Summaries of tigerclaw and bushbaby tracers from AUV Clio taken on R/V Atlantis (CliOMZ AT50-10 expedition) from Golfito Costa Rica to San Diego USA in May-June 2023.

Website: https://www.bco-dmo.org/dataset/928720
Data Type: Cruise Results
Version: 1
Version Date: 2024-09-09

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

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Abstract
This dataset contains processed profiling sensor data from Autonomous Underwater Vehicle (AUV) Clio which was obtained during the CliOMZ AT50-10 expedition onboard R/V Atlantis from May-June 2023. The mean and standard deviation are given for each sensor parameter during the period in which a particular SUPR sample was taken.

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Coverage

Spatial Extent: **N**:25.079886 **E**:-88.97062 **S**:-10.026301 **W**:-118.098373
Temporal Extent: 2023-05-04 - 2023-06-06

Methods & Sampling

The AT50-10 cruise contains Clio dives 031-050. Onboard samplers include: “TIGERCLAW” SUPR sampler and “BUSHBABY” SUPR sampler.

The mean and standard deviation are given for each sensor parameter during the period in which a particular

SUPR sample was taken (calculated over a specific valve's pumping time).

BCO-DMO Processing Description

* Combined all summary files into one.

Problem Description

* Clio031: No data due to ballast issues
* Clio032: BUSHBABY was inadvertently programmed with an incorrect port number for the last sample. The port number should have been 4. Optode failed to record data below 400 m
* Clio033: Incubation chamber bags did not fill
* Clio036: BUSHBABY started pumping too early on port 8 & 9
* Clio041: Vehicle surface an hour early due to a missed sample at 140 m.

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Data Files

File	
928720_v1_clio_sampler_processed.csv	(Comma Separated Values (.csv), 66.67 KB) MD5:ece392f6827d0eb51ab9b1d2bfc20861
Primary data file for dataset ID 928720, version 1	

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Related Publications

Jakuba, M. V., & Dalpe, A. J. (2024). Clio Operations Report for the AT50-10 Saito Cruise. Woods Hole Oceanographic Institution. https://doi.org/10.1575/1912/69648
Results

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Related Datasets

IsRelatedTo

Saito, M. A., Dalpe, A., Jakuba, M., Breier, J., Moore, N. (2024) **Log file from AUV Clio taken on R/V Atlantis (CliOMZ AT50-10 expedition) from Golfito Costa Rica to San Diego USA in May-June 2023.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-09-09 doi:10.26008/1912/bco-dmo.929764.1 [view at BCO-DMO]
Relationship Description: Dive log, containing location and dates for each dive.

Saito, M. A., Dalpe, A., Jakuba, M., Breier, J., Moore, N. (2024) **Raw Sensor files from AUV Clio taken on R/V Atlantis (CliOMZ AT50-10 expedition) from Golfito Costa Rica to San Diego USA in May-June 2023.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-09-09 doi:10.26008/1912/bco-dmo.925614.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
CRUISE_ID	cruise name	unitless
DIVE_ID	clio dive number, sequential	unitless
UID	Unique identifier of format dive#_SUPRsamplername_SUPRvalve# (TC = Tigerclaw; BB = Bushbaby)	unitless
SUBMERGE_TIME_UTC	Time of last Iridium update before submerging	unitless
SUBMERGE_LAT	Latitude of last Iridium update before submerging	decimal degrees
SUBMERGE_LON	Longitude of last Iridium update before submerging	decimal degrees
Tracer	?	unitless
Valve	valve number sample was pumped on	unitless
MeanCTDTemp	mean temperature measured during sample	celsius
StdCTDTemp	standard deviation of the temperature measured during sample	celsius
MeanCTDSal	mean salinity measured during sample	psu
StdCTDSal	standard deviation of the salinity measured during sample	psu
MeanCTDPressure	mean pressure measured during sample	decibar
StdCTDPressure	standard deviation measured during sample	decibar
MeanCTDConductivity	mean conductivity measured during sample	Siemens / meter
StdCTDConductivity	standard deviation of the conductivity measured during sample	Siemens / meter
MeanO2conc	mean oxygen concentration measured during sample	micromolar, uM
StdO2	standard deviation of the oxygen concentration measured during sample	micromolar, uM

MeanChl	mean chlorophyll concentration measured during sample	micrograms per deciliter
StdChl	standard deviation of the chlorophyll concentration measured during the sample	micrograms per deciliter
MeanTurb	mean turbidity measured during sample	Nephelometric Turbidity unit
StdTurb	standard deviation of the turbidity measured during sample	Nephelometric Turbidity unit
MeanTransAtten	mean calculated beam attenuation coefficient	m^-1
StdTransAtten	standard deviation of the calculated beam attenuation coefficient	m^-1
MeanNitrate	mean nitrate concentration	micromolar, uM
StdNitrate	standard deviation concentration	micromolar, uM

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	AUV Clio
Generic Instrument Description	Clio is an autonomous underwater vehicle (AUV) created to accomplish the dual goals of global ocean mapping and biochemistry sampling. The ability to sample dissolved and particulate seawater biochemistry across ocean basins while capturing fine-scale biogeochemical processes sets it apart from other AUVs. Clio is designed to efficiently and precisely move vertically through the ocean, drift laterally to observe water masses, and integrate with research vessel operations to map large horizontal scales up to a depth of 6,000 meters. More information is available at https://www2.whoi.edu/site/deepsubmergencelab/clio/

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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

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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.

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Funding

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

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