



E62 Increasing the Precision of Human Geolocation: A City Scale Investigation of Stable Isotopes in Tap Water

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After attending this presentation, attendees will understand the forensic importance of the isotopic compositions of tap water on a citywide geographical scale for the utilization of stable isotope analysis on human tissues for human provenancing.

This presentation will impact the forensic science community by demonstrating the necessity of understanding the isotopic values of drinking water sources and water distribution systems, at a high geographical resolution, in preference to estimating drinking water values derived from local precipitation water.

The geographical and temporal life history of an individual may be determined by the stable isotope analysis of human tissues. The isotopic compositions of tissues are reflective of the environment in which tissue formation took place, with drinking water being the major contributor for hydrogen and oxygen stable isotopes. Human provenancing through the use of stable isotope analysis becomes possible with the understanding of the isotopic patterns of drinking water across a geographical area, as an isotopic gradient exists for precipitation water across the globe. The term “drinking water” is commonly used interchangeably with both “precipitation” and “tap water” and while the isotopic compositions of tap water is influenced by local precipitation water, the compositions are not necessarily identical. The isotopic distribution of tap water has been previously investigated for the United States, on a large geographical scale, showing the isotopic gradient across the country; however, no previous studies have investigated the isotopic distribution of tap waters across a single city at high resolution.

This study investigated the isotopic distribution of hydrogen and oxygen stable isotopes in tap waters across Metro Vancouver (MV), at a high geographical resolution, to determine whether the isotopic compositions of tap water can vary across a city and, secondarily, can be sourced. MV tap water is supplied by multiple sources with three major watersheds supplying the majority of MV and a complex system of 18 groundwater aquifers providing the remaining areas. Tap water samples were collected from across MV with the help of volunteers during a one-week period in the summer of 2013. Samples were collected in a 30mL airtight glass vial and were stored in a refrigerator until analysis. Triple Liquid Water Isotope Analyzer (TLWIA) was utilized for the isotopic analysis of tap water samples with an instrumental precision of $\pm 0.8\%$ for d^2H and $\pm 0.2\%$ for $d^{18}O$. The Online Isotopes in Precipitation Calculator was utilized for the estimation of isotopic values of local precipitation for MV.

The results revealed that $d^{18}O$ and d^2H in tap water varied across MV with a variation of 5.3‰ for $d^{18}O_{tap}$ and 29.3‰ for d^2H_{tap} . The isotopic compositions of MV tap water were unique to its water source, depending on the water distribution system supplied by multiple water sources, and differed from estimated local precipitation values. This finding has significant forensic importance as MV tap water can be sourced solely by its isotopic compositions and suggests the possibility of ultimately sourcing human values to specific areas within MV, which could aid in forensic investigations by increasing the precision of geolocating human remains. Thus, understanding the isotopic distribution of tap water across a geographical area with high geographical resolution is considered essential for the utilization of stable isotope analysis for human provenancing purposes. It also demonstrates the power of this method and similar studies for all North American cities are recommended.

Stable Isotopes, Tap Water, Human Geolocation