Characterization and Visualization of Fish Otoliths Towards a Mechanistic Understanding of Calcium Carbonate Polymorph Nucleation and Growth

Brenda M. Pracheil[1], Bryan C. Chakoumakos[2], R. Seth Wood[3], Allison M. Fortner, Alison R. Loeppky[4], W. Gary Anderson[4]

[1]Environmental Sciences Division, Oak Ridge National Laboratory, pracheilbm@ornl.gov, fortneram@ornl.gov
[2]Neutron Scattering Division, Oak Ridge National Laboratory, Oak Ridge, TN, chakoumakobc@ornl.gov
[3]Department of Earth and Planetary Sciences, University of Tennessee-Knoxville, Knowville, TN, rwood19@vols.utk.edu
[4]Department of Biological Sciences, University of Manitoba, Winnepeg, MB, loeppkar@myumanitoba.ca, Gary.Anderson@umanitoba.ca

Otoliths, the calcium carbonate ear bones of fish, are particularly interesting biological structures due to their ability to incorporate trace elements within daily to annual growth rings— much like rings of a tree— that allow for temporal interpretation of elemental signatures. Most otoliths are composed of the calcium carbonate polymorph aragonite, but some otoliths are made of calcite, vaterite, or any combination of the three polymorphs. Currently, the biotic and abiotic factors affecting otolith composition are elusive; however, these factors can be teased apart by assessing the bulk composition and spatial distribution of $CaCO_3$ polymorphs in otoliths. In this talk, we synthesize our characterization of $CaCO_3$ polymorphs in otoliths through neutron and X-ray diffraction, X-ray tomography, X-ray fluorescence, and Raman spectroscopy and discuss how these characterizations provide insight into the formation of biogenic $CaCO_3$ polymorphs.