Average nitrate d15N values from the upper 1000 meters of the water column at four stations sampled in the Eastern Tropical North Pacific on R/V Sally Ride cruise SR2113 in December 2021

Website: https://www.bco-dmo.org/dataset/933292
Data Type: Cruise Results
Version: 1
Version Date: 2024-09-13

Project
» Collaborative Research: New approaches to study calcium carbonate dissolution on the sea floor and its impact on paleo-proxy interpretations (CDISP 2021)

Contributors	Affiliation	Role
Wang, Xingchen	Boston College (BC)	Principal Investigator
Landry, Kameko	Boston College (BC)	Student
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
We report nitrate isotope data at four stations (CR01, CR02, CR03, and CR05) in the Eastern Tropical North Pacific (ETNP). The cruise (R/V Sally Ride SR2113) occupied these four stations near the Cocos Ridge between 6.8 to 5.3 degrees North latitude and 86.6 to 88.26 degrees West longitude. Sampling occurred between December 2-14, 2021. A 24-bottle Niskin rosette and CTD were used to collect 30-milliliter (mL) water samples that were later analyzed using the denitrifier method. The data were collected by Kameko Landry in the Stable Isotope Biogeochemistry Laboratory at Boston College.

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Coverage

Location: Cocos Ridge, Eastern Equatorial Pacific
Spatial Extent: **N**:6.7849 **E**:-86.696 **S**:5.9596 **W**:-88.261
Temporal Extent: 2021-12-02 - 2021-12-14

Dataset Description

Data were collected on the NSF-funded 2021 "CDISP" cruise on R/V Sally Ride (SR2113). Analyses of the samples presented in this dataset were funded through Boston College.

Methods & Sampling

Water samples were collected directly from the CTD Niskin bottles and filtered through 0.2-micrometer (um) PVDF syringe filters. Samples were collected from approximately 24 depths throughout the water column ranging from 7 to 2900 meters (m), with the shallowest depths being sampled first to avoid nitrate contamination from deeper, higher nitrate samples. The samples were collected in pre-cleaned acid-washed 30-milliliter (mL) HDPE bottles. The bottles and caps were rinsed three times with the sample water. The syringe was rinsed three times before attaching the PVDF syringe filter and, once attached to the syringe, 10 mL of sample water was used to rinse the filter before filling the sample bottles. Once filled, sample bottles were labeled and parafilmed. Samples were immediately frozen on the ship and continued to be frozen until analysis.

Nitrate/nitrite in seawater were quantitatively converted into nitrous oxide using the denitrifier method (Sigman et al., 2001; Weigand et al., 2016). The isotopic composition of the resulting nitrous oxide was analyzed on a custom gas bench system coupled to a Delta V Plus isotope ratio mass spectrometer.

Data Processing Description

The data are processed and corrected using nitrate isotope standards IAEA NO3 and USGS34.

BCO-DMO Processing Description

- Imported original file "CCR_BCODMO_FINAL.xlsx" into the BCO-DMO system.
- Marked "nd" as a missing data value (missing data are empty/blank in the final CSV file).
- Converted the date column to YYYY-MM-DD format.
- Renamed fields to comply with BCO-DMO naming conventions.
- Saved the final file as "933292_v1_water_column_nitrate_d15n_cocos_ridge.csv".

Problem Description

Did not collect water samples at CR04.

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Data Files

File	
933292_v1_water_column_nitrate_d15n_cocos_ridge.csv	(Comma Separated Values (.csv), 2.77 KB) MD5:e6f6881f4212ba717cff880a8ad630e3
Primary data file for dataset ID 933292, version 1	

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Related Publications

Sigman, D. M., Casciotti, K. L., Andreani, M., Barford, C., Galanter, M., & Böhlke, J. K. (2001). A Bacterial Method for the Nitrogen Isotopic Analysis of Nitrate in Seawater and Freshwater. Analytical Chemistry, 73(17), 4145–4153. doi:10.1021/ac010088e
Methods

Weigand, M. A., Foriel, J., Barnett, B., Oleynik, S., & Sigman, D. M. (2016). Updates to instrumentation and protocols for isotopic analysis of nitrate by the denitrifier method. Rapid Communications in Mass Spectrometry, 30(12), 1365–1383. doi:10.1002/rcm.7570
Methods

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Parameters

Parameter	Description	Units
Station_ID	Cocos Ridge station number + cast number + Niskin bottle number	unitless
Depth_m	Sample depth	meters (m)
WC_NO3	Nitrate concentration	micromoles per kilogram (umol/kg)
WC_d15N	Averaged d15N in permille vs air. Blank/empty values in this column mean water was not collected from this specific bottle.	permille vs air
WC_d15N_1sd	Standard deviation of measurements for samples analyzed with more than one run	permille vs air
Latitude	Latitude of sample collection	decimal degrees
Longitude	Longitude of sample collection; negative values = West	decimal degrees
Date	Date of sample collection	unitless

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Instruments

Dataset-specific Instrument Name	Delta V Plus isotope ratio mass spectrometer
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	The isotopic composition of the resulting nitrous oxide was analyzed on a custom gas bench system coupled to a Delta V Plus isotope ratio mass spectrometer.
Generic Instrument Description	The Isotope-ratio Mass Spectrometer is a particular type of mass spectrometer used to measure the relative abundance of isotopes in a given sample (e.g. VG Prism II Isotope Ratio Mass-Spectrometer).

Dataset-specific Instrument Name	24-bottle Niskin CTD rosette
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.

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Deployments

SR2113

Website	https://www.bco-dmo.org/deployment/925232
Platform	R/V Sally Ride
Start Date	2021-11-20
End Date	2021-12-20

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Project Information

Collaborative Research: New approaches to study calcium carbonate dissolution on the sea floor and its impact on paleo-proxy interpretations (CDISP 2021)

Coverage: Cocos Ridge, Eastern Equatorial Pacific

NSF Award Abstract:
The uptake of anthropogenic CO2 by the ocean will eventually be mitigated by the dissolution of CaCO3 on the sea floor. Dissolution is an important component of the carbon cycle in models used for climate projections though the relative importance of where it occurs (water column versus sediments) and the rates and processes involved are not fully understood. This ambitious field and laboratory study is designed to advance our knowledge of the important factors that control carbonate dissolution/ preservation in deep ocean sediments. Using a novel tracer approach and multiple in situ sampling strategies, the project will investigate sea floor dissolution rates, their kinetic controlling factors, the depth in sediments at which dissolution occurs, the role that oxidation of particulate organic carbon plays, and the ramifications of solid phase alteration for the use of geochemically-based paleoceanographic proxies. The project will foster further development of benthic lander technology and yield key information relating sea floor conditions to carbonate dissolution rate, thereby helping to constrain the rate at which the ocean can neutralize the impacts of ocean acidification. Graduate and undergraduate students will be trained and the research team will use film and animation to bring this work to a broader audience through a collaboration with the Los Angeles Natural History Museum.

The research team has developed a new approach to quantify calcium carbonate dissolution rates based on 13-C labeled carbonate substrates, a technique which is significantly more sensitive than traditional approaches based on alkalinity and/or calcium measurements. This has opened a range of new opportunities and insights into the governing mechanisms and rates of calcium carbonate dissolution, a challenging and long-standing geochemical problem. Carbonate dissolution rates on the sea floor will be directly assessed by benthic chamber flux measurements of alkalinity and calcium as well as pore water models of TCO2 and alkalinity and their isotopic composition. The potential impacts of organic carbon remineralization will be measured through

oxygen and nutrient flux determinations, pore water gradients and modeling. Labeled 13C-enriched calcite will serve as a tracer of near surface dissolution processes when added to benthic chambers and of down-core dissolution processes using 13C-labeled rods inserted into the sediment column. These in situ experiments of labeled carbonate dissolution will be the first of their kind. To complement these measurements, the team will continue development of a rhizon-based pore water sampler that works on a multi-corer at all ocean depths. Field experiments will be conducted at sea at 4-6 sites in a transect through water column supersaturation to undersaturation between Panama and the Galapagos. Dissolution rate measurements, coupled with analyses of cation/Ca ratios in CaCO3 foraminiferal shells will help calibrate the impact of dissolution on paleo-proxy interpretations. Further, analyses of sediment calcite and aragonite fractions will help explain net dissolution and sediment response with time. The results from this study should help to better parameterize sediment variables in ocean-climate models (GCMs), which has important implications for predicting the consequences of ocean acidification and the modeling of paleoceanographic records. The methodologies and new techniques will surely be adopted by other researchers, therefore impacting the larger geochemical community.

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
Boston College	BC internal award

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