H63 The Analysis and Variance of Strontium Isotopes in a Forensic Context: Determination of Geolocation Reliability for a Modern New England Population

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After attending this presentation, attendees will gain an understanding of how strontium isotopes in the environment are reflected in human enamel and bone and how its presence can be used to assist in the geolocation of unidentified human remains.

This presentation will impact the forensic science community by providing data concerning the reliability of applying a strontium isotope analysis to a forensic investigation. The regional geographic information gained from strontium isotopes can potentially be used to assist in identifying an individual through his/her region of origin.

Positive identification of skeletonized human remains is a difficult task when dental records and/or DNA are unavailable. Through archaeological research, strontium isotope analysis has successfully been used to trace individuals back to their place of birth using cortical bone and tooth enamel.[1] In forensic anthropological contexts, this method has the potential to help narrow down the search for missing persons to their geographical region of origin.[2] While strontium isotope analysis may be of use to forensic professionals, few studies have examined regionally-specific strontium isotope ratios among modern Americans.

This study utilized dental enamel from teeth of 76 individuals living in the New England region of the United States. Thirty-five of the samples were obtained from individuals donated to the Anatomical Gifts program in the Department of Anatomy and Neurobiology at Boston University School of Medicine. Forty-one samples were collected through individual donations from pre-arranged standard-of-care surgical dental procedures approved by an Institutional Review Board (IRB). In addition to birthplace, the type of water consumed during childhood was documented for the collected samples. The birthplaces represented by these individuals include the greater Northeast and Midwest of the United States (n=53), Central America (n=6), Caribbean Islands (n=7), West Africa (n=5), and Europe (n=3). Local faunal and water samples were collected from the New England region for local range comparisons. The samples were cleaned and approximately 10mg of enamel was removed from each tooth, acid washed, dried, and dissolved in nitric acid before analyzing the samples using a Thermal Ionization Mass Spectrometer (TIMS) for analysis of $^{87}Sr/^{86}Sr$ ratios.

The human $^{87}Sr/^{86}Sr$ ratios ranged from 0.705736 to 0.711876 and were grouped by geographical region. An analysis of variance was used to test for regional variation and significant differences were found. The samples from the United States were significantly different from the samples in Central America, Caribbean Islands, West Africa, and Europe. Central American samples were also significantly different from the other groups. No significant differences were observed between the Caribbean Islands, West Africa, and Europe. A significant difference was observed between bottled and tap water consumed by individuals from West Africa. The New England faunal samples from Pembroke, MA, and water sample from Braintree, MA, were not significantly different from the New England human samples, but the Brighton, MA, water sample was significantly different.

Based on the acquired data, regional differences in $^{87}Sr/^{86}Sr$ ratios are detectable using strontium isotope analysis. The results suggest that the differences observed are due to a combination of geological effects and influences from the globalization of food. The three distinct strontium ranges found across the five geographical regions correlated with the differing surface geology, yet slight differences in geology between the Caribbean Islands, West Africa, and Europe were not detected by strontium ratios. This suggests that region of origin may not be as reliable when analyzing only strontium isotopes in tooth enamel.

References:

1. Bentley RA. Strontium isotopes from the earth to the archaeological skeleton: A review. J. Archaeol Method Th 2006; 13(3).
2. Juarez CA. Strontium and geolocation, the pathway to identification for deceased undocumented Mexican border-crossers: A preliminary report. J. Forensic Sci 2008;53(1):46-49.

Teeth, Isotopes, Human Identification

 ** Presenting Author*