## Using Fission Track Analysis on Plasma Samples <u>Heidi A. Walk</u>, Melinda P. Krahenbuhl, Ph.D Center for Excellence in Nuclear Technology, Engineering, and Research University of Utah Nuclear Engineering Program

The Center for Excellence in Nuclear Technology, Engineering, and Research (C.E.N.T.E.R.) currently uses fission track analysis (FTA) of urine samples to determine general population Pu-239 exposures. However, FTA of urine has a number of drawbacks. Samples are typically 1-2L, requiring large amounts of HCl, HNO<sub>3</sub>, and ethanol to perform the chemical separations. Large sample sizes also increase turn around time, usually 30-90 days. The large consumption of reagents and extensive use of labor make FTA of urine expensive.

High costs have encouraged economical modifications. Plasma samples are being considered as a viable alternative to urine samples. A Pu transport model, based on ICRPs 30 and 67, calculates plutonium concentrations in blood to be 2 orders of magnitude greater than those found in urine. Unpublished documents indicate that whole blood samples were once processed at C.E.N.T.E.R. up to the precipitation step. The blood experiment was abandoned due to unusual appearing precipitates, with no assessment of plutonium recovery.

The documents do not provide conclusive evidence of failure; therefore, more experiments were needed to determine the feasibility of using FTA on blood samples. Plasma ordered from Sigma Chemical was used for initial experiments to minimize matrix effects. As most of the plutonium binds to the plasma protein transferrin, the blood cells are not needed. A test matrix of 10 samples each with a volume of 10ml was used. All samples were traced with 1 pCi Pu-236, and 5 of the samples were spiked with 1fCi of Pu-239 to test recovery. The 5 un-spiked samples were used as background monitors.

Thus far the samples have been chemically processed, irradiated and counted, but the data is still being analyzed. Other than mild differences in appearance during chemical processing, the plasma samples responded in a manner consistent with a typical urine sample, but requiring much less reagents, and with a 15 day turn around time. Some of the end results, however, do not correspond as hoped. The Pu-236 tracer (assessed using alpha spectrometry) follows the same elution pattern as seen in urine samples, with yields ranging from  $15 \pm 2\%$  to  $45 \pm 6\%$ . Unfortunately, the optical counting of the spiked Pu-239 samples indicated an elution pattern inconsistent with the Pu-236 tracer. The Pu-239 spike does not seem to have followed the Pu-236 tracer. The background monitors showed activities ranging from 150 to 375 aCi/10ml of plasma; values comparable to our averages from Rocky Flats, Marshall Islands, and Nevada Test Site urine samples, which were  $142 \pm 428$  aCi/1000ml,  $280 \pm 505$  aCi/ 1000ml, and 649  $\pm$  1476 aCi/1000ml, respectively.

Elution pattern failures usually indicate a uranium breakthrough during ion exchange. We are exploring the possibility that elevated amounts of uranium (elevated compared to urine) in the plasma saturated the column during ion exchange, taking over too many binding sites, and thereby preventing the Pu-239 spike from attaching to the column. The extra uranium could also interfere with the oxidation of plutonium to the +4 state. U(IV) is not reduced to U(III) using the hydrionic acid plutonium elutant; however, excessive amounts could cause breakthrough.