# Microscopy counts (Beggiatoa-like filaments, Cable bacteria), together with in situ temperature and salinity and surface sediment chlorophyll concentrations, of ex situ sediment cores collected in the Chesapeake Bay during 2017-2018

**Website**: https://www.bco-dmo.org/dataset/847974
**Data Type**: Other Field Results
**Version**: 1
**Version Date**: 2021-04-07

**Project**
» Collaborative Research: Probing the Metabolic and Electrical Interactions of Cable Bacteria in Anoxic Sediments (Anoxic Sediment Bacteria Interactions)



| Contributors | Affiliation | Role |
|---|---|---|
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**Abstract**
This dataset includes microscopy counts (Beggiatoa-like filaments, Cable bacteria), together with in situ temperature and salinity and surface sediment chlorophyll concentrations, of ex situ sediment cores collected in the Chesapeake Bay during 2017-2018.

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## Coverage

**Spatial Extent**: **N**:38.55728 **E**:-76.42794 **S**:38.55505 **W**:-76.49402
**Temporal Extent**: 2017-03-27 - 2018-08-24

### Methods & Sampling

**Methodology:**
Immediately after sediment core retrieval, temperature and salinity of the water overlying sediments were measured with hand-held sensors (Orion Star A329 portable multimeter).

In the lab, surficial sediments were sectioned at 0.5 cm depth increments from which aliquots were collected for microscope enumeration of *Beggiatoa*-like filaments and cable bacteria filaments. *Beggiatoa*-like filament enumeration proceeded by methods adapted from Jorgensen et al. 2010 (doi: 10.1111/j.1574-6941.2010.00918), using inverted light microscopy (Zeiss AxioVert A1) with Utermöhl well slides. Filaments were identified as living *Beggiatoa*-like filaments if they were motile, unpigmented, and contained refractive sulfur granules. The length and diameter of each *Beggiatoa*-like filament encountered was recorded. Data are

reported as volumetric density of *Beggiatoa*-like filaments (computed assuming a cylindrical shape), integrated to 5.0 cm depth.

To enumerate cable bacteria, cells were first detached from sediment particles using methods adapted from Kallmeyer et al. 2008, using density centrifugation with Nycodenz (50% wt/vol), and finally captured on filters (0.2 µm cellulose acetate). The identity of cable bacteria was first confirmed using fluorescent *in situ* hybridization (FISH) with the DSB706 oligoprobe (Schauer et al. 2014) on a subset of samples, and then enumerated following staining by Sybr Green I. A minimum of 200 randomly selected fields were viewed at 630X (Zeiss Axio Imager 2). Data are reported as cumulative length of cable bacteria filaments per volume of sediment, and as cumulative volume of cable bacteria computed assuming a cylindrical shape and cell diameter of 1 micron, each integrated to 4.0 cm depth.

For analysis of chlorophyll *a* (Chl*a*) concentration in surface sediments (0-0.5 cm), pigments were extracted into 90% acetone, applying agitation by gentle sonication, and pooling 2-3 successive extractions. Pigment concentration was determined colorimetrically (ThermoScientific Evolution 60S), applying the empirical formula of (Jeffrey et al. 1975).

**Sampling and Analytical Procedures:**
Replicate sediment cores were collected using a gravity corer (Uwitec; clear PVC liners, Ø = 8.6 cm). Immediately after sediment core retrieval, temperature and salinity of the water overlying sediments were measured with hand-held sensors (Orion Star A329 portable multimeter). Cores were then capped, kept in the dark at bottom water temperature in a water bath, and transported back to the laboratory, where they were held in a climate-controlled room. Core sectioning was conducted within 1 day of core retrieval.

**Data Processing Description**

**BCO-DMO Processing:**
- changed date format to YYYY-MM-DD;
- converted longitude from positive degrees West to negative degrees East.

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## Data Files

| File |
|---|
| **microscopy_counts.csv** (Comma Separated Values (.csv), 1.40 KB) MD5:ec56046bf0ecc9f2a85ca6410fb04bea<br>Primary data file for dataset ID 847974 |

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## Related Publications

Jeffrey, S. W., & Humphrey, G. F. (1975). New spectrophotometric equations for determining chlorophylls a, b, c1 and c2 in higher plants, algae and natural phytoplankton. Biochemie Und Physiologie Der Pflanzen, 167(2), 191–194. doi:10.1016/s0015-3796(17)30778-3 https://doi.org/10.1016/S0015-3796(17)30778-3
*Methods*

Jørgensen, B. B., Dunker, R., Grünke, S., & Røy, H. (2010). Filamentous sulfur bacteria, Beggiatoa spp., in arctic marine sediments (Svalbard, 79°N). FEMS Microbiology Ecology, no–no. doi:10.1111/j.1574-6941.2010.00918.x
*Methods*

Kallmeyer, J., Smith, D. C., Spivack, A. J., & D'Hondt, S. (2008). New cell extraction procedure applied to deep subsurface sediments. Limnology and Oceanography: Methods, 6(6), 236–245. doi:10.4319/lom.2008.6.236
*Methods*

Schauer, R., Risgaard-Petersen, N., Kjeldsen, K. U., Tataru Bjerg, J. J., B Jørgensen, B., Schramm, A., & Nielsen, L. P. (2014). Succession of cable bacteria and electric currents in marine sediment. The ISME Journal, 8(6),

1314–1322. doi:10.1038/ismej.2013.239
*Methods*

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## Related Datasets

### IsRelatedTo

Malkin, S. (2025) **SRA accession and collection metadata for sediments samples collected at two Chesapeake Bay stations from Mar 2017 to Aug 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-06-02 doi:10.26008/1912/bco-dmo.963428.1 [view at BCO-DMO]
*Relationship Description: This dataset includes measurements collected from the same set of field sampling campaigns.*

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## Parameters

| Parameter | Description | Units |
|---|---|---|
| date_local | date of field sampling (local time zone; EST); format: YYYY-MM-DD | unitless |
| Year | year of field sampling | unitless |
| Month | month of field sampling | unitless |
| Day | day of month of field sampling | unitless |
| site | site of sediment collection | site |
| lat | latitude | degrees North |
| lon | longitude | degrees East |
| site_depth | depth of sampling site | meters (m) |
| T_degC_BW | Temperature, in situ, of bottom water | degrees Celsius |
| Salinity_BW | Salinity, in situ, of bottom water | unitless |
| Begg_Density | Density of Beggiatoa-like filaments, integrated to 5 cm depth | cubic millimeters per square centimeter (mm^3 cm^-2) |
| DSB_Density_len | Density of cable bacteria filaments, integrated to 4 cm depth, expressed as sum length of filaments | meters per square centimeter (m cm-2) |
| DSB_Density_vol | Density of cable bacteria filaments, integrated to 4 cm depth, expressed as sum volume of filaments | cubic millimeters per square centimeter (mm^3 cm^-2) |
| SurfaceChla | Extracted Chla concentration in surface (0-0.5cm depth) sediment | micrograms Chla per gram DW sediment |

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## Instruments

| | |
|---|---|
| **Dataset-specific Instrument Name** | Zeiss Axio Imager 2 |
| **Generic Instrument Name** | Fluorescence Microscope |
| **Generic Instrument Description** | Instruments that generate enlarged images of samples using the phenomena of fluorescence and phosphorescence instead of, or in addition to, reflection and absorption of visible light. Includes conventional and inverted instruments. |

| | |
|---|---|
| **Dataset-specific Instrument Name** | gravity corer (Uwitec) |
| **Generic Instrument Name** | Gravity Corer |
| **Generic Instrument Description** | The gravity corer allows researchers to sample sediment layers at the bottom of lakes or oceans. The coring device is deployed from the ship and gravity carries it to the seafloor. (http://www.whoi.edu/instruments/viewInstrument.do?id=1079). |

| | |
|---|---|
| **Dataset-specific Instrument Name** | Zeiss AxioVert A1 |
| **Generic Instrument Name** | Inverted Microscope |
| **Generic Instrument Description** | An inverted microscope is a microscope with its light source and condenser on the top, above the stage pointing down, while the objectives and turret are below the stage pointing up. It was invented in 1850 by J. Lawrence Smith, a faculty member of Tulane University (then named the Medical College of Louisiana). Inverted microscopes are useful for observing living cells or organisms at the bottom of a large container (e.g. a tissue culture flask) under more natural conditions than on a glass slide, as is the case with a conventional microscope. Inverted microscopes are also used in micromanipulation applications where space above the specimen is required for manipulator mechanisms and the microtools they hold, and in metallurgical applications where polished samples can be placed on top of the stage and viewed from underneath using reflecting objectives. The stage on an inverted microscope is usually fixed, and focus is adjusted by moving the objective lens along a vertical axis to bring it closer to or further from the specimen. The focus mechanism typically has a dual concentric knob for coarse and fine adjustment. Depending on the size of the microscope, four to six objective lenses of different magnifications may be fitted to a rotating turret known as a nosepiece. These microscopes may also be fitted with accessories for fitting still and video cameras, fluorescence illumination, confocal scanning and many other applications. |

| | |
|---|---|
| **Dataset-specific Instrument Name** | Orion Star A329 portable multimeter |
| **Generic Instrument Name** | Multi Parameter Portable Meter |
| **Generic Instrument Description** | An analytical instrument that can measure multiple parameters, such as pH, EC, TDS, DO and temperature with one device and is portable or hand-held. |

| | |
|---|---|
| **Dataset-specific Instrument Name** | ThermoScientific Evolution 60S |
| **Generic Instrument Name** | Spectrophotometer |
| **Generic Instrument Description** | An instrument used to measure the relative absorption of electromagnetic radiation of different wavelengths in the near infra-red, visible and ultraviolet wavebands by samples. |

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## Project Information

**Collaborative Research: Probing the Metabolic and Electrical Interactions of Cable Bacteria in Anoxic Sediments (Anoxic Sediment Bacteria Interactions)**

**Coverage**: Chesapeake Bay sediments; Mid-Atlantic Coastal sediments

*NSF Award Abstract:*
Marine sediments represent the world's largest repository of stored organic carbon, and understanding how microorganisms break down this carbon is an imperative for understanding global carbon cycling. Yet long-standing questions remain regarding how networks of microorganisms work together to accomplish the complete breakdown of organic carbon in marine sediments. Sediment microbes interact in a myriad of ways that couple their metabolism to the break down of organic carbon, including by sharing products of metabolism. Accumulating evidence further suggests that some microorganisms can interact by transferring electrons directly to other unrelated microorganisms. This ability occurs across diverse microorganisms and appears to be widespread in the biosphere, particularly in anaerobic environments such as marine sediments. This project addresses emerging questions about the identity and metabolic linkages between microorganisms that work together in natural anaerobic marine and estuarine sediments to break down organic carbon. The investigators approach these questions by focusing on the influence of a keystone bacterium on its surrounding microbial community. "Cable bacteria" are a recently discovered group of long filamentous bacteria that act as electrical conductors in aquatic sediments providing a conduit for electrons to commute from deeper sulfidic sediments up to the surface oxygen layer by the process of centimeter-scale electron transport. Since their discovery about 6 years ago, these bacteria have been observed in a wide range of depositional sedimentary environments, often at extremely high cell densities. Where these bacteria are abundant, such as in coastal marine muds, they drive intense localized changes in pH and strongly influence the mineral cycling. This research explores the direct and indirect influence of cable bacteria on the metabolic activity of associated microorganisms. This project also advance the education and training of two early-career investigators, two PhD students, and undergraduate students. The skills and expertise gained from these PhD research projects will enable the students to be competitive in academic pursuits and in bioinformatics and technology applications relevant to private industry. The scientific discoveries emerging from this work is being incorporated into undergraduate and graduate level courses in marine microbial ecology. The research team will reach out to the broader community by hosting public lectures promoting a better understanding of environmental microbial ecology.

The proposed work is to investigate the role of cable bacteria in structuring sediment microbial communities. Due to their growth strategy and morphology, cable bacteria are particularly amenable to experimental manipulation, providing an outstanding opportunity to better understand community interactions among microorganisms in a natural and complex anaerobic environment. The investigators will explore the interactions and relationships between cable bacteria and their associated microbial community by manipulating the growth and activity of cable bacteria and quantifying the resultant microbial community response. Specifically, this project aims to (1) identify microorganisms whose growth is enhanced by cable bacteria, (2) identify metabolic processes linked with cable bacteria activity using metatranscriptomics, (3) test specific metabolic links between sediment microorganisms and cable bacteria activity using a DNA-stable isotope probing (SIP) approach, and (4) visually confirm the identity and quantify key microorganisms associated with cable bacteria using microscopy. As more is learned about the identity and the mechanisms by which microorganisms are metabolically linked in anoxic sediments, we will be better able to understand and make predictions about how

microorganisms function in their environment and how they can be utilized in bioengineered systems.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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## Funding


| Funding Source | Award |
| --- | --- |
| NSF Division of Ocean Sciences (NSF OCE) | OCE-1756877 |
| NSF Division of Ocean Sciences (NSF OCE) | OCE-1756851 |


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