Rapid processing of ^{85}Kr/Kr ratios using Atom Trap Trace Analysis

J. C. ZAPPALA[1,2]*, K. BAILEY[1], P. MUELLER[1], T. P. O'CONNOR[1], AND R. PURTSCHERT[3]

[1]Physics Division, Argonne National Laboratory, Argonne, IL 60439, USA (*correspondence: jzappala@anl.gov)
[2]Department of Physics and Enrico Fermi Institute, University of Chicago, Chicago, IL 60637, USA
[3]Climate and Environmental Physics Division, Physics Institute, University of Bern, Sidlerstrasse 5, CH-3012 Bern, Switzerland

The noble gas isotope ^{85}Kr (half-life = 10.7 years) is a useful tracer for young groundwater in the age range of 5–50 years. Tracers in this age regime are crucial to water resource management given the global increased dependency on groundwater, including instances of complete dependency on young, shallow groundwater for drinking water [1]. However, ^{85}Kr-dating has not been applied routinely at a large scale due to slow sample processing times and comparatively large sample volume requirements [2].

We report a methodology for measuring ^{85}Kr/Kr isotopic abundances using Atom Trap Trace Analysis (ATTA) that increases sample measurement throughput by over an order of magnitude to six samples per 24 hours. ATTA, an efficient and selective laser-based atom counting method, has recently been applied to ^{85}Kr/Kr isotopic abundance measurements, requiring 5–10 μL of krypton gas at STP extracted from 50 to 100 L of water. Previously, a single such measurement required 48 hours [3]. Our new method demonstrates that we can measure ^{85}Kr/Kr ratios with 3–5% relative uncertainty every 4 hours, on average, with the same sample requirements.

This work is supported by Department of Energy, Office of Nuclear Physics, under Contract No. DEAC02-06CH11357.

[1] Moran *et al*. (2005), Rep. UCRL-TR209191, Lawrence Livermore Natl. Lab., Livermore, Calif. [2] Loosli and Purtschert (2005), *Isotopes in the Water Cycle: Past, Present and Future of a Developing Science*, 91–95, IAEA, Vienna. [3] Jiang *et al*. (2012) *Geochim. Cosmochi. Acta* **91**, 1.