Coscinodiscus sinking behavior under various light and nutrient conditions from April 2019

Website: https://www.bco-dmo.org/dataset/773858
Data Type: experimental
Version: 1
Version Date: 2019-08-13

Project
» Dynamic sinking behavior in diatoms: New insights from individual-based high resolution video observations (Diatom Dynamic Sinking)

Contributors	Affiliation	Role
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Abstract
Sinking behavior of the diatom Coscinodiscus wailesii was recorded following exposure to light or dark or to varying nutrient conditions.

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Coverage

Temporal Extent: 2019-04-09 - 2019-04-12

Dataset Description

Sinking behavior of the diatom Coscinodiscus wailesii was recorded following exposure to light or dark or to varying nutrient conditions. More details on the treatments can be found in the Methods & Sampling section below. Each description corresponds to the individual package referenced below.

2019-04-09: https://datadocs.bco-dmo.org/data/302/Diatom_Dynamic_Sinking/773858/1/da... (992MB)
2019-04-11: https://datadocs.bco-dmo.org/data/302/Diatom_Dynamic_Sinking/773858/1/da... (1.3GB)
2019-04-12: https://datadocs.bco-dmo.org/data/302/Diatom_Dynamic_Sinking/773858/1/da... (2.2GB)

Methods & Sampling

2019-04-09:
Coscinodiscus wailesii diatom sinking behavior was recorded after exposure to light conditions or 2, 5, or 7 hours after exposure to dark conditions.

Treatments:
01 Light
02 Dark 2h
03 Dark 5h
04 Dark 7h

2019-04-11:
Coscinodiscus wailesii diatom sinking behavior was recorded after exposure to L1/2 media (replete) or exposure to L1/2 media depleted of one nutrient.
Treatments:
01 Replete
02 N Depleted
03 Si Depleted
04 P Depleted

2019-04-12:
Coscinodiscus wailesii diatom sinking behavior was recorded after exposure to L1/2 media (replete) or L1/2 media depleted of one nutrient or after exposure to L1/2 media depleted of one nutrient followed by a spike of the missing nutrient.
Treatments:
01 Minus P
02 Minus P Spike
03 Minus Si
04 Minus Si Spike
05 Minus N
06 Minus N Spike
07 Replete

BCO-DMO Processing Description

- Repackaged the submission into dated subpackages to reduce download package size.

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Data Files

File	
2019-04-09.zip	(ZIP Archive (ZIP), 991.41 MB) MD5:0ba2acbe11747079ae42c9bc9255e0a6
Coscinodiscus wailesii diatom sinking behavior was recorded after exposure to light conditions or 2, 5, or 7 hours after exposure to dark conditions. Treatments: 01 Light 02 Dark 2h 03 Dark 5h 04 Dark 7h	
2019-04-11.zip	(ZIP Archive (ZIP), 1.23 GB) MD5:2cbc5b7678e84e2abeecf8d1d389060f
Coscinodiscus wailesii diatom sinking behavior was recorded after exposure to L1/2 media (replete) or exposure to L1/2 media depleted of one nutrient. Treatments: 01 Replete 02 N Depleted 03 Si Depleted 04 P Depleted	
2019-04-12.zip	(ZIP Archive (ZIP), 2.20 GB) MD5:56dc206edb220b18a2316ea19eb64aa8
Coscinodiscus wailesii diatom sinking behavior was recorded after exposure to L1/2 media (replete) or L1/2 media depleted of one nutrient or after exposure to L1/2 media depleted of one nutrient followed by a spike of the missing nutrient. Treatments: 01 Minus P 02 Minus P Spike 03 Minus Si 04 Minus Si Spike 05 Minus N 06 Minus N Spike 07 Replete	

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Parameters

Parameters for this dataset have not yet been identified

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Instruments

Dataset-specific Instrument Name	Edgertronic SC1 camera
Generic Instrument Name	Camera
Dataset-specific Description	Camera: Edgertronic SC1 camera (Sanstreak Corp., San Jose, CA, USA) Lens: Nikon 105 mm 1:1 macro lens Resolution: 1280 x 1024 px Frame rate: 10 fps Illumination: LED infrared illuminator
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

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Project Information

Dynamic sinking behavior in diatoms: New insights from individual-based high resolution video observations (Diatom Dynamic Sinking)

Coverage: laboratory studies, Univ. of Texas at Austin, University of South Florida

Description from NSF award abstract:
The sinking of diatoms out of the well-lit upper layers of the ocean is responsible for transport of material to the deep-sea and is an important factor in controlling the overall abundance of this grass of the sea. Their sinking characteristics are important to understand in detail so they can be accurately represented in models of ocean dynamics. It has been assumed that all members of these non-flagellated, microscopic cells sink at approximately the same rate, at a constant rate, and that the direction of motion is downward. However, a re-examination of sinking rates at an individual cell level indicates that all three assumptions are incorrect. Using sophisticated optical and computing techniques, these researchers are examining how individual diatom cells sink, their ability to start and stop, and assessing what fraction can actually ascend. This study will yield new insights into how diatoms interact with their external environment by altering their movement through it. It will also address what fraction of these populations are actually moving upwards, thereby enhancing the movement of nutrients upward into the well-lit portions of the ocean. These are novel insights into how small unicellular species interact with the ocean around them and will significantly enrich our understanding of a problem that had been thought to be well understood. The project will train one graduate student and two undergraduate students in this research. Outreach is also provided by K-12 activities bringing holographic instruments into the classroom, and a public lecture series at our institute.

Diatom sinking rates are important life history characteristics that control both loss rates and nutrient flux to the cell surface. Positive buoyancy (m per hour rates) is an attribute of the largest diatom cells and plays a role in a vertical migration life history strategy. However, rates in smaller diatoms are typically described from a modified Stokes equation and are generally assumed to uniform and downward. The investigators previously observed that a species sinking rate is not monotonic within a sample but is distributed around a mean value, may be both upward and downward, and is under cellular control from near-zero to maximum velocity over second time scales. Thus, ascending behavior can be limited to a small portion of a population with a substantial downward rate. The goal of this project is to determine how widespread these characteristics are, determine the role of this unique start-stop sinking behavior, and examine how pervasive positive buoyancy is using a series of carefully controlled laboratory studies and a broad suite of diatom species. These characteristics will be considered within a framework of the complex form/function patterns that occur in diatoms. Boundary layers around cells differ vastly during the stop/start sequence and can be directly visualized by our techniques. Nutrient diffusion to the cell is accelerated during fast sinking; the investigators hypothesize that diffusion to cellular surfaces has been underestimated by using a constant bulk sinking rate. This work is only possible with the advent of high resolution cameras and advanced processing that allows particle and fluid flow to be quantified in a dynamic water column.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1537546

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