A47 The Use of Portable X-Ray Fluorescence (pXRF) Spectrometry for a Large Commingled Assemblage

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After attending this presentation, attendees will understand the potential application of trace elemental concentrations in bone as measured by pXRF to large commingled skeletal collections when used in conjunction with other segregation techniques, as well as the pitfalls of its use stemming from taphonomic alteration.

This presentation will impact the forensic science community by serving as a further means of segregation in extensively commingled skeletal assemblages and will discuss approaches to combining elemental concentration data with other segregation techniques. These methods also have the advantage of being relatively inexpensive, rapid, and non-destructive.

Commingled skeletal assemblages present a challenge to the accurate segregation of skeletal remains, particularly when individuals from the loss incident share demographic similarities. PXRF has been shown to be useful in segregating individuals in small commingled assemblages, though its utility has not been established in larger scale cases. Developed methods use intraskeletal similarities in the trace elemental composition of bones (including some of the following: potassium, calcium, iron, magnesium, phosphorus, zinc, strontium, lead, sodium, silicon, titanium, vanadium, chromium, manganese, cobalt, nickel, and copper) to chemometrically group skeletal remains based on the relative concentrations of each element; however, many of these concentrations may be affected by taphonomic processes. This research compares elemental concentrations as measured by the pXRF at the bone surface to those measured on internal cortical bone exposed by previous DNA sampling. These data were also compared to trace element concentrations present in the surrounding burial environment. Trace elements with measurements that are much higher at the bone surface are likely to have been taphonomically affected, as are skeletal remains that exhibit an element concentration profile matching that of the burial environment. Additionally, pXRF analysis of these remains alongside standard reference materials with known elemental concentrations may be able to provide accurate measures of individual trace elements that can then be better compared across the skeleton. This research will use the resulting trace elemental concentrations in multivariate analysis to create groups that can be used in conjunction with other segregation methods.

The sample represents the remains of close to 400 men lost aboard the USS *Oklahoma* on December 7, 1941. After multiple identification attempts in the late 1940s, these remains were buried in the National Memorial Cemetery of the Pacific, Honolulu, HI. Their recent disinterment revealed extensive commingling with an estimated minimum number of 390 individuals, based on mitochondrial DNA profiles. Preliminary analysis of three bones, each from four individuals (a humerus, a femur, and an innominate) identified the potential for the use of specific trace elements in segregating remains. One individual displayed high concentrations of potassium and iron, another was characterized by relatively high values of titanium, and another by steady values in strontium, lead, and zinc. The fourth exhibited large fluctuations between measurements obtained at the bone surface and from exposed cortical bone. High concentrations of iron, the presence of vanadium and chromium, and variability in trace elements such as potassium and zinc imply that the composition of these skeletal remains may have been affected by taphonomic processes.

This study will present methods for integrating these chemometric data into visual examination and the use of DNA sequence information for a large commingled assemblage. This research will explore methods for increasing the accuracy of measurement for trace elements throughout this assemblage to better differentiate those useful for segregation of individuals and those indicative of taphonomic alteration.

The views herein are those of the authors and do not necessarily represent those of the Department of Defense or the United States government.

Commingled, X-Ray Fluorescence, Trace Elements

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