The Determination of Natural Uranium in Human Tissues by Recovery Corrected Kinetic Phosphorescence Analysis

J. T. Elliston[1], S. E. Glover[2], and R. H. Filby[3]

[1]United States Transuranium and Uranium Registries, Nuclear Radiation Center, Washington State University, P. O. Box 641300, Pullman, WA 99164-1300, USA; [2]Department of Environmental and Occupational Health, 260 Kappa Dr., University of Pittsburgh, Pittsburgh, PA 15238, USA; [3]Department of Chemistry, Washington State University, P.O. Box 644630, Pullman, WA 99164-4630, USA.

Two typical methods used for the determination of uranium in human autopsy tissues are kinetic phosphorescence analysis (KPA) and alpha spectrometry, both of which have significant limitations and advantages. KPA is limited because of the amount of sample used (1-10 mL for sample digestion followed by one mL KPA aliquots), no isotopic information is provided, phosphorescence degradation by salts in solution, and even more importantly, it does not provide chemical recovery information. For example with sub ng uranium concentrations per g of inorganic material, preconcentration is necessary, which may require chemical recovery (other than simple evaporation). While alpha spectrometry has very good radiometric detection limits for ^{238}U, the very long half-life of ^{238}U (4.468×10^9 y) restricts its mass detection limit (27 ng). KPA, on the other hand, has a detection limit three orders of magnitude lower (0.02 ng) for natural uranium. A recovery corrected method for the determination of natural uranium in human tissues was developed combining preconcentration of human tissues dissolved in 6 M HCI by anion exchange with alpha spectrometry and kinetic phosphorescence analysis, utilizing ^{232}U as a tracer. Solution aliquots containing up to 6g of bone ash were pre-concentrated for KPA measurement thereby allowing the use of up to 25% of the original sample solution weight for analysis by KPA. The radiochemical yield of ^{232}U was determined by alpha spectrometry and the uranium content was determined by KPA. The mean radiochemical yields obtained for human tissue samples range from 65% to 106% with a mean of 85% ± 8%.

USTUR-0168-00