Concentration and Ratio of Uranium Isotopes in the Fine-Fraction of Surface Soil from Baghdad and Basra Collected after Operation Iraqi Freedom

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Introduction

The purpose of this study was the quantitative determination of the concentration and ratio of four uranium isotopes in the fine surface-soil fraction after coalition operation Iraqi Freedom.

Warthog A-10 DU 30mm Gatling gun strafing of tank with craters left in the asphalt, As Suweirah.

Black uranium oxides on ground and tree, site of removed Iraqi tank, Baghdad Gate.

Materials & Methods

Ten samples, representing normal as well as obviously contaminated surface soils, were collected by the Uranium Medical Research Centre field team from different sites of Baghdad, Basra, and the Suweirah farming area. Soil fine-fractions (< 150 micrometers), corresponding to 6-50% of the total samples, were separated and leached in hot aqua regia, leaving most of the natural uranium behind in undissolved minerals. The uranium fraction was purified by ion-exchange chromatography and analyzed by a double-focusing multicollector ICPMS Neptune equipped with a retarding potential quadrupole lens and a secondary electron multiplier for detection of ^{234}U and ^{236}U. A certified isotope reference solution of uranium was analyzed along side the samples. Errors were propagated by including all uncertainties involved during analyses, data processing, and data corrections.

Results

The uranium concentration in the soil fine-fraction varies from about 1 to 1,000 mg/kg and is clearly positive correlated with the ^{238}U:^{235}U ratio, which ranges from 139.3 to 542.1. The ^{234}U:^{238}U ratio ranges from 7.42×10^{-6} to 7.05×10^{-5} and is negative correlated with the ^{238}U:^{235}U ratio. ^{236}U is present in all samples, ranging from 0.23 to 30,724 ng/kg with a ^{236}U:^{238}U ratio of 1.4×10^{-7} to 1.2×10^{-5}. The latter generally correlates positive with the ^{238}U:^{235}U ratio; the data, however, also suggest the use of depleted uranium with different amounts of ^{236}U.

Left) Destroyed Iraqi tank at one of several positive DU collection sites of samples in Abu Khasib.

Right) DU positive collection site on the outskirts of Baghdad International Airport.

Left) Most radioactive penetration site found at 2000 times background levels, Abu Khasib.

Right) Tank crew member's vest showing a surface radiation count of 97.5 cps (5850 cpm).

Victoreen 990 GM detector supplied by Cardinal Health.

Left) Double-focusing multi-collector ICPMS Neptune mass spectrometer .

Right) Man with son salvages engines and parts from Iraqi tanks; black stains on lower arms are a combination of dirt, grease, and DU oxide

Conclusion

Our results demonstrate the presence of depleted uranium (DU) in the superficial soil fine-fraction from all three regions and warrant further objective, interdisciplinary evaluation of the environmental and health impact of the uranium contamination of the biosphere in Iraq.

Left) Nine bunker busters destroyed main telephone exchange, Baghdad.
Top) Bunker buster penetration hole in Baath Headquarters, Baghdad.
Right) Baghdad central market collapsed by a single bomb.

Sample	Location	U mg/kg	$^{238}U/^{235}U$	$^{234}U/^{238}U$	$^{236}U/^{238}U$
1	Baghdad Gate	35.38	484.7	7.42×10^{-6}	3.72×10^{-6}
2	East Central, Baghdad	0.09	148.9	3.74×10^{-5}	1.32×10^{-6}
3	Suburb 512, Baghdad	0.34	175.2	5.51×10^{-5}	3.78×10^{-6}
4	As Suweirah	1029.80	487.0	7.26×10^{-6}	1.21×10^{-5}
5	Abu Khasib, Basra	1.34	415.5	1.18×10^{-5}	2.34×10^{-5}
6	Abu Khasib, Basra	0.54	234.9	3.52×10^{-5}	7.10×10^{-6}
7	Abu Khasib, Basra	0.95	139.3	7.05×10^{-5}	1.40×10^{-7}
8	Abu Khasib, Basra	76.19	542.1	6.38×10^{-6}	2.82×10^{-5}
9	Baghdad Int. Airport	0.09	145.7	6.77×10^{-5}	1.62×10^{-6}
10	Baghdad Int. Airport	0.20	234.1	3.92×10^{-5}	7.65×10^{-6}
Average		114.49	300.75	3.64×10^{-5}	8.90×10^{-6}
Std Dev		322.57	162.51	2.67×10^{-5}	9.65×10^{-6}
Std Error		101.63	47.19	7.81×10^{-6}	3.00×10^{-6}