Size of sinking aggregates of a Sargasso Sea Plankton community from roller tank experiments with seawater collected during R/V Atlantic Explorer cruises AE1718 and AE1808 in 2017 and 2018

Website: https://www.bco-dmo.org/dataset/774841
Data Type: Cruise Results, experimental
Version: 1
Version Date: 2019-08-14

Project
» Aggregation of Marine Picoplankton (Marine Plankton Aggregation)

Contributors	Affiliation	Role
Neuer, Susanne	Arizona State University (ASU)	Principal Investigator, Contact
Cruz, Bianca N.	Arizona State University (ASU)	Student
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Abstract
Size of sinking aggregates of a Sargasso Sea Plankton community from roller tank experiments with seawater collected during R/V Atlantic Explorer cruises AE1718 and AE1808 in 2017 and 2018.

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Coverage

Spatial Extent: **N**:32.3027 **E**:-64.38 **S**:31.9795 **W**:-64.5752
Temporal Extent: 2017-09-17 - 2018-03-21

Dataset Description

Size of sinking aggregates of a Sargasso Sea Plankton community from roller tank experiments with seawater collected during R/V Atlantic Explorer cruises AE1718 and AE1808 in 2017 and 2018.

These data were published in Cruz and Neuer, 2019.

Related Datasets:
* Sargasso Sea Plankton Aggregation: Aggregate Abundances https://www.bco-dmo.org/dataset/774813
* Sargasso Sea Plankton Aggregation: Sinking Velocities https://www.bco-dmo.org/dataset/774820
* Sargasso Sea Plankton Aggregation: Excess Densities https://www.bco-dmo.org/dataset/774827
* Sargasso Sea Plankton Aggregation: TEP https://www.bco-dmo.org/dataset/774834

Methods & Sampling

Sargasso Seawater was incubated in 1.25 L roller tanks for 5 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. TEP concentrations were determined as in Passow and Alldredge (1995). The stock of Alcian-Blue dye used for TEP quantification had a calibration factor (f-factor) of 84.15.

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.

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Data Files

File
sarg_size.csv (Comma Separated Values (.csv), 456 bytes) MD5:ff8477fb5c194f08f9b9ee07f05b8bd2 Primary data file for dataset ID 774841

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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

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Parameters

Parameter	Description	Units
Cruise	Cruise identifier	unitless
Depth_m	Depth from which seawater was collected for roller tank incubations	meters (m)
Lat	Latitude	decimal degrees
Lon	Longitude	decimal degrees
Aggregate_ESD_Control1	Aggregate equivalent spherical diameter (ESD). Treatment = Control, replicate 1, no kaolinite clay.	millimeters (mm)
Aggregate_ESD_Control2	Aggregate equivalent spherical diameter (ESD). Treatment = Control, replicate 2, no kaolinite clay.	millimeters (mm)
Aggregate_ESD_0_5mg_Lkaolinite1	Aggregate equivalent spherical diameter (ESD). Treatment = concentration of 0.5 mg per L of kaolinite clay, replicate 1.	millimeters (mm)
Aggregate_ESD_0_5mg_Lkaolinite2	Aggregate equivalent spherical diameter (ESD). Treatment = concentration of 0.5 mg per L of kaolinite clay, replicate 2.	millimeters (mm)
Aggregate_ESD_5_0mg_Lkaolinite1	Aggregate equivalent spherical diameter (ESD). Treatment = concentration of 5.0 mg per L of kaolinite clay, replicate 1.	millimeters (mm)
Aggregate_ESD_5_0mg_Lkaolinite2	Aggregate equivalent spherical diameter (ESD). Treatment = concentration of 5.0 mg per L of kaolinite clay, replicate 2.	millimeters (mm)

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Instruments

Dataset-specific Instrument Name	Stemi 2000-C, Axiocam 105 Color, Carl Zeiss, Germany
Generic Instrument Name	Microscope - Optical
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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Deployments

AE1808

Website	https://www.bco-dmo.org/deployment/775195
Platform	R/V Atlantic Explorer
Start Date	2018-03-14
End Date	2018-03-16

AE1718

Website	https://www.bco-dmo.org/deployment/775032
Platform	R/V Atlantic Explorer
Start Date	2017-09-11
End Date	2017-09-16

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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.

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Funding

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

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