Radiocarbon [14C] ages of sedimentary organic matter and sedimentation rates for Guaymas Basin and Sonora Margin sediments collected from R/V El Puma, leaving Guaymas on October 14, 2014 and returning to Mazatlan on October 27, 2014

Website: https://www.bco-dmo.org/dataset/763941
Data Type: Cruise Results
Version: 1
Version Date: 2019-03-13

Project
» RAPID proposal: Site characterization cruise to document the active and extensive subsurface biosphere in the Guaymas Basin (RAPID Guaymas Basin)

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

Contributors	Affiliation	Role
Teske, Andreas	University of North Carolina at Chapel Hill (UNC-Chapel Hill)	Principal Investigator
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Abstract
Radiocarbon [14C] ages of sedimentary organic matter and sedimentation rates for Guaymas Basin and Sonora Margin sediments collected from R/V El Puma (the Pacific Coast research vessel of the Autonomous University of Mexico) from October 14, 2014 to October 27, 2014.

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Coverage

Spatial Extent: **Lat**:27 **Lon**:-111
Temporal Extent: 2014-10-14 - 2014-10-27

Dataset Description

Radiocarbon [14C] ages of sedimentary organic matter and sedimentation rates for Guaymas Basin and Sonora Margin sediments collected from R/V El Puma (the Pacific Coast research vessel of the Autonomous

University of Mexico) from October 14, 2014 to October 27, 2014.

Methods & Sampling

Sediment cores were obtained by Piston coring (using commercial PVC core liners) onboard R/V El Puma. The sediment cores were recovered during the RV El Puma cruise in October 2014. Core PO3 is from the northwestern ridge flanks [27°N 37.6759/111°W 52.5740; 1611 m depth], P10 is from ca. 1 mile west of Ringvent [27°N 30.5193/111°W 42.1722 W; 1731 m depth], core P11 is from the center of Ringvent [27°N 30.5090/111°W 40.6860, 1749 m], core P12 is from the upper Sonora Margin [27°N 52.1129/111°W 41.5902, 667 m], and core P13 is from the southeastern ridge flank of Guaymas Basin [27°N 12.4470/111°W 13.7735, 1859m]. Sedimentation rates were not inferred from cores P5 and P6 due to distortions by slumping. Measurements were made on bulk sediment without authigenic carbonate phases, and thus the majority of carbon in the samples is organic carbon produced by primary producers.

Samples selected for radiocarbon analyses were freeze-dried, homogenized, and acidified to remove $CaCO_3$, allowing for the analysis of remaining organic matter, and preventing the distortion of radiocarbon ages by methane-derived carbonates. Acidification was performed on ~200 mg of sample, which was treated with ~5ml buffered pH 5 acetic acid solution for ~24 hours to dissolve the $CaCO_3$. Samples were then rinsed with Milli-Q water 6 to 8 times to remove the acetic acid. Acidified samples were then freeze-dried again, re-homogenized and stored for ^{14}C and ^{13}C analysis. Radiocarbon dating was performed at Lawrence Livermore National Laboratory Center for Accelerator Mass Spectrometry, and a reservoir age of 406 years was used before conversion to calendar years using CALIB REV7.1.0. (Stuiver et al. 2019). The $d^{13}C$ values of all the acidified samples used for radiocarbon analyses were approximately -20 to -22‰, as expected from marine (primary producers) derived organic matter.

Data Processing Description

Data notes:
The sedimentation Rate (Sed_Rate) is based on using the youngest and oldest samples to obtain an average for the dated part of the core.
** = outlier

BCO-DMO Processing:
- copied values from merged cells into each row;
- modified column headers (replaced spaces with underscores, renamed standard deviation columns for clarity);
- separated original C14_age column into two: one for the value and one for the stdev.

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Data Files

File
Radiocarbon.csv (Comma Separated Values (.csv), 596 bytes) MD5:a5a5969d4d6ac129e3a3ea9f1e86fe6f Primary data file for dataset ID 763941

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Related Publications

Stuiver, M., Reimer, P.J., and Reimer, R.W., 2019, CALIB 7.1 [WWW program] at http://calib.org.
Software

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Parameters

Parameter	Description	Units
Core	Core identification	unitless
Depth_in_core	Depth in core	centimters (cm)
C14_age	14C age	years before present (ybp)
C14_age_uncertainty	Inherent uncertainty in the 14C method (+/- years)	+/- years before present (ybp)
Calendar_age	Calendar age	years before present (ybp)
Sed_Rate	Sedimentation rate; based on using the youngest and oldest samples to obtain an average for the dated part of the core.	millimeters per year (mm/year)

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Accelerator Mass Spectrometer
Dataset-specific Description	Radiocarbon dating was performed at Lawrence Livermore National Laboratory Center for Accelerator Mass Spectrometry, using the 1 MV AMS system based around a NEC 3SDH-1 accelerator.
Generic Instrument Description	An AMS measures "long-lived radionuclides that occur naturally in our environment. AMS uses a particle accelerator in conjunction with ion sources, large magnets, and detectors to separate out interferences and count single atoms in the presence of 1x1015 (a thousand million million) stable atoms, measuring the mass-to-charge ratio of the products of sample molecule disassociation, atom ionization and ion acceleration." AMS permits ultra low-level measurement of compound concentrations and isotope ratios that traditional alpha-spectrometry cannot provide. More from Purdue University: http://www.physics.purdue.edu/primelab/introduction/ams.html

Dataset-specific Instrument Name	
Generic Instrument Name	Piston Corer
Generic Instrument Description	The piston corer is a type of bottom sediment sampling device. A long, heavy tube is plunged into the seafloor to extract samples of mud sediment. A piston corer uses a "free fall" of the coring rig to achieve a greater initial force on impact than gravity coring. A sliding piston inside the core barrel reduces inside wall friction with the sediment and helps to evacuate displaced water from the top of the corer. A piston corer is capable of extracting core samples up to 90 feet in length.

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Deployments

Guaymas_2014

Website	https://www.bco-dmo.org/deployment/661688
Platform	R/V El Puma
Start Date	2014-10-14
End Date	2014-10-27

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Project Information

RAPID proposal: Site characterization cruise to document the active and extensive subsurface biosphere in the Guaymas Basin (RAPID Guaymas Basin)

Coverage: Guaymas Basin

Description from NSF project abstract:
The Guaymas Basin in the central Gulf of California is an active tectonic spreading center overlain with thick, organic-rich sediments. In contrast to typical deep-water, mid-ocean ridge spreading centers that have very focused magmatism and little or no sediment, magmatism in the Guaymas Basis is more broadly distributed. This broadly-distributed magmatism significantly expands the fraction of organic-rich sediments that may be subject to alteration by the magmatic heat and thus it greatly expands the range of environments that support hydrocarbon generation and microbial populations in the sediments. Recognition that magmatism is not confined to the spreading axis, but instead is distributed throughout Guaymas Basin, suggests that models for the natural sequestration of carbon, the formation of oceanic crust, and life in the subsurface in marginal rift basins should be reconsidered as this has implications for the long-term removal of atmospheric carbon dioxide (and hence potential climatic implications). The Principal Investigator of this RAPID proposal is a lead proponent on an International Ocean Discovery Program (IODP) proposal to study this system in depth through scientific ocean drilling. To properly plan this expensive IODP expedition, additional site characterization gained from sediment sampling and seismic data is required. This proposal requests funds for the Principal Investigator to participate on an already planned site survey cruise aboard the Mexican Research Vessel (RV) El Puma. The results from this cruise will provide valuable data, at an exceptionally low investment, to guide decisions about potential future scientific drilling in the Guaymas Basin.

This RAPID proposal requests funds for the Principal Investigator to participate on a Mexican site survey cruise in October 2014 on RV El Puma to collect five-meter gravity cores of an extensive sediment transect across

the Guaymas Basin and to integrate sequencing-based microbial community analyses of subsurface bacteria and archaea with biogechemical characterizations of these subsurface sediments. Gravity coring and microbial community analysis will target cold non-hydrothermal sediments as well as off-axis hydrothermally-influenced sediments. The gravity coring campaign and the geochemistry/microbiology studies are coordinated with heatflow measurements and extensive 2D seismic analysis and high-resolution 3D seismic mapping by other planned Mexican and German cruises. This multi-pronged strategy will deliver the additional data and complete the site characterizations that are required to properly plan a potential IODP drilling expedition by the JOIDES Resolution.

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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
NSF Division of Ocean Sciences (NSF OCE)	OCE-1449604

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