A114 Examining Stable Isotope Ratios From Victims of the Internal Armed Conflict in Peru (1980s–2000) to Establish Local or Non-Local Geographic Origins: A Preliminary Analysis of the Victims of the Military Base Los Cabitos, Ayacucho, Peru

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Learning Overview: The objective of this presentation is to educate attendees about using stable oxygen carbon and nitrogen isotope analyses as a method for evaluating whether a deceased individual is from the geographic region where a body was disposed. This presentation will also provide attendees with specific information about a case from the Internal Conflict in Peru that left hundreds of unidentified bodies at the Los Cabitos exhumation site in Ayacucho, Peru, the geographical heart of the conflict between the Shining Path and the Peruvian State.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by presenting methods and results that will teach attendees about the benefits and limitations of using stable isotope analysis and missing persons' databases as part of the methodological toolkit for moving closer to identifying unknown persons.

This study applied isotopic analyses to evaluate whether unidentified persons recovered from the Los Cabitos exhumation site in Ayacucho, Peru, were from the local Ayacucho region. Those bodies were disposed there during the Time of Violence in Peru in the 1980s–2000s. This is the first phase of isotopic analysis of the victims' bodies, which will be used to estimate possible geographic origins of the unidentified persons. The oxygen isotope ratios (^{18}O:^{16}O) in drinking water sources are affected by latitude, temperature, elevation, distance from the coast, and other factors. If a person consumes local water, the oxygen isotope ratio in human tissues should align with local water drinking sources. Carbon isotope ratios (^{13}C:^{12}C) in humans are determined by the plants consumed (and of the animals that eat those plants), and nitrogen isotope ratios (^{15}N:^{14}N) from collagen vary depending on protein sources, among other factors (e.g., fertilization of crops). Depending on cultural/ecological contexts, certain ranges of carbon and nitrogen isotope values are expected for particular populations (e.g., a high-altitude, subsistence-based pastoralist from the 1980s in the Andes is likely to have lower carbon isotope ratios due to less access to maize, which grows in lower altitudes, and lower nitrogen isotope ratios because of little-to-no consumption of marine resources).

Research Goals: This presentation documents carbon and oxygen isotope ratios from dental carbonates and nitrogen isotope ratios from bone collagen from 45 unidentified persons from the Los Cabitos exhumation site. If outliers are identified based on isotope data, then that likely suggests that those individuals are not from the local Ayacucho region. Those "outlier" individuals can then be compared to the missing persons database of individuals who were imprisoned at Los Cabitos in the 1980s and 1990s.

Methods: Two enamel powder samples were taken from each tooth. Chemical preparation of the specimens was conducted at the Vanderbilt Bioarchaeology and Stable Isotope Research Laboratory (BSIRL) and processed at the Yale Analytical and Stable Isotope Center on a Thermo DeltaPlus Advantage (for carbon and nitrogen in collagen) and a Thermo™ DeltaPlus™ XP (for carbon and oxygen in dental carbonates). Carbon and oxygen isotopes are reported relative to the Vienna PeeDee Belemnite (VPDB) standard: $\delta^{13}C=([(^{13}C/(^{12}C_{sample})/ (^{13}C/(^{12}C_{standard}] - 1) \times 1{,}000)$ and $\delta^{18}O‰=([(^{18}O /(^{16}O_{sample})/ (^{18}O /(^{16}O_{standard}] - 1) \times 1{,}000)$. Nitrogen isotope ratios are reported relative to Atmospheric Nitrogen (AIR):$([(^{15}N/^{14}N)_{sample}/(^{15}N/^{14}N)_{standard}] - 1 \times 1{,}000)$.

Results: Results showed that among the enamel carbonate samples, the mean $\delta^{18}O_{PDB}$=-9.0‰ (s.d.=1.1) and the mean $\delta^{13}C_{PDB}$=-8.2‰ (s.d.=1.9); *N*=89 enamel samples for both isotopes. From the bone collagen samples, the mean $\delta^{13}C_{PDB}$=-16.2‰ (s.d.=1.9) and the $\delta^{15}N$=9.8‰ (s.d.=0.5); *N*=12 bone collagen samples for both isotopes. There are two outliers with both oxygen and carbon isotope values that are more than four times the standard deviation for one individual and four times the standard deviation for oxygen for the other. These isotope data strongly suggest that these two individuals spent their childhood in a distant locale, outside of the Ayacucho region. The bone collagen data suggest that the individuals then moved to Ayacucho, residing there for at least the last five to ten years before death, consuming diets similar to all of the other natal individuals. There are 16 individuals who were born outside of the Department of Ayacucho in the missing persons database for the Los Cabitos military complex.

Conclusion: These results can be used to evaluate whether the outliers were one of the non-local people in the missing persons database. Although isotope studies as a sole method do not arrive at positive identifications, these methods do narrow the range of options, which may aid in more focused DNA studies and other identification techniques.

Stable Isotopes, Peru, Shining Path Conflict

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