Log for the samples taken using the Underway system on board of the R/V Atlantis during the CliOMZ AT50-10 expedition from Golfito, Costa Rica to San Diego, USA that occurred in May - June of 2023.

Website: https://www.bco-dmo.org/dataset/922268
Data Type: Cruise Results
Version: 1
Version Date: 2024-04-30

Project
» Collaborative Research: Underexplored Connections between Nitrogen and Trace Metal Cycling in Oxygen Minimum Zones Mediated by Metalloenzyme Inventories (CliOMZ)

Contributors	Affiliation	Role
Saito, Mak A.	Woods Hole Oceanographic Institution (WHOI)	Principal Investigator
Santoro, Alyson E.	University of California-Santa Barbara (UCSB)	Co-Principal Investigator
Lopez, Paloma Z.	Woods Hole Oceanographic Institution (WHOI)	Contact, Technician
Soenen, Karen	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This is the log for the samples taken using the Underway system on board of the R/V Atlantis during the CliOMZ AT50-10 expedition from Golfito, Costa Rica to San Diego, USA that occurred in May - June of 2023. The log contains metadata associated with the locations where samples were collected, including coordinates, depth, time, volume filtered, filter type, and subsamples' fractions. A Geotech in-line acrylic filter holder connected to a flowmeter were attached to the Underway water flow and particulates were collected. The Science party included members from WHOI, UCSB, UTGRV, and Clark University

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Table of Contents

Coverage

Spatial Extent: **N**:31.2508 **E**:-88.9709 **S**:-10.0643 **W**:-120.279
Temporal Extent: 2023-05-04 - 2023-06-08

Methods & Sampling

A system with a Geotech in-line acrylic filter holder (142mm diameter) connected to a flowmeter was attached to the Underway water flow on R/V Atlantis and particulates were collected for approximately one hour. The filtration system was arranged to split the water flow between two filter holders/flowmeters to achieve dual sampling from the same water mass. One side contained a combusted Glass Fiber FIlter (GFF) and the other side fractionated the sample with a 51um pore size Nitex mesh and a 0.2um pore size Supor (PES) filter. The

Nitex and Supor filters were cleaned with 5% for 4 hours and neutrilized to pH6 before use. Samples were collected at station and while on transit (between stations).

A Geotech in-line acrylic filter holder 142mm diameter was used along with a flowmeter for this dataset.

Data Processing Description

All geographic locations presented here were taken from the ship's R2R elog. The volume filtered was calculated from the difference between end and start flow meter readings.

Problem Description

The ship had water flow issues related to the water pump in the Underway system. Comments where added for the samples where water flow issues were present.

[table of contents | back to top]

Data Files

File
922268_v1_underwaysampling.csv (Comma Separated Values (.csv), 18.42 KB) MD5:b66e9f9697802f26ae6768590611a401 Primary data file for dataset ID 922268, version 1

[table of contents | back to top]

Parameters

Parameter	Description	Units
Cruise_ID	Cruise ID AT50-10	unitless
Station_number	Station number	unitless
Start_Date_UTC	Filtration start date	UTC
Start_Time_UTC	Filtration start time	UTC
End_Date_UTC	Filtration end date	UTC
End_Time_UTC	Filtration end time	UTC
Start_Lat	Filtration start latitude	decimal degrees

Start_Long	Filtration start longitude	decimal degrees
End_Lat	FIltation end latitude	decimal degrees
End_Long	Filtation end longitude	decimal degrees
Depth	Sample depth	meter (m)
Sampling_device	Sampling device	unitless
At_station_or_transit	Description of geographical location	unitless
Filter_type	Filter type	unitless
Volume_filtered	Volume of water filtered	liters (L)
DEPLOYMENT_COMMENTS	Comments on deployment	unitless
SAMPLE_PRFEIX	Sample prefix	unitless
SUPOR_0_2_PROTEIN1	Fraction of 142mm diameter 0.2um pore size Supor (PES) filter assigned for global metaproteomics	unitless
SUPOR_0_2_PROTEIN2	Fraction of 142mm diameter 0.2um pore size Supor (PES) filter assigned for global metaproteomics	unitless
SUPOR_0_2_DNA1	Fraction of 142mm diameter 0.2um pore size Supor (PES) filter assigned for genomic DNA analysis, sample 1 of 2	unitless
SUPOR_0_2_DNA2	Fraction of 142mm diameter 0.2um pore size Supor (PES) filter assigned for genomic DNA analysis, sample 2 of 2	unitless
SUPOR_0_2_eDNA	Fraction of 142mm diameter 0.2um pore size Supor (PES) filter assigned for environmental DNA analysis	unitless
SUPOR_0_2_pMetal	Fraction of 142mm diameter 0.2um pore size Supor (PES) filter assigned for particulate metal content analysis	unitless
SUPOR_0_2_POS	Fraction of 142mm diameter 0.2um pore size Supor (PES) filter assigned for particulate organic sulfur analysis	unitless

NITEX_51_PROTEIN1	Fraction of 142mm diameter 51um pore size Nitex filter assigned for global metaproteomics	unitless
NITEX_51_DNA1	Fraction of 142mm diameter 51um pore size Nitex filter assigned for genomic DNA analysis	unitless
NITEX_51_pMetal	Fraction of 142mm diameter 51um pore size Nitex filter assigned for particulate metal content analysis	unitless
GFF_PROTEIN1	Fraction of 142mm diameter 0.7um pore size Glass Fiber Filter (GFF) filter assigned for global metaproteomics	unitless
GFF_CA	Fraction of 142mm diameter 0.7um pore size Glass Fiber Filter (GFF) filter assigned for carbonic anhydrase activity analysis	unitless
GFF_PIGS	Fraction of 142mm diameter 0.7um pore size Glass Fiber Filter (GFF) filter assigned for photosynthetic pigments analysis	unitless
GFF_POC	Fraction of 142mm diameter 0.7um pore size Glass Fiber Filter (GFF) filter assigned for particulate organic carbon analysis	unitless
GFF_HG	Fraction of 142mm diameter 0.7um pore size Glass Fiber Filter (GFF) filter assigned for mercury content analysis	unitless
SAMPLE_COMMENTS	Comments on sample taken	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Flow Meter
Dataset-specific Description	A Geotech in-line acrylic filter holder 142mm diameter was used along with a flowmeter for this dataset.
Generic Instrument Description	General term for a sensor that quantifies the rate at which fluids (e.g. water or air) pass through sensor packages, instruments, or sampling devices. A flow meter may be mechanical, optical, electromagnetic, etc.

[table of contents | back to top]

Deployments

AT50-10

Website	https://www.bco-dmo.org/deployment/916122
Platform	R/V Atlantis
Report	https://www.rvdata.us/search/cruise/AT50-10
Start Date	2023-05-02
End Date	2023-06-09

[table of contents | back to top]

Project Information

Collaborative Research: Underexplored Connections between Nitrogen and Trace Metal Cycling in Oxygen Minimum Zones Mediated by Metalloenzyme Inventories (CliOMZ)

Coverage: Eastern Tropical Pacific

NSF abstract:
Though scarce and largely insoluble, trace metals are key components of sophisticated enzymes (protein molecules that speed up biochemical reactions) involved in biogeochemical cycles in the dark ocean (below 1000m). For example, metalloenzymes are involved in nearly every reaction in the nitrogen cycle. Yet, despite direct connections between trace metal and nitrogen cycles, the relationship between trace metal distributions and biological nitrogen cycling processes in the dark ocean have rarely been explored, likely due to the technical challenges associated with their study. Availability of the autonomous underwater vehicle (AUV) Clio, a sampling platform capable of collecting high-resolution vertical profile samples for biochemical and microbial measurements by large volume filtration of microbial particulate material, has overcome this challenge. Thus, this research project plans an interdisciplinary chemistry, biology, and engineering effort to test the hypothesis that certain chemical reactions, such as nitrite oxidation, could become limited by metal availability within the upper mesopelagic and that trace metal demands for nitrite-oxidizing bacteria may be increased under low oxygen conditions. Broader impacts of this study include the continued development and application of the Clio Biogeochemical AUV as a community resource by developing and testing its high-resolution and adaptive sampling capabilities. In addition, metaproteomic data will be deposited into the recently launched Ocean Protein Portal to allow oceanographers and the metals in biology community to examine the distribution of proteins and metalloenzymes in the ocean. Undergraduate students will be supported by this project at all three institutions, with an effort to recruit minority students. The proposed research will also be synergistic with the goals of early community-building efforts for a potential global scale microbial biogeochemistry program modeled after the success of the GEOTRACES program, provisionally called "Biogeoscapes: Ocean metabolism and nutrient cycles on a changing planet".

The proposed research project will test the following three hypotheses: (1) the microbial metalloenzyme distribution of the mesopelagic is spatially dynamic in response to environmental gradients in oxygen and trace metals, (2) nitrite oxidation in the Eastern Tropical Pacific Ocean can be limited by iron availability in the upper mesopelagic through an inability to complete biosynthesis of the microbial protein nitrite oxidoreductase, and (3) nitrite-oxidizing bacteria increase their metalloenzyme requirements at low oxygen, impacting the distribution of both dissolved and particulate metals within oxygen minimum zones. One of the challenges to characterizing the biogeochemistry of the mesopelagic ocean is an inability to effectively sample it. As a sampling platform, we will use the novel biogeochemical AUV Clio that enables high-resolution vertical profile samples for biochemical and microbial measurements by large volume filtration of microbial particulate material on a research expedition in the Eastern Tropical Pacific Ocean. Specific research activities will be orchestrated to test the hypotheses. Hypothesis 1 will be explored by comparison of hydrographic, microbial distributions, dissolved and particulate metal data, and metaproteomic results with profile samples collected by Clio. Hypothesis 2 will be tested by incubation experiments using 15NO2- oxidation rates on Clio-collected incubation samples. Hypothesis 3 will be tested by dividing targeted nitrite oxidoreductase protein copies by qPCR (quantitative polymerase chain reaction)-based nitrite oxidizing bacteria abundance (NOB) to determine if cellular copy number varies with oxygen distributions, and by metalloproteomic analyses of NOB cultures. The

demonstration of trace metal limitation of remineralization processes, not just primary production, would transform our understanding of the role of metals in biogeochemical cycling and provide new ways with which to interpret sectional data of dissolved and particulate trace metal distributions in the ocean. The idea that oxygen may play a previously underappreciated role in controlling trace metals due not just to metals' physical chemistry, but also from changing biological demand, will improve our ability to predict trace metal distributions in the face of decreasing ocean oxygen content.

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.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1924554

[table of contents | back to top]