

# Quantitative Analysis of Uranium Isotopes in the Civilians of Iraq after Operation Iraqi Freedom (OIF)\*

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This study determines the concentration and precise isotopic ratios of 4 uranium isotopes in the urine specimens of civilians of Iraq following OIF.

Twenty-two symptomatic Iraqi civilians were selected from sites of military conflict in Baghdad, Basra, and Nasiriyah. Symptoms included headaches, fatigue, intermittent fever, and affect disorders. Urine specimens were collected under controlled conditions. The samples were analyzed by a double-focusing Thermo Finnigan Neptune multi-collector ICP-MS.

Fourteen subjects had natural  $^{238}\text{U}:^{235}\text{U}$  ratios of  $138.05 \pm 1.24$ . Eight subjects had a  $^{238}\text{U}:^{235}\text{U}$  ratio of  $141.73 \pm 1.00$  indicative of contamination with depleted uranium (DU). The  $^{234}\text{U}:^{238}\text{U}$  ratio was  $6.72 \times 10^{-5} \pm 3.65 \times 10^{-6}$  in DU positive subjects and  $7.09 \times 10^{-5} \pm 8.45 \times 10^{-6}$  in DU negative subjects.  $^{236}\text{U}$  was present in the urine of all DU positive subjects with a mean  $^{236}\text{U}:^{238}\text{U}$  ratio of  $7.39 \times 10^{-7} \pm 4.39 \times 10^{-7}$ . A detectable presence of  $^{236}\text{U}$  was also found in three DU negative subjects  $^{236}\text{U}:^{238}\text{U}$  ratio of  $2.30 \times 10^{-7} \pm 2.20 \times 10^{-7}$ . The mean concentration of total uranium was  $30.68 \pm 19.67$  ng/L in DU positive subjects and  $22.08 \pm 13.35$  ng/L in DU negative subjects.

Our results demonstrate the presence of DU and  $^{236}\text{U}$  in the civilians of Baghdad, Basra, and Nasiriyah after OIF. This may be consistent with our previous reported findings in civilians after Operation Enduring Freedom and Allied Forces veterans of Gulf War I and II by inhalation of uranium containing aerosols.

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