

Human Provenancing: It's Elemental... Aiding Victim Identification through Stable Isotope Records of Diet and Geographic Provenance in Human Remains.

W. Meier-Augenstein^{1,2} & H.F. Kemp¹

¹Stable Isotope Forensics Laboratory, SCRI, Invergowrie, Dundee DD2 5DA

²Centre for Anatomy & Human Identification, University of Dundee, DD1 5EH

Tooth enamel

Incorporation of ¹⁸O and ⁸⁷Sr/⁸⁶Sr into tooth enamel of late erupting molars (2nd and 3rd molar) reflects source water (as water or as e.g. fruit water content) consumed during adolescence and can provide information where a person has lived during the period of 8 to 16 years of age. Similarly, ¹³C incorporation into the carbonate fraction of tooth enamel provides a time averaged record of the dietary ¹³C isotopic composition during adolescence.

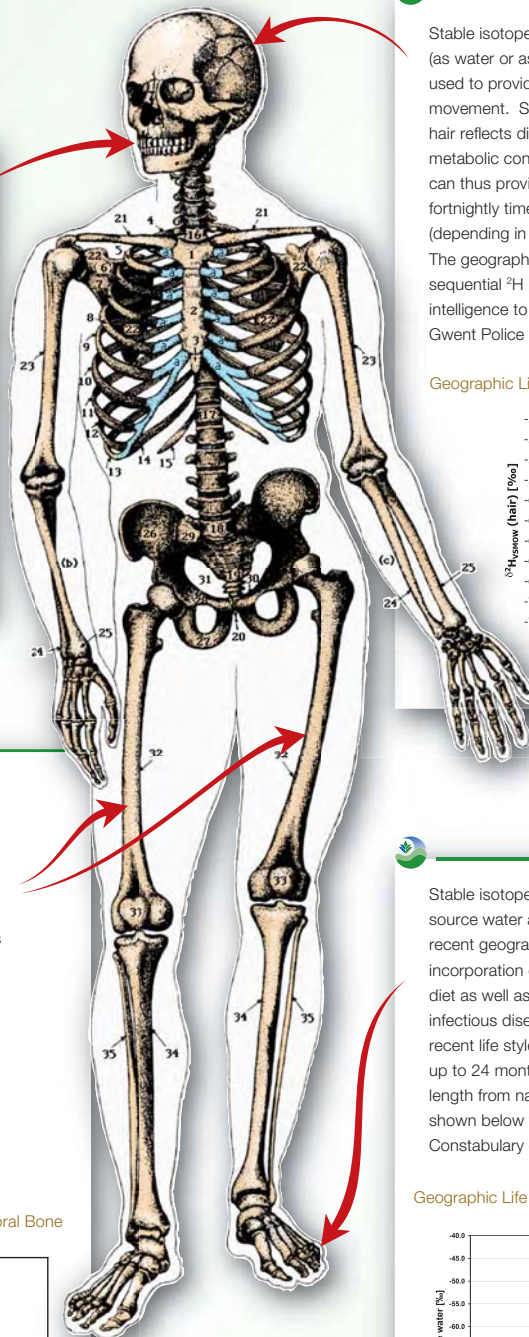
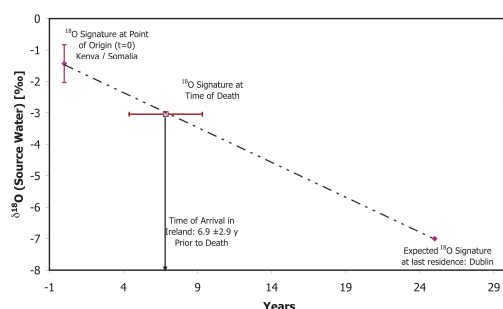
Stable isotope record of ²H, ¹³C and ¹⁵N contained in collagen extracted from tooth dentin is hypothesized to provide additional insights into life style (dietary habits), provenance and health status of a person. Research in this area and how dentin isotope record correlates with data from other tissue is the subject of a joint PhD project with the McMaster University, (Hamilton, Ontario, Canada).

Bone mineral

Incorporation of ¹⁸O and ⁸⁷Sr/⁸⁶Sr into mid-shaft femoral bone bio-apatite reflects source water consumed (as water or comprised in one's diet) and can provide information where a person has lived during the last 20 to 25 years. Similarly, ¹³C incorporation into the carbonate fraction of femoral bone bio-apatite provides a time averaged record of the dietary ¹³C isotopic composition consumed during the last 20 to 25 years in a person's life. It is possible to obtain chronological information reflecting time integrals of approx. 6 to 8 years from sequential analysis of samples taken a cross section of the bone.

The geographic life trajectory from ¹⁸O isotope analysis of femoral bone shown here formed an integral part of a murder investigation by the Gardai (Dublin, Ireland) leading to the positive identification of the victim and ultimately to the successful conviction of the perpetrators.

Geographic Life Trajectory based on ¹⁸O Incorporation into Femoral Bone

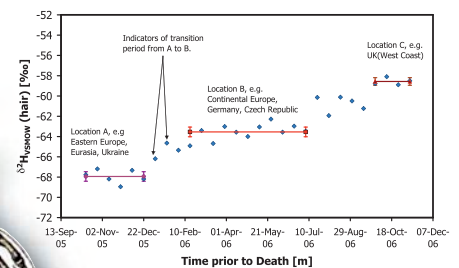


Scalp hair

Stable isotope incorporation of ²H into scalp hair reflects source water (as water or as water contained in fruit and vegetables) and can be used to provide a chronological record of recent geographic movement. Similarly, stable isotope incorporation of ¹³C into scalp hair reflects diet while ¹⁵N reflects diet as well as physiological / metabolic conditions (prolonged infectious disease; crash diet) and can thus provide information on recent life style / life circumstance in fortnightly time increments for up to 15 months into a person's past (depending in hair length).

The geographic life trajectory shown below that was based on sequential ²H isotope analysis of scalp hair provided valuable intelligence to an investigation into serious organised crime by Gwent Police (South Wales, UK) and SOCA.

Geographic Life Trajectory based on ²H Incorporation into Scalp Hair



Toenail keratin

Stable isotope incorporation of ²H into toenail keratin reflects source water and can be used to provide a chronological record of recent geographic movement. Similarly, stable isotope incorporation of ¹³C into scalp hair reflects diet while ¹⁵N reflects diet as well as physiological / metabolic conditions (prolonged infectious disease; crash diet) and can thus provide information on recent life style / life circumstance in 1 monthly time increments for up to 24 months into a person's past (depending in overall nail length from nail bed to the tip). The recent geographic life history shown below was generated for a cold case enquiry by Norfolk Constabulary on murder carried out in 1974.

Geographic Life Trajectory based on ²H Incorporation into Toenail Keratin

