JOURNAL OF FORENSIC SCIENCES

J Forensic Sci, November 2011, Vol. 56, No. 6
doi: 10.1111/j.1556-4029.2011.01863.x
Available online at: onlinelibrary.wiley.com

BOOK REVIEW

Mary Anne Katzenberg,[1] *Ph.D., F.R.S.C.*

Review of: *Stable Isotope Forensics: An Introduction to the Forensic Application of Stable Isotope Analysis*

REFERENCE: Meier-Augenstein W. Stable isotope forensics: an introduction to the forensic application of stable isotope analysis. Chichester, UK: Wiley-Blackwell, John Wiley & Sons Ltd., 2010, 271 pp.

The potential to use stable isotope analysis in forensic science has been appreciated by isotope specialists for many years. Tracing the source of sugars or grains used in foods and beverages is possible because sugarcane and maize fix carbon using a different mode of photosynthesis than other sugars and grains and therefore contain relatively more carbon-13. Elephant ivory sources have been determined using stable isotope ratios of oxygen and carbon, which vary geographically. More recently, stable isotope methods have been used to reveal diet and residence of people, helping to identify their place of residence before death. *Stable Isotope Forensics* is a timely book that provides the current state of research on the use of stable isotopes in these and other forensic applications. This fast-growing field is now at the stage where just such a book is needed. The author, a chemist by training, has considerable experience in stable isotope analyses, including advances in instrumentation, as well as considerable experience in forensic science applications.

Stable isotopes act as natural tracers because the abundances of stable isotopes for any particular element vary, and further variation occurs during the course of chemical reactions, such as photosynthesis (carbon), evaporation and rainfall (oxygen and hydrogen), metabolism (carbon, nitrogen, and sulfur), and some manufacturing processes (explosives and pollution). Stable isotopes can also help to identify the sources of particular ingredients in narcotics, explosives, and pollutants. Chapters on each of these topics are provided, along with specific case studies that illustrate the promises as well as the limitations of stable isotope applications for each question.

In Part 1, basic information is provided on stable isotopes, their relative abundances, the factors that result in variation in stable isotope ratios during chemical reactions, and the distribution of isotopic variation in light elements in natural systems. These light elements include hydrogen, oxygen, carbon, nitrogen, and sulfur. The section concludes with some examples of applications in foods, drugs, pollution, wildlife conservation, and antidoping research.

Part 2 covers instrumentation, standard notation, sample preparation methods, and an Appendix on how to set up a laboratory for isotope ratio mass spectrometry. This information is presented very clearly and with considerable detail. It is important for nonspecialists to understand what can and what cannot be done using stable isotope methods. It is also important to understand the differences in the types of samples that can be analyzed using different types of instruments, for example, compound specific analyses of complex organic molecules versus elemental analysis using isotope ratio mass spectrometry. This section also provides information on calibration of instruments, standards, and statistical approaches to working with forensic data. In particular, multivariate approaches are presented for working with isotope data from multiple elements, which is useful in sourcing foods, animals, and people.

Part 3 provides a number of case studies that illustrate the current state of research in the use of stable isotopes to address forensic problems. The alliterative subtitles include "Distinguishing Drugs, Elucidating Explosives, and Provenancing People." Each case study includes graphic presentations of data and the steps in the research that lead to the demonstration that one or, more often, multiple isotopes can be used to trace specific substances back to their sources.

One indication of the progress of a particular research area is standardization. Stable isotope laboratories have long used international standards to ensure comparability of results among different laboratories. However, standardization with respect to sample preparation, statistical treatment, and verification of distinctiveness are needed in order for stable isotope evidence to be accepted in forensic contexts. *Stable Isotope Forensics* goes a long way toward recommending such standards. Prominent mention is made of FIRMS, the Forensic Isotope Ratio Mass Spectrometry Network, and the book includes a Foreword by Sean Doyle, Past Chair of the FIRMS Network. This network and its website provide a forum for establishing international standards, as well as databases that can be used as references for sourcing questions. It will also help to streamline international research and prevent duplication of research efforts.

In summary, *Stable Isotope Forensics* is a rich source of current information, which will be useful to students of forensic sciences and individuals in law enforcement and the legal profession. Physical chemists, anthropologists, and geochemists who use stable isotopes will appreciate the extensive background information as well as the case studies, which reinforce basic principles of isotope partitioning in natural systems. The author is to be commended for putting together this state-of-the-art volume, which is part of a series, titled "Developments in Forensic Science," sponsored by the Forensic Science Society.

[1]University Professor, Department of Archaeology, University of Calgary, University of Calgary, 2500 University Dr. N.W., Calgary, Alberta, Canada T2N 1N4.