Crystallising ideas on the mechanism of calcification in microfossils

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Key Words
Calcification, coccolithophores, confocal microscopy, ocean acidification

Overview
As the oceans acidify due to the addition of anthropogenic CO₂ to the atmosphere, understanding the mechanism by which calcium carbonate is generated by pelagic organisms is becoming an urgent question. The accumulation of empirical knowledge about the response of organisms to ocean acidification, there is as yet very little mechanistic understanding which can be used as a predictive tool for effects of such chemical change across different species. In order to calcify, organisms must transport Ca and C to the site of calcification, generate supersaturation and control nucleation and growth on an organic template (see figure). This project will focus on the microscopic marine plankton, the coccolithophores, and will generate fresh constraints on this mineralisation process through probing the chemistry and dynamics of the internal pool of coccolithophores together with the chemistry of the templating process. There have been huge advances in fluorescent dyes that can cross membranes and novel approaches to their calibration in intracellular conditions which should allow us to visualise optically the chemistry of the interior of the cells. Furthermore, co-supervisor Erez has been pioneering new stable isotopic techniques for extracting the size and composition of the internal pool. Within this project we want to explore the sensitivity of calcification to a whole range of environmental conditions in culture, from temperature to seawater chemistry to changing trace metal and nutrient availabilities and track their impact on the internal chemistry of the cell. We also aim to use some specific enzyme inhibitors in experiments with a MIMS to understand their impact on the dynamics of C flow through the cell.

The aims of the project are:

To investigate the role of nutrients, seawater chemistry and species on coccolithophore calcification

To measure the chemistry and stable isotopic composition of the internal carbon pool of coccolithophores

Methodology
The student will be based in Oxford Earth Sciences and will culture organisms using the OceanBug set up, and will use the confocal microscopy system in Plant Sciences (with Mark Fricker). They will undertake a number of research visits to the Marine Institute in Eilat (with Jonathan Erez) to learn MIMS and some of the stable isotopic tracing techniques. A background in Earth Sciences, Chemistry or Biology is ideal to undertake this project and an interest in the ongoing health of the oceans.
Training & Skills
The student will be trained in stable isotope techniques, sterile culture, confocal and optical microscopy with use of intracellular dyes

References & Further Reading


Further Information
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