Inorganic structures across kingdoms of life: From skeletal support to metabolic function

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Living organisms across kingdoms build inorganic structures that serve a variety of tasks, ranging from skeletal support to metabolic functions. Specifically, this talk will discuss i) how planktonic organisms engineer single-crystalline skeletons, ii) how chemistry and structural hierarchy affect the biomechanical function of mineralized shark vertebrae, and iii) how cyanobacteria use trace metals to carry out biochemical reactions.

i) Acantharia (*Acantharea*) are wide-spread marine protozoa, presenting one of the rare examples of strontium sulfate mineralization in the biosphere. Our research uses synchrotron-based nanotomography at the P05 imaging beamline (PETRA III, DESY) to resolve the complex internal morphology of Acantharian endoskeletons.

ii) Mineralized cartilage in shark vertebrae presents a morphologically complex material composed of type-II collagen, sulfated sugars, and hydroxyapatite mineral. By combining confocal Raman imaging with Transmission Electron Microscopy (TEM), we investigate how the composition and crystallite orientation affect nanomechanical characteristics at the tissue level.

iii) Cyanobacteria, also called blue-green algae, are an ancient group of prokaryotic microbes that form Harmful Algae Blooms. Towards a better understanding of the trace metal uptake, metabolism, and storage in cyanobacteria, we quantitatively image the sub-cellular elemental distribution using synchrotron X-ray nanofluorescence imaging at the Advanced Photon Source (APS), Argonne National Laboratory.