Porosity from sediment cores collected on the R/V Nathaniel B. Palmer cruise NBP1601 to the West Antarctic continental shelf in January of 2016

Website: https://www.bco-dmo.org/dataset/813159
Data Type: Cruise Results
Version: 1
Version Date: 2020-06-08

Project
» Organic Carbon Oxidation and Iron Remobilization by West Antarctic Shelf Sediments (Antarctic Shelf Sediments)

Contributors	Affiliation	Role
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Abstract
Porosity from sediment cores collected on the R/V Nathaniel B. Palmer cruise NBP1601 to the West Antarctic continental shelf in January of 2016.

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Coverage

Spatial Extent: **N**:-64.1583 **E**:-62.7317 **S**:-67.7717 **W**:-71.2217
Temporal Extent: 2016-01-14 - 2019-01-28

Dataset Description

Porosity from sediment cores collected on the R/V Nathaniel B. Palmer cruise NBP1601 to the West Antarctic continental shelf in January of 2016.

Methods & Sampling

Sediment and pore water collection:

Short sediment cores were collected using a Bowers & Connelly megacorer, a multiple coring device that can collect ~20-40 cm long sediment cores with undisturbed sediment surfaces. At two sites (stations 41 and 64) longer cores (up to ~2 m) were also collected with a Kasten corer.

Megacorer cores were either sectioned for solid phase analysis, profiled with polarographic microelectrodes to determine dissolved O2 concentrations, or sectioned in a cold van under N2 for pore water sample extraction. Samples for solid phase analyses were placed in pre-cleaned screw-capped vials and frozen for porosity determinations at the New England Oceanographic Laboratory (NEOL).

Kasten cores were brought into a large cold room on-board ship, laid on their side and one side of the core box removed to expose the sediment in the core. A plastic block was placed against the top of the core to prevent slumping of the sediment during processing, and pore waters were collected from these cores using Rhizon samplers inserted directly into the cores at measured intervals. After pore water sampling was complete, samples for solid phase analyses were removed from the cores with plastic spoons and again placed in pre-cleaned screw-capped vials for porosity determinations.

While it is possible to recover cores with intact sediment-water interfaces using a megacorer, loss of surface sediments is typical during Kasten coring, making it not possible to directly determine absolute depths below the sediment-water interface in a Kasten core. We therefore determined the absolute depths of pore water and solid phase sample intervals from Kasten cores by aligning Kasten core profiles of pore water alkalinity to megacore alkalinity profiles from the same site (Berelson et al., 2005; Komada et al., 2016).

Sediment porosity determination:

The water content of the frozen porosity samples was determined by weight difference, where each sample was thawed, and a portion weighed, dried at 60°C for 24 hours and then reweighed. The porosity was expressed in terms of ml of seawater per cubic centimeter of whole sediments, where the weight of dried sediment was reduced by the weight of sea salts within the pore water (assuming bottom water salinity), and the volume of dried sediments was calculated assuming a dry density of 2.65 g cm-3 (Christensen, 1989).

Data Processing Description

BCO-DMO Data Manager Processing Notes:
* Data from file "porosity.txt" imported into the BCO-DMO data system.
* added a conventional header with dataset name, PI name, version date
* modified parameter names to conform with BCO-DMO naming conventions (spaces, +, and - changed to underscores).
* blank values in this dataset are displayed as "nd" for "no data." nd is the default missing data identifier in the BCO-DMO system.
* Joined with supplemental station information file to add station lat, lon, and ISO 8601 timestamp (UTC) into the dataset.

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Data Files

File
porosity.csv (Comma Separated Values (.csv), 18.54 KB) MD5:7532682fd0036b64b77b9c16c6e61675 Primary data file for dataset ID 813159

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Supplemental Files

File
NBP 1601 Station Information filename: stations.csv (Comma Separated Values (.csv), 1.63 KB) MD5:2d8b6e6a1341ed3f9d2e6e61d7368c6c Station locations and sampling information on cruise NBP 1601 (R/V Nathaniel B. Palmer, January 2016). Comma delimited file with column names: St_ID,Mo,Da,Yr,Time,Lat,Lon,Activity,ISO_DateTime_UTC Parameter information: St_ID,Station identifier,unitless Mo,"Month (local time, Punta Arenas, UTC-3)",unitless Da,"Day (local time, Punta Arenas, UTC-3)",unitless Yr,"Year in format yyyy (local time, Punta Arenas, UTC-3)",unitless Time,"Time in format HH:MM (local time, Punta Arenas, UTC-3)",unitless Lat,Station latitude,decimal degrees Lon,Station longitude,decimal degrees Activity,"C = CTD cast; M = Mega-core collected; K = Kasten core collected",unitless ISO_DateTime_UTC,Station date and time (UTC) in ISO 8601 format yyyy-mm-ddTHH:MMZ,unitless

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Related Publications

Berelson, W. M., Prokopenko, M., Sansone, F. J., Graham, A. W., McManus, J., & Bernhard, J. M. (2005). Anaerobic diagenesis of silica and carbon in continental margin sediments: Discrete zones of TCO2 production. Geochimica et Cosmochimica Acta, 69(19), 4611–4629. doi:10.1016/j.gca.2005.05.011
Methods

Christensen, J. P. (1989). Sulfate reduction and carbon oxidation rates in continental shelf sediments, an examination of offshelf carbon transport. Continental Shelf Research, 9(3), 223–246. doi:10.1016/0278-4343(89)90025-3
Methods

Komada, T., Burdige, D. J., Li, H.-L., Magen, C., Chanton, J. P., & Cada, A. K. (2016). Organic matter cycling across the sulfate-methane transition zone of the Santa Barbara Basin, California Borderland. Geochimica et Cosmochimica Acta, 176, 259–278. doi:10.1016/j.gca.2015.12.022
Methods

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Parameters

Parameter	Description	Units
St_ID	station ID number	unitless
Sa_ID	sample ID (station ID #-core ID #-sample #)	unitless
Core	core type (M = mega-corer; K = Kasten core)	unitless
Depth	sediment depth	centimeters (cm)
Error	half of the thickness of the sediment sample	centimeters (cm)
Porosity	sediment porosity	ml porewater/cm^3 total sediment
ISO_DateTime_UTC	station timestamp (UTC) in ISO 8601 format yyyy-mm-ddTHH:MM	yyyy-MM-dd'T'HH:mm'Z'
Lat	station latitude, south is negative	decimal degrees
Lon	station longitude, west is negative	decimal degrees

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Instruments

Dataset-specific Instrument Name	Kasten corer
Generic Instrument Name	Gravity Corer
Generic Instrument Description	The gravity corer allows researchers to sample sediment layers at the bottom of lakes or oceans. The coring device is deployed from the ship and gravity carries it to the seafloor. (http://www.whoi.edu/instruments/viewInstrument.do?id=1079).

Dataset-specific Instrument Name	Bowers & Connelly megacorer
Generic Instrument Name	Multi Corer
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.

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Deployments

NBP1601

Website	https://www.bco-dmo.org/deployment/813143
Platform	RVIB Nathaniel B. Palmer
Start Date	2016-01-08
End Date	2016-02-03

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Project Information

Organic Carbon Oxidation and Iron Remobilization by West Antarctic Shelf Sediments (Antarctic Shelf Sediments)

Coverage: West Antarctic Continental Shelf

NSF Award Abstract:

General Statement:

The continental shelf region west of the Antarctic Peninsula has recently undergone dramatic changes and ecosystem shifts, and the community of organisms that live in, or feed off, the sea floor sediments is being impacted by species invasions from the north. Previous studies of these sediments indicate that this community may consume much more of the regional productivity than previously estimated, suggesting that sediments are a rich and important component of this ecosystem and one that may be ripe for dramatic change. Furthermore, under richer sediment conditions, iron is mobilized and released back to the water column. Since productivity in this ecosystem is thought to be limited by the availability of iron, increased rates of iron release from these sediments could stimulate productivity and promote greater overall ecosystem change. In this research, a variety of sites across the shelf region will be sampled to accurately evaluate the role of sediments in consuming ecosystem productivity and to estimate the current level of iron release from the sediments. This project will provide a baseline set of sediment results that will present a more complete picture of the west Antarctic shelf ecosystem, will allow for comparison with water column measurements and for evaluation of the fundamental workings of this important ecosystem. This is particularly important since high latitude systems may be vulnerable to the effects of climate fluctuations. Both graduate and undergraduate students will be trained. Presentations will be made at scientific meetings, at other universities, and at outreach events. A project web site will present key results to the public and explain how this new information improves understanding of Antarctic ecosystems.

Technical Description of Project:
In order to determine the role of sediments within the west Antarctic shelf ecosystem, this project will determine the rates of sediment organic matter oxidation at a variety of sites across the Palmer Long Term Ecosystem Research (LTER) study region. To estimate the rates of release of iron and manganese from the sediments, these same sites will be sampled for detailed vertical distributions of the concentrations of these metals both in the porewaters and in important mineral phases. Since sediment sampling will be done at LTER sites, the sediment data can be correlated with the rich productivity data set from the LTER. In detail, the project: a) will determine the rates of oxygen consumption, organic carbon oxidation, nutrient release, and iron mobilization by shelf sediments west of the Antarctic Peninsula; b) will investigate the vertical distribution of diagenetic reactions within the sediments; and c) will assess the regional importance of these sediment rates. Sediment cores will be used to determine sediment-water fluxes of dissolved oxygen, total carbon dioxide, nutrients, and the vertical distributions of these dissolved compounds, as well as iron and manganese in the pore waters. Bulk sediment properties of porosity, organic carbon and nitrogen content, carbonate content,

biogenic silica content, and multiple species of solid-phase iron, manganese, and sulfur species will also be determined. These measurements will allow determination of total organic carbon oxidation and denitrification rates, and the proportion of aerobic versus anaerobic respiration at each site. Sediment diagenetic modeling will link the processes of organic matter oxidation to metal mobilization. Pore water and solid phase iron and manganese distributions will be used to model iron diagenesis in these sediments and to estimate the iron flux from the sediments to the overlying waters. Finally, the overall regional average and distribution of the sediment processes will be compared with the distributions of seasonally averaged chlorophyll biomass and productivity.

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Funding

Funding Source	Award
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	OPP-1551195

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