A153 The Application of Multi-Isotope Analysis to Assist with Georeferencing Unidentified Decedents

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After attending this presentation, attendees will better understand how heavy and stable isotope analysis assists with the estimation of geographic origin and migration of unidentified decedents.

This presentation will impact the forensic science community by providing and highlighting results from several ongoing cold cases, successful identifications, and known Floridian individuals' isotope values for the Tampa Bay region.

Forensic anthropologists employ methods involving skeletal analysis to estimate age, sex, ancestry, trauma, and pathology assessment for the unidentified decedent. By collaborating with other scientists in the field of geochemistry, the biochemistry of human tissue (i.e., bone, enamel, hair, nails) elucidates evidence of geoprofiling for the unidentified decedent. This research has two objectives: (1) to demonstrate how isotope analysis can aid with the solvability of unsolved cases of the unidentified; and, (2) how Florida has a particularly unique demographic situation in terms of a transient population.

An additional goal of this study was to collect more modern enamel and bone samples for known individuals from Florida and throughout the United States to improve reference sample sizes for forensic investigations. Stable oxygen isotopes ($\delta^{18}O$) and carbon ($\delta^{13}C$) were also used to tighten constraints when estimating geographic origins for the unidentified decedent.

Strontium ($^{87/86}Sr$) and lead isotopes ($^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$, $^{208}Pb/^{204}Pb$) were analyzed from the teeth and bone of the unidentified individuals to infer either geographic origins or recent area of residence. Strontium is absorbed into the individual's biology via the food chain. The ultimate source is the local bedrock, soil, and water. Long-distance importation of food and water may affect the individual's strontium isotope ratios and may not be entirely controlled by the local environment. Similarly, the lead isotopic compositions of individuals can be linked back to local environmental sources of lead from the soil or anthropogenic sources, such as leaded gasoline. Over the individual's lifetime, lead is absorbed through dust inhalation at very minimal amounts.

In contrast to strontium, it is believed that lead is more directly absorbed through soil and/or dust ingestion or inhalation and, therefore, is not likely to be affected by importation of foods from other regions. Exposure to lead from lead paint or lead pipes can affect the lead isotopic signal in human teeth and bones. A comparison of the isotope ratios of the enamel and bone can yield a pattern of migration of when the individual moved from one geographic region to another region throughout their lifetime. The tooth enamel formation during early childhood provides a biochemical profile of the individual's early years, while bone will remodel over a course of seven to ten years continually as a person ages. The bone offers a biochemical profile of the individual's last years of life. Human teeth and bone are an archive of long-term strontium and lead exposure.

Analyses of oxygen, carbon, lead, and strontium isotopes were completed on selected current and cold cases, which included a sample of 53 individuals (n=27 males, n=21 females, and n=5 unknown) from 2010 to 2017. Additionally, donated teeth (n=20) with known demographic information were utilized to generate an increased reference sample for Florida. Other known United States samples are included as a comparison for the heavy isotope values.

A trend in the isotope results also reveals that a number of cases in the Tampa Bay region are foreigners or out-of-state individuals. After the isotope analysis was performed for these cases, investigators were able to redirect their investigations and reach out to other agencies with the new information concerning the case. Two interesting non-local cases, which were positively identified, will be highlighted in this presentation. Moving forward, collaborative and multidisciplinary research across the board will enhance the solvability and success in current and cold casework.

Isotope Analysis, Cold Cases, Geoprofiling

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