Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.12650

A multi-isotope approach to reconstructing dinosaur diets: trophic structure and niche partitioning

MASON A SCHER[1], HENRY C FRICKE[2], TYLER R LYSON[3] AND JOHN A HIGGINS[1]

[1]Princeton University

[2]Colorado College

[3]Denver Museum of Nature and Science

Presenting Author: mscher@princeton.edu

Paleodietary information for dinosaurs has been inferred using many methods including morphological studies of teeth, jaw mechanics, rarely found fossilized stomach contents, and coprolites. Though these methods glean valuable information, coprolites and stomach content analyses are only snapshots of paleodiets, and while morphological studies can infer the general class of food that was eaten, they lack specificity. The enamel matrix of teeth is an excellent archive for geochemical reconstructions of diets; traditional carbon and oxygen isotope analyses (of carbonate substituted into the hydroxyapatite matrix) have been used to infer feeding locations, the possibility of migratory behavior, and niche partitioning [1-3]. Relatively recent developments in instrumentation have enabled measurements of non-traditional stable isotopes like calcium and magnesium ($\delta^{44/40}$Ca and δ^{26}Mg) in fossil enamel. Paleodietary reconstructions can help answer big questions in dinosaur ecosystems: How did Cretaceous ecosystems support such a large quantity of physically large animals, often at the same trophic level? The utility of $\delta^{44/40}$Ca has been demonstrated in dinosaur ecosystems to look at trophic relationships like predator diet 'fishiness' [4,5] and herbivore niche partitioning [5]. δ^{26}Mg has been shown to be a useful trophic-level indicator in modern animals [6]. In this work, we present the first known coupled measurements of $\delta^{44/40}$Ca and δ^{26}Mg in dinosaur tooth enamel and gar scale ganoine to investigate trophic structure and herbivore niche partitioning in Cretaceous ecosystems. We construct trophic relationships for theropods, gar, and herbivorous dinosaurs in three late Cretaceous localities. We propose that a negative correlation between $\delta^{44/40}$Ca and δ^{26}Mg in herbivorous dinosaurs reflect vertical niche partitioning between hadrosaur and ceratopsian dinosaurs. The multi-isotope approach presented in this work allows for more nuanced conclusions to be drawn about the diets of extinct animals and will be a useful tool for a variety of settings.

[1] Fricke et al. (2011), *Nature* 480, 513–515.

[2] Fricke & Pearson (2008), *Paleobiology* 34, 534–552.

[3] Fricke et al. (2009), *Paleobiology* 35, 270–288.

[4] Hassler et al. (2018), *Proceedings of the Royal Society B: Biological Sciences* 285, 20180197.

[5] Martin et al. (2022), *GSA Bulletin*.

[6] Martin et al. (2015), *PNAS* 112, 430–435.