H11 Multi-Isotope Study of Modern Human Dental Enamel From a Dutch Population

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After attending this presentation, attendees will understand the potential of combining isotope ratios for different elements in dental enamel to assist in estimating the origin of unidentified victims.

This presentation will impact the forensic science community by providing insight into the use of isotope ratios to assist in estimating the origin of unidentified victims.

Isotope ratio analyses (δ18O, Sr and Pb) have been carried out in wisdom teeth (third molars) from Dutch individuals that were born and lived in The Netherlands (30 individuals) and from individuals (five individuals) that were born abroad (South Africa, Surinam, Germany, Poland, Kenya), and moved into The Netherlands during childhood or adulthood. Also included are results for four front teeth (central and lateral incisors) from two young children (five to six years old), who were born and live in The Netherlands. Results demonstrate the use of isotope ratios for estimating the origin of unidentified human victims.

Variations in radiogenic isotopic systems (Sr and Pb) in wisdom teeth from the foreign individuals were compared to the variations of the Dutch population. The combination of δ18O stable isotope ratios with radiogenic isotope ratios, such as Sr and Pb provides provenance information from different perspectives: For isotopic studies of dental enamel, δ18O provides information on the isotope composition of waters ingested by the individual, the Sr isotope composition links the individual to the geological environment, and Pb isotopes reflect exposure of individuals to Pb sources present in the environment. The multi-isotope method has great potential application in forensic sciences.

The average δ18O isotope composition of dental enamel from the collection of third molars from modern Dutch individuals is 25.62 ± 0.41 (1σ) ‰. The individual from South Africa has a similar δ18O isotope composition compared to the Dutch dental enamel. This is in accordance with the information provided for the South African individual who moved to The Netherlands at two years of age, which is before the formation of third molars that begin to calcify at seven to nine-years-old.

From the δ18O isotope composition of dental enamel, the δ18O isotope composition of the water ingested by the individuals has been calculated using the equations of Daux et al.[1] and Chenery et al.[1,2] The calculated δ18O isotope compositions of the ingested water by the different individuals clearly indicated variable isotopic compositions that depended on the place of origin.[1,2]

Srontium isotope ratios in dental enamel show large variations (0.707 – 0.710) in teeth from Uganda and Surinam due to the different geology (tertiary sediments and volcanics to granitic metamorphic rocks, respectively) in these areas. The Sr isotope results in dental enamel from the Dutch population vary between 0.709 – 0.710, which is comparable to the Sr isotope values in scalp hair, water, and soils in The Netherlands. The combination of Sr isotopes with δ18O isotope composition show distinctive compositions related to place of origin. By only using one isotopic system; for instance δ18O in dental enamel from Uganda and Surinam or Sr isotopes in tooth enamel from Poland and The Netherlands, the place of origin could not be distinguished. Similarly, Pb isotope results in dental enamel will be discussed.

References:

1. Daux V, Lécuyer C, Héran M-A, Amiot R, Simon L, Fourel F, Adam F, Lynnerup N, Reychler H. Oxygen isotope fractionation between human phosphate and water revisited. J. Human Evol 2008;55(6):1138-47.
2. Chenery CA, Pashley V, Lamb AL, Sloane HJ, Evans JA. The oxygen isotope relationship between the phosphate and structural carbonate fractions of human bioapatite. Rapid Commun Mass Spectrom 2012;26:309–19.

Teeth, Isotopes, Human Provenancing

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