H67 Application of X-Ray Fluorescence for Sorting Commingled Human Remains

Alexandra Perrone, 2940 Grinnel Drive, Davis, CA 95618; Janet E. Finlayson, BS*, California State University, Chico, Dept of Anthropology, #311 Butte, 400 W First Street, Chico, CA 95929-0400; Eric J. Bartelink, PhD*, CSUC, Dept of Anthro, Butte 311, 400 W First Street, Chico, CA 95929-0400; and Kevin Dalton, MA**

After attending this presentation, attendees will gain an understanding of the application and reliability of portable X-Ray Fluorescence Spectrometry (pXRF) for differentiating skeletal elements of different individuals.

This presentation will impact the forensic science community by highlighting the application of pXRF in forensic anthropology. The challenges and limitations of this method for resolving cases involving commingled remains will be discussed.

Commingling of human remains presents complex challenges for forensic anthropologists. In such cases, it is important to accurately segregate each individual represented and determine the number of individuals present. For small-scale commingling cases, pXRF spectrometry provides a rapid and non-destructive method for potentially determining whether a set of remains belongs to a single or multiple individuals by analyzing trace element concentrations in human bone.

The goal of this study is to determine if pXRF can be used to reliably sort commingled remains. X-ray Florescence is capable of detecting minute differences in elemental concentrations, which is essential for discriminating between bones of different individuals. In order for the method to be useful for resolving commingling, there must be more variation in trace element concentrations *between* individuals than *within* individuals. To test this hypothesis, pXRF analysis was conducted on ten bones and one tooth from 20 human skeletons curated at the California State University, Chico's Human Identification Laboratory. From each individual, trace element concentrations were measured on the maxillary first molar enamel, the mental eminence of the mandible, the shaft of the fourth rib, the vertebral body of the fifth lumbar, and the midshaft of the humerus, ulna, radius, femur, tibia, and fibula. These elements represent the major anatomical regions of the skeleton and should account for expected variation within a single individual. Each sample was scanned without a filter for 180 seconds, and elemental concentrations were measured in reference to a mudrock calibration file. Slight differences were detected in comparisons of data from scans of cleaned versus uncleaned cortical bone surfaces. To reduce possible surface contamination effects, all bone surfaces were cleaned with 100% ethanol (EtOH) prior to analysis.

Elements detected included sodium, magnesium aluminum, silicon, phosphorous, sulfur, potassium, calcium, barium, titanium, vanadium, chromium, manganese, iron, cobalt, nickel, copper, and zinc. The elemental concentrations from each bone and tooth were analyzed using discriminant function analysis. One of the ten skeletal elements from each individual was assigned group membership (cross validated). Finally, the potential influence of diagenesis was examined by comparing variation within and between individuals who were processed as relatively intact bodies versus those that were either recovered as skeletal remains from outdoor surface environments or from buried contexts. Preliminary results indicate that there is more variation between skeletons than within skeletons, suggesting that pXRF has utility in resolving cases of commingling. Variation between skeletal elements from the same individual may reflect differences in remodeling rates between bones of varying density. The degree of overlap in trace elemental concentrations between some individuals suggests that the method has the greatest utility for small-scale commingling cases.

Forensic Anthropology, Portable X-Ray Fluorescence, Commingling

 ** Presenting Author*