

Calcium isotopes variability in modern and ancient elasmobranchs

ALLIYA A. AKHTAR¹ AND JOHN A. HIGGINS¹

¹Princeton University, Department of Geosciences, Guyot Hall, Washington Road, Princeton, NJ, 08544, USA

Bioapatite in tooth enamel is resistant to diagenetic overprinting, and therefore considered a robust source of paleoenvironmental information. Elasmobranchs represent an ideal candidate for such studies given their global distribution and species level diversity (capturing a range of feeding ecologies), long temporal range (from Devonian to present day) and abundance of samples (due to high replacement rates of teeth in individuals).

Here we present stable isotope ($\delta^{44/40}\text{Ca}$, $\delta^{26}\text{Mg}$ and $\delta^{88/86}\text{Sr}$), as well as trace element (e.g. Sr/Ca, Mg/Ca) data from modern and fossil teeth to elucidate 1) the controls on enameloid chemical and isotopic composition, and 2) if these signals can be used for reconstructions of ancient ecosystems or seawater chemistry.

Enameloid $\delta^{44/40}\text{Ca}$ is believed to reflect seawater composition at the time of precipitation, as well as the respective trophic level of the individual. Based on analyses of 60 modern teeth spanning primary to tertiary piscivores, we determine an average $\delta^{44/40}\text{Ca}$ of -2.04 ± 0.49 ‰. Our results suggest that trophic level effect alone is insufficient to explain the observed offset from modern seawater, and the isotopic variability observed within and between shark species. Calcium isotope variability associated with differences in the internal cycling of calcium and/or fractionation associated with the precipitation of bioapatite likely play a more dominant role in determining the $\delta^{44/40}\text{Ca}$ preserved in elasmobranch enameloid.

Expanding our analysis to fossil teeth spanning the Pleistocene to Cretaceous, our data broadly agrees with published geochemical records, highlighting the fidelity of elasmobranch teeth as a proxy for recreating geochemical trends in seawater through Earth history.