



Physical Anthropology Section – 2005

H37 Stable Strontium and Geolocation: The Pathway to Identification of Unidentified Mexican Aliens

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After attending this presentation, attendees will understand the incorporation of stable strontium into human teeth and bone, and how inductively coupled mass spectrometry analysis of this material can assist the process of identification.

This presentation will impact the forensic community and/or humanity by providing the assessment of a new technique to the troubling and complex issue of cross boundary forensic identification.

The goal of this presentation is to present the progress on the development of a mass spectrometry-based method for the identification of an individual's region of origin through analysis of strontium in the permanent first molar. The application of stable strontium to the identification of deceased Mexican undocumented aliens is a new frontier for this type of research.

Background: Strontium isotope ratios and strontium concentrations collected in teeth and bones have been analyzed by archaeologists to investigate patterns of residential mobility and migration among prehistoric peoples. In this study a similar methodology is applied to forensic material to determine the region of origin for Mexican individuals who died while crossing the border into the United States. Strontium, absorbed through the small intestine, commonly substitutes for calcium and becomes fixed in the crystalline lattice of bones and teeth. Unlike oxygen or nitrogen, the isotopes of strontium are geologically specific, and through mass spectroscopy analysis can be traced to their original source. Strontium levels in bone vary depending on bone structure. Cancellous bone has higher rates than cortical bone, but is also subject to higher rates of diagenesis (fractionation as a result of burial or leaching). The strontium present in cortical bone reflects a fifteen year history of incorporation, a change that is a result of the remodeling behavior of compact bone¹. Conversely, strontium levels in the roots of permanent teeth reflect the geochemistry of childhood residence and, unlike bone, do not go through significant diagenesis or remodeling. Tooth enamel incorporates strontium only during amelogenesis (process of enamel formation), which for most teeth takes place in early childhood. This strontium signal would provide the region of the individual's origin and potentially narrow down the search area.

Methodology: The teeth for this project came from several bay area clinics that donated the extracted teeth of their Mexicanborn patients. This preliminary investigation utilized the permanent first molars of 25 individuals originating from four different Mexican states. These tooth samples were accompanied by information on the individuals' regions of origin within Mexico, their ages, and sex. Each tooth was washed with diluted acetic acid to ensure the removal of any depositional contamination and processed. The tooth strontium was then analyzed using Inductively Coupled Plasma Mass Spectrometry (ICPMS). The delta units obtained through this analysis were compared to known geological ratios for the provided areas.

Results and Discussion: The goal of this project is to provide the most accurate pathway to identification possible. In order to achieve this goal, region of origin information has been broken down into the two-tiered analyses of state identification and region identification (within the state). The Strontium database initial results reveal four specific ranges for each of the four states involved in the analysis. The presence of these complex but clear ranges demonstrates the possibility to identify individuals at a state level. At this point in the study, within-state regional identification is highly complex because the strontium signatures demonstrate a significant amount of overlap. While providing a glimmer of hope, this information suggests the need for study expansion and the incorporation of other lines of evidence.

Stable Strontium, ICPMS, Mexican Aliens