# Cell counts from an experiment examining the effect of Sr on the coccolithophore Scyphosphaera apsteinii calcification

**Website**: https://www.bco-dmo.org/dataset/866456
**Data Type**: experimental
**Version**: 1
**Version Date**: 2021-12-10

**Project**
» NSFGEO-NERC: An unexpected requirement for silicon in coccolithophore calcification: physiological, ecological and evolutionary implications (Coccolithophore Silicon Requirements)

| Contributors | Affiliation | Role |
|---|---|---|
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**Abstract**
The effect of Sr on the coccolithophore Scyphosphaera apsteinii calcification was assessed over a 10 day period. Cells were counted on each collection day using a hemocytometer or Sedgwick-Rafter chamber.

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## Coverage

**Temporal Extent**: 2019-03 - 2019-03

### Acquisition Description

**Experiment Overview:**
The effect of strontium (Sr) on the coccolithophore *Scyphosphaera apsteinii* calcification was assessed over a 10 d period. This species of coccolithophore has unusually high levels of Sr in its calcite coccoliths as detected with Energy-dispersive X-ray spectroscopy (EDS), whereas Si levels are undetectable with EDS. The goal of the experiment was to determine whether Sr in seawater plays a significant role in coccolith production and/or coccolith crystal morphology. *S. apsteinii* was acclimated and grown in a range of Sr concentrations (deplete: 0.33 mmol/mol Sr/Ca, ambient: 9 mmol/mol Sr/Ca, and higher than ambient: 36 and 72 mmol/mol Sr/Ca). All treatments had four replicate flasks. Aliquots of cultures for cell counts and Fv/Fm were taken every two days between the start (T0 for cell counts, T4 for Fv/Fm) and end (T10) of the experiment. When cells were at mid-exponential phase (T4-T6) aliquots were collected for scanning electron microscopy (SEM) and EDS analysis to observe morphology and determine Sr incorporation into calcite coccoliths, respectively.

The laboratory experiments were conducted in March 2019 at the University of North Carolina - Wilmington. SEM/EDS analysis was done at the Analytical Instrumentation Facility at NC State from April

19th to May 9th, 2019.

**Cell Counting:**
Cells were counted on each collection day using a hemocytometer or Sedgwick-Rafter chamber. A minimum of 300 cells were counted per sample. Growth curves were plotted and specific growth rates were calculated for each species throughout the 8 d sampling period.

**Processing Description**

**Data Processing:**
Cell counts (cells per mL) were used to determine growth rate (r) and doublings per day (k) for each species using the following equations:
Rate of increase (r) = [(LN avg cells t0) - (LN avg cells t1)] / (t1 - t0)

Doublings per day (k) = r / 0.6931

LN is the natural log of the average cell numbers per L. t is the timepoint.

**BCO-DMO Processing:**
- removed units from data columns so values can be typed as numeric.

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## Related Datasets

**IsRelatedTo**

Taylor, A. (2021) **Coccolith morphology data from an experiment examining the effect of Sr on the coccolithophore Scyphosphaera apsteinii calcification.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-12-10 http://lod.bco-dmo.org/id/dataset/866738 [view at BCO-DMO]

Taylor, A. (2021) **Energy-dispersive X-ray spectroscopy (EDS) from an experiment examining the effect of Sr on the coccolithophore Scyphosphaera apsteinii calcification.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-12-10 http://lod.bco-dmo.org/id/dataset/866679 [view at BCO-DMO]

Taylor, A. (2021) **Quantum yield of photosystem II (Fv/Fm) from an experiment examining the effect of Sr on the coccolithophore Scyphosphaera apsteinii calcification.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-12-10 http://lod.bco-dmo.org/id/dataset/866648 [view at BCO-DMO]

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## Parameters

| Parameter | Description | Units |
|---|---|---|
| Sr_Concentration | The Sr concentration of the growth media that S. apsteinii was exposed to. The concentrations were 3.3, 90, 360, and 720 micromole. | micromoles per liter Si (umol/L) |
| Flask_Replicate | The replicate flask number for each Sr treatment. Each Sr concentration had 4 replicate flasks. | unitless |
| Sampling_Day | The day the aliquots were taken from flasks and cells were counted | days (d) |
| Cells_per_mL | The amount of cells in 1 mL of growth media on the day of sampling. Cells were counted with either a Sedgwick-Rafter or a hemocytometer. | cells per milliliter (cells/mL) |

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## Instruments

| | |
|---|---|
| **Dataset-specific Instrument Name** | hemocytometer |
| **Generic Instrument Name** | Hemocytometer |
| **Dataset-specific Description** | Cells were counted on each collection day using a hemocytometer or Sedgwick-Rafter chamber. |
| **Generic Instrument Description** | A hemocytometer is a small glass chamber, resembling a thick microscope slide, used for determining the number of cells per unit volume of a suspension. Originally used for performing blood cell counts, a hemocytometer can be used to count a variety of cell types in the laboratory. Also spelled as "haemocytometer". Description from: http://hlsweb.dmu.ac.uk/ahs/elearning/RITA/Haem1/Haem1.html. |

| | |
|---|---|
| **Dataset-specific Instrument Name** | Light microscope |
| **Generic Instrument Name** | Microscope - Optical |
| **Dataset-specific Description** | Light microscope: Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of visible light. Includes conventional and inverted instruments. Sedgewick-Rafter chamber used for cell counting. |
| **Generic Instrument Description** | Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of visible light. Includes conventional and inverted instruments. Also called a "light microscope". |

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## Project Information

**NSFGEO-NERC: An unexpected requirement for silicon in coccolithophore calcification: physiological, ecological and evolutionary implications (Coccolithophore Silicon Requirements)**

*NSF Abstract:*
Biomineralization by marine phytoplankton has had a profound impact on our planet. The production of special cell wall material, calcite coccoliths by coccolithophores and silica frustules by diatoms, are major drivers in global biogeochemical cycles, but the underlying cellular processes remain poorly understood. It is widely considered that calcification in coccolithophores occurs through a very different process to silicification in diatoms, however some ecologically important coccolithophore lineages possess diatom-like silicon (Si) transport systems and have an absolute requirement for Si during coccolith formation. Importantly, the abundant bloom-forming coccolithophores such as Emiliania huxleyi exhibit no requirement for Si. There is a clear need to understand how these different physiological requirements for dissolved Si have driven the ecology and evolution of the coccolithophores. The project will yield a more complete understanding of the Si requirements of coccolithophores, its role in the calcification process, and the impacts of Si availability on the biogeography of these important bloom forming phytoplankton. The results are expected to strengthen our ability to predict the responses of coccolithophores to short and long-term environmental change, and therefore the consequences for the marine biogeochemical cycles in which they participate. In addition to the scientific outcomes, the project provides independent research opportunities to a diverse pool of undergraduate students, provide interdisciplinary training for graduate students, and facilitate the professional development of post-doctoral researchers. Public engagement in the research is facilitated through participant involvement in regional science festivals, public outreach events, production of educational resources, and targeted K-12 summer camp activities.

Calcification in coccolithophores appears to represent a distinct process from silicification in diatoms, another major group of biomineralized phytoplankton. The apparent absence of a requirement for silicon (Si) in coccolithophores has been proposed to play a critical role in their ability to out-compete the otherwise dominant diatoms in areas of low dissolved Si availability. However, the investigators recently demonstrated that some globally important coccolithophores possess diatom-like Si transporters and exhibit an obligate requirement for Si in the calcification process. This discovery has important implications both for phytoplankton ecology and for the evolution of biomineralization. Using a range of physiological, molecular and computational approaches the project will 1) Establish Si requirements of ecologically important coccolithophore groups; 2) Determine the physiological role of Si in coccolithophores; 3) Determine the evolutionary events leading to the differing requirements for Si in calcification; 4) Examine the ecological distribution of Si-requiring coccolithophores, and 5) Determine the impact of the Si requirement on coccolithophore ecology. This project therefore integrates the molecular identification of genes (Si transporters), the physiological role of these transporters, and ecosystem scale models in order to examine how the requirement for Si influences ecosystem functioning and coccolithophore biogeography. The results of this work provides essential data that describes the cellular mechanisms of calcification and the range of physiological diversity between major coccolithophore lineages. The research also explores a previously unforeseen aspect of phytoplankton ecology; examining how the differing requirements for Si in calcifying coccolithophores may have shaped competitive interactions with other phytoplankton over both contemporary and evolutionary timescales. Overall, the research provides novel insights into physiology, ecology and evolution of coccolithophores, including information on how and why coccoliths are produced, which is currently poorly understood. This information is vital in order to understand how coccolithophores have been influenced by past changes in the Earth's climate, and their potential responses to future oceans.

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## Funding

| Funding Source | Award |
| --- | --- |
| NSF Division of Ocean Sciences (NSF OCE) | OCE-1638838 |


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