OSAC RESEARCH NEEDS ASSESSMENT FORM

Title of research need: Stable Isotope Analysis as a Geospatial Tool for Identification

Keyword(s): Stable isotope analysis; provenancing human remains; isoscapes

Submitting subcommittee(s):	**Date Approved:**
Anthropology	01/28/2016; Reviewed and reapproved Sept 2025

(If SAC review identifies additional subcommittees, add them to the box above.)

Background Information:

1. Description of research need:

To advance applications of stable isotope analysis for predicting region of origin and residence patterns of unknown decedents, more research is needed to develop baseline oxygen and hydrogen isotope water maps and geological strontium maps. Improvements in baseline data within the United States and globally will help to refine the use of stable isotope analysis as a geolocation tool. In addition, validation of stable isotope provenancing methods is needed using human tissue samples of known origin. Additional research on isotopic variation caused by sample preparation methods, analytical methods, and diagenesis is also needed to advance the science.

2. Key bibliographic references relating to this research need:

Bartelink Eric J., Rachel Berry, and Lesley A. Chesson. 2014a. Stable isotopes and human provenancing. In *Advances in Forensic Human Identification*, eds. Xanthe Mallett, Teri Blythe, and Rachel Berry, 157–184. Boca Raton: Taylor and Francis.

Bartelink Eric J., Greg E. Berg, Melanie M. Beasley, and Lesley A. Chesson. 2014b. Application of stable Isotope forensics for predicting region of origin of human remains from past wars and conflicts. *Annals of Anthropological Practice* 38: 124–136.

Bataille, Clément P., and Gabriel J. Bowen. 2012. Mapping $^{87}Sr/^{86}Sr$ variations in bedrock and water for large scale provenance studies. *Chemical Geology* 304–305: 39–52.

Bowen, Gabriel J. 2010. Statistical and geostatistical mapping of precipitation water isotope ratios. In *Isoscapes: Understanding movement, pattern, and process on Earth through isotope mapping*, eds. Jason B. West, Gabriel J. Bowen, Todd E. Dawson, and Kevin P. Tu, 139–160. Dordrecht, The Netherlands: Springer.

Bowen, Gabriel J., Lesley Chesson, Kristine Nielson, Thure E. Cerling, and James R. Ehleringer. 2005. Treatment methods for the determination of δ^2H and $\delta^{18}O$ of hair keratin by continuous-flow isotope-ratio mass spectrometry. *Rapid Communications in Mass Spectrometry* 19: 2371–2378.

Bowen, Gabriel J., and Justin Revenaugh. 2003. Interpolating the isotopic composition of modern meteoric precipitation. *Water Resources Research* 39: 1299–1311.

Bowen, Gabriel J., and Bruce Wilkinson. 2002. Spatial distribution of $\delta^{18}O$ in meteoric precipitation. *Geology* 30: 315–318.

Bowen, Gabriel J., James R. Ehleringer, Lesley A. Chesson, Erik Stange, and Thure E. Cerling. 2007. Stable isotope ratios of tap water in the contiguous United States. *Water Resources Research* 43: W03419.

Ehleringer, James R., Thure E. Cerling, and Jason B. West. 2007. Forensic science applications of stable isotope ratio analysis. In *Forensic analysis on the cutting edge: New methods for trace evidence analysis*, ed. Robert D. Blackledge, 399–422. San Diego: John Wiley & Sons, Inc.

Ehleringer, James R., Alexandra H. Thompson, David Podlesak, Gabriel J. Bowen, Lesley A. Chesson, Thure E. Cerling, Todd Park, Paul Dostie, and Henry Schwarcz. 2010. A framework for the incorporation of isotopes and isoscapes in geospatial forensic investigations. In *Isoscapes: Understanding movement, pattern, and process on Earth through isotope mapping*, eds. Jason B. West, Gabriel J. Bowen, Todd E. Dawson, and Kevin P. Tu, 357–387. Dordrecht, The Netherlands: Springer.

Lehn, Christine, Andreas Rossmann, and Matthias Graw. 2015. Provenancing of unidentified corpses by stable isotope technique: Presentation of case studies. *Science and Justice* 55:72–88.

Meier-Augenstein, Wolfram. 2007. Stable isotope fingerprinting - Chemical element "DNA". In *Forensic human identification: An introduction*, eds. Tim Thompson and Sue Black, 29–53. Boca Raton: Taylor & Francis.

Meier-Augenstein, Wolfram 2010. *Stable isotope forensics: An introduction to the forensic applications of stable isotope analysis*. Wiltshire, United Kingdom: Wiley.

3a. In what ways would the research results improve current laboratory capabilities?

New research results would help to better validate the use of stable isotope analysis as a provenancing tool for unidentified human remains cases, new baseline data would improve the precision of isoscape mapping approaches, and additional research on sample preparation and analytical methods would help to improve accuracy and precision of geospatial mapping.

3b. In what ways would the research results improve understanding of the scientific basis for the subcommittee(s)?

Research results would help to make stable isotope analysis a more commonly used method for unidentified human remains cases, border crosser deaths, and cold cases. It provides an additional line of evidence to an investigation to supplement information from the biological profile.

3c. In what ways would the research results improve services to the criminal justice system?

Improvements in stable isotope methods would aid in unidentified persons cases by providing new investigative leads. It would help by contributing toward the resolution of medicolegal cases, providing closure to families and case resolution.

4. Status assessment (I, II, III, or IV): II

	Major gap in current knowledge	Minor gap in current knowledge
No or limited current research is being conducted	I	III
Existing current research is being conducted	II	IV

This research need has been identified by one or more subcommittees of OSAC and is being provided as an informational resource to the community.

Approvals:

Subcommittee Approval date: 1/28/2016

(Approval is by majority vote of subcommittee. Once approved, forward to SAC.)

SAC

1. Does the SAC agree with the research need? Yes ☐ No ☐
2. Does the SAC agree with the status assessment? Yes ☐ No ☐

If no, what is the status assessment of the SAC: ☐

Approval date: ☐

(Approval is by majority vote of SAC. Once approved, forward to NIST for posting.)