

Public Abstract

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Department:Chemistry

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Title:MC-ICP-MS ANALYSIS OF URANIUM AND PLUTONIUM IN KERATINOUS SAMPLES FOR THE PURPOSES OF NUCLEAR FORENSIC AND BIOMARKER ESTABLISHMENT

One objective of nuclear forensics is to identify the source of interdicted nuclear materials in order to help ensure the safety and security of special nuclear materials. Since 1995, The International Atomic Energy Agency (IAEA) has reported at least 16 different cases involving the illegal possession and transportation of either plutonium or enriched uranium. A non-invasive assay capable of identifying whether a person of interest has been exposed to special nuclear materials, either environmentally or occupationally, would greatly aid in an investigation of the suspected handling and transport of enriched uranium or plutonium. Human hair and nail are used as effective biomonitors for exposure and intake of numerous trace-elements and potential toxins. The objective of this work was to investigate the hypothesis that the isotopic ratio composition of U and Pu in human hair and nail are reflective of exposure to special nuclear materials. Fingernail, toenail, and hair samples were collected from volunteers from national labs (Idaho, Oakridge, LLNL, Y-12) who self-reported exposure to either U or Pu, under the purview of a DOE CENTRAL IRB and control samples were collected from individuals living in the Columbia, MO region who had no exposure to enriched or depleted uranium or plutonium. Both the concentration and U and Pu isotopic composition was determined using the analytical procedure developed as part of this work. Average uranium recovery was  $105 \pm 4\%$ .  $^{242}\text{Pu}$  recovery ranged from 65-101%. Both  $^{235}\text{U}$  and  $^{236}\text{U}$  isotope ratios indicated exposure to special nuclear materials in several occupationally exposed volunteers.  $^{234}\text{U}$  isotope ratios were not correlated between controls or exposed workers. Additionally, concentration measurements for  $^{238}\text{U}$  were not correlated with either controls or exposures. Four volunteers had measurable amounts of  $^{239}\text{Pu}$  in their hair, nails, or toenails.