Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.14030

Diagenesis of fossil gar fish scales with implications for geochronological and paleoenvironmental applications

JOHN FINK[1], **MARISSA M TREMBLAY**[1], THOMAS TOBIN[2], LISA D STOCKLI[3], DANIEL F STOCKLI[3] AND RYAN ICKERT[1]

[1]Purdue University
[2]University of Alabama
[3]University of Texas at Austin

Presenting Author: tremblam@purdue.edu

Fossil gar fish scales are abundant in the terrestrial sedimentary record from the Cretaceous to the present. To assess whether gar scale bioapatite can be used to study paleoenvironments and for geochronology, we investigated the diagenetic characteristics of the two different components of gar scales: ganoine, which has similarities to tooth enamel, and bone. We examined microscopic textural characteristics, spatially resolved trace element patterns, and apparent gar scale ages using the (U-Th)/He and U-Th-Pb systems, in modern scales as well as fossil scales from the North American Williston and San Juan basins. Similar structural and chemical characteristics of modern and fossil ganoine suggests that ganoine is more resistant to diagenetic alteration and recrystallizes more rapidly than bone. Laser ablation ICP-MS trace element data from fossil ganoine often show systematic decreases in concentration with distance from the ganoine surface, while trace element data from bone are more spatially heterogenous. The ganoine trace element data are consistent with a fossilization model in which trace element concentrations are controlled by an inwardly propagating recrystallization front. However, (U-Th)/He ages of ganoine are systematically younger than expected based on basin thermal histories, and compared to conventional detrital apatite (U-Th)/He data from the same localities. Ganoine (U-Th)/He ages exhibit an inverse relationship with effective uranium concentrations, which may indicate late-stage addition of the parent nuclides U, Th, and Sm (Figure 1). An alternative hypothesis is that the diffusion length scale of helium in ganoine is small, resulting in high diffusivities, although this would not explain the age versus effective uranium relationship. Ongoing ID-TIMS analyses of U-Th-Pb systematics in ganoine will provide insight into the timing of U uptake and help us to discriminate between these two hypotheses.

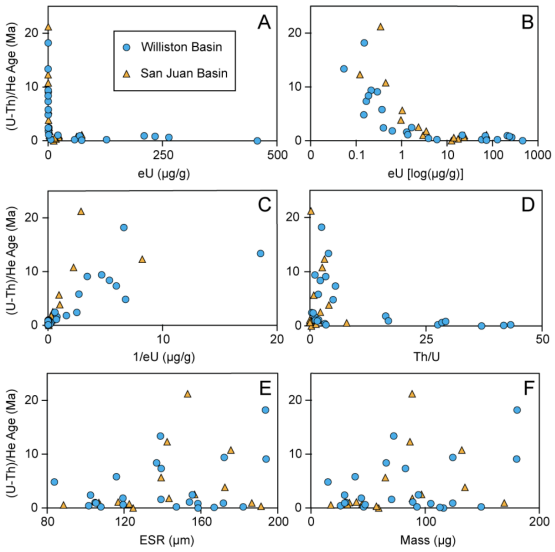

Figure 1. Gar scale bioapatite (U-Th)/He age as a function of A-B) effective uranium concentration (eU), C) 1/eU, D) measured Th/U, E) equivalent spherical radius (ESR), and F) mass of bioapatite analyzed.