Sinking PIC, PC in shallow sediment traps collected along a North Pacific transect between Hawaii and Alaska on R/V Kilo Moana cruise KM1712 in August 2017

Website: https://www.bco-dmo.org/dataset/860424
Data Type: Cruise Results
Version: 1
Version Date: 2021-09-21

Project
» Ocean Acidification - Collaborative Research: Measuring the kinetics of CaCO3 dissolution in seawater using novel isotope labeling, laboratory experiments, and in situ experiments (CaCO3 dissolution)

Contributors	Affiliation	Role
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Abstract
This dataset includes general measurements for sediment trap casts at 5 stations along a transect between Hawaii and Alaska. Data was collected in August 2017 onboard R/V Kilo Moana cruise KM1712.

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Coverage

Spatial Extent: **N**:50 **E**:-148 **S**:23 **W**:-158
Temporal Extent: 2017-08-02 - 2017-08-24

Dataset Description

North Pacific, 150 W, 20 to 60 N, all depths

Methods & Sampling

Suspended particles were collected at 5 different stations along a North Pacific transect between Hawaii and Alaska. Samples were collected on 142 mm diameter Glass Fiber Filters (GFF) using McLane Pumps. Particulate

Inorganic Carbon (PIC) content was measured by acidifying a subsample of the GFF filter and measuring total CO2 released on a Picarro gas concentration analyzer. Total Particulate Carbon (PC) and Particulate Nitrogen (PN) were analyzed by burning a subsample of the GFF on an Elemental Analyzer (EA).

Data Processing Description

BCO-DMO processing:
- Converted latitude and longitude to decimal degrees.
- Created column for ISO 8601 formatted times (UTC/GMT timezone)
- Rounded column values to submitter preference
- Replaced missing data identifier of 'NA' with 'nd' (BCO-DMO default for 'no data')
- Modified parameter (column) names to conform with BCO-DMO naming conventions.
    No spaces, hyphens, commas, parentheses, or Greek letters.
    The only chararacters allowed are A-Z, a-z, 0-9, and underscores.

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Data Files

File
trap_sinking_particles.csv (Comma Separated Values (.csv), 2.08 KB) MD5:c7f93f4124618024664d02540504b2ad Primary data file for dataset ID 860424

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Related Publications

Dong, S., Berelson, W. M., Rollins, N. E., Subhas, A. V., Naviaux, J. D., Celestian, A. J., Liu, X., Turaga, N., Kemnitz, N. J., Byrne, R. H., & Adkins, J. F. (2019). Aragonite dissolution kinetics and calcite/aragonite ratios in sinking and suspended particles in the North Pacific. Earth and Planetary Science Letters, 515, 1–12. https://doi.org/10.1016/j.epsl.2019.03.016
Methods
,
Results

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Parameters

Parameter	Description	Units
Cruise_ID	Cruise identifier	unitless
Cruise_synonym	Cruise name	unitless
Station	Station number	unitless
Longitude	Longitude of sample collection (West is negative)	decimal degrees
Latitude	Latitude of sample collection	decimal degrees
Depth	Depth of sample collection	meters (m)
Deploy_Time_local	Time of sediment trap deployment (local, Hawaii Standard Time)	unitless
Recover_Time_local	Time of sediment trap recovery (local, Hawaii Standard Time)	unitless
Duration	Duration of trap deployment	hours
Mass_trapped	Weight of trapped material	milligrams (mg)
Num_Tubes	Number of the sediment trap tubes used to collect the sinking particles	unitless
Mass_Flux	Mass flux	milligrams per squared meter per day (mg/m2/day)
Pct_PIC	Weight percent of Particulate Inorganic Carbon	percent (%)
Pct_Total_C	Weight percent of total Carbon (replicate sample)	percent (%)
Pct_Total_C_rep	Weight percent of total Carbon (replicate sample)	percent (%)
del13C	Delta 13C of total Carbon	per mil
del13C_rep	Delta 13C of total Carbon (replicate sample)	per mil
Total_C_flux	Total carbon flux	milligrams per squared meter per day (mg/m2/day)
PIC_flux	Particulate inorganic carbon flux	millimoles per squared meter per day (mmol/m2/day)
Pct_Aragonite	Aragonite percentage in PIC (particulate inorganic carbon)	percent
Deploy_DateTime_UTC	Time of sediment trap deployment in ISO8601 format	unitless
Recover_DateTime_UTC	Time of sediment trap recovery in ISO8601 format	unitless

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Instruments

Dataset-specific Instrument Name	Picarro Cavity Ring-Down Spectroscopy Gas Analyzer (G2131-i)
Generic Instrument Name	Cavity enhanced absorption spectrometers
Dataset-specific Description	Particulate Inorganic Carbon (PIC) content was measured by acidifying a subsample of the GFF filter and measuring total CO2 released on Picarro
Generic Instrument Description	Instruments that illuminate a sample inside an optical cavity, typically using laser light, and measure the concentration or amount of a species in gas phase by absorption spectroscopy. Techniques include cavity ring-down spectroscopy (CRDS) and integrated cavity output spectroscopy (ICOS).

Dataset-specific Instrument Name	Picarro Cavity Ring-Down Spectroscopy Gas Analyzer (G2131-i)
Generic Instrument Name	CO2 Analyzer
Dataset-specific Description	Particulate Inorganic Carbon (PIC) content was measured by acidifying a subsample of the GFF filter and measuring total CO2 released on Picarro
Generic Instrument Description	Measures atmospheric carbon dioxide (CO2) concentration.

Dataset-specific Instrument Name	Costech ECS4010 CHNSO Elemental Analyzer
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	Total Particulate Carbon (PC) and Particulate Nitrogen (PN) were analyzed by burning a subsample of the GFF on Elemental Analyzer (EA).
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	Sediment trap
Generic Instrument Name	Sediment Trap
Dataset-specific Description	Sinking particles were collected using sediment traps at 100 m and 200 m, at 5 different stations along a North Pacific transect between Hawaii and Alaska
Generic Instrument Description	Sediment traps are specially designed containers deployed in the water column for periods of time to collect particles from the water column falling toward the sea floor. In general a sediment trap has a jar at the bottom to collect the sample and a broad funnel-shaped opening at the top with baffles to keep out very large objects and help prevent the funnel from clogging. This designation is used when the specific type of sediment trap was not specified by the contributing investigator.

Dataset-specific Instrument Name	XRD
Generic Instrument Name	X-ray diffractometer
Dataset-specific Description	Calcite/aragonite ratios were analyzed by XRD
Generic Instrument Description	Instruments that identify crystalline solids by measuring the characteristic spaces between layers of atoms or molecules in a crystal.

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Deployments

KM1712

Website	https://www.bco-dmo.org/deployment/837321
Platform	R/V Kilo Moana
Start Date	2017-08-01
End Date	2017-09-01
Description	Additional cruise information is available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/KM1712

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Project Information

Ocean Acidification - Collaborative Research: Measuring the kinetics of CaCO3 dissolution in seawater using novel isotope labeling, laboratory experiments, and in situ experiments (CaCO3 dissolution)

Coverage: North Pacific, 150 W, 20 to 60 N, all depths

NSF Award Abstract:
Ocean acidification by anthropogenic carbon dioxide (CO2) emissions to the atmosphere will ultimately be balanced by sedimentary carbonate dissolution. The time constant for this reaction, however, is ca. 6,000 years. So, in the coming decades, the ocean's response to CO2 uptake will be based on the kinetics of supply and removal, not on the thermodynamics of the system. Unfortunately our understanding of the basic rate law for carbonate dissolution in the ocean is lacking. The order of the rate law is still argued to be anywhere from 1 to 4.5; this range represents a major difference in the sensitivity of the system to small changes in saturation state. The relative importance of aragonite vs. calcite dissolution, the influence of magnesium content in the minerals, and the sign of the role of organic matter are all still unknowns in the modern ocean. Of course, a truly useful rate law would be able to combine the relative importance of all of these factors into a predictive rule for how dissolution will respond to ocean acidification.

In this study, researchers at the California Institute of Technology and the University of Southern California will address this problem with a novel set of laboratory and in situ experiments that use carbon-13 (13C) tracer labeled biogenic carbonates to measure the dissolution rate under a wide range of saturation states. They will assemble a set of rules that will govern carbonate dissolution in sinking particles and in marine sediments. This will require two sub-projects. First, they will culture several different species of biogenic carbonate producers in the lab under the influence of a strong 13C label. With enrichments of around 30,000o/oo in the calcium carbonate (CaCO3), they will measure the change in dissolved inorganic carbon-13 at several time points over 1-2 weeks in specially built high-pressure reaction chambers. The construction of a prototype chamber is completed and it provides the means, for the first time, to control carbonate saturation state by changing

seawater chemistry, pressure, and temperature independently. Experiments with pure 13C labeled inorganic CaCO3 will provide the inorganic reference frame for the biogenic carbonate results. Secondly, to check the lab-based rate data, they will also use labeled biogenic particles in a simple Niskin bottle based reactor that will be deployable on regular hydrowire. The accumulation of 13C in the Niskin dissolved inorganic carbon over 1-2 days will provide an initial rate that is directly comparable to the more extensive laboratory study on the same sorts of materials. Using the San Pedro Basin as a test bed for these in situ experiments will sample a range of saturation states in a series of 3-day cruises. This high-sensitivity approach should allow the team to unpack the various components of carbonate dissolution in seawater under rising CO2 concentrations.

Broader Impacts. Producing a better rate law for carbonate dissolution will have broad implications for the fields of marine chemistry, marine biology, paleoceanography, and for potential societal response to ocean acidification. This rate law sits at the heart of the marine carbonate cycle. In addition, this work will benefit at least two graduate students and promote US-Israel collaborations via the inclusion of Jonathan Erez and his students. The specific involvement of underrepresented high school students in scientific/oceanographic research is built into the efforts of this project as well as ongoing efforts by both PIs to communicate their science to a broad array of non-scientific audiences.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1220600
NSF Division of Ocean Sciences (NSF OCE)	OCE-1220302

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