Known origin? Promise and limitations of North American stable isotope reference data for human geolocation

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Isotopic geolocation methods rely on reference data documenting spatial isotopic variation in human tissues. A growing number of studies have reported such data, collectively representing an *ad hoc* but potentially valuable baseline for forensic applications. The value of these data depends strongly on several factors, however, including standardization of metadata, variation in analytical protocols, and the geographic coverage of data from any given tissue and isotope system.

We reviewed >40 studies which present Sr or O isotopic data from North American human samples, including hair, bone, nail, and teeth. We attempted to compile and standardize the isotopic data and metadata on study methods and sample origin. In 23 studies the geographic location at which the sampled material formed was known or could be assumed, giving a dataset of >2,500 values. Geographic coverage differed widely among studies and tissue types, but substantial coverage gaps existed for all tissues. Variation in analytical protocols was also problematic for many datasets. Some such issues have been addressed through research on standardization and cross-calibration between laboratories, but uncertainty in the comparability of many data sets remains non-trivial.

Despite these limitations, the compilation reveals coherent and consistent isotopic patterns across studies and tissue types that imply promise for geolocation applications. Using environmental isoscapes as a baseline for comparison, we show that robust and consistent geographic variation is expressed in oxygen isotope ratios of multiple human tissues. Similarly, strontium isotope ratios of different tissues exhibit common large-scale patterns despite factors such as differing pathways of incorporation and potential contributions from non-local foods. Collectively, these results reinforce the potential promise of isotopic geolocation methods in forensics but highlight the value of coordinated programs for the collection of reference samples.