The Impact of Ocean Acidification on the Role of Lipids in Coral Biomineralisation

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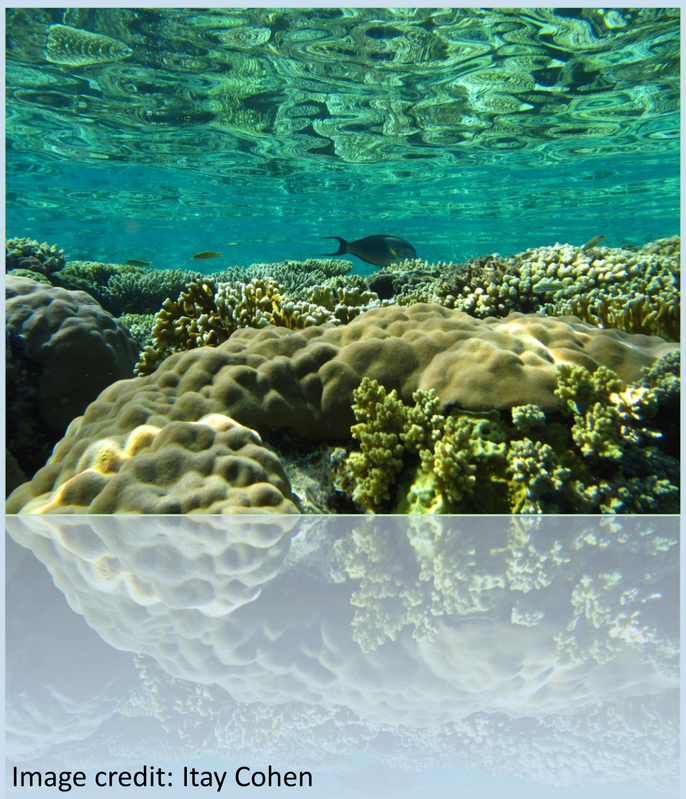

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BACKGROUND

An estimated 1 billion people benefit from coral reefs directly and indirectly, making this habitat vital[1]. The coral skeletons that build coral reefs are composite materials made up of the mineral aragonite and an organic matrix[2]. The matrix is composed of proteins, polysaccharides and lipids, but little is known about the role of lipids in skeleton formation[3]. Biomolecules are important for controlling aragonite morphology. Under ocean acidification (OA), the biomolecule concentration increases[4]. My project aims determine how the lipids palmitic acid (PA) and phosphatidylcholine (PC) affect aragonite formation and structure over a range of different concentrations.

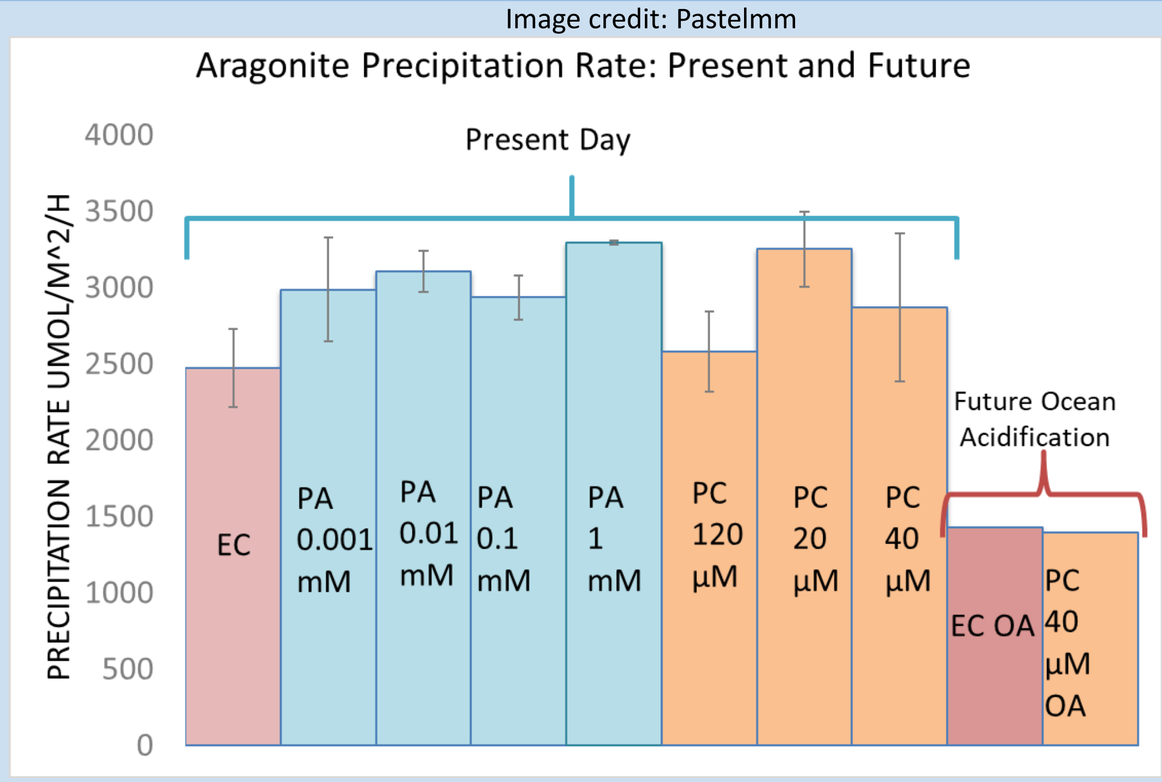


Figure 3 Legend:
EC – Ethanol Control; PA – Palmitic Acid; PC – Phosphatidylcholine; OA – Ocean Acidification

The experiments were conducted under different pH: the pH that occurs at the calcification site currently, and at a lower pH of ocean acidification.

Palmitic acid accelerates aragonite precipitation, as there was a significant difference between the ethanol control precipitation rate and the rate of 1 mM PA (Figure 3).

Phosphatidylcholine had no effect on the aragonite precipitation rate.

Under ocean acidification, aragonite precipitation rate decreased, but PC does not affect the precipitation rate at this pH.

METHOD

In this research project, I precipitated aragonite *in vitro* from modified seawater, adjusting the pH and saturation state (Ω_{ar}) to reflect conditions that may occur at the coral calcification site in the present day and under ocean acidification. A specialised apparatus was used to maintain the pH and composition of the solution at a stable level (Figure 1).

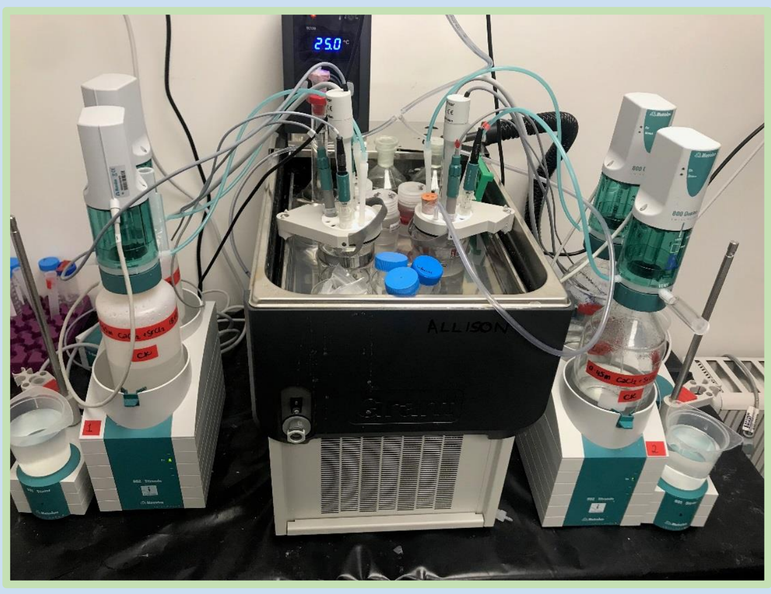


Figure 1 : The aragonite precipitation setup

RESULTS

Morphology: Scanning Electron Microscopy (SEM)

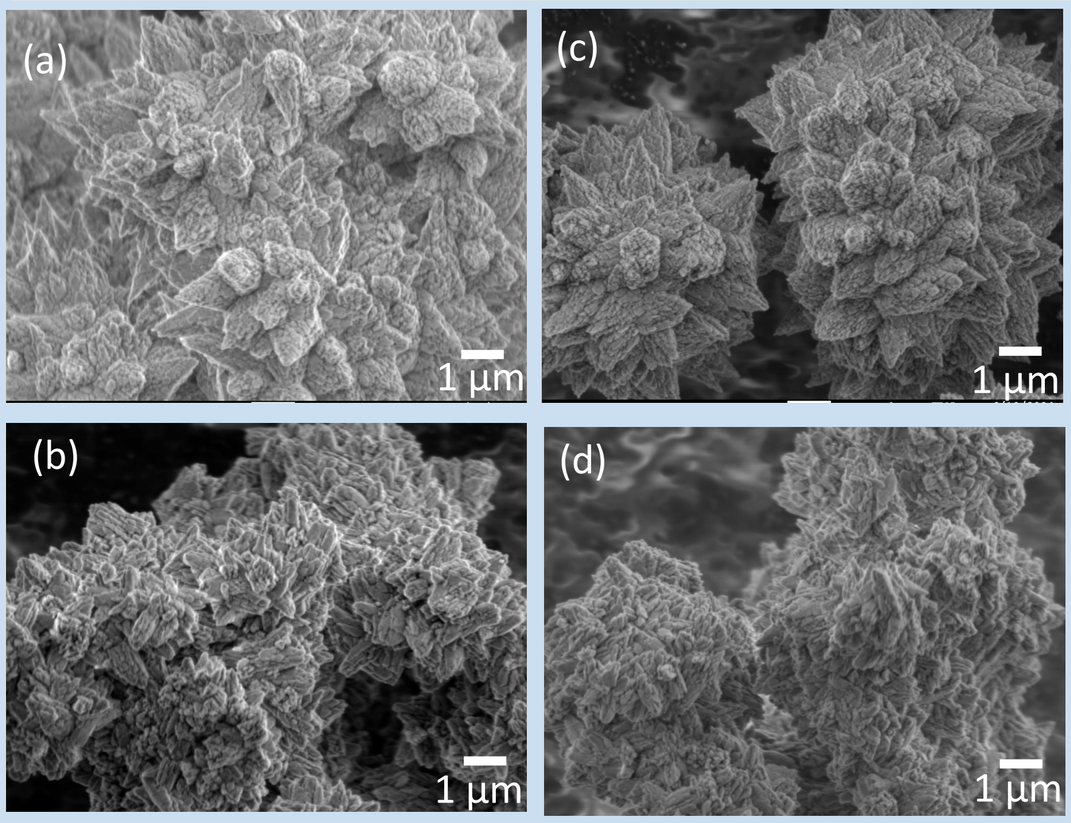
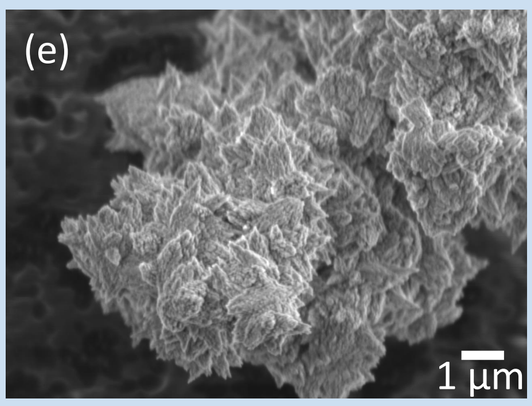


Figure 2: SEM images of aragonite samples (a) x10000 EC (b) x10000 EC OA (c) x10000 PC 110 µM (d) x10000 PC 40 µM OA (e) x10000 PA 1 mM



- Comparing ethanol control (EC) to EC under ocean acidification (OA):
- (a) has bigger crystals than (b).
- Under OA, crystals are smaller.

- Comparing phosphatidylcholine (PC) to PC under OA:
- (d) has smaller crystals than (c).
- (c) has similar morphology to (a).

- (e) crystals smaller than (a).
- Interesting that (e) grows faster but crystals are smaller.

- **Summary**: pH affects the crystal morphology.
- No effect with PC on morphology.
- But PA affects crystal morphology.

CONCLUSION

- Palmitic Acid, a very prevalent fatty acid in coral skeleton, accelerates aragonite precipitation[5]. There's a good chance that increasing PA concentration increases aragonite precipitation rate. Future work could be to look at what happens with PA under ocean acidification (OA) to identify if that helps to offset OA's effect.
- PA has a smaller crystal aragonite morphology despite it growing faster than phosphatidylcholine and the ethanol control samples- as usually faster precipitation rates mean larger aragonite crystals (Figure 2). More work need to identify why this occurred.
- SEM showed that PC has no effect on aragonite precipitation rate or crystal morphology.
- Ocean acidification lowers aragonite precipitation rate, but PC has no role in determining the precipitation rate.
- Aragonite morphologies under ocean acidification lead to smaller crystals.

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