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Stable isotope ratios and trace elements in modern mammal tooth enamel

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Bioapatite from mammal tooth enamel is a popular biomineral used in the reconstruction of palaeoenvironment and palaeodiet. It records information about the animal's environment and diet on a sub-annual scale and is proven to be highly resistant to diagenesis, allowing the preservation of its original chemical composition through archaeological and geological timescales. In this study, stable carbon and oxygen isotope analysis are used as a stepping stone to investigate the use of other chemical proxies for the reconstruction of environment and diet from mammal teeth. Concentration profiles of trace element distributions (measured with µXRF and cross-validated with Laser Ablation ICP-MS) and stable isotope ratios ($\delta^{13}C_{ap}$, $\delta^{18}O_c$ & $\delta^{18}O_p$) are combined to test the reliability of trace element profiles from mammal teeth in recording seasonal changes in environment and diet of the animal.

A method is presented that links the various geochemical records within a tooth sequence using mineralization sequences and oxygen isotope seasonality. This way, a 3 year trace element and stable isotope record from horse tooth enamel is created showing seasonal variation in trace elements and isotope ratios linked to changes in climatic conditions and diet through the animal's lifetime.

This study shows how an entire new set of trace element proxies, that can be measured quickly and non-destructively, may yield information on palaeoenvironment and palaeodiet. These trace element measurements yield information from precious archaeological samples that could otherwise be obtained solely through destructive sampling. The versatility of the µXRF and LA-ICP-MS methods opens up a wide range of applications for trace element analysis in archaeology.