

**LOCAL AND GLOBAL FALLOUT PRESERVED IN LAKE SEDIMENT FROM THE SIERRA NEVADA, CALIFORNIA**

R.W. Williams, A.M. Gaffney, G. Balco\*, C.R. Bates, C.L. Conrado, A.R. Crable, S.A. Faye,  
M.P. Kelley, S.M. Williams

Lawrence Livermore National Laboratory, Chemical Science Division, PO Box 808, Livermore, CA  
\*Berkeley Geochronology Center, Berkeley, CA, USA

Cesium-137, plutonium and  $^{236}\text{U}$  have been identified in the topmost 10 cm of sediment from Upper Highland Lake in the Sierra Nevada, Alpine County, California. The depth-profile of fallout material in the sediment core was investigated as part of a summer student internship program at LLNL designed to teach laboratory and instrumental techniques for analysis of environmental samples for safeguards and nuclear forensics. Two-centimeter segments of the sediment core were analyzed first by gamma spectrometry and then spiked with  $^{233}\text{U}$  and  $^{244}\text{Pu}$  tracers and leached in nitric-hydrofluoric acid to extract labile U and Pu from the sediment. The U and Pu were separated from the leachate, purified and analyzed by multi-collector ICPMS (NuPlasma HR) to determine the isotopic compositions and concentrations. With increasing depth, the first four 2-cm increments have  $^{240}\text{Pu}/^{239}\text{Pu}$  of 0.136, 0.142, 0.156 and 0.113, which are all significantly lower than the accepted average of 0.18 for global fallout, and point to a contribution from atmospheric testing at the Nevada Test Site. In these same increments, the Pu concentration decreases from 3.08 to 0.20 pg/g-dry sediment, and  $^{236}\text{U}$  decreases from  $1.48 \times 10^9$  to  $2.8 \times 10^8$  atoms/g-dry sediment. These  $^{236}\text{U}$  concentrations are similar to those reported by Sakaguchi et al. [1] for soil samples from Japan affected only by global fallout. The  $^{236}\text{U}/^{239}\text{Pu}$  is 0.26 in the upper 8 cm of our lake sediment core, which, again, is consistent with the estimates for global fallout by Sakaguchi et al.. Our measurements of  $^{236}\text{U}/^{238}\text{U}$  in the leachate fractions also decrease with depth in the core from  $2.12 \times 10^{-7}$  to  $2.8 \times 10^{-8}$ , while the  $^{236}\text{U}/^{239}\text{Pu}$  is essentially constant over the first 6 cm indicating lack of significant chemical fractionation between fallout derived uranium and plutonium in this lake.

[1] First results on  $^{236}\text{U}$  levels in global fallout, Sakaguchi *et al.*, Science of the Total Environment, 407, (2009) 4238-4242.