

# ISO-TOPICS - FIRMS NEWSLETTER SPRING 2011



## Forensic Isotope Ratio Mass Spectrometry

The network developing forensic applications  
of stable isotope mass spectrometry

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Apologies that it has been a long time since we (The FIRMS Network) distributed a newsletter. Hopefully, you will see that it is not through laziness but because we have been busy. Our mailing lists may be a little out of date so please let us know of any changes and pass this newsletter to any colleagues who might be interested.

Jim Carter (chair)

## 1. FIRMS Approve IRMS Practitioners



The FIRMS Network now offers an Approval Procedure for forensic practitioners in the field of isotope forensics. Approval provides an assurance of Evidentiary Reliability and involves assessment against a set of criteria drawn up by the FIRMS Steering Group. The procedure followed and the criteria applied are set out in The FIRMS Network Approval Procedure and Regulatory Framework document.

Approved Practitioners will be listed as such on the FIRMS Web site.

The service is certified to the standard ISO9001. The documented Procedure and Framework will shortly be made available on the FIRMS Web site. Until that time controlled copies can be obtained on request.

Practitioners who are interested in gaining FIRMS Approval should, in the first instance, register that interest by contacting FIRMS. An Initial Assessment Questionnaire will then be issued for completion by the candidate.

### contact us:

web site [www.forensic-isotopes.org](http://www.forensic-isotopes.org)  
email [FIRMS@forensic-isotopes.org](mailto:FIRMS@forensic-isotopes.org)

## 2. The FIRMS Network Ltd

In 2009 the FIRMS Network was incorporated and registered as a not-for-profit organization in the UK. FIRMS Network was started by a grant from the UK to a group of government and academic scientists, led by Sean Doyle (then at DSTL-Forensic Explosive Laboratory) and Max Coleman (then at the University of Reading).

Initial work assessed the needs and directions of the application isotope ratio analysis in forensic application. A series of international conferences were held to assess the current status of research and applications.

By 2010 the combined effort was considered mature enough to warrant the efforts for incorporation.

The FIRMS Network is operated by a **Steering Group** made up of scientists from around the globe. The current membership is listed below. We will call upon other expertise as needed.

Sarah Benson (AFP, Australia), Jim Carter (MSA Ltd, UK), Max Coleman (Caltech, USA), Sean Doyle (Linked Forensic Consultants, NZ), Philip Dunn (LGC, UK), Russell Frew (University of Otago, NZ), Jurian Hoogewerff (UEA, UK), Claire Lock (FEL, UK), Wolfram Meier-Augenstein (James Hutton Institute, UK), Niamh Nic Daeid (University of Strathclyde, UK), Helen Salouros (NMI, Australia), Sabine Schneiders (BKA, Germany), Libby Stern (FBI, USA), Gerard van der Peijl (NFI, Netherlands), David Widory (BRGM, France).

### 3. The 6<sup>th</sup> FIRMS Inter-Laboratory Comparison Exercise

The FIRMS Network has recently completed the 6<sup>th</sup> Inter-Laboratory Comparison (ILC) exercise. The final deadline for submission of results was March 15, 2011 and the results are now compiled and analysed. The materials for this study were sodium nitrate, 4-nitroacetanilide, and glycine. The purposes of conducting these ILC studies are

1. to allow laboratories to assess their external accuracies
2. help laboratories seeking ISO certification to participate in an external ILC, as required by ISO; and
3. for the forensic isotope ratio community to gain consensus on what measurements may be problematic.

The inclusion of sodium nitrate in this study was motivated by a previous ILC which included ammonium nitrate, and for which there was an unusually high range of nitrogen isotope variability. The inclusion of sodium nitrate in the 6<sup>th</sup> ILC may identify the difficulties in “oxidizing” highly oxidized materials, such as nitrates in an Elemental Analyzer.

Results have now been sent to individual laboratories and a summary will appear on the FIRMS website in due course.

### 4. IRMS Good Practices Guide

The FIRMS network is collaborating with LGC, the UK’s designated National Measurement Institute for chemical and bioanalytical measurements is to draft a “Good Practices Guide” for isotope ratio measurements. This guide is not specifically aimed at forensic applications, but due to the importance of traceability of measurements in forensic applications, FIRMS Network is leading this effort. Among the topics to be covered in this guide

1. descriptions of common instrument configurations, both dual inlet and continuous flow
2. instrument quality controls
3. evaluation of data
4. descriptions of a few applications
5. interpretation of data

The guide is not aimed at providing methodologies for all preparative methods employed in making light stable isotope ratio measurements. There are several other resources for that purpose, in particular the excellent books edited by Pier de Groot. Instead, this guide is designed to be a first step for aiding acquisition of high quality isotope ratio measurements using some of the most commonly used methods.

Publication is planned for September 2011.

### 5. FIRMS People

The FIRMS Network says a fond “farewell” to **Jenny Hill** from MSA Ltd (UK). Jenny was involved in the FIRMS Network for many years and played a key role in the incorporation and in organizing the 2010 conference. Never someone to rest on her success she has moved to Canada to take up a career in Landscape Architecture.

Another big “thank you” goes to **Martin van Breukelen** from the NFI for his help in maintaining the FIRMS website. Martin is moving on to Radboud University Nijmegen.

**Dr Ian Bull** at Bristol University has agreed to take on the role of membership secretary. Hopefully, he will be in contact soon.

### Help Wanted

With the departure of some key members, the FIRMS Network is looking for volunteers to help with the newsletter, website *etc.* We would like to hear from anyone who feels they have something to contribute. (contact details above)



Jim Carter (chair) presents Jenny Hill with an engraved FIRMS pen in recognition of her work in organizing the 2010 conference

## 6. The 4<sup>th</sup> International FIRMS Conference The Carnegie Institute - Washington 2010



The Fourth Forensic Isotope Ratio Mass Spectrometry (FIRMS) Network Conference took place April 11-14, 2010, in Washington D.C., at the headquarters of the Carnegie Institution for Science. This venue encouraged lively scientific exchange with its intimate size and inspiring, scientifically theme murals. This meeting was co-hosted by the Laboratory of the Federal Bureau of Investigation.

The Fourth FIRMS conference highlighted the forensic use of isotopes of light elements, as well as the potential applications of isotopes of “heavy” elements such as strontium and lead. The FIRMS Conference was kicked off with a welcoming address by the FBI Laboratory director, Dr. Christain Hassell and an introduction to the FIRMS Network by Dr Jim Carter. This was followed by a plenary talk by Professor James Ehleringer (University of Utah and IsoForensics) describing the state-of-the-art in the use of isotope composition for forensic applications.

Research and applications in the forensic use of isotope ratios were presented for a wide variety of topics including: the use of isotope composition to link a reactant to contraband products (drugs and explosives), geographic attribution of contraband or counterfeit commodities, authenticating food products, documenting archeological forgeries, and characterizing the origin and growth conditions of microbial bio-terrorism agents. Additionally, there were numerous presentations on technical innovations aimed at reducing sample-size requirements as well as developing novel chromatographic techniques coupled to isotope ratio measurements. The second plenary talk was presented by Professor Paul Philp of the University of Oklahoma, on the application of isotope ratios to environmental forensics. This presentation highlighted the application of isotope analysis for attributing hydrocarbon contaminants in the environment.

Perhaps, more important than the high quality technical presentations at the FIRMS Conference was a session devoted to incorporating isotope ratio data within a legal system. As this is a relatively novel technique within a forensic context, these discussions are critical to set this technique off in the right direction. It is much more fruitful to have critical discussions and disagreements regarding evidence in a conference to avoid these confrontations in the courtroom.

The dust darkening the skies over this successful conference is that many conference participants were stranded in Washington D.C. due to the eruption of volcanic ash from Iceland’s Eyjafjallajokull volcano and the consequent disruption of Trans-Atlantic flights.

Abstracts for this conference and previous conferences are available from the FIRMS website.

Volcanic ash left members of the FIRMS Steering Group waiting for a plane!



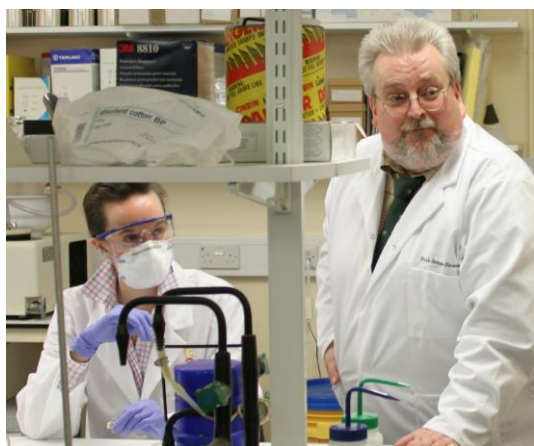


## 7. Forensic Isotopes @ EGU, Vienna

The following article appeared in Carolyn Gramling's BLOG for EARTH. Originally Posted: 08 Apr 2011

### Cold case files: Light and heavy isotopes forging forensic "isoscapes"

Law enforcement may have a new tool, courtesy of geoscientists. About five years ago, scientists coined the word "isoscape" to describe a new kind of map: a spatial distribution of stable isotope ratios (from elements such as carbon, hydrogen, oxygen, nitrogen and strontium) in different parts of the world, based on known ways that these isotopes behave in the environment. Different isotopes tell different stories — carbon can help identify diet, while hydrogen and oxygen can help identify provenance (for example, about 30 percent of the hydrogen deposited in a human hair comes from the water or water-based beverages the person drank) — so the combination of different isotopic values into one map creates a far more powerful tool than a map based on any single element.



The potential usefulness of isoscapes is wide-ranging and thrilling: By measuring the isotopic ratios in anything from bones to hair to plants to gems, and then comparing those values (perhaps even changing over time, as bones, plants and teeth grow) with an isoscape, it might be possible to track human geographic origins, identify the source of illicit drugs, detect counterfeit food products and follow the migration of wildlife.

**LEFT** – Drs Helen Kemp and Meier-Augenstein prepare human teeth for isotopic analysis.

The potential for using stable isotopes in forensics is certainly of interest to police. One of the most interesting and unusual presentations in the EGU meeting session was a poster by geochemist Wolfram Meier-Augenstein (one of the conveners of the session) of the [James Hutton Institute](#) in Dundee, Scotland, geochemist Helen Kemp, also of the James Hutton Institute, and other colleagues. The police force of Gwent, in South Wales, approached them to do a stable isotope analysis on the remains of an unidentified Asian man, to see if he could be identified somehow. [Using stable isotopes from a hair](#) on the man's head — of a length coinciding with about 14.5 months of life — the scientists were able to sketch out the man's last year of life, which included several months spent in Eastern Europe, a longer stint in Central Europe, and then finally arrival in the U.K. about three months before he died. That information — combined, it should be noted, with additional data from Interpol that began to unfold as the case progressed — ultimately led to his identification: He was Vietnamese, a victim of human trafficking, and had been killed by a Vietnamese organized crime gang for not repaying a debt. The gang, it seems, was in the habit of bringing people in through Eastern Europe, then Central Europe, and finally depositing them in the U.K.

Although there are many other interesting success stories, the field as a whole is still in the early stages. The number-one drawback, as was made clear in many of the talks today, is simply a lack of sufficient data to construct consistently effective maps. Obviously, this method improves dramatically the more baseline data one has, Kemp says. And for some projects still in a preliminary phase, a lack of sufficient data just makes it too difficult to say anything definitive about provenance.

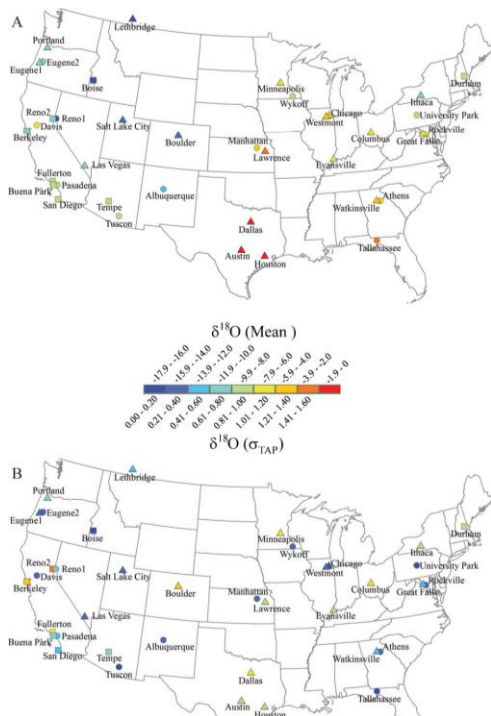
With that problem in mind, a number of scientists are now engaged in constructing large-scale isotopic ratio maps of Europe, the United States and other regions, using what actual data are available, as well as GIS and modeling. For example, the other convener of today's session, geochemist Julian Hoogewerff of the University of East Anglia in England, announced that his team had constructed the first low-resolution strontium-isotope geochemical map of all of Europe. Other isotopic maps are not likely to be far behind.

## 8. Recent Publications of interest to FIRMS Network

### Temporal variation of oxygen isotope ratios ( $\delta^{18}\text{O}$ ) in drinking water: Implications for specifying location of origin with human scalp hair

Casey D. Kennedy<sup>a</sup>, , , Gabriel J. Bowen<sup>a, b</sup>,  and James R. Ehleringer<sup>c, d</sup>, 

Forensic Science International 208 (2011) 156–166



#### Abstract

Previous work suggests that  $d_{18}\text{O}$  values of human hair can be used to constrain the region-of-origin of unknown individuals, but robust assessments of uncertainties in this method are lacking. Here we assess one source of uncertainty – temporal variation in the  $d_{18}\text{O}$  value of drinking water – using a monthly tap water survey of  $d_{18}\text{O}$  to develop geospatial models (i.e., maps) of the intra-annual variation (seasonality) in tap water  $d_{18}\text{O}$  for the contiguous USA. Temporal variation in tap water  $d_{18}\text{O}$  was correlated with water-supply type, and was related to geographic patterns of precipitation  $d_{18}\text{O}$  seasonality and water residence time. The maps were applied in a Bayesian framework to identify the geographic origin of an unidentified woman found in Utah, based on measured  $d_{18}\text{O}$  of scalp hair. The results are robust in specifying parts of the western USA as the most likely region-of-origin. Incorporation of tap water  $d_{18}\text{O}$  seasonality in the analysis reduces the precision of geographic assignments, but other sources of uncertainty (e.g., spatial interpolation uncertainty) have an equal or larger effect.

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

Wolfram Meier-Augenstein

ISBN: 978-0-470-51705-5

Hardcover

296 pages

March 2010

£55.00 / €66.00 from all good booksellers

"The book is timely and important, it is pleasantly written, generally with a positive 'open' mind to what stable isotope analysis can and cannot contribute to forensic and scientific investigations. It is well produced and reasonably priced. The figures, tables, and photographs in the book are generally informative and this aiding the overall (educational) value of the book." (*MassMatters*, November 2010)

Below is a non-comprehensive list of recent publications relevant to the FIRMS Network.

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#### Explosives

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- Benson, S.J., Lennard, C.J., Hill, D.M., Maynard, P., and Roux, C., 2010, Forensic Analysis of Explosives Using Isotope Ratio Mass Spectrometry (IRMS)-Part 1: Instrument Validation of the DELTAplusXP IRMS for Bulk Nitrogen Isotope Ratio Measurements, *Journal of Forensic Sciences*, Volume 55, p. 193-204.
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