Transparent exopolymer particle (TEP) concentrations of xenic and axenic marine Prochlorococcus and Synechococcus cultures from laboratory experiments conducted in 2016 and 2017

Website: https://www.bco-dmo.org/dataset/774646
Data Type: experimental
Version: 1
Version Date: 2019-08-13

Project
» Aggregation of Marine Picoplankton (Marine Plankton Aggregation)

Contributors	Affiliation	Role
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Abstract
Transparent exopolymer particle (TEP) concentrations of xenic and axenic marine Prochlorococcus and Synechococcus cultures from laboratory experiments conducted in 2016 and 2017.

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Coverage

Temporal Extent: 2016 - 2017

Dataset Description

Transparent exopolymer particle (TEP) concentrations of xenic and axenic marine Prochlorococcus and Synechococcus cultures from laboratory experiments conducted in 2016 and 2017

These data were published in Cruz and Neuer, 2019.

Related datasets from the same laboratory experiments:
Picocyanobacteria TEP: Cell Abundance https://www.bco-dmo.org/dataset/774628
Picocyanobacteria TEP: Growth Rates https://www.bco-dmo.org/dataset/774634
Picocyanobacteria TEP: Suspended Aggregates https://www.bco-dmo.org/dataset/774639

Methods & Sampling

Methodology:

Duplicate cultures of Synechococcus WH8102 (axenic), Synechococcus WH7805 (xenic) and Prochlorococcus marinus MED4 (xenic and axenic) were sampled every other day for 17-19 days for the quantification of single cells, suspended aggregates (aggregates ca. 5-60 µm), and TEP. 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 415.

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
TEP.csv (Comma Separated Values (.csv), 1.48 KB) MD5:9fda4a6c460354a3bbc25f6062e9690f Primary data file for dataset ID 774646

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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

Passow, U., & Alldredge, A. L. (1995). A dye-binding assay for the spectrophotometric measurement of transparent exopolymer particles (TEP). Limnology and Oceanography, 40(7), 1326–1335. doi:10.4319/lo.1995.40.7.1326
Methods

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Parameters

Parameter	Description	Units
Culture	Culture name	unitless
Days	Days since experiment start	count (days)
TEP_Concentration_rep1	Concentration of transparent exopolymeric particles (TEP) for replicate 1. TEP concentrations are expressed in Xanthan Gum equivalent units (see Passow and Alldredge, 1995).	ug XG per mL
TEP_Concentration_rep2	Concentration of transparent exopolymeric particles (TEP) for replicate 2. TEP concentrations are expressed in Xanthan Gum equivalent units (see Passow and Alldredge, 1995).	ug XG per mL

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Instruments

Dataset-specific Instrument Name	UV-1601, Shimadzu, Japan
Generic Instrument Name	UV Spectrophotometer-Shimadzu
Generic Instrument Description	The Shimadzu UV Spectrophotometer is manufactured by Shimadzu Scientific Instruments (ssi.shimadzu.com). Shimadzu manufacturers several models of spectrophotometer; refer to dataset for make/model information.

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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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