A20 Stable and Heavy Isotope Analysis: The Successful Use of Chemical Research in the Tampa Bay Cold Case Initiative

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After attending this presentation, attendees will understand the principles underlying heavy isotope analysis. Isotope analysis, utilized in forensic investigations, assists in the estimation of geographic origin and migration patterns of unidentified decedents. Isotope analysis has been utilized in bioarchaeology for decades. More recently, heavy isotope analyses involving strontium isotope and lead isotope ratios have been utilized in the estimation of geographic origins for migrant populations and unidentified decedents.

This presentation will impact the forensic science community by highlighting the importance of biogeochemical methods to enhance forensic anthropological investigations. This current research study will yield local strontium and lead isotope values that can assist with current unsolved cases for Florida and the southeast region of the United States.

Forensic anthropologists systematically apply a comprehensive set of methods for unsolved cases (i.e., the estimation of age, sex, ancestry, trauma, pathology, and unique identifying characteristics) to aid in the identification of decedents. Application of methods such as chemical and elemental analysis offers long-term unsolved cases new lines of evidence. These methods are proving to be valuable by yielding georeferencing information for the identification of victims.

Human teeth and bones are an archive of long-term strontium and lead exposure. Strontium and lead isotopes were analyzed from the teeth of unidentified individuals. Permanent teeth begin enamel mineralization during early childhood, as early as three to six months during infancy with central incisors and up to 12-15 years of age with the first permanent molars. Strontium is absorbed into the individual's biology via the food chain with the ultimate source being 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 from anthropogenic sources such as leaded gasoline.

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. A comparison of the isotope ratios of the enamel and bone can yield a pattern of migration from when the individual moved from one geographic region to another region throughout their lifetime. The enamel formation during early childhood gives a biochemical profile of the individual's early years, with bone remodeling over a course of 7-10 years continually as a person ages. The bone offers a biochemical profile of the individual's last years of life.

For this research, stable and heavy isotope analysis of δ13C (carbon), δ15N (nitrogen), δ18O (oxygen), 87Sr/86Sr (strontium), and the lead isotopes (206Pb/204Pb, 207Pb/204Pb, and 208Pb/204Pb) were completed on current and cold cases, which includes a sample of 30 individuals (15 males, 10 females, and 5 unknown) since 2010. Stable isotopes of carbon and nitrogen were utilized to investigate diet and nutrition, while oxygen, strontium, and lead isotopes were used to evaluate geographic origin and environment. Isotopic analysis aided in identifying the individual's diet over their lifetime and the geography of their living environments. Heavy isotope results were instrumental in the estimation of the decedent's birth location versus where they were recovered in Florida.

In the cases of successful identification encompassed within the Tampa Bay Cold Case Initiative, the isotope results have successfully revealed geographic origins and migration patterns for the decedent. A trend in the isotope results also reveals numerous cases in the Tampa Bay region are foreigners or out-of-state individuals. From the isotope results for the unsolved cases, cold case investigators were able to redirect their investigations and reach out to other agencies with the new information concerning the case.

The Tampa Bay Cold Case Initiative is a noteworthy example of collaborative work and research by forensic anthropologists, scientists, and medicolegal agencies. The goal of this project is to reinvestigate and highlight "cold cases," which has led isotope analysis to be applied to recent skeletal cases due to the transient nature and population of the Tampa Bay region. Collaborative and multidisciplinary research is a key function for casework involving unidentified human remains.

Isotope Analysis, Cold Cases, Biogeoreferencing