H34 Isotopic Determination of Region of Origin in Modern Peoples: Applications for Identification of U.S. War-Dead From the Vietnam Conflict

Laura A. Regan, MS, and Anthony B. Falsetti, PhD, C.A. Pound Human Identification Lab, Department of Anthropology, University of Florida, PO Box 112545, Building 114, Gainesville, FL 32611; and Andrew Tyrrell, PhD, Joint POW/MIA Accounting Command-CIL, 310 Worchester Avenue, Hickam Air Force Base, HI 96853*

After attending this presentation, attendees will understand the benefits and limitations of undertaking a multi-element approach when utilizing stable isotopes for determining region of origin of dental remains.

This presentation will impact the forensic community and/or humanity by facilitating identification efforts in a variety of contexts. When compared to isotopic signatures developed for geographic areas of Southeast Asia, the information in this study will assist in identifying the origin of unknown dental remains unilaterally turned over to, or recovered by, the Joint POW/MIA Accounting Command Central Identification Laboratory. Additionally, this information may be applied to identification efforts of fallen servicemen and women in conflicts outside of Southeast Asia, the identification of decedents resulting from mass fatality incidents and in the identification efforts of undocumented aliens or otherwise unprovenienced human remains.

To facilitate the construction of identification shortlists, especially from large open ended decedent populations, a highly effective means of excluding possible candidates for identification would be the establishment of the geo-political region of origin for a set of remains. However, ascertaining the national origin of unidentified human skeletal remains whose provenance is either unknown or suspect is particularly problematic. Factors that can encumber this process include long postmortem intervals, highly fragmented friable remains, and diagenesis.

The goal of this study is to create a geographic "fingerprint" utilizing carbon, oxygen, strontium, and lead isotope ratios sampled from the teeth of modern people. This fingerprint will enable identification of region of origin for unidentified skeletal material without an established or well-documented provenance. The initial efforts of this project have focused on the approximately 1,800 service members who remain unaccounted for from the Vietnam conflict. The authors have utilized a two-pronged approach based on the operating hypotheses that: 1) discernable differences exist between the isotope ratios incorporated into North American and South East Asian tooth enamel and that these differences can be used to determine region of origin; and 2) regional differences in natal isotopic signatures are also discernable within populations raised within the United States (and hence, by implication, other global regions as well).

Stable isotope analyses, long used in paleontological and archaeological studies, are emerging as a powerful tool in the forensic realm as well. Forensic pilot studies have hinted at the utility stable isotopes may provide to forensic anthropology. This study is unique in that it employs a multi-element approach in combination with a large sample size. The standard deviations of isotope ratio values often overlap in single-element studies making discrimination between regional signatures virtually impossible. This tendency is reduced through the introduction of multi-element analyses to forensic work. A multivariate, multi-element approach should allow finer resolution, especially since deposition of different elements within dental enamel depends upon very different factors. Carbon isotope ratios reflect the photosynthetic pathways of ingested plants and echo cultural food preferences. It is expected that individuals who have subsisted on a rice-based (C_3 plant) South East Asian diet will differ significantly in their carbon isotope signature from individuals who have subsisted on a heavier corn and sugar-reliant (C_4 plants) American diet. Oxygen isotope signatures rely on the variation of oxygen isotope ratios in meteoric water according to variations in temperature, altitude, and distance from major bodies of water. Variations in strontium and lead isotopes reflect underlying bedrock and soil as well as exposure to pollutants.

Tooth enamel is ideally suited for isotope studies. Teeth are much more robust than bone, exhibiting preferential preservation and reduced susceptibility to diagenetic processes. Dental enamel does not remodel and hence the inand outflow of materials ceases once amelogenesis is complete. This means that examining the permanent dentition provides a snapshot of the "nutritional ecology" of that individual during the period of crown mineralization for a specific tooth.

A Southeast Asian reference population of 61 individuals was sampled from the Joint POW/MIA Accounting Command (JPAC) Central Identification Laboratory's "Mongoloid hold" collection. Remains originating from South East Asia are unilaterally turned over to the Central Identification Laboratory. Despite best efforts, the Governments of South East Asia are often reluctant to repatriate those remains thus obtained by the Central Identification Laboratory that are identified as Asian in origin. This reference sample was compared against stable light isotope ratio data obtained from living subjects at two separate dental facilities, the U.S. Air Force Academy, Colorado Springs, Colorado and the Malcolm Randall Veterans Affairs Medical Center, Gainesville, Florida. At each clinic, patients already identified for tooth extraction were asked to donate their extracted teeth and participate in a brief survey listing their childhood residency and biological and cultural factors that might potentially affect isotopic deposition in enamel. Military members and their dependents were chosen as subjects due to their varied geographic backgrounds. Spatial analyses were layered with temporal analyses by comparing cadets (ages 18-25) to veterans. The results to date are presented as well as the distinct advantages and limitations to undertaking a mosaic approach to stable isotope analyses of dental tissues.

 ** Presenting Author*

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 ** Presenting Author*