Molybdate reactive phosphorus concentrations in NMR pretreatment extracts from sediment samples collected during R/V JOIDES Resolution cruise JRES-336 (IODP336, North Pond) to the western flank of the mid-Atlantic Ridge in November of 2011

Website: https://www.bco-dmo.org/dataset/816527
Data Type: Cruise Results
Version: 1
Version Date: 2020-06-23

Project
» Potential phosphorus uptake mechanisms of the deep sedimentary biosphere (Deep sea sediments)

Program
» Center for Dark Energy Biosphere Investigations (C-DEBI)

Contributors	Affiliation	Role
Paytan, Adina	University of California-Santa Cruz (UCSC)	Principal Investigator
Defforey, Delphine	University of California-Santa Cruz (UCSC)	Co-Principal Investigator
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Abstract
Molybdate reactive phosphorus concentrations in nuclear magnetic resonance (NMR) pretreatment extracts from sediment samples collected during R/V JOIDES Resolution cruise JRES-336 (IODP336, North Pond) to the western flank of the mid-Atlantic Ridge in November of 2011. Samples were analyzed in 2016.

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Coverage

Spatial Extent: **Lat**:22.75589 **Lon**:-46.08125
Temporal Extent: 2011 - 2016

Dataset Description

Molybdate reactive phosphorus concentrations in nuclear magnetic resonance (NMR) pretreatment extracts from sediment samples collected during R/V JOIDES Resolution cruise JRES-336 (IODP336, North Pond) to the western flank of the mid-Atlantic Ridge in November of 2011. Samples were analyzed in 2016.

These data were published in Defforey et al. (2016). See the related-resource page https://www.bco-dmo.org/project/664073 for other datasets related to this publication.

Additional award information:

* NSF C-DEBI subaward # 156246 to Adina Paytan
* NSF C-DEBI subaward # 157598 to Delphine Defforey

Methods & Sampling

Location: North Atlantic, western flank of the mid-Atlantic Ridge 22.75589 N 46.08125 W

Methodology:

Prior to the extraction, we freeze-dried, ground and sieved sediment samples to less than 125 µm (Ruttenberg 1992). For a given sample, we weighed four sample replicates (2 g) and placed each in 250 mL HDPE bottles. Sodium dithionite (F.W. 147.12 g/mol; 7.4 g) was added to each sample split, followed by 200 mL of citrate-bicarbonate solution (pH 7.6). This step produces effervescence, so the solution should be added slowly to the sample. We shook samples for 8 h and then centrifuged them at 3,700 rpm for 15 min. We filtered the supernatants with a 0.4 µm polycarbonate filter. We took 20 mL aliquots from the filtrate for each sample split for MRP and total P analyses, and kept them refrigerated until analysis within 24 h. We added 200 mL of ultrapure water to the solid residue for each sample split as a wash step after the above reductive step, shook samples for 2 h, and then centrifuged them at 3,700 rpm for 15 min. We filtered the supernatants with 0.4 µm polycarbonate filters and set aside 20 mL of filtrate from each sample split for MRP and total P analyses. We then extracted the solid sample residues in 200 mL of sodium acetate buffer (pH 4.0) for 6 h. At the end of this extraction step, we centrifuged the bottles at 3,700 rpm for 15 min, filtered the supernatants with 0.4 µm polycarbonate filters and took a 20 mL aliquot of filtrate from each sample split for MRP and total P analyses. We added 200 mL of ultrapure water to the solid residue for each sample split as a wash step, shook samples for 2 h, and then centrifuged them at 3,700 rpm for 15 min. We filtered the supernatants with 0.4 µm polycarbonate filters and set aside 20 mL of filtrate from each sample split for MRP and total P analyses. We repeated the water rinse step, and collected aliquots for MRP and total P analyses as in the previous steps. The concentrations of MRP were determined as described below.

The MRP concentrations were measured on a QuikChem 8000 automated ion analyzer. Standards were prepared with the same solutions used for the extraction step to minimize matrix effects on P measurements. Sediment extracts and standards (0 – 30 µM PO4) were diluted ten-fold to prevent matrix interference with color development. The detection limit for P on this instrument is 0.2 µM. We derived MUP concentrations by subtracting MRP from total P concentrations, which are included in a different spreadsheet.

Data Processing Description

Data were processed in Excel.

BCO-DMO Data Manager Processing Notes:
* Data from originally submitted Excel file Data_MRP.xlsx exported as csv. Sheets for step 1 and step 2 combined into one data table. Values exported as formatted in excel with decimals with three decimal places.
* added a conventional header with dataset name, PI name, version date
* modified parameter names to conform with BCO-DMO naming conventions
* blank values in this dataset are displayed as "nd" for "no data." nd is the default missing data identifier in the BCO-DMO system.
* Date format changed to ISO 8601 format yyyy-mm-dd

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Data Files

File
iodp336_mrp_sed_pre.csv (Comma Separated Values (.csv), 8.79 KB) MD5:94ece69543256b9a100d100a3ae38c20 Primary data file for dataset ID 816527

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Related Publications

Defforey, D. (2016). Phosphorus cycling in the deep sedimentary subseafloor environment. PhD Thesis, UC Santa Cruz. https://escholarship.org/uc/item/85p2s7dx
Results

Ruttenberg, K. C. (1992). Development of a sequential extraction method for different forms of phosphorus in marine sediments. Limnology and Oceanography, 37(7), 1460–1482. doi:10.4319/lo.1992.37.7.1460
Methods

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Parameters

Parameter	Description	Units
Extract	Extraction solution	unitless
Step	Step in the sequential extraction scheme (1–4)	unitless
Dilution	Sample dilution or "None"	unitless
Date	Date the samples were analyzed in ISO 8601 format yyyy-mm-dd	unitless
Sample_ID	Unique sample identifier	unitless
Analyte_Name	Element analyzed	unitless
Peak_Concentration	Phosphate concentration (uncorrected)	micromolar (uM)
Blank_corrected	Concentration adjusted after blank	unitless
Actual_PO4	Concentration corrected for dilution	micromolar (uM)
P_extracted	Amount of phosphorus extracted	micromoles (umol)
Sed_mass	Dried sediment mass	grams (g)
PO4	Micromoles of phosphorus per gram of sediment (ground dry weight)	micromoles per gram (umol/g)
Peak_Area	Peak area	volts
Peak_Height	Peak height	volts

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Instruments

Dataset-specific Instrument Name	QuikChem 8000 automated ion analyzer
Generic Instrument Name	Flow Injection Analyzer
Generic Instrument Description	An instrument that performs flow injection analysis. Flow injection analysis (FIA) is an approach to chemical analysis that is accomplished by injecting a plug of sample into a flowing carrier stream. FIA is an automated method in which a sample is injected into a continuous flow of a carrier solution that mixes with other continuously flowing solutions before reaching a detector. Precision is dramatically increased when FIA is used instead of manual injections and as a result very specific FIA systems have been developed for a wide array of analytical techniques.

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Deployments

JRES-336

Website	https://www.bco-dmo.org/deployment/628214
Platform	R/V JOIDES Resolution
Report	http://dmoserv3.whoi.edu/data_docs/C-DEBI/cruise_reports/336PR.pdf
Start Date	2011-09-16
End Date	2011-11-16
Description	More information is available from the IODP website: http://iodp.tamu.edu/scienceops/expeditions/midatlantic_ridge_microbio.html

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Project Information

Potential phosphorus uptake mechanisms of the deep sedimentary biosphere (Deep sea sediments)

Coverage: Mid-Atlantic Ridge flank

The goal of this project is to explore potential microbial P uptake mechanisms in marine sediments beneath the North Atlantic Gyre and their effects on the relative distribution of organic P compounds as a function of burial depth and changing redox conditions. We use a combination of metagenomic analyses and solution 31P nuclear magnetic resonance spectroscopy (31P NMR) to investigate (1) the presence of microbial functional genes pertaining to P uptake and metabolism and (2) the possible P substrates for the deep biosphere in these oligotrophic sediments.

NSF C-DEBI Award #156246 to Dr. Adina Paytan

NSF C-DEBI Award #157598 to Dr. Delphine Defforey

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Program Information

Center for Dark Energy Biosphere Investigations (C-DEBI)

Website: http://www.darkenergybiosphere.org

Coverage: Global

The mission of the Center for Dark Energy Biosphere Investigations (C-DEBI) is to explore life beneath the seafloor and make transformative discoveries that advance science, benefit society, and inspire people of all ages and origins.

C-DEBI provides a framework for a large, multi-disciplinary group of scientists to pursue fundamental questions about life deep in the sub-surface environment of Earth. The fundamental science questions of C-DEBI involve exploration and discovery, uncovering the processes that constrain the sub-surface biosphere below the oceans, and implications to the Earth system. What type of life exists in this deep biosphere, how much, and how is it distributed and dispersed? What are the physical-chemical conditions that promote or limit life? What are the important oxidation-reduction processes and are they unique or important to humankind? How does this biosphere influence global energy and material cycles, particularly the carbon cycle? Finally, can we discern how such life evolved in geological settings beneath the ocean floor, and how this might relate to ideas about the origin of life on our planet?

C-DEBI's scientific goals are pursued with a combination of approaches:
(1) coordinate, integrate, support, and extend the research associated with four major programs—Juan de Fuca Ridge flank (JdF), South Pacific Gyre (SPG), North Pond (NP), and Dorado Outcrop (DO)—and other field sites;
(2) make substantial investments of resources to support field, laboratory, analytical, and modeling studies of the deep subseafloor ecosystems;
(3) facilitate and encourage synthesis and thematic understanding of submarine microbiological processes, through funding of scientific and technical activities, coordination and hosting of meetings and workshops, and support of (mostly junior) researchers and graduate students; and
(4) entrain, educate, inspire, and mentor an interdisciplinary community of researchers and educators, with an emphasis on undergraduate and graduate students and early-career scientists.

Note: Katrina Edwards was a former PI of C-DEBI; James Cowen is a former co-PI.

Data Management:
C-DEBI is committed to ensuring all the data generated are publically available and deposited in a data repository for long-term storage as stated in their Data Management Plan (PDF) and in compliance with the NSF Ocean Sciences Sample and Data Policy. The data types and products resulting from C-DEBI-supported research include a wide variety of geophysical, geological, geochemical, and biological information, in addition to education and outreach materials, technical documents, and samples. All data and information generated by C-DEBI-supported research projects are required to be made publically available either following publication of research results or within two (2) years of data generation.

To ensure preservation and dissemination of the diverse data-types generated, C-DEBI researchers are working with BCO-DMO Data Managers make data publicly available online. The partnership with BCO-DMO helps ensure that the C-DEBI data are discoverable and available for reuse. Some C-DEBI data is better served by specialized repositories (NCBI's GenBank for sequence data, for example) and, in those cases, BCO-DMO provides dataset documentation (metadata) that includes links to those external repositories.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0939564

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