A63 Application of Stable Isotope Forensics for Predicting Region-of-Origin of Unidentified Border Crossers Found Deceased in the United States

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After attending this presentation, attendees will understand the application of stable isotope analysis in predicting the region-of-origin of unidentified border crossers found deceased within the United States. Attendees will better understand the applications and limitations of stable isotope analysis as an investigative tool for forensic scientists in identifying foreign nationals.

The development of this form of forensic analysis will impact the forensic science community by demonstrating how stable isotope analysis can aid the repatriation process for unidentified border crossers from Latin America.

Over the past two decades, there has been a steady increase in the number of deaths of Unidentified Border Crossers (UBCs) along the United States-Mexico border. Since 1999, there have been more than 6,000 deaths in the United States border states (especially Arizona and Texas), representing Mexican, Central American, and South American nationals. The large volume of UBC casework has created an unprecedented human identification challenge, especially given the lack of personal documentation, antemortem records, and DNA family reference samples for these individuals.

Recently, a large-scale effort has been mounted to identify deceased UBCs recovered from Brooks County, TX. This area is along a major migration route from Mexico into Texas and has experienced a large number of UBC deaths in recent years. In 2013, Baylor University and the University of Indianapolis began the process of exhuming UBCs from this region to aid in personal identification efforts. Current efforts toward identification have focused on DNA, craniometrics, personal effects, and the use of missing persons databases.

Stable Isotope Analysis (SIA) can provide another investigative tool to aid in the identification effort of UBCs. Recently, SIA has been successfully used to provenance human remains from past wars and conflicts, as well as unidentified human remains cases from local jurisdictions. Stable isotope ratios measured in bones, teeth, and hair can provide a record of a person's dietary preferences, recent travel history, and childhood residence. Dietary information gleaned from stable carbon and nitrogen isotope values of bone collagen and bioapatite, tooth enamel bioapatite, and hair keratin provide useful information on an individual's food consumption practices during life. More importantly, stable oxygen and strontium isotopes in human tissues can be used to predict a region-of-origin. Because stable oxygen isotopes of water vary based on environmental factors, isotope ratios measured in bones and teeth reflect the local water source imbibed at the time of tissue formation. Strontium isotopes reflect geological age of a region's underlying bedrock and are incorporated into humans who consume plant and animal resources from the local landscape. When combined, these isotopes provide a powerful "geolocation" tool (i.e., an "isoscape") for predicting an individual's region-of-origin or travel history.

The goal of this study is to present stable isotope results and isoscape maps for a subset of UBCs (n=13) recovered from Brooks County, TX. Human bone and tooth samples were prepared for mass spectrometry, including stable carbon and nitrogen isotopes of bone collagen, stable carbon and oxygen isotopes of enamel bioapatite, and strontium isotopes of enamel.

Mean bone collagen $\delta^{13}C$ is -14.1‰ (±1.9, 1 Standard Deviation (SD); range=6.5) and mean $\delta^{15}N$ is 10.3‰ (±1.1, 1 SD; range=4.2). Tooth enamel bioapatite, which reflects childhood diet, is even more variable, with a mean $\delta^{13}C$ value of -6.8‰ (±2.4, 1 SD; range=7.6). As expected for individuals of Latin American origin, these mean values are consistent with a diet that emphasized C_4-based resources (e.g., corn products). The extent of dietary heterogeneity suggests that these individuals may be from different regions within Latin America; however, two individuals have especially low $\delta^{13}C$ bone and tooth bioapatite values and somewhat high $\delta^{15}N$ values, suggesting a diet more focused on C_3-based resources and higher trophic level protein sources.

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For enamel bioapatite, mean $\delta^{18}O$ is -5.0‰ (±1.7, 1 SD; range=6.0). Isoscape predictions based on precipitation water maps are consistent with several Latin American countries for the majority of the sample. In at least one case, the $\delta^{18}O$ value is only consistent with an origin within the United States and in another case, only within the northeastern coast of South America. Stable isotope analysis can provide a useful investigative tool to aid in the identification effort of UBCs. The addition of the strontium isotope data should aid in narrowing down a more specific region.

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