H130 A Comparative Study of Biogeochemical Signatures in Bone From Two Groups: Deceased Undocumented Border Crossers From Mexico and Individuals From the Northeastern United States

Jennifer J. Prutsman-Pfeiffer, PhD, Univ of Rochester Medical Center, Autopsy & Neuropathology, 601 Elmwood, Box 626, Rochester, NY 14642; Lori E. Baker, PhD*, Baylor Univ, Forensic Research Lab, One Bear Place, #97173, Waco, TX 76798-7173; Thomas H. Darrah, MS, Univ of Rochester, Dept Earth & Environmental Sciences, 227 Hutchison Hall, Rochester, NY 14627; and Erich J. Baker, PhD, Baylor Univ, Dept of Computer Science, One Bear Place #97356, Waco,*
TX 76798

After attending this presentation, attendees will understand the utility of incorporating bone biogeochemical studies into casework involving the analysis of unidentified skeletal remains. This research tests the hypothesis that human bones from geographically distant areas of North America (Mexico and western New York State) will reflect the respective environments of residence. The environmental regions differ based on concentrations of trace elements and lead isotope ratios. Diet differences may be reflected in the contrasting populations, as well as differences in sources of lead exposure and possibly other elements associated with occupation or medical interventions.

This presentation will impact the forensic science community by showing how the methods discussed will assist in the identification of migrant individuals in determination of their foreign origin which will impact the forensic science community.

This analysis provides a picture of the elements and isotopes that offer the most discrimination between disparate geographical populations. If it is possible to narrow a possible area of origin, whether natal or residential, this technique could provide a geographical area of focus for investigators to concentrate their efforts in resolving cold cases and the unidentified. There is a national concerted effort for medical examiners/coroners, police agencies, and families of missing persons to utilize repositories like the National Missing and Unidentified Persons System (NamUs) to associate missing persons and unidentified remains through demographic, personal, medical, and biological information. This effort also encompasses the identification work of deceased migrants along the southern U.S. border. DNA services are offered free of charge to agencies and families with the goal of finding identities for the deceased and unidentified; however, the reality of unidentified remains is that the pool of possibilities is very large and there must be a familiar sample for comparison. Biogeochemical analysis of bone may narrow the target geographic area of the unidentified person, help direct the investigation, and improve the likelihood of making an identification.

This study investigates the elemental and isotopic composition of human bones of 22 deceased undocumented southwestern border crossers with positive DNA identifications (residence of Mexico) and 38 deceased individuals from the northeastern United States (residence of western and central New York State). Inductively Coupled Plasma Mass Spectrometry (ICP-MS) was used to obtain concentrations of 31 elements and Pb isotope ratios of parietal, femoral, and tibial bone samples from Mexico (parietal N=17, femoral N=14 and tibial N=4; paired samples: parietal/femoral, N=11) and western New York State (parietal bone from autopsy series, N=32; parietal and tibial bone from anatomical gift series, N=6).

A metric Multidimensional Scaling (MDS) analysis was performed for all samples with all elements. This showed separation of the two geographically separated groups (New York vs. Mexico) when all data is considered. The significance of the differences between the groups for each element and Pb isotope ratios was then analyzed. When comparing only parietal samples, there were five elements (Al, Mn, Sn, Zn, Fe) that were significantly different between the New York State samples and the Mexico samples at the 0.01 level and one (Hg) that was significant at the 0.5 level. MDS was then performed on all of the parietal samples and included only those elements that were significantly different between the two groups. This analysis showed even better differentiation of the two groups with the elimination of nonsignificant elements. In addition, the pairing of bone samples from the same individual allowed a comparison of elemental concentration and isotopic ratios between different anatomic bone locations. The New York parietal/tibial pairs showed no significant difference, indicating that either bone would yield similar results. The Mexican parietal/femoral pairs only showed a significant difference in the concentrations of Mn with a p-value of 0.007.

A plot of lead isotopes (208PB/206Pb vs. 207Pb/206Pb) revealed both overlap and differences between the southwest and northeast parietal bones. The NY group clustered around values previously reported for individuals from this region, showing relationship to local soil, inputs from U.S. and Canadian gasoline sources, and local atmospheric ratios. Both groups revealed outliers that may be explained by different sources of environmental and anthropogenic lead.

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 ** Presenting Author*