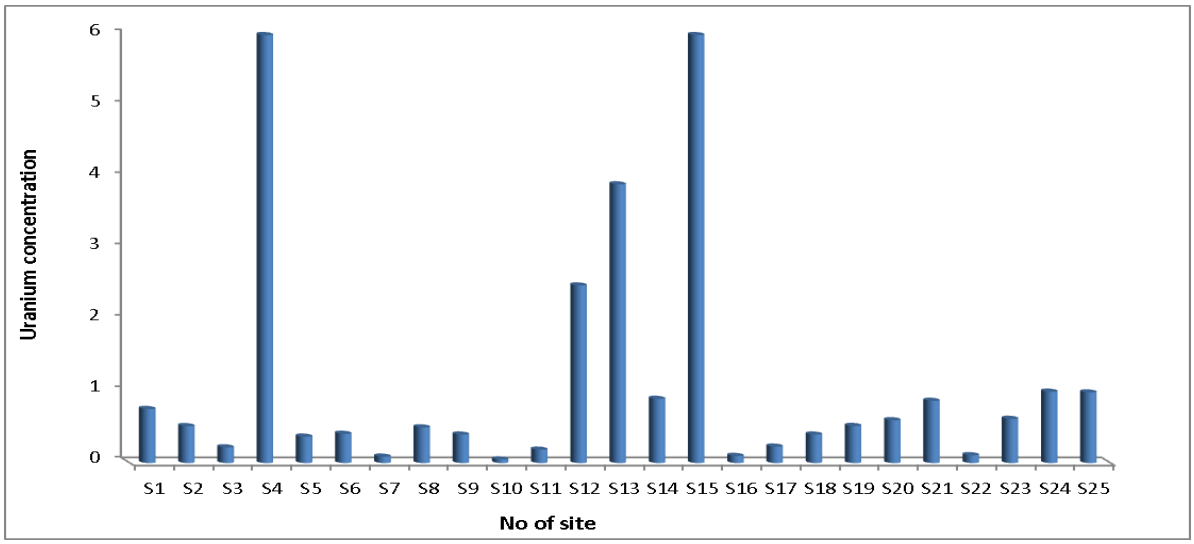

Fig. 2. ICP-MS analysis of the uranium content of soil samples from various northern Basra Governorate sites

Conclusion

This is the first study of its kind to assess uranium concentration at the locations under investigation in northern Basra, Iraq, as it included border areas, oil sites, and military locations. Samples of well soil from the area under investigation are frequently heavily mineralized. A high positive correlation between uranium and a few particular chemical components found in soil samples was found by the link investigation. Obtaining high-quality soil samples is critical for human health and a serious public health concern. The high caliber of soil samples was preserved by making sure that unprocessed soil samples were available and that soil water was cleaned. Raw soil samples can be made available by making sure that undesirable elements are kept out of soil samples by using efficient watershed management plans and pollution control measures. The soil sample containing the highest concentration of uranium, (S4) and (S15), did not surpass the maximum

permitted limit of (11.7 ppm) at a concentration of (6 ppm). The West Qurnah Oil and North Rumaila Oil Fields have the highest rates of uranium contamination in comparison to other locations, which puts workers there at higher risk of uranium exposure. Although the uranium contamination levels in the (S12 and S13) sectors are within the allowed range, they are nonetheless very considerable. Therefore, even in cases where the remaining ratios in other regions are reasonable, it is advised that all essential safeguards be taken to guarantee that the population is shielded from continual exposure to uranium.

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Journal of Basrah Researches (Sciences) **51**(1), 130 (2025)
DOIhttps://doi.org/10.56714/bjrs.51.1.11

تحديد تركيز اليورانيوم في عينات التربة من شمال محافظة البصرة باستخدام ICP-MS

مسلم جاسم البهائي*، ثائر منشد سلمان

قسم الفيزياء، كلية التربية للعلوم الصرفة، جامعة البصرة، العراق.

معلومات البحث

الاستلام 13 تشرين الثاني 2024
المراجعة 5 اذار 2025
القبول 15 اذار 2025
النشر 30 حزيران 2015

الكلمات المفتاحية

شمال البصرة, طريقةICP-MS , عينات التربة, حقول النفط, تركيز اليورانيوم.

الملخص

في هذه الدراسة ، تم أخذ عينات من التربة من ٢٥ موقعًا في شمال محافظة البصرة .تم تحديد تركيز اليورانيوم باستخدام تقنية مطيافية الكتلة مع التحفيز بالحث .(ICP-MS) بعد إزالة الشوائب، تم سحقها ونخلها من خلال منخل ذي فتحات ٧٥ ميكرون. تشير النتائج إلى أن تركيزات اليورانيوم في حقول النفط في شمال الرميلة وغرب القرنة تتراوح بين. 0.05 جزء في المليون إلى 6 أجزاء في المليون .تم فحص النتائج ومقارنتها مع الدراسات السابقة .فيما يتعلق بالمناطق الأخرى، كانت جميعها ضمن هذا النطاق من تركيز اليورانيوم في العينات التي تم التحقيق فيها .تُرافق النتائج مقارنات مع أبحاث أخرى .احتوت عينات التربة التي تم فحصها على أقل من 100 جزء في المليون (ppm) من اليورانيوم، مما يشير إلى أن جودة التربة السطحية والردم أكثر أهمية من الاحتياطيات القابلة للاستخراج .تم جمع وقياس تركيز اليورانيوم في مناطق شمال البصرة، كما هو مفصل في هذا التقرير .وجدت التحقيقات أن جميع عينات التربة السطحية كانت تحتوي على مستويات من اليورانيوم أقل من العتبة الخطرة .وجد التحقيق .وفقًا لتوصية لجنة الأمم المتحدة العلمية لآثار الإشعاع الذري (UNSCEAR) لعام 1993، كانت تركيزات اليورانيوم في عينات التربة السطحية للدراسة أقل من الحد المسموح به البالغ 11.7 جزء في المليون.

Citation: M. J. Al-Baha'I , T. M. Salman , J.Basrah Res. (Sci.) **51**(1),130 (2025). DOI:https://doi.org/10.56714/bjrs.51.1.11

***Corresponding author email :** Muslim123701@gmail.com

ISSN: 1817-2695 (Print); 2411-524X (Online)
Online at: https://jou.jobrs.edu.iq