

Modeling bio-energetics for South Pacific Gyre marine sediment at site U1370

Website: <https://www.bco-dmo.org/dataset/778703>

Data Type: model results

Version: 1

Version Date: 2019-12-20

Project

» [Develop a 1D biogeochemical-evolutionary model for deep sediments](#) (BIO-SED)

Program

» [Center for Dark Energy Biosphere Investigations](#) (C-DEBI)

Contributors	Affiliation	Role
Bradley, James	University of Southern California (USC)	Principal Investigator
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Abstract

This data relates to the calculation of bio-energetics for South Pacific Gyre marine sediment (site U1370).

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Coverage

Spatial Extent: Lat:-41.85 Lon:-153.1

Dataset Description

This data relates to the calculation of bio-energetics for South Pacific Gyre marine sediment (site U1370).

This project quantifies the role of microbial necromass and organic carbon as a power source to living microorganisms in marine sediments. The project utilizes a physiochemical model of marine sediment bioenergetics using data available in the literature and well-established modeling constructs. Data sources and model formulation are described in Bradley et al. 2018 (DOI: 10.1002/2017JG004186). For modelling South Pacific Gyre sediments, cell abundance and particulate organic carbon concentrations were determined for site U1370 (IODP Expedition 329) based on published analysis of extracted drill cores: D'Hondt et al. 2015 (DOI: 10.1038/ngeo2387); D'Hondt et al. 2011 (DOI: 10.2204/iodp.proc.329.2011). For modelling global cell abundance, we use the formulation described in Parkes et al. 2014 (DOI: 10.1016/j.margeo.2014.02.009).

Data Processing Description

BCO-DMO Processing Notes:

- added conventional header with dataset name, PI name, version date

- modified parameter names to conform with BCO-DMO naming conventions

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Data Files

File
spg.csv (Comma Separated Values (.csv), 30.14 KB) MD5:1242e16a33622248c76f846103f58851 Primary data file for dataset ID 778703

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Related Publications

(2011). Proceedings of the IODP. doi:[10.2204/iodp.proc.329.2011](https://doi.org/10.2204/iodp.proc.329.2011)

Methods

Bradley, J. A., Amend, J. P., & LaRowe, D. E. (2018). Necromass as a Limited Source of Energy for Microorganisms in Marine Sediments. *Journal of Geophysical Research: Biogeosciences*, 123(2), 577–590. doi:10.1002/2017jg004186 <https://doi.org/10.1002/2017JG004186>

Methods

D'Hondt, S., Inagaki, F., Zarikian, C. A., Abrams, L. J., Dubois, N., Engelhardt, T., ... Ziebis, W. (2015). Presence of oxygen and aerobic communities from sea floor to basement in deep-sea sediments. *Nature Geoscience*, 8(4), 299–304. doi:[10.1038/ngeo2387](https://doi.org/10.1038/ngeo2387)

Methods

Parkes, R. J., Cragg, B., Roussel, E., Webster, G., Weightman, A., & Sass, H. (2014). A review of prokaryotic populations and processes in sub-seafloor sediments, including biosphere:geosphere interactions. *Marine Geology*, 352, 409–425. doi:[10.1016/j.margeo.2014.02.009](https://doi.org/10.1016/j.margeo.2014.02.009)

Methods

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Parameters

Parameter	Description	Units
lat	latitude of hole U1370 with negative values indicating South	decimal degrees
lon	longitude of hole U1370 with negative values indicating West	decimal degrees
Depth_below_SWI	Depth below the sediment-water interface	meters (m)
Age	Age of sediment	years
Porosity	sediment porosity	unitless

TOC	total organic carbon	grams of Carbon per centimeter cubed (g C/cm ³)
POC_degradation_rate	Organic carbon degradation rate	grams of Carbon per centimeter cubed per year (g C cm ⁻³ y ⁻¹)
Biomass	biomass	cells per centimeter cubed (cells/cm ³)
Necromass_produced	Necromass produced by dying cells	cells per centimeter cubed per year (cells cm ⁻³ y ⁻¹)
Specific_death_rate	Mortality rate	per year (y ⁻¹)
Small_cell_size_Necromass_C_mass	Necromass produced (assuming small cell mass of 5 fg C cell ⁻¹)	grams of Carbon per centimeter cubed per year (g C cm ⁻³ y ⁻¹)
small_size_power_from_necromass_plus_O2	Power from oxidation of necromass (small cells) with O ₂	Jules per year (J y ⁻¹)
Medium_cell_size_Necromass_C_mass	Necromass produced (assuming medium cell mass of 14 fg C cell ⁻¹)	grams of Carbon per centimeter cubed per year (g C cm ⁻³ y ⁻¹)
medium_size_power_from_necromass_plus_O2	Power from oxidation of necromass (medium cells) with O ₂	(J y ⁻¹)
Large_cell_size_Necromass_C_mass	Necromass produced (assuming large cell mass of 75 fg C cell ⁻¹)	grams of Carbon per centimeter cubed per year (g C cm ⁻³ y ⁻¹)
large_size_power_from_necromass_plus_O2	Power from oxidation of necromass (large cells) with O ₂	Jules per year (J y ⁻¹)
Acetate_Power_POC_plus_O2	Power from oxidation of organic carbon (acetate) with O ₂	Jules per year (J y ⁻¹)
Type_III_IV_kerogen_Power_POC_plus_O2	Power from oxidation of organic carbon (Type III/IV kerogen) with O ₂	Jules per year (J y ⁻¹)

Lipid_n_alkane_Power_POC_plus_O2	Power from oxidation of organic carbon (Lipid n-alkane) with O2	Jules per year (J y-1)
Power_H2_plus_O2	Power from oxidation of H2 with O2	Jules per year (J y-1)

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Project Information

Develop a 1D biogeochemical-evolutionary model for deep sediments (BIO-SED)

Website: <https://www.darkenergybiosphere.org/award/develop-a-1d-biogeochemical-evolutionary-model-for-deep-sediments/>

Microorganisms buried in marine sediments endure prolonged energy-limitation over geological timescales. This C-DEBI project will investigate energy and activity levels among microbial communities in the marine subsurface. We use thermodynamic and microbial-biogeochemical modelling principles to explore and quantify:

- The energy sources to deeply buried microorganisms and their demand for energy.
- The activity of microorganisms and the factors that determine physiological transitions between active and dormant states.
- The varying energy requirements of active and dormant microbes and the allocation of energy between maintenance and growth.
- The cell-specific energy utilization (i.e. power) of subsurface life on a global scale.

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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 seafloor 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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