Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.18717

The resilience of coral skeletons under ocean acidification: how biomolecules influence the structure and dissolution of aragonites produced in vitro

BOONTHAREE CHOMHOM[1,2], CHAO DUN TAN[3], GEORG HAEHNER[3], ALEX BRASIER[4], JOHN STILL[4] AND NICOLA ALLISON[2,5]

[1]Scottish ocean institute, University of St Andrews
[2]Earth and Environmental sciences, University of St Andrews
[3]School of Chemistry, University of St Andrews
[4]Department of Geoscience, University of Aberdeen
[5]Scottish Oceans Institute, University of St Andrews
Presenting Author: bc78@st-andrews.ac.uk

Tropical coral skeletons are composed of aragonite ($CaCO_3$) and organic macromolecules. The pCO_2 in coral skeletal pore fluids can be high due to microbial activity, and this can lead to dissolution of the skeleton. Biomolecules (e.g., aspartic acid) are produced at higher concentrations in coral skeletons at higher seawater pCO_2. But how increased concentrations of biomolecules affect coral skeletal structures and their tendency to dissolve is poorly understood.

Here, we precipitated synthetic aragonites in the presence of key coral skeleton amino acids (aspartic acid, glutamic acid, and glycine). Aragonite crystals were precipitated from solutions of 1µM, 100µM and 5mM of each amino acid, and from a control solution. The aragonite crystals precipitated with and without 5mM of Aspartic acids(5mMAsp) were dissolved at low seawater alkalinity and saturation state (Ω_{Ar}). To investigate the effect of biomolecules on aragonite precipitation and dissolution, the surfaces and cross-sections of crystals precipitated with and without amino acids were imaged using scanning electron microscopy(SEM), and the resulting structures were visually compared. To identify how organic materials are incorporated in the aragonite structure Atomic force microscopy(AFM) was used. This involved investigating the surface topography and adhesion on the nanometre scale using PeakForce Tapping mode. Finally, Raman fluorescence spectroscopy was used to track the distribution of organics in the particles. Aragonite crystals precipitated without biomolecules are irregular in shape and have a spiky crystal surface, while aragonites precipitated with biomolecules are more circular in shape and have a smoother surface. In SEM images, we observed concentric rings in cross sections of all the aragonite particles deposited with amino acids. However, rings were not observed in aragonite precipitated without amino acids. Aragonite crystals deposited with amino acids had higher adhesion in cross-sections compared to the control aragonites. When the aragonites precipitated with 5mM Asp and without biomolecules were exposed to seawater with $\Omega_{Ar}<1$, dissolution occurred across the surface of the particles. This dissolution was observed along the lines of concentric rings in 5mMAsp particles. We conclude that the inclusion of biomolecules in coral skeletons likely influences the skeletal aragonite structure and its resistance to dissolution at high seawater pCO_2.