Growth rates of the polar diatom Chaetoceros RS19 under various +Zn and +Co conditions from September 2019 (MM Saito project)

Website: https://www.bco-dmo.org/dataset/858743
Data Type: experimental
Version: 1
Version Date: 2021-08-31

Project
» Marine Microbial Investigator Award: Investigator Mak Saito (MM Saito)

Program
» Marine Microbiology Initiative (MMI)

Contributors	Affiliation	Role
Saito, Mak A.	Woods Hole Oceanographic Institution (WHOI)	Principal Investigator
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Abstract
Growth rates of the Ross Sea diatom isolate Chaetoceros sp. RS19 under various Zinc and Cobalt conditions. Chaetoceros RS19 was originally isolated by D. Moran from the Ross Sea, Antarctica in 2019.

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Coverage

Spatial Extent: **Lat**:-76.48338 **Lon**:177.12379
Temporal Extent: 2019-09 - 2019-09

Dataset Description

Growth rates of the Ross Sea diatom isolate Chaetoceros sp. RS19 under various Zn and Co additions.

Acquisition Description

Methodology:

Sampling and analytical procedures:

Media and culturing techniques

Chaetoceros RS19 cultures were maintained in a 4°C incubator under constant fluorescent lighting (30 µmol photon m-2 s-1). All cultures were randomly repositioned each day to avoid any effect of subtle variation in light intensity on growth. *Chaetoceros* RS19 was originally isolated by D. Moran from the Ross Sea, Antarctica, and cultures were maintained in the Saito laboratory culture collection at the Woods Hole Oceanographic Institution. All cultures were axenic and maintained by sterile technique until needed. Polycarbonate and plastic bottles were cleaned to remove trace metal contaminants before use. This procedure involved, at minimum, a 72h soak in <1% Citranox detergent, five rinses in Mili-Q water, a 7 day soak in 10% HCl, and five rinses with dilute acid (HCl, pH 2). Cultures were grown in microwave-sterilized 28 mL polycarbonate centrifuge tubes and all solutions were pipetted after a tip rinse procedure consisting of three rinses with 10% HCl followed by three rinses with sterile dilute HCl (pH 2). All culture work was conducted in a Class 100 clean room and transferring of cultures was conducted in a laminar flow hood within the clean room.

Culture media was prepared after that used by Sunda and Huntsman for trace metal experimentation (Sunda and Huntsman 1995). Microwave sterilized, 0.2 µm-filtered Equatorial Pacific surface seawater collected at station 14 of the 2016 ProteOMZ expedition (10.5600°S, 146.3133° W; cruise code FK160115) was used as the media base. Macronutrients were added to this sterile base to a final concentration of 88.2 µM NaNO3, 41.5 µM NaH2PO4, and 106 µM Na2SiO3 and were chelexed before use. Added vitamins included 2 nM biotin, 0.37 nM B12 as cyanocobalamin, and 300 nM thiamine and were also chelexed before use. Trace metals were added to final media concentrations of 10-7 M FeCl3, 4.8 x 10-8 M MnCl2, 4.0 x 10-8 M CuSO4, 10-7 M NiCl2, and 10-8 M Na2O3Se within a 10-4 M ethylenediamine tetraacetic acid disodium salt (EDTA, Acros Organics, C10H14N2Na2O8) metal ion buffer system. All media amendments were sterile filtered through acid-rinsed 0.2 µm filters before addition to final media, and final media equilibrated for at least 12h before inoculation.

Established cultures were first acclimated in low-metal media containing 1 nM total added Zn or less for at least three transfers. These acclimated cultures were used to inoculate initial cultures at 1% volume. All growth media was chilled at 4°C prior to inoculation. Zn or Co limitation experiments were first performed using a range of added Zn concentrations with Co omitted and vice versa. We refer to growth rate experiments using media amended with Zn *or* Co (while omitting the other) as "simple limitation" experiments. Growth rate experiments in which one metal was held at a constant total added value while varying the added concentration of the other metal were also conducted—we refer to these as "double addition" experiments. Growth of all experiment cultures was monitored by relative chlorophyll fluorescence using a Turner TD-700 fluorometer, calibrated prior to measurement with a solid standard. All cultures were grown in 28 mL acid cleaned, microwave sterilized polycarbonate tubes (Nalgene) that are compatible with the fluorometer, which enabled measurements to be taken without exposing cultures to contaminating metals. Growth rates were calculated as the slope of the natural logarithm of the increase in chlorophyll fluorescence over a four-measurement (usually 4 day) period during exponential growth. Computed ratios of [Zn2+] and [Co2+] to total concentrations, whose values are 10-3.99 and 10-3.63 respectively, were used to convert total added metal concentrations to free ion concentrations and are the same as those used by Sunda and Huntsman (Sunda and Huntsman 1995).

Processing Description

BCO-DMO Processing Notes:

- Split columns to separate growth rate average from its standard deviation (separated by a plus-minus sign)

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Related Publications

Kellogg, M.M., Moran, D.M., McIlvin, M.R., Subhas, A.V., Allen, A.E., Saito, M.A. Lack of a Zn/Co substitution ability in the polar diatom Chaetoceros RS19.
Results

Sunda, W. G., & Huntsman, S. A. (1995). Cobalt and zinc interreplacement in marine phytoplankton: Biological and geochemical implications. Limnology and Oceanography, 40(8), 1404–1417. doi:10.4319/lo.1995.40.8.1404
Methods

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Related Datasets

IsRelatedTo

Kellogg, R., Saito, M. A. (2021) **Metal quotas (ratios of Metal:P) of the polar diatom Chaetoceros sp. RS19 in +Zn and +Co incubation studies from January 2020 (MM Saito project).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-08-30 http://lod.bco-dmo.org/id/dataset/859211 [view at BCO-DMO]

Kellogg, R., Saito, M. A. (2021) **Metal uptake rates of the polar diatom Chaetoceros RS19 in +Zn and +Co incubation studies from January 2020 (MM Saito project).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-08-30 http://lod.bco-dmo.org/id/dataset/859581 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Experiment_Type	One (simple) or both (double addition) metals added	unitless
Added_Zn	Total amount of added zinc (Zn) to incubation	nanomoles per liter (nmol/L)
Added_Co	Total amount of added cobalt (Co) to incubation	nanomoles per liter (nmol/L)
Total_Zn	Total zinc (Zn). Added Zn and background media Zn.	nanomoles per liter (nmol/L)
Total_Co	Total cobalt (Co). Added Co and background media Co.	nanomoles per liter (nmol/L)
log_Zn2plus	Log of calculated free Zn2+ ion concentration in media [Zn2+]	moles per liter (mol/L)
log_Co2plus	Log of calculated free Co2+ ion concentration in media. [Co2+]	moles per liter (mol/L)
Growth_rate_replicate_A	Growth rate of treatment replicate A	per day (d-1)
Growth_rate_replicate_B	Growth rate of treatment replicate B	per day (d-1)
Growth_rate_average_base_value	Average growth rate of replicates A and B	per day (d-1)
Growth_rate_average_standard_deviation	Standard deviation of average growth rate of replicates A and B (+/-)	per day (d-1)

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Instruments

Dataset-specific Instrument Name	Incubator
Generic Instrument Name	In-situ incubator
Dataset-specific Description	Chaetoceros RS19 cultures were maintained in a 4°C incubator under constant fluorescent lighting (30 µmol photon m-2 s-1).
Generic Instrument Description	A device on a ship or in the laboratory that holds water samples under controlled conditions of temperature and possibly illumination.

Dataset-specific Instrument Name	Turner Instruments TD-700 Fluorometer
Generic Instrument Name	Turner Designs 700 Laboratory Fluorometer
Dataset-specific Description	Growth of all experiment cultures was monitored by relative chlorophyll fluorescence using a Turner TD-700 fluorometer, calibrated prior to measurement with a solid standard. All cultures were grown in 28 mL acid cleaned, microwave sterilized polycarbonate tubes (Nalgene) that are compatible with the fluorometer, which enabled measurements to be taken without exposing cultures to contaminating metals. Growth rates were calculated as the slope of the natural logarithm of the increase in chlorophyll fluorescence over a four-measurement (usually 4 day) period during exponential growth.
Generic Instrument Description	The TD-700 Laboratory Fluorometer is a benchtop fluorometer designed to detect fluorescence over the UV to red range. The instrument can measure concentrations of a variety of compounds, including chlorophyll-a and fluorescent dyes, and is thus suitable for a range of applications, including chlorophyll, water quality monitoring and fluorescent tracer studies. Data can be output as concentrations or raw fluorescence measurements.

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Project Information

Marine Microbial Investigator Award: Investigator Mak Saito (MM Saito)

In support of obtaining deeper knowledge of major biogeochemically relevant proteins to inform a mechanistic understanding of global marine biogeochemical cycles.

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Program Information

Marine Microbiology Initiative (MMI)

Website: https://www.moore.org/initiative-strategy-detail?initiativeId=marine-microbiology-initiative

A Gordon and Betty Moore Foundation Program.

Forging a new paradigm in marine microbial ecology:

Microbes in the ocean produce half of the oxygen on the planet and remove vast amounts of carbon dioxide, a greenhouse gas, from the atmosphere. Yet, we have known surprisingly little about these microscopic organisms. As we discover answers to some long-standing puzzles about the roles that marine microorganisms play in supporting the ocean’s food webs and driving global elemental cycles, we realized that we still need to learn much more about what these organisms do and how they do it—including how they evolved and contribute to our ocean's health and productivity.

The Marine Microbiology Initiative seeks to gain a comprehensive understanding of marine microbial communities, including their diversity, functions and behaviors; their ecological roles; and their origins and evolution. Our focus has been to enable researchers to uncover the principles that govern the interactions among microbes and that govern microbially mediated nutrient flow in the sea. To address these opportunities, we support leaders in the field through investigator awards, multidisciplinary team research projects, and efforts to create resources of broad use to the research community. We also support development of new instrumentation, tools, technologies and genetic approaches.

Through the efforts of many scientists from around the world, the initiative has been catalyzing new science through advances in methods and technology, and to reduce interdisciplinary barriers slowing progress. With our support, researchers are quantifying nutrient pools in the ocean, deciphering the genetic and biochemical bases of microbial metabolism, and understanding how microbes interact with one another. The initiative has five grant portfolios:

Individual investigator awards for current and emerging leaders in the field.
Multidisciplinary projects that support collaboration across disciplines.
New instrumentation, tools and technology that enable scientists to ask new questions in ways previously not possible.
Community resource efforts that fund the creation and sharing of data and the development of tools, methods and infrastructure of widespread utility.
Projects that advance genetic tools to enable development of experimental model systems in marine microbial ecology.
We also bring together scientists to discuss timely subjects and to facilitate scientific exchange.

Our path to marine microbial ecology was a confluence of new technology that could accelerate science and an opportunity to support a field that was not well funded relative to potential impact. Around the time we began this work in 2004, the life sciences were entering a new era of DNA sequencing and genomics, expanding possibilities for scientific research – including the nascent field of marine microbial ecology. Through conversations with pioneers inside and outside the field, an opportunity was identified: to apply these new sequencing tools to advance knowledge of marine microbial communities and reveal how they support and influence ocean systems.

After many years of success, we will wind down this effort and close the initiative in 2021. We will have invested more than $250 million over 17 years to deepen understanding of the diversity, ecological activities and evolution of marine microbial communities. Thanks to the work of hundreds of scientists and others involved with the initiative, the goals have been achieved and the field has been profoundly enriched; it is now positioned to address new scientific questions using innovative technologies and methods.

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Funding

Funding Source	Award
Gordon and Betty Moore Foundation: Marine Microbiology Initiative (MMI)	GBMF3782
NSF Division of Ocean Sciences (NSF OCE)	OCE-1657766
NSF Division of Ocean Sciences (NSF OCE)	OCE-1658030
NSF Division of Ocean Sciences (NSF OCE)	OCE-1736599
NSF Division of Ocean Sciences (NSF OCE)	OCE-1850719

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