Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.15838

Inter- and intra-tooth variability in enamel-bound nitrogen isotopic composition of modern African mammals from Gorongosa National Park, Mozambique

SVEN BRÖMME[1], ALFREDO MARTINEZ-GARCIA[1], JACINTO MATHE[2,3], JENNIFER NICOLE LEICHLITER[1], HUBERT VONHOF[1], RENÉ BOBE[2,3], SUSANA CARVALHO[2,3] AND TINA LÜDECKE[1,3]

[1]Max Planck Institute for Chemistry
[2]University of Oxford
[3]Gorongosa National Park
Presenting Author: sven.broemme@mpic.de

Nitrogen isotopes ($\delta^{15}N$) are a well-established tool for reconstructing diet and trophic level because $\delta^{15}N$ values increase with each step up the food chain. $\delta^{15}N$ measured in collagen provides insight into the dietary behavior of species in modern ecosystems and the recent geological past. However, $\delta^{15}N$ analyses are challenging in fossil materials due to degradation of organic matter. Unlike bone or dentin, N-containing material in tooth enamel is protected from alteration by its highly mineralized structure, and thus an isotopic fingerprint can be preserved over deeper geological timescales. Enamel's low organic content long prevented $\delta^{15}N$ analyses in this material, but recent advances in the oxidation-denitrification method have made this possible. Using this method, data from a controlled feeding experiment, and from mammals in Gorongosa National Park (GNP, Mozambique) show that $\delta^{15}N_{enamel}$ reflects diet and preserves trophic level spacing [1, 2].

Here we present inter- and intra-tooth analysis of $\delta^{15}N_{enamel}$ of modern teeth from GNP. We analysed $\delta^{15}N_{enamel}$ from 302 tooth enamel samples including 16 herbivores and six carnivores. Complete dentition was analyzed for $\delta^{15}N_{enamel}$ to investigate variability between teeth formed during different periods of a mammal's life (e.g., before and after weaning). In each individual, the tooth reflecting its adult diet was serially sampled to investigate seasonality. Additionally, stable carbon ($\delta^{13}C$) and oxygen ($\delta^{18}O$) isotopes were analyzed from the same aliquot of tooth enamel to evaluate dietary preferences of individuals with different feeding behaviours.

This study enables the evaluation of inter- and intra-tooth variability in enamel-bound $d^{15}N$ and shows that the proxy reflects trophic level and dietary behavior in a well-studied modern natural ecosystem. Overall, our results show expected patterns reflecting seasonality and different developmental periods in an animal's life, illustrating the high potential of multi-isotope approaches for paleontological applications using diagenetically robust tooth enamel.

[1] Leichliter J.N. *et al.* Nitrogen isotopes in tooth enamel record diet and trophic level enrichment: Results from a controlled feeding experiment. Chem. Geol. 563:120047 (2021).

[2] Lüdecke T. *et al.* Carbon, nitrogen, and oxygen stable isotopes in modern tooth enamel: A case study from Gorongosa National Park, central Mozambique. Front. Ecol. Evol., 10:1107 (2022).