A17 Trace Element Analysis of Dental Enamel for the Geographic Attribution of Unidentified Remains

Robert H. Stein, BS, Virginia Commonwealth, Dept of Forensic Science, 1015 Floyd Avenue, Rm 2015, Richmond, VA 23284; Tal Simmons, PhD, Virginia Commonwealth University, Dept of Forensic Science, 1015 Floyd Avenue, Richmond, VA 23284; Christopher J. Ehrhardt, PhD, Virginia Commonwealth University, Dept of Forensic Science, 1015 Floyd Avenue, Rm 2015, Richmond, VA 23284; and Jennifer L. Hankle, DMD, ViCU School of Dentistry, MCV Campus, Lyons Bldg, Rm 430C, Richmond, VA 23298-0566*

After attending this presentation, attendees will understand the potential of utilizing trace elements in both surface and subsurface enamel to add pertinent information to biological profiles of unidentified individuals.

This presentation will impact the forensic science community by adding to existing geographic attribution methodologies to assist in the identification of unidentified remains. Ultimately, aspects of this methodology could be implemented in a forensic setting to benefit the Undocumented Border Crosser (UBC) crisis at the United States-Mexico border.

The remains of hundreds of UBCs must be examined every year and identification efforts are frequently hindered by the rapid early decomposition due to the extreme desert environment. Therefore, calcified tissues that preserve well (i.e., dental enamel) may hold the key to improving identification methods. The static, sub-surface enamel of permanent dentition remains unchanged during life after its formation *in utero* and for a brief post-natal period and thus can reflect an individual's birthplace, whereas the dynamic nature of the exchange of ions at the enamel surface can reflect the recent geographic residence of the individual.[1-3] Previous studies have shown that trace elements in dental enamel and bone, namely strontium isotopes, can be influenced by diet and geographic locality in humans.[4,5] Two drawbacks of these studies are addressed by this project: (1) lack of evaluation of other trace elements which are inevitably present; and, (2) utilization of bulk dental enamel alone.[1] By looking at both surface and subsurface (bulk) enamel separately, rather than solely bulk enamel, greater discrimination may be obtained (i.e., birthplace and recent residence geographic locality), which will aid in identification efforts.

This study examined ca. 60 teeth from 33 individuals obtained from the Virginia Commonwealth University (VCU) Dental Clinic with Institutional Review Board (IRB) consent. These individuals currently reside in Virginia, but originated from a variety of countries, including El Salvador, Mexico, Guatemala, China, and Somalia. Surface enamel was etched directly using a solution of trace metal-free nitric acid and glycerin, and bulk enamel was dissolved in trace metal-free nitric acid. Samples were analyzed for the following trace elements via Inductively Coupled Plasma/Mass Spectrometry (ICP/MS): ^{7}Li; ^{24,25,26}Mg; ^{27}Al; ^{49}Ti; ^{58,60}Ni; ^{63,65}Cu; ^{64,66,68}Zn; ^{69,71}Ga; ^{75}As; ^{86,87,88}Sr; ^{137,138}Ba; and ^{204,206,207,208}Pb. Principal Component Analysis (PCA) and Discriminant Function Analysis (DFA) were performed to assess multivariate relationships among samples and determine which trace elements drive compositional differences among the samples and the locality groups.

Based on results from the surface enamel, a correlation-matrix PCA plot was generated using ^{55}Mn, ^{63,65}Cu, ^{137,138}Ba, and ^{206,207,208}Pb isotopes as these isotopes yielded the best clustering of individuals originating from the same locality. Standardized function coefficients demonstrated that all isotopes used in the statistical analysis (i.e., ^{55}Mn, ^{63,65}Cu, ^{137,138}Ba, and ^{206,207,208}Pb) had a relatively equal influence on the separation of the individuals' teeth chemical compositions (the range of function coefficients was from 0.339 to 0.363). Variables, such as enamel erosion and age, are likely to influence the persistence of certain trace metals and require further investigation to determine their effects.

In conclusion, Inductively Coupled Plasma/Mass Spectrometry (ICP/MS) analysis of surface and deeper enamel is a promising method for determining the birthplace and recent residence of individuals, providing essential information for identification purposes.

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