Hydrothermal sediment temperature profiles sampled near Beggiatoa mats using Alivn's heatlow and temperature probes, deployed from R/V Atlantis cruises AT15-40, AT15-56 in the Guaymas Basin from 2008-2009

Website: https://www.bco-dmo.org/dataset/3676
Data Type: Cruise Results
Version: 1
Version Date: 2012-07-23

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

Contributors	Affiliation	Role
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Abstract
This dataset includes temperature profiles from hydrothermal sediments sampled near Beggiatoa mats using Alivn's heatlow and temperature probes, deployed from R/V Atlantis cruises AT15-40 and AT15-56 in the Guaymas Basin from 2008-2009.

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Coverage

Spatial Extent: **N**:27.0116 **E**:-111.4044 **S**:27.0065 **W**:-111.4148
Temporal Extent: 2008-12-06 - 2009-12-04

Dataset Description

In-situ temperature profiles of Guaymas Basin hydrothermal sediments (Southern Spreading segment, 27°00.44N and 111°24.55W; 2000 m water depth).

Geochemical and temperature data from Guaymas sediments are published or referenced in Biddle et al. (2012) and McKay et al. (2012).

Methods & Sampling

During Alvin dives 4483-4492 (Dec 6-17, 2008) and 4562-4573 (Nov 22-Dec 6, 2009) in the 2000 meters (m) deep Southern Guaymas trench, 113 temperature profiles were taken in sediments near and within *Beggiatoa* mats, at the hydrothermally active areas from 27°N00.30 to 27°N00.60, and 111°W24.65 to 111°W24.35. All temperature probe measurements, positions of the 139 probes in the mat, and penetration depths were checked with the Alvin dive videotapes that provide a continuous record of all dive operations. Of the 113 temperature profiles, 78 were measured in mats with both orange and white filaments to focus on the relationship between differently colored *Beggiatoa*.

A Heatflow probe manufactured by the Woods Hole Oceanographic Institution (WHOI) was used to measure 69 of the 78 temperature profiles. This is a 0.6 m titanium tube containing a linear heater and five thermistors (type 44032, Omega Engineering, Inc.) at 10-centimeter (cm) intervals along the length of the tube (personal communication with Lane J. Abrams, WHOI). The thermistors have a tolerance of +/- 0.2 up to 40 degrees Celsius (C), and +/- 1 degree C up to 200 degrees C. It is considered fully inserted when a disc at the base reaches the sediment surface, and takes temperature readings at 0, 10, 20, 30, and 40 centimeters below seafloor (cmbsf).

For 28 profiles, 5 cm depth resolution was achieved by first inserting the probe 5 cm less than complete insertion and recording one profile, and then inserting the probe the rest of the way and recording a second profile, 5 cm offset from the first. Temperatures were recorded after the readings had stabilized for each of the five depths. Occasionally, this technique resulted in channel formation, and the second set of readings was higher than the first. During dive 4490, one temperature profile was repeated three times, giving a range of sensor precisions from 1.0 to 4.1 C. A high-temperature probe was used to produce nine additional temperature profiles with varying depth intervals from the sediment surface down to 37.5 cmbsf. The high-temperature probe has a type-K thermocouple located at the tip, with a tolerance of +/-3 degrees C up to 400 degrees C. To measure temperature profiles with this probe, the tip touched the sediment surface for the first reading before inserting the probe sequentially to desired depths and taking readings.

Data Processing Description

To analyze the relationship of sediment depth 161 and mat color to surface and subsurface temperatures we performed a 2-way analysis of variance (ANOVA) using SigmaStat (Systat Software, San Jose, CA). Because data violated both normality and equal variance, alpha (2) values were reduced so that $p < 0.005$. Post-hoc Tukey tests were performed to estimate differences between treatment levels and the results were plotted using SigmaPlot (Systat Software, San Jose, CA). The clearest images of Beggiatoa mats captured by the submersible's high definition cameras were used to create maps indicating all temperature measurement locations in relation to mat cover with Adobe Photoshop CS (Adobe Systems, San Jose, CA). Two red lasers that project from Alvin 10 cm apart were used to create scale bars.

BCO-DMO 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. The original data was transposed so that profile depths are displayed in one column, rather than separate columns for each depth.

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Data Files

File
temperature.csv (Comma Separated Values (.csv), 279.68 KB) MD5:fd32c751042a8b4aee550264c4732cd8 Primary data file for dataset ID 3676

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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
Results

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
Results

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Parameters

Parameter	Description	Units
site_descrip	Description of the location where the sample was taken. Orange_mat = orange Beggiatoa mat; White_mat = white Beggiatoa mat; lt_1m_Sediment = bare sediments less than 1 m from a mat; gt_1m_Background = background sediments greater than 1 m from a mat.	dimensionless
cruise_id	Unique identifier of the cruise.	dimensionless
year	Four-digit year.	dimensionless
dive_profile	Unique ID number of the temperature profile.	dive number - profile number
dive_id	ID number of the Alvin dive.	dimensionless
dive_target	Name of the target marker (sampling location) for the dive.	dimensionless
depth	Depth at which the sample was collected.	meters
lat	Ship's latitude at start of dive, in decimal degrees (North = Positive).	decimal degrees
lon	Ship's longitude at start of dive, in decimal degrees (West = Negative).	decimal degrees
lat_sub	Latitude when submersible Alvin began its ascent, in decimal degrees (North = Positive).	decimal degrees
lon_sub	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
depth_profile	Depth of the temperature probe into the sediment.	centimeters
temp	Probe temperature reading.	degrees C

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Instruments

Dataset-specific Instrument Name	Alvin Heatflow Probe
Generic Instrument Name	Alvin Heatflow Probe 0.66m
Dataset-specific Description	A Heatflow probe manufactured by the Woods Hole Oceanographic Institution (WHOI) was used to measure 69 of the 78 temperature profiles. The thermistors have a tolerance of +/- 0.2 up to 40 degrees C, and +/- 1 up to 200 degrees C.
Generic Instrument Description	The Heatflow probe is a temperature measuring device on the submersible Alvin. It is a 0.6 m titanium tube containing a linear heater and 5 thermistors. The Heatflow probe is designed to measure temperature gradients when inserted into soft sediments.

Dataset-specific Instrument Name	Alvin High Temperature Probe
Generic Instrument Name	Alvin High Temperature Probe
Dataset-specific Description	The high temperature probe has a type-K thermocouple located at the tip, with a tolerance of +/-3 up to 400 degrees C. To measure temperature profiles with this probe, the tip touched the sediment surface for the first reading before inserting the probe sequentially to desired depths and taking readings.
Generic Instrument Description	A temperature measuring device on the submersible Alvin. The high temperature probe is capable of reading in-situ water temperatures from 0 to 450 degrees C.

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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.

AT15-56

Website	https://www.bco-dmo.org/deployment/58832
Platform	R/V Atlantis
Report	http://www.marine.whoi.edu/at_synop.nsf/9452cb38d8d28f30852568cd004b8077/13f181c7f933dbac052574e4006399a9?OpenDocument
Start Date	2009-11-22
End Date	2009-12-06
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

AT15-56_Alvin_Dives

Website	https://www.bco-dmo.org/deployment/58838
Platform	Alvin
Start Date	2009-11-23
End Date	2009-12-05
Description	The Alvin dives of cruise AT15-56 (dive numbers 4562 through 4574) are listed below, with dive targets and shipfix position. Dive 4562 November 23, Monday Pilot: Sean Kelley Portside Observer: Andreas Teske Starboard Observer: Kai Hinrichs Dive target: Marker 14 Position: 27°00.47 N, 111°24.431 W Dive 4563 November 24, Tuesday Pilot: Bob Waters Portside Observer: Jennifer Biddle Starboard Observer: Marc Mussmann Dive target: Marker 14 Position: 27°00.47 N, 111°24.43 W Dive 4564 November 25, Wednesday Pilot: Bruce Strickrott Portside Observer: Dirk DeBeer Starboard Observer: Howard Mendlovitz Dive target: Marker 14 Position: 27°00.47 N, 111°24.43 W Dive 4565 November 26, Thursday Pilot: Dave Walter Portside Observer: Andreas Teske Starboard Observer: Dan Albert Dive target: Cathedral Hill Position: 27°00.696 N, 111°24.265 W Dive 4566 November 27, Friday Pilot: Sean Kelley Portside Observer: John MaDonald Starboard Observer: Hans Røy Dive target: Marker 14 Position: 27°00.47 N, 111°24.431 W Dive 4567 November 28, Saturday Pilot: Mark Spear Portside Observer: Luke McKay Starboard Observer: Javier Caraveo Dive target: Cold sediment Dive 4568 November 29, Sunday Pilot: Bob Waters Portside Observer: Barbara MacGregor Starboard Observer: Gunter Wegener Dive target: Marker 6 Position: 27°00.419 N, 111°24.888 W Dive 4569 November 30, Monday Pilot: Bruce Strickrott Portside Observer: Howard Mendlovitz Starboard Observer: Dan Hoer Dive target: Marker 14 Position: 27°00.47 N, 111°24.431 W Dive 4570 December 1, Tuesday Pilot: David Walter Portside Observer: Dirk deBeer Starboard Observer: Kaspar Kjeldsen Dive target: Marker 14 Position: 27°00.47 N, 111°24.431 W Dive 4571 December 2, Wednesday Pilot: Mark Spear Portside Observer: Meg Tivey Starboard Observer: Kristen Myers Dive target: Busted Mushroom Position: 27°00.63 N, 111°24.41 W Dive 4572 December 3, Thursday Pilot: David Walter Portside Observer: Jeff McDonald Starboard Observer: Kai Ziervogel Dive target: Marker 27 Position: 27°00.445 N, 111°24.529 W Dive 4573 December 4, Friday Pilot: Sean Kelly Portside Observer: Thomas Holler Starboard Observer: Yu-Shih Lin Dive target: Cathedral Hill, Marker 24 Position: 27°00.696 N, 111°24.265 W Dive 4574 December 5, Saturday Pilot: Bruce Strickrott Portside Observer: Mark A. Lever Starboard Observer: Nancy Cabanillas Dive target: Big Pagoda Position: 27°00.901 N, 111°24.635 W

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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.

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Funding

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

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