

ArChTES: An investigation of dental enamel mineralization combining spectromicroscopy and isotopic analyses

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ArChTES combines Tender-Energy X-ray Absorption Microspectroscopy with stable isotope analyses, to characterize dental enamel during different stages of mineralization. The study couples stable isotope signatures with spatially resolved chemical characterization, to address questions about enamel biomineralization. It provides chemical information critical to answering questions that isotopes alone cannot; and addresses a fundamental limitation of X-ray probes, that they are not sensitive to isotopes.

Enamel is well-preserved over long time scales, and is formed at very specific stages of life, thus recording information about not only conditions when and where an animal was alive, but at a particular time in its life. Although enamel of a specific tooth forms at a specific stage of development, and once formed is not altered during life, the sequences and processes of biomineralization and element incorporation are not uniform during enamel formation. Trace element chemistry and biogenic isotope signatures have potential to provide information on diet, climate and location, but better understanding of biomineralization processes is needed to guide sampling of enamel structures, thus enabling greater resolution of the timing of life events. Our study provides the baseline results to enable future work targeting life events, through linking enamel isotope ratio values and trace element chemistry.