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Using X-PEEM and XANES to explore barnacle exoskeleton mineralization

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Introduction

Barnacles, such as *Amphibalanus amphitrite* studied here, are found throughout marine intertidal communities. As adults, *Amphibalanus amphitrite* have a calcified exoskeleton consisting of multiple plates: parietal or lateral plates surrounding the body, a base plate securing the barnacle to its substrate, and an operculum that opens and closes for feeding. However, barnacles begin life as unmineralized free-floating larvae that then undergo two metamorphoses, before settling onto a substrate, adhering for life, ad forming a mineralized exoskeleton. Despite their importance in intertidal communities and the role they play in biofouling, little is known about the formation process of barnacles' exoskeletons. Through the combination of synchrotron based techniques x-ray photoemission electron microscopy (X-PEEM) and x-ray absorption near-edge structure spectroscopy (XANES) with scanning electron microscopy (SEM) we were able to provide an unprecedented view of the early stages of mineralization within the exoskeletal plates.

Results

X-PEEM [1, 2] and SEM show that 1-day after metamorphosis, the parietal and opercular plates have already begun the mineralization process, with both parietal and opercular plates consisting of small calcite crystallites of varied orientation. In comparison, the parietal and opercular plates of a 6-day post-metamorphosis barnacle appears to have larger co-oriented crystalline domains and a thicker mineralized region within the parietal plates. These results begin to provide hints to how mineralization progresses within the barnacle exoskeleton and provides a baseline for on-going experiments into how predicted changes in ocean temperature will impact the barnacle exoskeleton mineralization process.

References

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