Trace metal rosette log of samples taken 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/929694
Data Type: Cruise Results
Version: 1
Version Date: 2024-06-13

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

Contributors	Affiliation	Role
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Abstract
This is the log for the trace metal rosette niskin bottles deployed on the R/V Atlantis 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 each rosette deployment, including location, bottle depth, and time. The rosette was launched on 1/4" kevlar line spooled on a MASH2K winch from the East Coast Winch Pool. The Science party included members from WHOI, UCSB, UTGRV, and Clark University.

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Coverage

Location: International waters of the Eastern Tropical North and South Pacific Ocean, including the Costa Rica Dome. Full depth water column.
Spatial Extent: **N**:31.083413 **E**:-88.887522 **S**:-10.010761 **W**:-120.232278
Temporal Extent: 2023-05-04 - 2023-06-08

Methods & Sampling

Data was logged and collected from Trace Metal Clean Rosette (TMR) deployments during reseach cruise AT50-10. The TMR was deployed on a non-conducting 1/4" Kevlar line and preprogrammed to trip at pre-determined depths on the upcast.

Sampling was conducted using a Trace Metal Clean Rosette (TMR) outfitted with X-Niskin bottles and physicochemical parameters were measured using a mounted Sea-Bird SEACAT 19+. The TMR was deployed on a MASH-2K winch from the UNOLS East Coast Winch Pool.

Data Processing Description

Headers were modified in the log to comply with submission requirements (no special characters). Times and dates were converted to UTC.

BCO-DMO Processing Description

* adjusted column names to comply with database requirements
* converted date and time notations to iso format
* added iso datetime variable (merging time and date)
* removed incorrect data (17:50) in column "cast_total_depth_m" after communication with submitter

Problem Description

Several casts failed due to low battery in the controller module (comment "failed cast"). Also depths are provided as target depths (programmed_depth_(m)) and measured depths (real_depth) by pressure sensor. These tend to only differ by a few meters, as the package is tripped while transiting the water column. At a few stations the recorded depth was not recorded (missing hex depths), we recommend substituting programmed_depth at those depths.

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Data Files

File	
929694_v1_tracemetallog.csv	(Comma Separated Values (.csv), 89.51 KB) MD5:e5f421eb4b122040b10372ab84d9f52c
Primary data file for dataset ID 929694, version 1	

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Parameters

Parameter	Description	Units
Cruise_ID	Cruise ID AT50-10	unitless
Station_number	Station number	unitless
Cast_number	Sequential cast number for TMR deployments	unitless
Start_date_UTC	Deployment start date, UTC time one. ISO format	unitless
Start_time_UTC	Deployment start time, UTC time zone. ISO format	unitless
ISO_DateTime_UTC_Start	Deployment start date and time, UTC timezone. ISO format.	unitless
Start_Lat	Deployment start latitude	decimal degrees
Start_Long	Deployment start longitude	decimal degrees
Cast_total_depth_m	Total depth of cast	m
Niskin	Niskin identifier	unitless
program_depth	Programmed depth	meter (m)
Real_depth	Actual depth	m
Notes	Deployment notes	unitless
sample_number	Sample naming scheme	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Niskin bottle
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Dataset-specific Instrument Name	
Generic Instrument Name	Sea-Bird SBE 19plus V2 SEACAT CTD
Generic Instrument Description	Self-contained self-powered CTD profiler. Measures conductivity, temperature and pressure (Digiquartz sensor) in both profiling (samples at 4 scans/sec) and moored (sample rates of once every 5 seconds to once every 9 hours) mode. Available in plastic or titanium housing with depth ranges of 600m and 7000m respectively. Miniature submersible pump provides water to the conductivity cell. Compared to the previous 19plus, the V2 incorporates an electronics upgrade and additional features, with six differentially amplified A/D input channels, one RS-232 data input channel, and 64 MB FLASH memory.

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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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