Porewater geochemistry data for sediment samples that were included in the global seep survey conducted via Alvin dives from R/V Atlantis cruise AT15-40 in the Guaymas Basin in 2008

Website: https://www.bco-dmo.org/dataset/3675
Data Type: Cruise Results
Version: 1
Version Date: 2015-11-12

Project
» Microbial carbon and sulfur cycling in the hydrothermally altered sediments of Guaymas Basin (Guaymas Basin Vents)
» Collaborative Research: Microbial Carbon cycling and its interactions with Sulfur and Nitrogen transformations in Guaymas Basin hydrothermal sediments (Guaymas Basin Interactions)

Contributors	Affiliation	Role
Teske, Andreas	University of North Carolina at Chapel Hill (UNC-Chapel Hill)	Principal Investigator
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Abstract
Porewater geochemistry of Guaymas Basin hydrothermal sediments (Southern Spreading segment, 27°00.44N and 111°24.55W, 2000 m water depth) including methane, CO2, and sulfate. During two R/V Atlantis cruises to Guaymas Basin, the association of Beggiatoa mats with hydrothermal seepage and the habitat preferences of various Beggiatoa types were investigated by geochemical and microbiological characterization of sediments underneath Beggiatoa mats in combination with temperature measurements down to 40 cm sediment depth. In particular, temperature profiles and corresponding sulfide, sulfate, dissolved inorganic carbon (DIC), delta 13C-DIC, methane, and delta 13C-methane gradients from mats exhibiting orange-to-white color transitions were examined to elucidate hydrothermal fluid delivery and/or tolerance associated with differently colored Beggiatoa types.

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Coverage

Spatial Extent: **N**:27.0077 **E**:-111.408 **S**:27.0065 **W**:-111.4093
Temporal Extent: 2008-12-06 - 2008-12-15

Dataset Description

Porewater geochemistry of Guaymas Basin hydrothermal sediments (Southern Spreading segment, 27°00.44N and 111°24.55W, 2000 m water depth) including methane, CO2, and sulfate.

During two R/V Atlantis cruises to Guaymas Basin, the association of Beggiatoa mats with hydrothermal seepage and the habitat preferences of various Beggiatoa types were investigated by geochemical and microbiological characterization of sediments underneath Beggiatoa mats in combination with temperature measurements down to 40 cm sediment depth. In particular, temperature profiles and corresponding sulfide, sulfate, dissolved inorganic carbon (DIC), delta 13C-DIC, methane, and delta 13C-methane gradients from mats exhibiting orange-to-white color transitions were examined to elucidate hydrothermal fluid delivery and/or tolerance associated with differently colored Beggiatoa types (McKay et al. 2012)

Methods & Sampling

Temperature profiling: Temperature profiles at the sampling site were recorded using *Alvin*'s external heatflow temperature probe, a 0.6 m titanium tube containing a linear heater and five thermistors (type 44032, Omega Engineering, Inc.) at 10 cm intervals along the length of the tube (McKay et al., 2012). When fully immersed in the sediment, this probe records five *in-situ* temperatures at the sediment/water interface, and at 10, 20, 30 and 40 cm sediment depth.

Geochemical Analyses: Sulfate concentration measurements were completed shipboard; after centrifuging sediment-filled 15 ml tubes, the overlying porewater was filtered through 0.45 um filters, acidified with 50 ul of 50% HCl and bubbled with nitrogen for 4 minutes to remove sulfide. Sulfate concentrations were then measured shipboard using a 2010i Dionex Ion Chromatograph (Sunnyvale, CA, USA) through Ag exchange columns (Dionex) so as to remove Cl (Martens et al., 1999). For sulfide, 1 ml porewater samples were combined with 0.1M zinc acetate and concentrations were analyzed spectrophotometrically on the ship (Cline 1969).

Headspace methane concentrations were determined onboard by standard gas chromatography with a flame ionization detector (FID), specifically using a HACH Carle Series 100 AGC Gas Chromatograph with a Alltech Molecular Sieve 5A packed column (80/100 mesh, 3.05 m length, 3.2 mm ID) and a 80 degree C isothermal temperature profile. Stable isotopic compositions of the same methane samples (core 4484-3) were measured post-cruise at UNC via gas chromatography-combustion-isotope ratio mass spectrometry (GC-C-IRMS) on a Finnigan MAT 252 Isotope Ratio Mass Spectrometer, using a HP 5890 Series II Gas Chromatograph with a HP Plot Q column (30 m length, 0.32 mm ID, 20 um film thickness) and a 30 degree C isothermal temperature profile. To measure DIC, 2 ml of unamended porewater from each sediment horizon were injected into evacuated serum vials (30 ml) and stored upside down at -20 degrees C. At UNC, the samples were thawed, and DIC was reacted to gaseous CO2 by adding 1 ml of a 30% phosphoric acid solution to each serum vial and shaking vigorously before GC analysis (Kelley et al., 1990). Stable isotopic values and concentrations of DIC were analyzed via coupled GC (Hewlett Packard 5890) and Isotope Ratio Mass Spectrometer (Finnigan MAT 252).

Data Processing Description

BCO-DMO Dataset Edits:
- Added dive_id, dive_target, month, day, year, lat and lon (shipfix and subfix), depth, and cruise_id columns;
- Parameter names were modified to conform to BCO-DMO conventions;
- Missing data was replaced with 'nd', indicating 'no data';
- 'DIC' and 'd13C_DIC' were notated as 'CO2' and 'delta 13C of CO2' in original data submission. Per correspondence with the PI, 'DIC' should replace 'CO2' in these parameter names. The samples were acidified so that all DIC (CO2 + HCO3- + CO3=) turns into CO2.

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Data Files

File
porewater_geochemistry.csv (Comma Separated Values (.csv), 11.29 KB) MD5:9da455e9402ffc43c9850a5bf7b5c24f Primary data file for dataset ID 3675

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Related Publications

Biddle, J. F., Cardman, Z., Mendlovitz, H., Albert, D. B., Lloyd, K. G., Boetius, A., & Teske, A. (2012). Anaerobic oxidation of methane at different temperature regimes in Guaymas Basin hydrothermal sediments. The ISME Journal, 6(5), 1018–1031. doi:10.1038/ismej.2011.164
Related Research

Cline, J. D. (1969). Spectrophotometric Determination of Hydrogen Sulfide in Natural Waters. Limnology and Oceanography, 14(3), 454–458. doi:10.4319/lo.1969.14.3.0454
Methods

Kelley, C. A., Martens, C. S., & Chanton, J. P. (1990). Variations in sedimentary carbon remineralization rates in the White Oak River estuary, North Carolina. Limnology and Oceanography, 35(2), 372–383. doi:10.4319/lo.1990.35.2.0372
Methods

Martens, C. S. (1999). Stable isotope tracing of anaerobic methane oxidation in the gassy sediments of Eckernfoerde Bay, German Baltic Sea. American Journal of Science, 299(7-9), 589–610. doi:10.2475/ajs.299.7-9.589
Methods

McKay, L. J., MacGregor, B. J., Biddle, J. F., Albert, D. B., Mendlovitz, H. P., Hoer, D. R., ... Teske, A. P. (2012). Spatial heterogeneity and underlying geochemistry of phylogenetically diverse orange and white Beggiatoa mats in Guaymas Basin hydrothermal sediments. Deep Sea Research Part I: Oceanographic Research Papers, 67, 21–31. doi:10.1016/j.dsr.2012.04.011
Methods

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Parameters

Parameter	Description	Units
dive_core_no	Dive-core number (first 4 digits represent dive, last 2 digits represent core).	dimensionless
dive_no	ID number of the Alvin dive.	dimensionless
core_no	ID number of the core.	dimensionless
depth_target	Target depth.	meters
shipfix_lat	Ship's latitude at start of dive, in decimal degrees (North = Positive).	decimal degrees
shipfix_lon	Ship's longitude at start of dive, in decimal degrees (West = Negative).	decimal degrees
subfix_lat	Latitude when submersible Alvin began its ascent, in decimal degrees (North = Positive).	decimal degrees
subfix_lon	Longitude when submersible Alvin began its ascent, in decimal degrees (West = Negative).	decimal degrees
month	Month that sampling occurred (01 to 12).	dimensionless
day	Day of month (01 to 31).	dimensionless
year	Four-digit year when sampling occurred.	dimensionless
cruise_id	Cruise ID number.	dimensionless
depth_core	Depth sampled within the core.	centimeters (cm)
CH4	Porewater methane concentration in mM.	milliMolar (mM)
d13C_CH4	Stable carbon isotope ratio of methane (13C/12C ratio) in CH4 in sediment porewater samples.	o/oo
DIC	Concentration of DIC in mM. Note: the samples were acidified so that all DIC (CO2 + HCO3- + CO3=) turns into CO2.	milliMolar (mM)
d13C_DIC	Concentration of dissolved inorganic carbon in sediment porewater samples. Notes: units are milli-Molar; the samples were acidified so that all DIC (CO2 + HCO3- + CO3=) turns into CO2.	o/oo
sulfate	Concentration of sulfate in sediment porewater samples.	milliMolar (mM)

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Instruments

Dataset-specific Instrument Name	Alvin tube core
Generic Instrument Name	Alvin tube core
Generic Instrument Description	A plastic tube, about 40 cm (16 inches) long, is pushed into the sediment by Alvin's manipulator arm to collect a sediment core.

Dataset-specific Instrument Name	Gas Chromatograph
Generic Instrument Name	Gas Chromatograph
Dataset-specific Description	The stable isotopic composition of methane and DIC was determined by GC/C/IRMS using a Hewlett Packard 5890 GC coupled to a Finnegan Mat 252 Isotope Ratio Mass Spectrometer (Hewlett Packard, Wilmington, DE, USA).
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)

Dataset-specific Instrument Name	Ion Chromatograph
Generic Instrument Name	Ion Chromatograph
Dataset-specific Description	Sulfate analyses were measured shipboard using a 2010i Dionex Ion Chromatograph (Sunnyvale, CA, USA) using Ag+ cation exchange columns (Dionex) to remove added Cl– ions as previously described (Martens et al., 1999).
Generic Instrument Description	Ion chromatography is a form of liquid chromatography that measures concentrations of ionic species by separating them based on their interaction with a resin. Ionic species separate differently depending on species type and size. Ion chromatographs are able to measure concentrations of major anions, such as fluoride, chloride, nitrate, nitrite, and sulfate, as well as major cations such as lithium, sodium, ammonium, potassium, calcium, and magnesium in the parts-per-billion (ppb) range. (from http://serc.carleton.edu/microbelife/research_methods/biogeochemical/ic....)

Dataset-specific Instrument Name	Isotope-ratio Mass Spectrometer
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	The stable isotopic composition of methane and DIC was determined by GC/C/IRMS using a Hewlett Packard 5890 GC coupled to a Finnegan Mat 252 Isotope Ratio Mass Spectrometer (Hewlett Packard, Wilmington, DE, USA).
Generic Instrument Description	The Isotope-ratio Mass Spectrometer is a particular type of mass spectrometer used to measure the relative abundance of isotopes in a given sample (e.g. VG Prism II Isotope Ratio Mass-Spectrometer).

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Deployments

AT15-40

Website	https://www.bco-dmo.org/deployment/58831
Platform	R/V Atlantis
Report	http://www.marine.whoi.edu/at_synop.nsf/9452cb38d8d28f30852568cd004b8077/13f181c7f933dbac052574e4006399a9?OpenDocument
Start Date	2008-12-05
End Date	2008-12-18
Description	R/V Atlantis cruise in Guaymas Basin where 12 Alvin dives were made. Cruise information and original data are available from the NSF R2R data catalog.

AT15-40_Alvin_Dives

Website	https://www.bco-dmo.org/deployment/58837
Platform	Alvin
Start Date	2008-12-06
End Date	2008-12-17
Description	The Alvin dives of cruise AT15-40 (dive numbers 4483 through 4493) are listed below, with dive targets and shipfix and subfix position. Alvin dive 4483 December 6, 2008 Pilot: Sean Kelley Observers: Andreas Teske, Karen G. Lloyd Dive target: Marker 4; 2004 m depth Ship fix: 27°N00.388, 111°W24.560; Subfix: none Alvin Dive 4484 December 7, 2008 Pilot: Bruce Strickrott Observers: Frank Wenzhoefer, Stephanie Gruenke Dive target: Marker 4; 2004 m depth Ship fix: 27°N00.388, 111°W24.560; Subfix: none Alvin Dive 4485 December 8, 2008 Pilot: Mark Spear Observers: Howard Mendlovitz, Jennifer Biddle Dive target: Marker 1; 2010 m depth Ship fix: 27°N00.464, 111°W24.512; Subfix: 27°N00.459, 111°W24.526 Alvin Dive 4486 December 9, 2008 Pilot: Sean Kelley Observers: Bo B. Jørgensen, Antje Vossmeyer Dive target: Marker 1; 2010 m depth Ship fix: 27°N00.464, 111°W24.512; Subfix: 27°N00.459, 111°W24.526 Alvin Dive 4487 December 10, 2008 Pilot: Bruce Strickrott, Pilot-in-Training: Mike Skowronski Observer: Javier Caraveo Dive target: Marker 1; 2010 m depth Ship fix: 27°N00.464, 111°W24.512; Subfix: 27°N00.459, 111°W24.526 Alvin Dive 4488 December 12, 2008 Pilot: Mark Spear Observers: Julius Lipp, Barbara MacGregor Dive target: Marker 1; 2010 m depth Ship fix: 27°N00.464, 111°W24.512; Subfix: 27°N00.459, 111°W24.526 Alvin Dive 4489 December 13, 2008 Pilot: Sean Kelley Observers: Daniel B. Albert, Luke McKay Dive target: Marker 1; 2010 m depth Ship fix: 27°N00.464, 111°W24.512; Subfix: 27°N00.459, 111°W24.526 Alvin Dive 4490 December 14, 2008 Pilot: Bruce Strickrott Observers: Andreas Teske, Frank Wenzhoefer Dive target: Marker 1; 2010 m depth Ship fix: 27°N00.464, 111°W24.512; Subfix: 27°N00.459, 111°W24.526 Alvin Dive 4491 December 15, 2008 Pilot: Mark Spear Observers: Howard Mendlovitz, Julia Rezende Dive target: Marker 6; 2005 m depth Ship fix: 27°N00.423, 111°W24.477; Subfix: 27°N00.423, 111°W24.492 Alvin Dive 4492 December 16, 2008 Pilot: Sean Kelley, Pilot-in-Training: Mike Skowronski Observer: Alban Ramette Dive target: Marker 1; 2010 m depth Ship fix: 27°N00.464, 111°W24.512; Subfix: 27°N00.459, 111°W24.526 Alvin Dive 4493 December 17, 2008 Pilot: Bruce Strickrott Observers: Daniel Santillano, Matthias Kellermann Dive target: Marker 1; 2010 m depth Ship fix: 27°N00.464, 111°W24.512; Subfix: 27°N00.459, 111°W24.526

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Project Information

Microbial carbon and sulfur cycling in the hydrothermally altered sediments of Guaymas Basin (Guaymas Basin Vents)

Website: https://sites.google.com/site/teskelab/Home/guaymas-basin

Coverage: Guaymas Basin hydrothermal vents, Southern Spreading segment, 27° 00.44N and 111° 24.55W; 2000 m water depth

While microbial communities in marine sediments are generally sustained by sedimentation of organic matter from the water column, the Guaymas Basin hydrothermal sediments provide a model system for the microbial utilization and transformation of thermally released microbial substrates from deeply buried marine organic matter. Thermal generation of subsurface organic carbon compounds is usually restricted to deeply buried subsurface sediments, where it sustains deep subsurface microbiota. However, in the Guaymas Basin, the thermally generated organic substrates of subsurface origin fuel a complex microbial ecosystem in surficial sediments that can be sampled by submersible. As a working hypothesis, the physiologically distinct, layered microbial communities force the geothermally produced substrates through a double “microbial gauntlet” of anaerobic metabolism and autotrophic carbon fixation, where terminal anaerobic degradation of organic matter is performed by methanogenic and methane-oxidizing archaea, by sulfate-reducing bacteria and archaea, and (to be tested) by novel subsurface archaeal populations within the upper sediments, while inorganic and organic remineralization products are assimilated by sulfur-oxidizing *Beggiatoa* mats at the sediment surface. We aim at a quantitative understanding of how the dense and highly active benthic microbial populations of the Guaymas system utilize and recycle organic and inorganic carbon and sulfur of subsurface origin, how geochemical controls affect the community structure, and how uncultured, globally occurring subsurface archaea and bacteria thrive in their sediment habitat. More generally, microbial utilization and recycling of deeply buried, fossil carbon and sulfur in benthic sediments and the sedimentary subsurface is a “seldom seen“ but essential part of these microbially driven processes in the marine biosphere. To analyze the complex interplay of thermogenic and biogenic carbon sources and sinks, and the role of uncultured microbial populations in these processes, geochemical and molecular-biological approaches are integrated and combined. The microbial community composition and activity patterns will be analyzed quantitatively (rRNA membrane slot blot hybridization; single-strand rRNA conformation polymorphism) and with qualitative diversity surveys (PCR, cloning and sequencing). Carbon assimilation patterns in specific functional and phylogenetic groups of prokaryotes will be analyzed using carbon-isotopic analysis of ribosomal RNA, intact polar lipids, and whole microbial cells (using FISH-SIMS). Carbon substrate profiles and microbial process rates (sulfate reduction, methanogenesis, methane oxidation) across hydrothermally active sediment sites and down-core will correlate microbial populations and substrate utilization. Stable carbon isotopic analysis of key microbial substrates will further constrain the microbial utilization patterns of isotopically distinct carbon pools in specific sediment layers.

To summarize, in situ and lab results indicate that newly discovered, phylogenetically distinct populations of Anaerobic Methane-oxidizing archaea (ANMEs) in Guaymas Basin, and their presumed syntrophic bacterial partners, are capable of methane oxidation at high temperatures, at least up to 70-75°C. Isotopically light carbon (indicative of a methane-derived contribution) permeates into sedimentary microbial populations and microbial mats in hydrothermally active areas, as shown by 13C analysis of extracted bacterial and archaeal rRNA. Manipulative incubations with Guaymas sediments suggest a mode of anaerobic methane oxidation which appears to operate uncoupled to sulfate reduction, and requires near in situ methane concentration. Rigorous testing is required for validation of the process and identification of the organisms responsible. High-temperature tolerant and sulfate-uncoupled anaerobic methane oxidation require re-evaluation of the classical controls of this process, temperature and sulfate availability.

By installing autonomous temperature loggers in Guaymas sediments covered with *Beggiatoa* spp. mats, we have obtained continuous temperature profiles, from the sediment surface to 40 cm depth, over up to 11 days. In contrast to previous one-time temperature measurements that provided only a static snapshot, these data revealed substantial temperature fluctuations in the upper cm layers underlying orange *Beggiatoa* mats, indicative of fluctuations in hydrothermal flux and/or advective in-mixing of seawater. Such temperature regimes would select for eurythermal bacteria and archaea that tolerate a broad mesophilic/thermophilic temperature range, or for microbial communities that consist of members with different temperature optima, that co-occur or overlap in the same sediment layer but vary in activity depending on temperature and associated geochemical conditions.

Anaerobic microbial processes in sediments (sulfate reduction, remineralization of biomass, anaerobic methane oxidation) produce DIC and sulfide that, in turn, sustain the *Beggiatoa* mats, assuming autotrophic capability. To examine this link between sediment processes and surface mats, we quantified temperature gradients, porewater concentration gradients (sulfide, sulfate, methane, DIC, volatile organic acids), and 13C-isotopic signatures of methane and DIC underneath orange and white *Beggiatoa* mats (differentiated by 16S rRNA sequencing), and the bare sediment. The steepest temperature and porewater concentration gradients (sulfide and DIC) are mostly found under orange *Beggiatoa* mats that occur in the center of *Beggiatoa* patches. Temperature and geochemical gradients are attenuated under white *Beggiatoa mats*, which surround the orange mats in a sunny-side up pattern, and flatten out or disappear in the surrounding mat-free sediment

We are annotating the genome of an orange *Beggiatoa* spp. from Guaymas Basin [taxonomically revised as *Maribeggiatoa*], recovered from a single filament after whole genome amplification. Sequencing was completed at JCVI, supported by the Gordon and Betty Moore Foundation. The single-filament genome is not completely assembled, but is of approximately the expected total length and includes a full complement of ribosomal protein, tRNA, and tRNA synthetase genes. So far, the genome content is broadly consistent with a nitrate-reducing, facultatively autotrophic sulfur-oxidizing bacterium.

Publications associated with this project are as follows:
Note: this is now a list of all publications that use samples collected from the NSF-funded Guaymas cruises AT15-40 and AT15-56. All these publications were funded from NSF award OCE-0647633, the grant that funded these two cruises. Those publications that were written and published after 2013 continue to use samples collected and analyzed on cruises AT15-40 and AT15-56 under NSF award OCE-0647633, but the effort in analyzing the data and writing the manuscript also relied on funding by OCE-1357238. Since we will not have new samples until late in 2016, current work and publications on OCE-1357238 will continue to rely on samples collected during cruises AT15-40 and AT15-56.

Holler, T. F. Widdel, K. Knittel, R. Amann, M. Y. Kellermann, K.-. Hinrichs, A. Teske, A. Boetius, and G. Wegener. 2011. Thermophilic anaerobic oxidation of methane by marine microbial consortia. The ISME Journal 5:1946-1956. doi:10.1038/ismej.2011.77

Biddle, J.F., Z. Cardman, H. Mendlovitz, D.B. Albert, K.G. Lloyd, A. Boetius, and A. Teske. 2012. Anaerobic oxidation of methane at different temperature regimes in Guaymas Basin hydrothermal sediments. The ISME Journal 6:1018-1031. doi:10.1038/ismej.2011.164

McKay, L.J., B.J. MacGregor, J.F. Biddle, H.P. Mendlovitz, D. Hoer, J.S. Lipp, K.G. Lloyd, and A.P. Teske. 2012. Spatial heterogeneity and underlying geochemistry of phylogenetically diverse orange and white *Beggiatoa* mats in Guaymas Basin hydrothermal sediments. Deep-Sea Research I, 67:21-31. doi:10.1016/j.dsr.2012.04.011

Bowles, M.W., L.M. Nigro, A.P. Teske, and S.B. Joye.. 2012. Denitrification and environmental factors influencing nitrate removal in Guaymas Basin hydrothermally-altered sediments. Frontiers in Microbiology 3:377. doi:10.3389/fmicb.2012.03377

MacGregor, B.J., J.F. Biddle, J.R. Siebert, E. Staunton, E. Hegg, A.G. Matthysse, and A. Teske. 2013. Why orange Guaymas Basin *Beggiatoa* spp. are orange: Single-filament genome-enabled identification of an abundant octaheme cytochrome with hydroxylamine oxidase, hydrazine oxidase and nitrite reductase activities. Applied and Environmental Microbiology 79:1183-1190. doi:10.1128/AEM.02538-12

MacGregor, B.J., J.F. Biddle, and A. Teske. 2013. Mobile elements in a single-filament orange Guaymas Basin *Beggiatoa* ("Candidatus Maribeggiatoa") sp. draft genome; evidence for genetic exchange with cyanobacteria. Applied and Environmental Microbiology 79:3974-3985. doi:10.1128/AEM.03821-12

Meyer, S., G. Wegener, K.G. Lloyd, A. Teske, A. Boetius, and A. Ramette. 2013. Microbial habitat connectivity across spatial scales and hydrothermal temperature gradients at Guaymas Basin. Frontiers in Microbiology 4:207. doi:10.3389/fmic.2013.00207

MacGregor, B.J., J.F. Biddle, C. Harbort, A.G. Matthysse, and A. Teske. 2013. Sulfide oxidation, nitrate respiration, carbon acquisition and electron transport pathways suggested by the draft genome of a single orange Guaymas Basin *Beggiatoa* (*Cand.* Maribeggiatoa) sp. filament. Marine Genomics 11:53-65. doi:10.1016/j.margen.2013.08.001

Ruff, E., J.F. Biddle, A. Teske, K. Knittel, A. Boetius, and A. Ramette. 2015. Global dispersion and local diversification of the methane seep microbiome. Proc. Natl. Acad. Sci. USA, 112:4015-4020. doi:10.1073/pnas.1421865112

McKay, L., V. Klokman, H. Mendlovitz, D. LaRowe, M. Zabel, D. Hoer, D. Albert, D. de Beer, J. Amend, A. Teske. Thermal and geochemical influences on microbial biogeography in the hydrothermal sediments of Guaymas Basin. Environmental Microbiology, in revision.

Dowell, F., Z. Cardman, S. Dasarathy, M.Y. Kellermann, L.J. McKay, B.J. MacGregor, S.E. Ruff, J.F. Biddle, K.G. Lloyd, J.S. Lipp, K-U. Hinrichs, D.B. Albert, H. Mendlovitz, and A. Teske. Microbial communities in methane and short alkane-rich hydrothermal sediments of Guaymas Basin. Frontiers in Microbiology, In Revision.

Conference abstracts (post 2013, only NSF-OCE 1357238):
B.J. MacGregor. 2014. Receiver (REC) domains in the orange Guaymas "Maribeggiatoa" (BOGUAY) draft genome: an evolutionary network of sensor networks. The Human and Environmental Microbiome Symposium 2014. Duke Center for the Genomics of Microbial Systems, Durham, NC.

B.J. MacGregot. 2015. Abundant intergenic repeats and a possible alternate RNA polymerase betra subunit in the orange Guaymas "Maribeggiatoa" genome. American Society for Microbiology 2015 General Meeting. New Orleans, LA.

Z. Cardman, L.J. McKay, E. Dowell, S. Dasarathy, V. Klokman, J.F. Biddle, K.G. Lloyd, H. Mendlovitz, D. Albert, M. Kellermann, K.-U.

Hinrichs, B.J. MacGregir and A.P. Teske. 2014. American Society for Microbiology 2014 General Meeting. Boston, MA.

Collaborative Research: Microbial Carbon cycling and its interactions with Sulfur and Nitrogen transformations in Guaymas Basin hydrothermal sediments (Guaymas Basin Interactions)

Coverage: Guaymas Basin, Gulf of California, 27.00 N, 111.00W

Description from NSF award abstract:
Hydrothermally active sediments in the Guaymas Basin are dominated by novel microbial communities that catalyze important biogeochemical processes in these seafloor ecosystems. This project will investigate genomic potential, physiological capabilities and biogeochemical roles of key uncultured organisms from Guaymas sediments, especially the high-temperature anaerobic methane oxidizers that occur specifically in hydrothermally active sediments (ANME-1Guaymas). The study will focus on their role in carbon transformations, but also explore their potential involvement in sulfur and nitrogen transformations. First-order research topics include quantifying anaerobic methane oxidation under high temperature,in situ concentrations of phosphorus and methane , and with alternate electron acceptors; sulfate and sulfur-dependent microbial pathways and isotopic signatures under these conditions; and nitrogen transformations in methane-oxidizing microbial communities, hydrothermal mats and sediments.

This integrated biogeochemical and microbiological research will explore the pathways of and environmental controls on the consumption and production of methane, other alkanes, inorganic carbon, organic acids and organic matter that fuel the Guaymas sedimentary microbial ecosystem. The hydrothermal sediments of Guaymas Basin provide a spatially compact, high-activity location for investigating novel modes of methane cycling and carbon assimilation into microbial biomass. In the case of anaerobic methane oxidation, the high temperature and pressure tolerance of Guaymas Basin methane-oxidizing microbial communities, and their potential to uncouple from the dominant electron acceptor sulfate, vastly increase the predicted subsurface habitat space and biogeochemical role for anaerobic microbial methanotrophy in global deep subsurface diagenesis. Further, microbial methane production and oxidation interlocks with syulfur and nitrogen transformations, which will be explored at the organism and process level in hydrothermal sediment microbial communities and mats of Guaymas Basin. In general, first-order research tasks (rate measurements, radiotracer incorporation studies, genomes, in situ microgradients) define the key microbial capabilities, pathways and processes that mediate chemical exchange between the subsurface hydrothermal/seeps and deep ocean waters.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0647633
NSF Division of Ocean Sciences (NSF OCE)	OCE-1357238

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