Solid phase measurements of sediment cores from the Cocos Ridge (Eastern Equatorial Pacific) acquired during cruise SR2113 between November - December 2021.

Website: https://www.bco-dmo.org/dataset/925132
Data Type: Other Field Results
Version: 1
Version Date: 2024-06-20

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
Adkins, Jess F.	California Institute of Technology (Caltech)	Co-Principal Investigator
Berelson, William M.	University of Southern California (USC)	Co-Principal Investigator
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Rollins, Nick E.	University of Southern California (USC)	Technician
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Abstract
These data include solid phase measurements on sediment cores from the Cocos Ridge in the Eastern Equatorial Pacific. This cruise was aboard the R/V Sally Ride between 2021-11-20 and 2021-12-20. Instruments used were a multicorer, Liaison autosampler coupled to a Picarro cavity ring-down spectrometer, and Element Analyzer coupled to a Picarro cavity ring-down spectrometer. These data contributed to our understanding of the carbonate chemistry system in this region, particularly regarding carbonate dissolution in deep-sea sediments. Sijia Dong (Caltech) and Nick Rollins (USC) measured CaCO3 (PIC) and Organic_C (POC).

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Coverage

Spatial Extent: **N**:6.78487 **E**:-86.5999 **S**:5.35008 **W**:-88.2609
Temporal Extent: 2021-12-01 - 2021-12-14

Methods & Sampling

The sediment cores are taken from the Cocos Ridge in the Eastern Equatorial Pacific using a multicorer at 4 different locations. This cruise was aboard the R/V Sally Ride between 2021-11-20 and 2021-12-20.

Data Processing Description

Porosity was obtained by mass of water loss upon drying and assigned a standard salinity (34.6 ppt) and sediment grain density (2.6 g/cm3). Bulk sediment samples were dried in an oven at 50°C for 72 h and then homogenized for TC and mineralogical analyses.

2-10 mg of the samples were used for PIC (% CaCO3) and delta 13C of PIC and analyzed on a Picarro Cavity Ring-Down Spectrometer (G2131-i) with Liaison autosampler, following acidification. TC and delta 13C of TC measurements were conducted using an Elemental Analyzer (EA, Costech) coupled to a Picarro Cavity Ring-Down Spectrometer (G2131-i).

Particulate Organic Carbon (POC) was calculated by subtracting PIC from TC. Uncertainties in PIC and TC concentrations were evaluated based on the average offset between duplicate sample measurements and were identified to be ± 0.04 % PIC (7 pairs of duplicates) and ± 0.03 % TC (5 pairs of duplicates). Uncertainty in delta 13C was evaluated based on the standard error of the measured optical calcite standard and was 0.02 ‰.

Mineralogy of the sediment was measured with a Bruker D8 Advance X-Ray Diffraction (XRD). Roughly 200 mg of each ground sediment sample was mounted onto a rotating disc and scanned for ~1 h. Data analysis was conducted using the software Jade.

BCO-DMO Curation Notes

* Added sample acquisition description (approved by submitter)
* Adjusted parameter names to comply with database requirements

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Data Files

File
925132_v1_solidphase.csv (Comma Separated Values (.csv), 4.24 KB) MD5:3c3c47cab66afdad40f0a41cf991cfb9 Primary data file for dataset ID 925132, version 1

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Related Publications

Submitted to GCA: Cetiner J. E. P., Berelson W. M., Rollins N. E., Liu X., Pavia, F. J., Waldeck, A. R., Dong S., Fleger, K., Barnhart H. A., Quinan, M., Wani, R., Rafter, P. A., Jacobson, A. D., Byrne R. H. and Adkins J. F. Carbonate dissolution fluxes in deep-sea sediments as determined from in situ porewater profiles in a transect across the saturation horizon
Results

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Parameters

Parameter	Description	Units
Station	Station ID number	unitless
Date	Date of porewater sampler/multi-corer deployment in ISO format (yyyy-mm-dd)	unitless
Latitude	Station latitude, south is negative	decimal degrees
Longitude	Station longitude, west is negative	decimal degrees
Water_Column_Depth	Water column depth	meters (m)
Sediment_Depth	Sediment depth relative to sediment-water interface	centimeters (cm)
Porosity	Porosity	percent (%)
CaCO3	CaCO3 (carbonate) content; Particulate Inorganic Carbon (PIC)	percent (%)
Organic_C	Organic carbon content; Particulate Organic Carbon (POC)	percent (%)

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Instruments

Dataset-specific Instrument Name	Elemental Analyzer (EA, Costech)
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	Elemental Analyzer (EA, Costech) coupled to a Picarro Cavity Ring-Down Spectrometer (G2131-i) was used to measure Total Carbon
Generic Instrument Description	Instruments that quantify carbon, nitrogen and sometimes other elements by combusting the sample at very high temperature and assaying the resulting gaseous oxides. Usually used for samples including organic material.

Dataset-specific Instrument Name	Liaison autosampler
Generic Instrument Name	Laboratory Autosampler
Dataset-specific Description	A Picarro Cavity Ring-Down Spectrometer (G2131-i) coupled to a Liaison autosampler was used to measure PIC and delta13C of PIC.
Generic Instrument Description	Laboratory apparatus that automatically introduces one or more samples with a predetermined volume or mass into an analytical instrument.

Dataset-specific Instrument Name	Ocean Instruments MC 800 Multicolor
Generic Instrument Name	Multi Corer
Dataset-specific Description	Ocean Instruments MC 800 Multicolor was used to collect sediment cores.
Generic Instrument Description	The Multi Corer is a benthic coring device used to collect multiple, simultaneous, undisturbed sediment/water samples from the seafloor. Multiple coring tubes with varying sampling capacity depending on tube dimensions are mounted in a frame designed to sample the deep ocean seafloor. For more information, see Barnett et al. (1984) in Oceanologica Acta, 7, pp. 399-408.

Dataset-specific Instrument Name	Picarro Cavity Ring-Down Spectrometer (G2131-i)
Generic Instrument Name	Spectrophotometer
Dataset-specific Description	Elemental Analyzer (EA, Costech) coupled to a Picarro Cavity Ring-Down Spectrometer (G2131-i) was used to measure Total Carbon. A Picarro Cavity Ring-Down Spectrometer (G2131-i) coupled to a Liaison autosampler was used to measure PIC and delta13C of PIC.
Generic Instrument Description	An instrument used to measure the relative absorption of electromagnetic radiation of different wavelengths in the near infra-red, visible and ultraviolet wavebands by samples.

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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
NSF Division of Ocean Sciences (NSF OCE)	OCE-1834475

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