

USING ISOTOPES IN THE ENVIRONMENTAL SCIENCES
PART I: MEASUREMENTS
PART II: APPLICATIONS

Michael E. Ketterer

*Department of Chemistry and Biochemistry, Northern Arizona University, Box 5698,
Flagstaff, AZ USA 86011-5698 [michael.ketterer@nau.edu]*

This two-part course will discuss how isotope measurements are used as tracers in the environmental sciences for monitoring and forensic studies. **Part I** of the course will cover measurement principles and practices:

- mass spectrometric techniques: “stable isotope ratio” MS, ICPMS, TIMS, AMS
- precision and accuracy
- counting statistics
- mass discrimination: sources and correction methods
- sample handling and preparation

Emphasis will be placed on how to select the appropriate measurement techniques for a given isotopic measurement.

Part II will describe the underlying sources of variation in isotope abundances in Nature, and will survey all types of isotope systems:

- traditional light elements (H, Li, B, C, N, O, S)
- non-traditional elements exhibiting fractionation (e.g., Cr, Fe, Ni, Cu, Zn, Mo, Hg)
- radiogenic isotope systems (Sr, Nd, Hf, Pb)
- disequilibria in the ^{238}U , ^{235}U and ^{232}Th decay series
- cosmogenic isotopes (^{14}C , ^3H , ^{129}I)
- synthetically produced or fractionated elements (U, Pu)

Part II will emphasize how to select one or more isotope systems for studying a given environmental question. We will concentrate on two case studies introduced by the instructor, and will discuss in roundtable format any problems of interest to the audience. If there is audience interest, the use of artificially introduced isotope tracers in environmental experiments and/or isotope dilution analysis will also be described.

Keywords: Environmental monitoring, isotope ratios, case studies, fingerprinting, mass spectrometry

Michael E. Ketterer received his undergraduate education at the University of Notre Dame (BS, Chemistry, 1980) and earned a PhD in Analytical Chemistry in 1985 from the University of Colorado. His PhD research was in the area of electroanalytical chemistry, but he now considers himself a “recovering electrochemist”. He was employed in industry for two years, then he worked from 1987-1993 at the USEPA’s National Enforcement Investigations Center. In 1988, while employed at EPA-NEIC, he began working with quadrupole ICPMS. From 1993-1998 he was Assistant Professor of Chemistry at John Carroll University and in 1998 he moved to Northern Arizona University, where he is currently Professor of Chemistry and Biochemistry. He now manages a laboratory equipped with quadrupole and multiple collector ICPMS.

Ketterer's current research interests are in isotopic measurements, isotopic tracing of environmental pollutants, and investigating the naturally occurring and artificial radionuclides in the environment.