OXYGEN ISOTOPES IN NYC TAP WATER: IMPLICATIONS FOR ESTIMATING GEOLOCATION OF UNIDENTIFIED HUMAN REMAINS

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Abstract

In forensic contexts, stable isotope analysis presents possible geolocation data for human remains and can help to identify unknown individuals with the addition of other identification methods. With ingestion of food and water, isotopes of various chemical elements are incorporated into tissues during formation or remodeling. Previous studies show a strong relationship between oxygen isotope values in human tissues and source water. This project explores the oxygen isotope values for New York City (NYC), a water supply system that contains 19 reservoirs and three controlled lakes located in the Catskill Mountains and the Hudson Valley. Since oxygen isotope values are dependent on latitude, altitude, and temperature, reservoirs in the Catskill Mountains have lower oxygen isotope values than those in the Hudson Valley reservoirs, potentially contributing to lower tap water oxygen isotopes to NYC.

This project utilized oxygen isotope values for predicted average annual precipitation ($\delta^{18}O_W$) at all reservoirs and lakes in the NYC water supply system and oxygen isotope values in NYC tap water ($\delta^{18}O_{tap}$) to examine differences between water sources and differences in tap water supplied to NYC's five boroughs (Manhattan, the Bronx, Brooklyn, Queens, and Staten Island). Statistically significant differences were found between $\delta^{18}O_W$ values in the Catskill/Delaware watershed systems and Croton watershed system as well as between $\delta^{18}O_{tap}$ values in water supplied to Brooklyn and Manhattan. Differences in $\delta^{18}O_{tap}$ values reveal the need for a lowering of the $\delta^{18}O_{tap}$ range for the NYC area compared to the established isoscape values by Bowen et al. (2007). A proposed shift in this range was used to classify oxygen isotope values for ingested water ($\delta^{18}O_{IW}$) from dental enamel samples of five unknown individuals from the NYC-Office of Chief Medical Examiner (OCME) as possibly local or non-local to NYC during tooth development. Additional NYC $\delta^{18}O_{tap}$ sampling is warranted to improve accuracy for the classification of unknown individuals as local or non-local.