

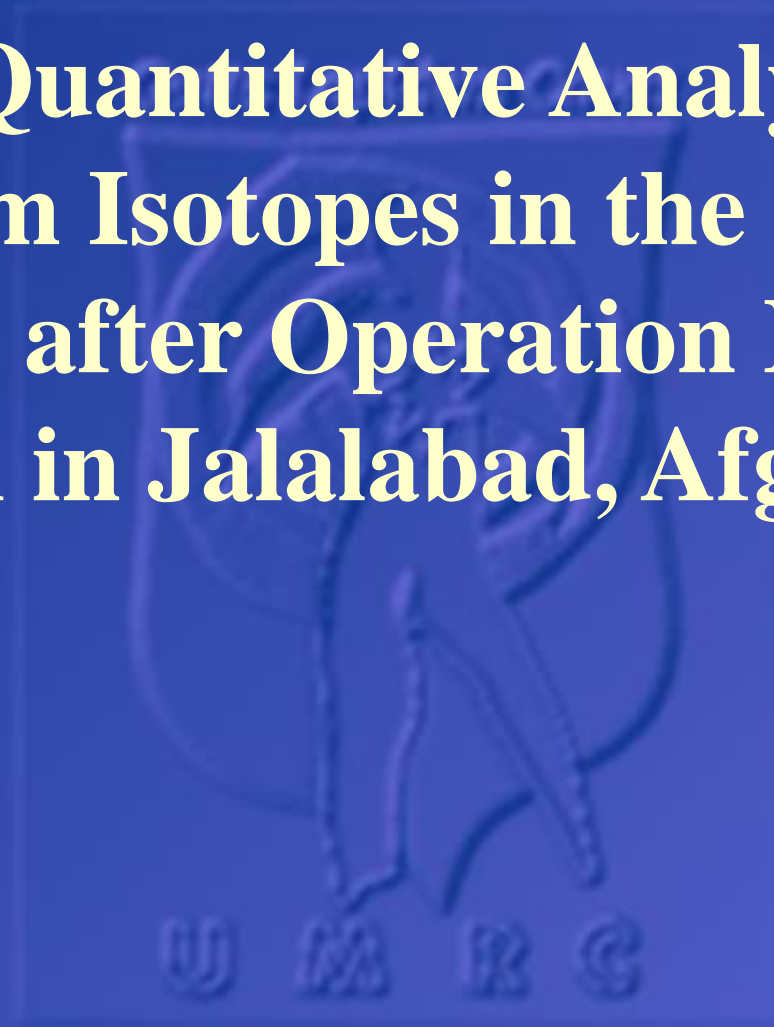
Uranium Medical Research Center



Washington, New York, Toronto, London

www.umrc.net

**The Quantitative Analysis of
Uranium Isotopes in the Urine of
Civilians after Operation Enduring
Freedom in Jalalabad, Afghanistan**



A. Durakovic, R. Parrish,
A. Gerdes, I. Zimmerman

Uranium Medical Research Center
Washington, D.C., USA
Toronto, Ontario, Canada

NERC Isotope Geosciences Laboratory
British Geological Survey
Keyworth, Notts, United Kingdom

Objective

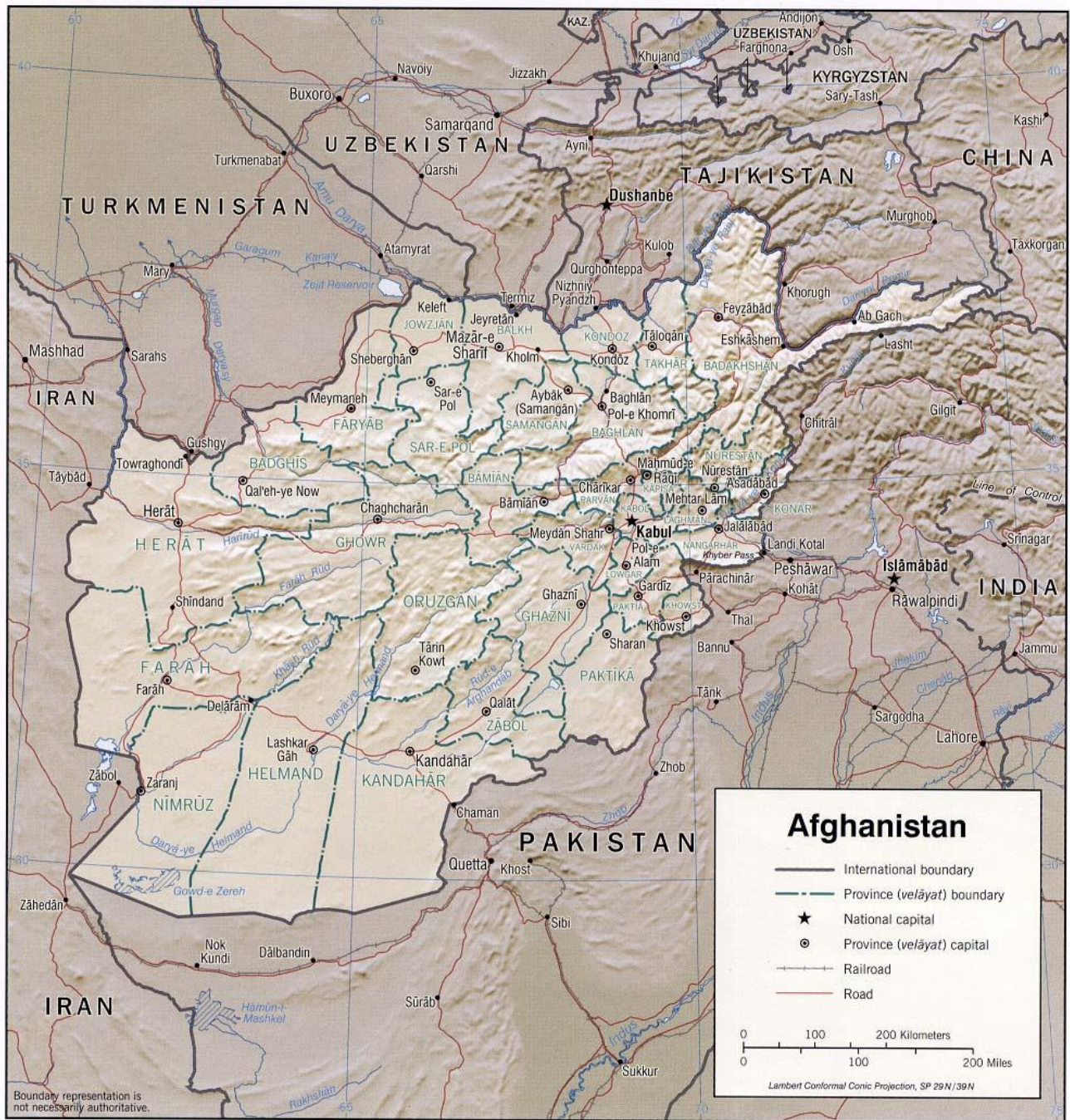
The purpose of this study was to determine the concentration and isotopic composition of four isotopes of uranium (^{234}U , ^{235}U , ^{236}U , ^{238}U) in the urine specimens of the civilian population following the bombing raids of Afghanistan during Operation Enduring Freedom.

Subjects

Eight male civilians from Jalalabad-Nangarhar province presenting with non-specific symptoms:

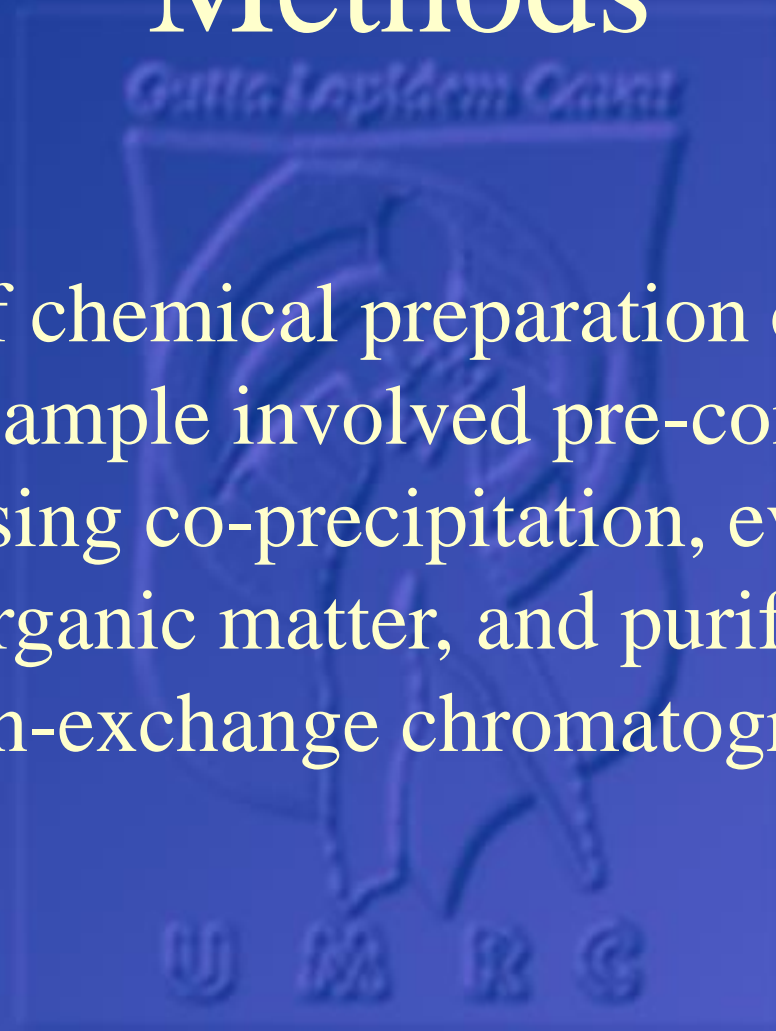
- Fever
- Fatigue
- Musculoskeletal pain
- Headaches
- Neurological alterations
- Respiratory impairment

and a history of being in the vicinity of OEF bombing raids had their 24-hr urine samples collected under controlled conditions. Each subject signed informed consent to participate in the study.



Methods

The method of chemical preparation of the uranium in each urine sample involved pre-concentration of the uranium using co-precipitation, evaporation, oxidation of organic matter, and purification of uranium by ion-exchange chromatography.



Methods

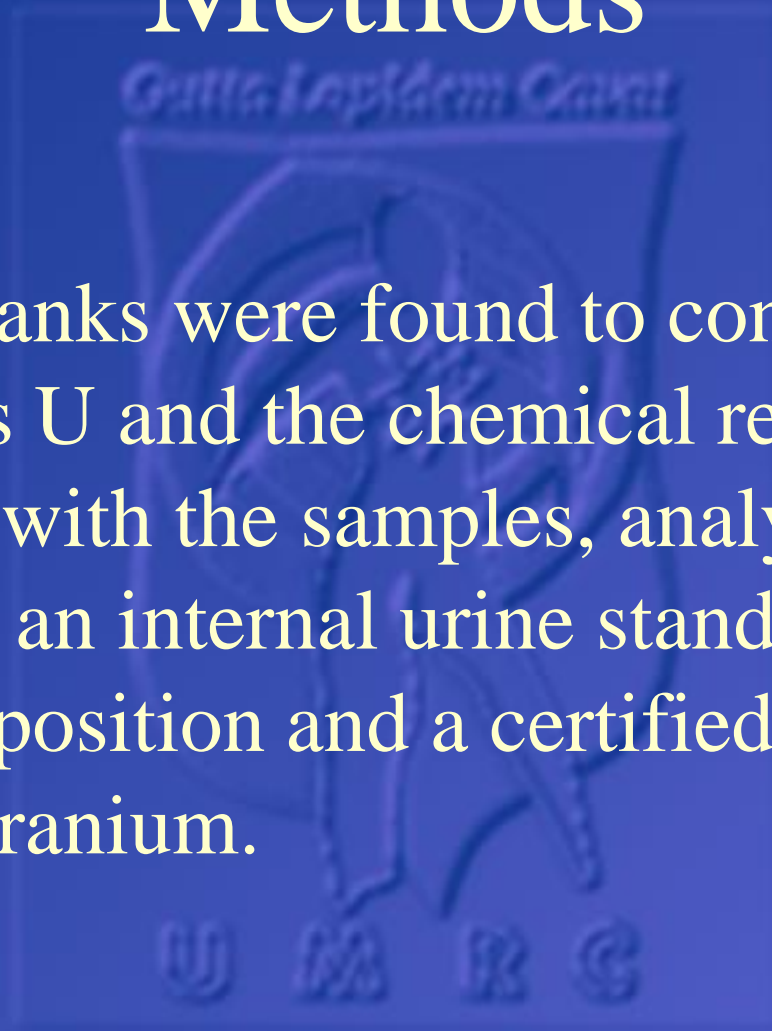
The samples were analyzed in duplicate for ^{234}U , ^{235}U , ^{236}U , and ^{238}U using a double-focusing Thermo-Elemental Plasma54 multi-collector ICP-MS system equipped with a Daly detector for ion counting and multiple faraday cups.

Thermo-Elemental Plasma54 multi-collector ICP-MS



Methods

Analytical blanks were found to contain less than 50 picograms U and the chemical recovery was $> 80\%$. Along with the samples, analyses were conducted of an internal urine standard of natural isotopic composition and a certified isotopic standard of uranium.



Results

The $^{238}\text{U}/^{235}\text{U}$ ratio was 137.87 compared with the natural uranium ratio of 137.88.

The $^{234}\text{U}/^{238}\text{U}$ ratio of 5.51×10^{-5} was also consistent with natural uranium at 5.54×10^{-5} .

The mean concentration of uranium (275.04 ng/L) of all eight urine samples was considerably greater than expected for a normal population (1-20 ng/L).

Table 1: Isotopic Abundance

<u>Subject</u>	<u>% ²³⁸U</u>	<u>% ²³⁵U</u>	<u>% ²³⁴U</u>	<u>% ²³⁶U</u>
1	99.2732	0.7212	5.49 x 10 ⁻³	3.67 x 10 ⁻⁶
2	99.2757	0.7189	5.39 x 10 ⁻³	6.63 x 10 ⁻⁶
3	99.2727	0.7217	5.51 x 10 ⁻³	9.53 x 10 ⁻⁶
4	99.2750	0.7196	5.41 x 10 ⁻³	8.84 x 10 ⁻⁷
5	99.2756	0.7190	5.41 x 10 ⁻³	2.16 x 10 ⁻⁷
6	99.2751	0.7195	5.40 x 10 ⁻³	2.63 x 10 ⁻⁶
7	99.2741	0.7203	5.58 x 10 ⁻³	7.73 x 10 ⁻⁶
8	99.2743	0.7201	5.58 x 10 ⁻³	7.30 x 10 ⁻⁶
Average	99.2745	0.7201	5.47 x 10 ⁻³	4.82 x 10 ⁻⁶
SD	1.07 x 10 ⁻³	1.01 x 10 ⁻³	8.14 x 10 ⁻⁵	3.44 x 10 ⁻⁶
SE	3.78 x 10 ⁻⁴	3.57 x 10 ⁻⁴	2.88 x 10 ⁻⁵	1.22 x 10 ⁻⁶
Internal Urine				
Control	99.2702	0.7220	7.66 x 10 ⁻³	8.42 x 10 ⁻⁵

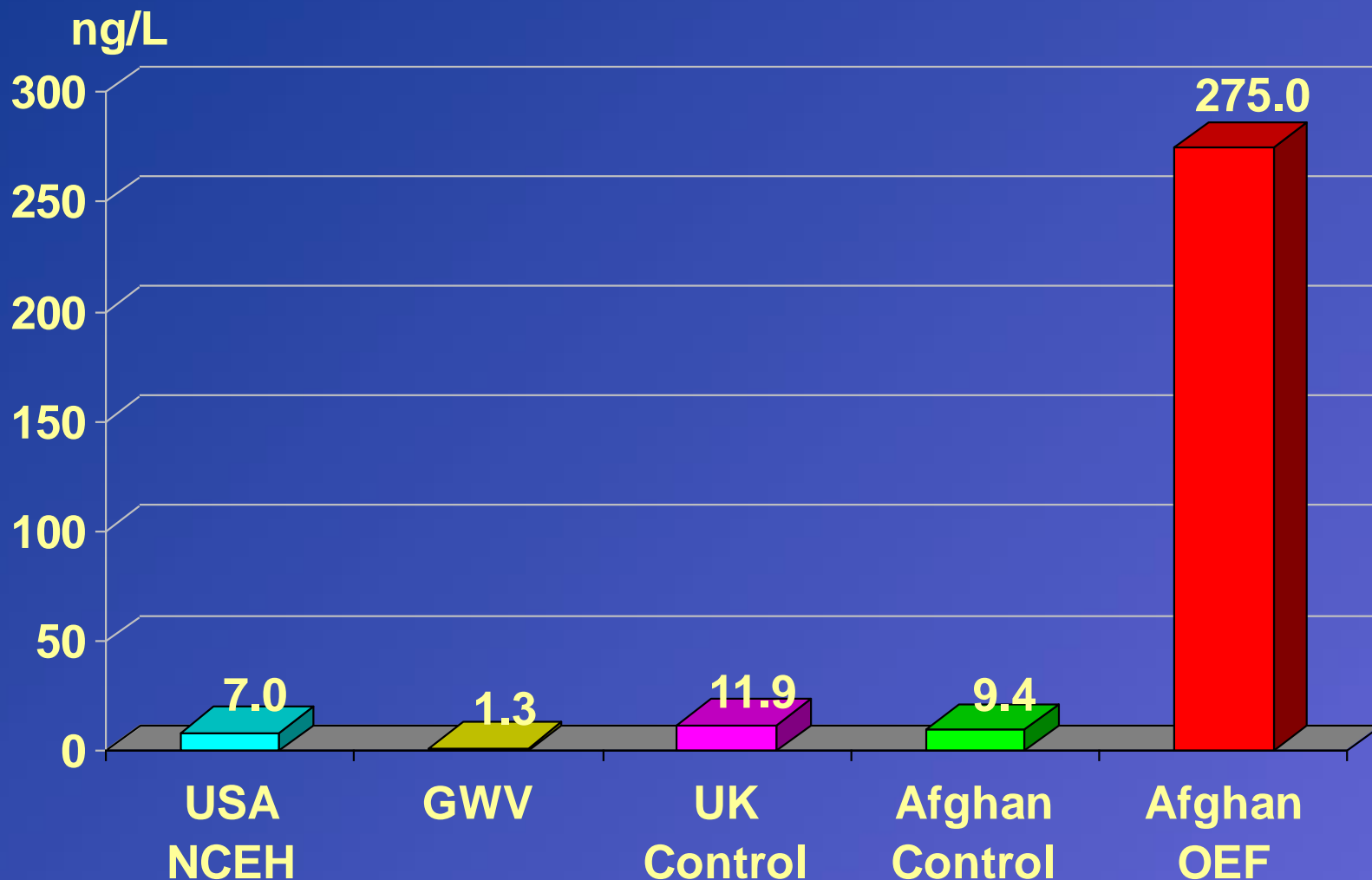
Table 2: Isotopic Ratios

<u>Subject</u>	<u>$^{238}\text{U} / ^{235}\text{U}$</u>	<u>Sigma</u>	<u>$^{234}\text{U} / ^{238}\text{U}$</u>	<u>Sigma</u>
1	137.65	0.07	5.53×10^{-5}	6.33×10^{-7}
2	138.09	0.09	5.43×10^{-5}	6.12×10^{-7}
3	137.54	0.09	5.55×10^{-5}	6.83×10^{-7}
4	137.95	0.07	5.45×10^{-5}	5.94×10^{-7}
5	138.08	0.07	5.45×10^{-5}	5.87×10^{-7}
6	137.98	0.08	5.44×10^{-5}	6.55×10^{-7}
7	137.82	0.07	5.63×10^{-5}	7.86×10^{-7}
8	137.86	0.07	5.63×10^{-5}	7.71×10^{-7}
Average	137.87		5.51×10^{-5}	
SD	0.19		8.20×10^{-8}	
SE	0.07		2.90×10^{-9}	
Internal Urine				
Control	137.49	1.47	7.72×10^{-5}	2.16×10^{-5}

Table 3: Total Uranium Concentration

<u>Subject</u>	<u>Uranium ng/L</u>
1	281.21
2	247.06
3	128.97
4	453.26
5	477.88
6	298.64
7	88.52
8	224.81
Average	275.04
SD	137.80
SE	48.72
Internal Urine Control	11.88

Human Contamination with Uranium in Afghanistan



Water and Soil



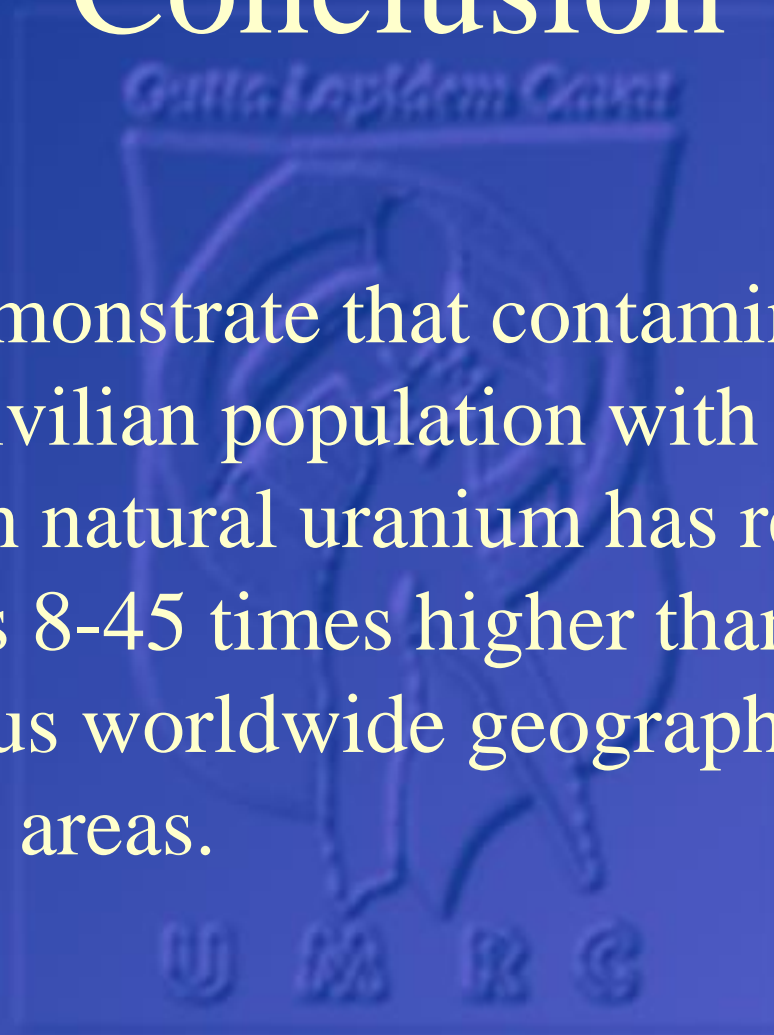
Drinking water from the village karaize had a uranium concentration of 38,278 ng/L.

Soil from a bomb crater in the vicinity of Jalalabad contained 18.6 mg/kg of uranium.



Conclusion

Our results demonstrate that contamination of the Afghanistan civilian population with a source consistent with natural uranium has resulted in total uranium levels 8-45 times higher than the normal range of various worldwide geographic and environmental areas.



Summary

The high uranium concentration could be the result of either of two contrasting explanations:

- 1) Inhalational exposure to uranium contaminated dust in the localized areas of Jalalabad as a result of weapons containing non-depleted uranium.
- 2) Exposure to excessively high levels of uranium contained in the environment by extremely unusual geological circumstances.

Uranium Medical Research Center



Washington, New York, Toronto, London

www.umrc.net