Particulate Carbon Concentrations and Stable Carbon Isotopes in Marine Particles Captured by In Situ Mclane Pumps at Cocos Ridge Coco Ridge (Eastern Equatorial Pacific) during cruise SR2113 between November - December 2021

Website: https://www.bco-dmo.org/dataset/925258
Data Type: Other Field Results
Version: 1
Version Date: 2024-05-10

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
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Abstract
This dataset includes particulate carbon concentrations and isotopes collected in December, 2021. Suspended particles are collected at 4 different stations near Cocos Ridge, at two different size fractions using Mclane pumps. The two size fractions are large size fraction (LSF) that is >51 um, and small size fraction (SSF) that is 0.5 -- 51 um. Concentrations and stable carbon isotopes of particulate inorganic carbon (PIC) and total carbon (TC) are measured and reported. PIC content are measured by acidifying a subsample of the Glass Fiber Filter (GFF) and measuring total CO2 released using a Picarro Cavity Ring-down Spectroscopy. TC content are analyzed by burning a subsample of the GFF on Elemental Analyzer (EA). Samples were collected during SR2113 onboard Sally Ride, under the project "new approaches to study calcium carbonate dissolution on the sea floor and its impact on paleo-proxy interpretations", as a water-column side determination of particle compositions and carbonate dissolution. This data reveals changes in concentrations and stable carbon isotopes with water depth, and has implications for multiple biogeochemical processes associated with both the inorganic and the organic carbon within marine particles in the water column.

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Coverage

Spatial Extent: **N**:6.78488 **E**:-86.5932 **S**:5.1696 **W**:-88.2609

Temporal Extent: 2021-12-02 - 2021-12-14

Methods & Sampling

Dual-flowpath *in situ* pumps (McLane WTS-6-1-142LVUP) were deployed at targeted depths for 3-5 hours at 4 stations (CR1, CR2, CR3 and CR5), with approximately 1400 L seawater flowing through the filters. The filter holders had two stages for two size fractions and multiple baffle systems designed to ensure even particle distribution and prevent particle loss (Bishop et al. 2012; Lam et al. 2018).

Samples analyzed in this study were collected on the filter holder/flowpath which was loaded with a 51 um Sefar polyester mesh prefilter followed by a paired 0.5 um Glass Fiber Filter (GF/F) (Advantec GC-50, LOT No. 70207718, 142 mm diameter). The 51 um prefilter was underlain by a 150 um Sefar polyester mesh support filter to facilitate filter handling. The GF/F filters were pre-combusted at 450 C overnight to remove any potential organic matter. In this dataset, data reported from the 51 um prefilter were referred to as “LSF” to indicate large size fraction (> 51 um); data reported from the main filters (GF/F, 0.5 – 51 um) were referred to as “SSF” to indicate small size fraction. Upon recovery of the pumps, the 51 um prefilters were subsampled into slices of 1/4 or 1/2 of the total filter, and the LSF particles were rinsed onto 26 mm diameter Glass Fiber Filters. The LSF and SSF GF/Fs were then dried at room temperature for 24 h. At CR, 1/4 of each LSF and SSF filter was used for Particulate Inorganic Carbon (PIC) concentration and d13C measurements; 1/4 of each LSF and a circle of 26 mm diameter of the SSF was used for Total Carbon (TC) concentration and d13C measurements.

For each pump cast, a dipped blank sample was collected, and all concentration calculations were corrected by subtracting the dipped blank signal to remove the potential effect of DOC absorbed onto the filters. The effect of DOC on the isotopic values of filter TC is neglected because the amount of DOC is trivial compared to POC on the filters.

BCO-DMO Processing Description

* added sampling date in ISO format
* adjusted parameter names to comply with database requirements
* converted longitudes to negative values

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Data Files

File	
925258_v1_isotopepoc.csv	(Comma Separated Values (.csv), 10.18 KB) MD5:488b5feb2245836f2a1b74a614986b46
Primary data file for dataset ID 925258, version 1	

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Related Publications

Bishop, J. K. B., Lam, P. J., & Wood, T. J. (2012). Getting good particles: Accurate sampling of particles by large volume in-situ filtration. Limnology and Oceanography: Methods, 10(9), 681–710. doi:10.4319/lom.2012.10.681
Methods

Lam, P. J., Lee, J.-M., Heller, M. I., Mehic, S., Xiang, Y., & Bates, N. R. (2018). Size-fractionated distributions of suspended particle concentration and major phase composition from the U.S. GEOTRACES Eastern Pacific Zonal Transect (GP16). Marine Chemistry, 201, 90–107. doi:10.1016/j.marchem.2017.08.013
Methods

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
GFF_ID	Glass Fiber Filter ID Number. Station number - Cast number - Pump number, for cast number, PC is short for pump cast (deployment of pumps only), B is short for blade cast (pumps deployed during the deployment of Blades), for example. CR1-PC1-Pump1 means, Station CR1 - Pump cast 1 - Pump 1.	unitless
Station_Number	Sampling station number	unitless
Latitude	Latitude of sampling location, south is negative	decimal degrees
Longitude	Longitude of sampling location, west is negative	decimal degrees
Date	Sampling date in ISO format	unitless
Depth	Water Depth. Depth of the pump deployment according to wire-out information	meters
Bottom_Depth	Bottom Water Depth	meters
LSF_PIC_13C	Large Size Fraction Particulate Inorganic Carbon delta_13C	per mil
LSF_PIC	Large Size Fraction Particulate Inorganic Carbon Concentration	micro-moles per kilogram
SSF_PIC_13C	Small Size Fraction Particulate Inorganic Carbon delta_13C	per mil
SSF_PIC	Small Size Fraction Particulate Inorganic Carbon Concentration	micro-moles per kilogram
LSF_TC_13C	Large Size Fraction Total Particulate Carbon delta_13C	per mil
LSF_TC	Large Size Fraction Total Particulate Carbon Concentration	micro-moles per kilogram
SSF_TC_13C	Small Size Fraction Total Particulate Carbon delta_13C	per mil
SSF_TC	Small Size Fraction Total Particulate Carbon Concentration	micro-moles per kilogram

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Instruments

Dataset-specific Instrument Name	Elemental Analyzer (Costech)
Generic Instrument Name	Elemental Analyzer
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	In situ pumps (McLane WTS-6-1-142LVUP)
Generic Instrument Name	McLane Pump
Generic Instrument Description	McLane pumps sample large volumes of seawater at depth. They are attached to a wire and lowered to different depths in the ocean. As the water is pumped through the filter, particles suspended in the ocean are collected on the filters. The pumps are then retrieved and the contents of the filters are analyzed in a lab.

Dataset-specific Instrument Name	Picarro Cavity Ring-Down Spectroscopy (G2131-i)
Generic Instrument Name	Spectrometer
Generic Instrument Description	A spectrometer is an optical instrument used to measure properties of light over a specific portion of the electromagnetic spectrum.

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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
NSF Division of Ocean Sciences (NSF OCE)	OCE-1834492

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