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The Amount of Uranium in Soil Samples Collected from Particular Locations in the Southern Amara Governorate was measured using ICP-MS

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Abstract

In this particular research, 25 topsoil samples taken from various locations in the south of Amara Governorate were analyzed using ICP-MS (inductively coupled plasma mass spectrometry), many of which were, to the researchers' knowledge, analyzed for the first time. Uranium has been detected in soil at concentrations ranging from 0.57 ppm (Wadia2) to 1.99 ppm (aleadl1). The results are presented and compared with the results of a different study. The soil samples studied contained less than 100 ppm uranium, indicating that it is formed by overburden and trash rather than mineable deposits. This article describes and evaluates the uranium content in the southern Amara governorates. In addition, all 25 exposed ground samples contained uranium below the detection threshold. The results showed that the surface soil samples under investigation contained uranium concentrations below the permissible limit (11.7 parts per million) set by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) in 1993.

Keywords: Uranium; Government; ICP-MS

Introduction

The Earth's crust contains uranium; it is also present in soil in varied concentrations, sand, and rocks in different areas of the planet. Uranium, a heavy metal with a density of 18.95 g/cm^3 (1.7 times that of lead's density of 11.35 g/cm^3), is represented by the letter (U). A chemical and radioactive element is uranium. The melting and boiling points of metallic uranium are both quite high (1132°C and 4131°C), is highly chemically reactive, and has strength comparable to most steels. There are three isotopes of uranium in nature. The percentages of uranium-238, uranium-235, and uranium-234 in bulk are 99.276 percent, 0.718 percent, and 0.0056 percent, respectively [1-4]. The Earth's crust contains between 0.1 and20 mg of organic uranium metal per kilogram. It occurs much more often than gold or silver. Human health will be harmed as a result. The greatest threat to health is not radiation exposure but the chemical toxicity of uranium [5-8]. The toxicity of the substance contrasts with the toxicity of lead. Many geoscience disciplines have used large amounts of chemical and isotopic uranium extensively to study physical and biogeochemical processes [9]. However, the low concentrations of Uranium (U) and the predominance of uranium 234 in most natural samples, limit many uses due to measurement difficulties. To measure uranium radionuclides, alpha sampling techniques have been used for five decades [10,11], but the enormous needs for samples and the introduction of equipment with significantly improved performance and accuracy have made alpha calculation methodologies obsolete. To measure uranium concentration, Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-MAS) is widely used. However, many samples and extended test times often produce trustworthy results because uranium is very sensitive to these methods. Furthermore, the accuracy of the alpha spectrum measurement allows only an approximate calculation of uranium levels. Mass spectrometry provides one of the greatest alternatives to previous techniques due to its outstanding sensitivity and accuracy. Its main goal is to investigate all the many relationships, dealings and risks related to soil samples. The research area is located in the south of Al Amara Governorate in Iraq (Figure 1).

Figure 1: Shows the locations of obtaining samples in the Southern Amara Governorate.

Materials and Methods

Soil sample collection

Twenty-five soil samples distributed in: almajar alkabir1; almajar alkabir2; almajar alkabir3; almajar alkabir4; almajar alkabir5; almajar alkabir6; almajar alkabir7; almajar alkabir8; almajar alkabir9; almajar alkabir10; aleadl1; aleadl2; aleadl3; aleadl4; aleadl5; aleadl6; aleadl7; aleadl8; aleadl9; aleadl10; alwadia1; alwadia2; alwadia3; alwadia4; alwadia5. 5-15 cm deep when cleaning tests in Al-Amara Governorate, one of the study sites in the East. The materials were then ground into powder, filtered using a specific mesh size of 75 μm [7], and dried for a few hours in an oven set at 70°C.

ICP- MS

The ICP-MS approach combines two technologies: High-sensitivity ion sensor (MS) technology and ion source (ICP) technology. The generated ions are transferred from the plasma to the high-vacuum MS region through the sampler and scraper cone in the case of ICP-MS.

An ion optical system is used to focus on ions in the MS and measure the mass-to-charge ratios of the ion(s) of interest. A conventional quadrupole Mass Spectrometer (MS) can only pass ions with a specific mass-to-charge ratio through its mass filter. Ions flowing through the MS are transferred to an ion detector, which converts the ionic energy into a power source and allows the analyte to be measured. During a multi-element study, settings can be adjusted to make room for new ions with varying mass-to-charge ratios to flow through the detector. Single-element sequential analysis is used in multifunctional ICP-MS analysis. ICP-MS offers benefits over other methods in terms of sensitivity, detection, and simultaneous U concentration and U isotope ratios. The most accurate measurement of ICP-MS is U, which uses a method known as the analytical isotope dilution approach. Several studies have used the FI technique to preconcentrate and determine uranium by the isotope dilution method to increase sensitivity, accuracy, and detection capabilities.

Results and Discussion

Table 1 displays the findings of the investigation into the uranium concentration of soil samples collected from several locations in the southern Iraqi Amara Governorate. Table 1 and Figure 2 reveal that the uranium levels in these soil samples were lower than those reported by the US Environmental Protection Agency (EPA). Figure 2 and Table 1 in Figure 2, the results for these 25 samples are classified into 25 categories ranging from S1 to S25. In Al-Adl1, the highest level of uranium was (1.99 ppm), while above 10 meters (Al-Wadiya2) it was the lowest (0.57 ppm). The US Environmental Protection Agency (EPA) has set a maximum contamination limit (MCL) for uranium, which is approximately 30 g/L. Environmental samples should be tested for uranium levels on a regular basis. Uranium content is usually determined using Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES) and inductively coupled alpha spectroscopy. However, due to how sensitive these techniques are to uranium, they typically require a large number of objects and periods of measurements to provide accurate results. Furthermore, only a rough assessment of the amount of uranium can be made due to the precision of the alpha spectrum measurement. Qualitative mass spectrometry is one of the best alternatives to these techniques, as it has good sensitivity and accuracy. Abdul Sattar K. conducted Hashim and Laith wrote a paper in which they compared the results of the investigation. Tests were conducted on the uranium content and construction materials coming from Iraq. Uranium levels in these samples ranged from 0.074 to 5.055 ppm, with an average of 0.755 ppm. It is necessary to determine the uranium percentage based on a variety of different factors. Nuclear weapons are still present in some sites adjacent to South Amara Governorate as a result of the ongoing conflict [11].

Sites numbers	Sites	Uranium concentration in ppm
S1	Almajar alkabir1	0.94
S2	Almajar alkabir2	1.3
S3	Almajar alkabir3	0.85
S4	Almajar alkabir4	0.88
S5	Almajar alkabir5	0.75
S6	Almajar alkabir6	0.61
S7	Almajar alkabir7	1.75
S8	Almajar alkabir8	0.63
S9	Almajar alkabir9	1.85
S10	Almajar alkabir10	1.61
S11	Aleadl1	1.99
S12	Aleadl2	0.69
S13	Aleadl3	0.68
S14	Aleadl4	0.65
S15	Aleadl5	1.2
S16	Aleadl6	1.4
S17	Aleadl7	0.91
S18	Aleadl8	1.51
S19	Aleadl9	0.71
S20	Aleadl10	0.78
S21	Al wadia1	0.62

S22	Al wadia2	0.57
S23	Al wadia3	0.64
S24	Al wadia4	0.76
S25	Al wadia5	0.7

Table 1: Uranium content in soil samples from the southern Amara Governorate is measured using ICP-MS.

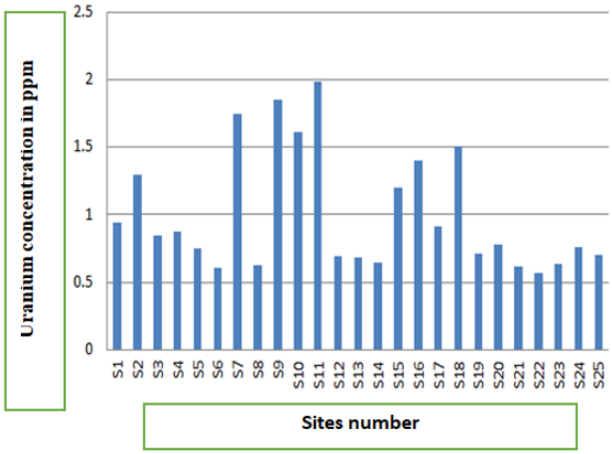

Figure 2: Uranium concentrations in soil samples collected from in South Amara as determined by ICP-MS analysis.

Conclusion

The southern Amara region in Iraq did not contain soil sources containing quantities of uranium before, according to this study. Often, soil samples from the investigated area are heavily mineralized. The test reveals a strong positive relationship between uranium and certain chemical components in soil samples. Healthy people rely on samples from safe lands, which is a serious public health concern. By maintaining the supply of raw soil samples and purifying soil water, high-quality soil samples can be maintained. The availability of untreated soil samples can be ensured through effective watershed management methods and pollution control measures that limit the introduction of undesirable materials into soil samples. As for the sample containing the highest concentration of uranium S25, it contained less than the maximum permitted in soil samples (1.99 parts per million), or (0.57 parts per million). Al Wadiya 2, unlike other areas, has the highest prevalence of uranium contamination, making nearby local residents there more vulnerable to uranium exposure. Due to its high level of pollution compared to other areas, the residents of this area (Al-Adl 1) are more exposed to uranium than other locations.

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