

Guaymas Basin Mineral Bound Biomarkers

Website: <https://www.bco-dmo.org/dataset/1011025>

Data Type: Cruise Results

Version: 1

Version Date: 2026-10-30

Project

» [Hydrothermal and microbial controls on organic carbon mobilization from Guaymas Basin sediments](#)
(GuaymasCarbon)

Contributors	Affiliation	Role
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Abstract

Marine sediments are one of the largest reservoirs of reduced carbon, but the influences controlling the amount and composition of organic matter stored for geologic time are not well understood. Mineral-associated organic matter, either bound to a mineral surface or within a larger matrix association, is thought to be non-bioavailable and sequestered within sediments. Heating of sediments, as found in hydrothermal environments and deep in the sedimentary column, has the potential to disrupt typical burial processes and alter mineral-associated organic matter. We analyze subsurface sediments for the concentration and composition of mineral-associated biomarkers to improve our understanding of how heating changes the composition and distribution. This dataset contains the concentrations (in micrograms per cubic centimeter (ug/cm³)) of organic biomarkers from 5-10 meters below seafloor (mbsf), 26-30 mbsf, and 54-57 mbsf within cores U1545, U1546, and U1547 from IODP Expedition 385, Guaymas Basin Tectonics and Biosphere. IODP cores U1545, U1546, and U1547, were chosen to represent a regional background core, previously heated core, and an actively heated core, respectively. This dataset reports concentrations of mineral-associated biomarkers, which are released through successive acid hydrolysis and base hydrolysis, which are performed on the same sediments following the traditional solvent extraction.

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Coverage

Location: Guaymas Basin, Gulf of California

Methods & Sampling

Samples were collected by the IODP Expedition 385 Scientific Party aboard the drilling ship JOIDES Resolution. Samples were obtained from IODP cores U1545, U1546, and U1547, which are 52, 51, and 27 kilometers northwest of the axial graben of the northern Guaymas Basin. We analyzed samples from three depth horizons (5-10 mbsf, 26-30 mbsf, and 54-57 mbsf) from U1545 and U1547. Samples from U1546 only contained two depth horizons (26-30 mbsf and 54-57 mbsf).

Cores were drilled using an advanced piston corer (APC) and half-length APC and sectioned by the science party (Teske et al., 2021). Samples were handled and preserved anoxically according to best practices for microbiological studies and stored at -80 degrees Celsius (C) in clean glass jars. After being transferred to the laboratory, frozen samples were thawed and extracted using a modified Bligh and Dyer solvent extraction to account for water content and to preserve intact lipid structures. All extractions were performed with cleaned glassware (combusted at 450 degrees C) or in cleaned Teflon bottles (pre-extracted with solvents). Extracts were separated into three polarity fractions using silica gel chromatography to remove intact polar lipids from the other compound classes. All extracts were then transesterified and re-separated into a fine scale chromatography scheme with 10 polarity fractions to allow for high-resolution analysis.

An Agilent 8890 gas chromatograph (GC) was used with 5977C MSD for identification and a FID for quantification. Samples were injected twice to analyze with both detectors. The GC was equipped with He carrier gas with either an Agilent 60m DB-5ms Ultra Inert column or a Thermo TR-FAME column for each compound class.

Data Processing Description

GC-MS were processed using Agilent MassHunter Unknowns Analysis while GC-FID were processed using Agilent MassHunter Qualitative. Identification of biomarkers from GC-MSD were verified using authentic standards and comparison of mass spectra to NIST library.

BCO-DMO Curation Notes

This section documents curation actions performed prior to publication review with the submitter, and additional information relevant to understanding and reusing this dataset. It distinguishes changes made to the submitted (meta)data from unresolved issues and/or enhancements that improve future reuse and interoperability.

CURATION ACTIONS PERFORMED ON DATA

- currently being processed

CURATION ACTIONS PERFORMED ON METADATA

- BCO-DMO's standard metadata entry and text formatting steps were performed. See: <https://www.bco-dmo.org/how-to/standard-curation-edits>

ISSUES POTENTIALLY IMPACTING REUSE

- The exact date/time and location (latitude, longitude) of collection of each core has not been provided.

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Related Publications

Teske, A., Lizarralde, D., Höfig, T. W., Aiello, I. W., Ash, J. L., Bojanova, D. P., Buatier, M. D., Edgcomb, V. P., Galerne, C. Y., Gontharet, S., Heuer, V. B., Jiang, S., Kars, M. A. C., Khogenkumar Singh, S., Kim, J., Koornneef, L. M. T., Marsaglia, K. M., Meyer, N. R., Morono, Y., ... Zhuang, G. (2021). Expedition 385 methods. Guaymas Basin Tectonics and Biosphere. Internet Archive. <https://doi.org/10.14379/iodp.proc.385.102.2021>
Methods

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Parameters

Parameters for this dataset have not yet been identified

Instruments

Dataset-specific Instrument Name	advanced piston corer (APC) and half-length APC
Generic Instrument Name	Advanced Piston Corer
Generic Instrument Description	The JOIDES Resolution's Advanced Piston Corer (APC) is used in soft ooze and sediments. The APC is a hydraulically actuated piston corer designed to recover relatively undisturbed samples from very soft to firm sediments. More information is available from IODP (PDF).

Dataset-specific Instrument Name	Agilent 8890 gas chromatograph was used with 5977C MSD
Generic Instrument Name	Gas Chromatograph
Generic Instrument Description	Instrument separating gases, volatile substances, or substances dissolved in a volatile solvent by transporting an inert gas through a column packed with a sorbent to a detector for assay. (from SeaDataNet, BODC)

Deployments

IODP-385

Website	https://www.bco-dmo.org/deployment/869491
Platform	R/V JOIDES Resolution
Report	https://doi.org/10.14379/iodp.pr.385.2020
Start Date	2019-09-15
End Date	2019-11-15
Description	Guaymas Basin Tectonics and Biosphere - International Ocean Discovery Program Expedition 385, General information: https://iodp.tamu.edu/scienceops/expeditions/guaymas_basin_tectonics_bio...

Project Information

Hydrothermal and microbial controls on organic carbon mobilization from Guaymas Basin sediments (GuaymasCarbon)

Coverage: Guaymas Basin

Project Overview

Organic carbon stored in marine sediments and sedimentary rocks are a critical component of the global carbon cycle. Buried organic carbon balances atmospheric CO₂ concentrations over long timescales and is linked to the regulation of Earth's climate. Microbial activity is a key driver of processes that break down and release carbon from sediments. This project investigates organic carbon in marine sediments and examines its bioavailability to microbes. The setting for the project is the Guaymas Basin of the Gulf of California which receives organic matter inputs from land during seasonal rains and from marine phytoplankton at the sea surface. Guaymas Basin is also a site of active seafloor spreading and hydrothermal heating (i.e., the transfer of heat from magma to sediments and ocean water), which will allow the effects of heating on the bioavailable portion of organic carbon to be investigated. Results from this project will improve our understanding of how microbes reintroduce this buried organic carbon back into the "active" carbon cycle, as well as how this microbial activity is influenced by hydrothermal heating and organic carbon composition. The project also incorporates an international collaboration and an educational cross-border exchange of students between the US and Canada. Results will be shared broadly through videos produced by the Delaware Sea Grant and a content created by the Canadian podcast, Broad Science.

Using the gradients available in the context of Guaymas Basin sediments, we will investigate the effects of hydrothermal heating, burial depth (physical factors), sedimentary organic carbon composition and oxygen availability (geochemical factors) and microbial community (biological factors) on the bioavailability and mobilization/utilization of sedimentary organic carbon. Guaymas Basin features several advantages that make it uniquely suited for our proposed studies including the fact that 150 meters of sediment thickness are within the analytical window of radiocarbon dating which will allow us to take advantage of ¹⁴C (radiocarbon) as a natural tracer of marine carbon sources. Large gradients of temperature and geochemistry are also created by widespread emplacement of magmatic sills at varied depths in the sediment column. Such hydrothermal heating transforms sedimentary organic carbon in some locations from freshly synthesized photosynthetic biomass to petroleum hydrocarbons on a compressed, ¹⁴C-friendly timescale. Analyses will include: (1) carbon isotopic analysis of biomarkers representative of marine-derived, terrestrial and hydrothermal organic carbon reservoirs within sediments, (2) carbon isotopic measurements on biomolecules representative of natural microbial populations, (3) aerobic bioreactor incubations of sediments with their natural microbial population and analysis of the isotopic composition of CO₂ released by respiration, and (4) aerobic bioreactor incubations of sediments that have been pre-heated to promote organic carbon transformations and isotopic analysis of CO₂ respired by a bacterial isolate. Our results will provide an exceptionally detailed view of the dependence of organic carbon bioavailability on burial depth, heating history, in situ temperature, oxygen availability, organic carbon composition, and microbial functional capabilities that, to our knowledge, will be unprecedented.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2023656

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