Excess density of sinking aggregates of xenic and axenic marine Prochlorococcus and Synechococcus from roller tank experiments conducted in 2016 and 2017

Website: https://www.bco-dmo.org/dataset/774806
Data Type: experimental
Version: 1
Version Date: 2019-08-14

Project
» Aggregation of Marine Picoplankton (Marine Plankton Aggregation)

Contributors	Affiliation	Role
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Abstract
Excess density of sinking aggregates of xenic and axenic marine Prochlorococcus and Synechococcus from roller tank experiments conducted in 2016 and 2017.

Table of Contents

- Coverage
- Dataset Description
  - Methods & Sampling
  - Data Processing Description
- Data Files
- Related Publications
- Parameters
- Project Information
- Funding

Coverage

Temporal Extent: 2016-01-01 - 2018-01-01

Dataset Description

Excess density of sinking aggregates of xenic and axenic marine Prochlorococcus and Synechococcus from roller tank experiments conducted in 2016 and 2017.

These data were published in Cruz and Neuer, 2019.

Related Datasets:
* Picocyanobacteria Sinking Aggregates: Abundances https://www.bco-dmo.org/dataset/774784
* Picocyanobacteria Sinking Aggregates: Sinking Velocities https://www.bco-dmo.org/dataset/774792
* Picocyanobacteria Sinking Aggregates: Sizes https://www.bco-dmo.org/dataset/774799

Methods & Sampling

Cultures of Synechococcus WH8102 (axenic), Synechococcus WH7805 (xenic) and Prochlorococcus marinus MED4 (xenic and axenic) were incubated in 1.25 L roller tanks for 7 days in the dark at 3.5 RPM (for further details on roller tanks, see Shanks and Edmondson, 1989). Aggregation was tested with and without the addition of kaolinite clay. All treatments had n = 2 tanks. Aggregates formed were quantified, sized, and their

sinking velocities and excess densities determined.

Aggregation was tested with and without the addition of kaolinite clay (control, 0.5 mg per L of kaolinite clay, 5.0 mg per L of kaolinite clay)

Data Processing Description

BCO-DMO Data Manager Processing Notes: Growth Rates
* Excel sheet extracted to a csv file
* added a conventional header with dataset name, PI name, version date
* modified parameter names to conform with BCO-DMO naming conventions
* blank values in this dataset are displayed as "nd" for "no data." nd is the default missing data identifier in the BCO-DMO system.

[table of contents | back to top]

Data Files

File
pico_dens.csv (Comma Separated Values (.csv), 460 bytes) MD5:68a7b2b6f147ccfd26f41acc993da6af Primary data file for dataset ID 774806

[table of contents | back to top]

Related Publications

Cruz, B. N., & Neuer, S. (2019). Heterotrophic Bacteria Enhance the Aggregation of the Marine Picocyanobacteria Prochlorococcus and Synechococcus. Frontiers in Microbiology, 10. doi:10.3389/fmicb.2019.01864
Results

Shanks, A. L., & Edmondson, E. W. (1989). Laboratory-made artificial marine snow: a biological model of the real thing. Marine Biology, 101(4), 463–470. doi:10.1007/bf00541648 https://doi.org/10.1007/BF00541648
Methods

[table of contents | back to top]

Parameters

Parameter	Description	Units
Culture	Culture name	unitless
Aggregate_Excess_Density_Control1	Aggregate excess density. Treatment = Control, replicate 1, no kaolinite clay.	grams per milliliter (g/mL)
Aggregate_Excess_Density_Control2	Aggregate excess density. Treatment = Control, replicate 2, no kaolinite clay.	grams per milliliter (g/mL)
Aggregate_Excess_Density_0_5mg_Lkaolinite1	Aggregate excess density. Treatment = concentration of 0.5 mg per L of kaolinite clay, replicate 1.	grams per milliliter (g/mL)
Aggregate_Excess_Density_0_5mg_Lkaolinite2	Aggregate excess density. Treatment = concentration of 0.5 mg per L of kaolinite clay, replicate 2.	grams per milliliter (g/mL)
Aggregate_Excess_Density_5_0mg_Lkaolinite1	Aggregate excess density. Treatment = concentration of 5.0 mg per L of kaolinite clay, replicate 1.	grams per milliliter (g/mL)
Aggregate_Excess_Density_5_0mg_Lkaolinite2	Aggregate excess density. Treatment = concentration of 5.0 mg per L of kaolinite clay, replicate 2.	grams per milliliter (g/mL)

[table of contents | back to top]

Project Information

Aggregation of Marine Picoplankton (Marine Plankton Aggregation)

Coverage: Bermuda Atlantic Time-Series station

NSF abstract:

Marine phytoplankton are microscopic algae that live in the sunlit zone of the ocean. They play an important role in the uptake of carbon dioxide from the atmosphere through photosynthesis, similar to what plants do on land, and are the basis of the marine food web. However, instead of storing this organic carbon in leaf tissue and roots, marine phytoplankton are grazed by planktonic animals, or die and subsequently sink out of the sunlit zone in the form of aggregates, also called "Marine Snow". These particles not only export the organic carbon contained in their cells to the deep ocean, but also serve as food for animals and bacteria that live in the deep. A considerable portion of these phytoplankton are extremely small, among the tiniest of all organisms known. These extremely small cells have not been thought to play an important role in the formation and sinking of marine snow; however, recent findings challenge this view. This project will investigate how the smallest of these phytoplankton contribute to the rain of sinking particles from the sunlit surface to the deep ocean. This research is important because, in some of the largest expanses of the open oceans, these minute cells dominate the phytoplankton community, and larger plankton organisms are very sparse. The project, through a combination of work in the laboratory and at a field station, will shed light on how these tiny phytoplankton cells make aggregates, which ultimately enable them to sink as "Marine Snow". The project also provides unique opportunities for undergraduate students at Arizona State University, a land-locked public university, to gain experience in working with marine research. The project will serve to educate one PhD student, one MS student in an accelerated BS-MS program, and 8-10 undergraduate students/semester in a unique, inquiry based learning effort termed Microbial EducatioN Training and OutReach (MENTOR). The undergraduate students will also participate in Arizona State University (ASU)'s School of Life Sciences, Undergraduate Research Program (SOLUR), which seeks to increase the participation of minorities in science. They will also contribute towards developing web and classroom materials, based on this project, which will then be distributed through a partnership with the award-winning ASU-sponsored Ask A Biologist K-12 web site.

The oceanic "biological carbon pump", the photosynthetically mediated transformation of dissolved inorganic

carbon into particulate and dissolved organic carbon and its subsequent export to deep water, functions as a significant driver of atmospheric carbon uptake by the oceans. The traditional view of the biological carbon pump in the ocean is that of sinking of large aggregates (marine snow) or fecal pellets, which are made up of large, mineral ballasted cells of phytoplankton. However, recent evidence, stemming from in situ investigations of particulate matter, trap studies and modelling studies, have shown that micron-sized phytoplankton such as picocyanobacteria as well as picoeukaryotes can contribute significantly to the sinking of particulate matter. The specific mechanisms behind the sinking of these micrometer sized cells remain elusive as the cells are too small to sink on their own, and mesozooplankton is likely unable to ingest single cells. Intriguingly, recent research by the investigators has shown that the ubiquitous picocyanobacteria Synechococcus are able to form aggregates and sink at velocities comparable to those of marine snow. They found that the matrix of the Synechococcus aggregates was made of Transparent Exopolymeric Particles (TEP), and that TEP production was enhanced under nutrient limited culture conditions. Interaction with clays and presence of heterotrophic bacteria also enhanced aggregation and sinking velocity. This study aims to further investigate aggregation of other common picoplankton in the laboratory and aggregation occurring in natural settings at an oligotrophic open ocean site, the Bermuda Atlantic Time-series Site (BATS). Ultimately, this project will increase and refine our understanding of the role of the smallest phytoplankton in aggregation and sinking - information vital to understanding carbon cycling processes in the oceans.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1658527

[table of contents | back to top]