Uranium Isotopes Concentration and Ratios in the Urine of the Civilian Population of Southeastern Afghanistan

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Abstract

The purpose of this study was to determine the concentration and ratio of four uranium isotopes (^{234}U, ^{235}U, ^{236}U, ^{238}U) in urine samples of the civilians in southeastern Afghanistan.

Five male subjects from Nangarhar province with reported inhalation of dust during the bombing operations in June, 2002 and presenting with symptoms of headaches, fever, fatigue, musculoskeletal and neurological alterations, and respiratory impairment had their 24-hour urine samples collected under controlled conditions and analyzed in duplicate for uranium isotopes by multicollector inductively coupled plasma ionization mass spectrometry (MC-ICP-MS).

The analytical methodology involved pre-concentration of the uranium using co-precipitation and/or evaporation, oxidation of organic matter, ion exchange chromatography, and mass spectrometry using a double focusing Thermo-Elemental Plasma54 multi-collector ICP-MS equipped with a Daly® detector for ion counting. Analytical blank controls had insignificant concentrations (<50 pg) of uranium compared to sample concentrations, and chemical recovery was > 80% in most cases. A urine internal standard (with c. 11 ng/l uranium) of natural isotopic composition (atomic ratio 137.88 for $^{238}U/^{235}U$) and certified isotopic standards of uranium were also analyzed by the same methodology, both returned the correct values for the standards.

The $^{238}U/^{235}U$ and $^{234}U/^{238}U$ ratios for the urine samples were consistent with natural uranium with values of 137.86 ± 0.25 and 0.000055 ± 0.000001 respectively. ^{236}U was not detected (measured $^{236}U/^{238}U < 10^{-7}$). The five samples, repeatedly analyzed in 3-4 series, had a mean concentration of uranium of 315.37 ± 65.09 ng/L which is

considerably greater than normal values of 1-20 ng/L. Our results demonstrate an excessive concentration of uranium isotopes in the body internal environment of Afghan civilians consistent with a natural uranium source of contamination significantly higher than the geographic and environmental worldwide range.

Possible explanation of our findings could be the exposure to uranium isotopes in localized areas as a result of deployment of weapons containing natural uranium or exposure to excessively high levels of uranium contained in drinking water or soil by highly unlikely geological conditions. Our current investigations are attempting to further test these hypotheses.