

2009 NDSF Science User Reports

December 13, 2009

Alvin Reports

Geoffrey Wheat

Atlantis/Alvin

February 8-16, 2009

Costa Rica CORKs

Geoff Wheat

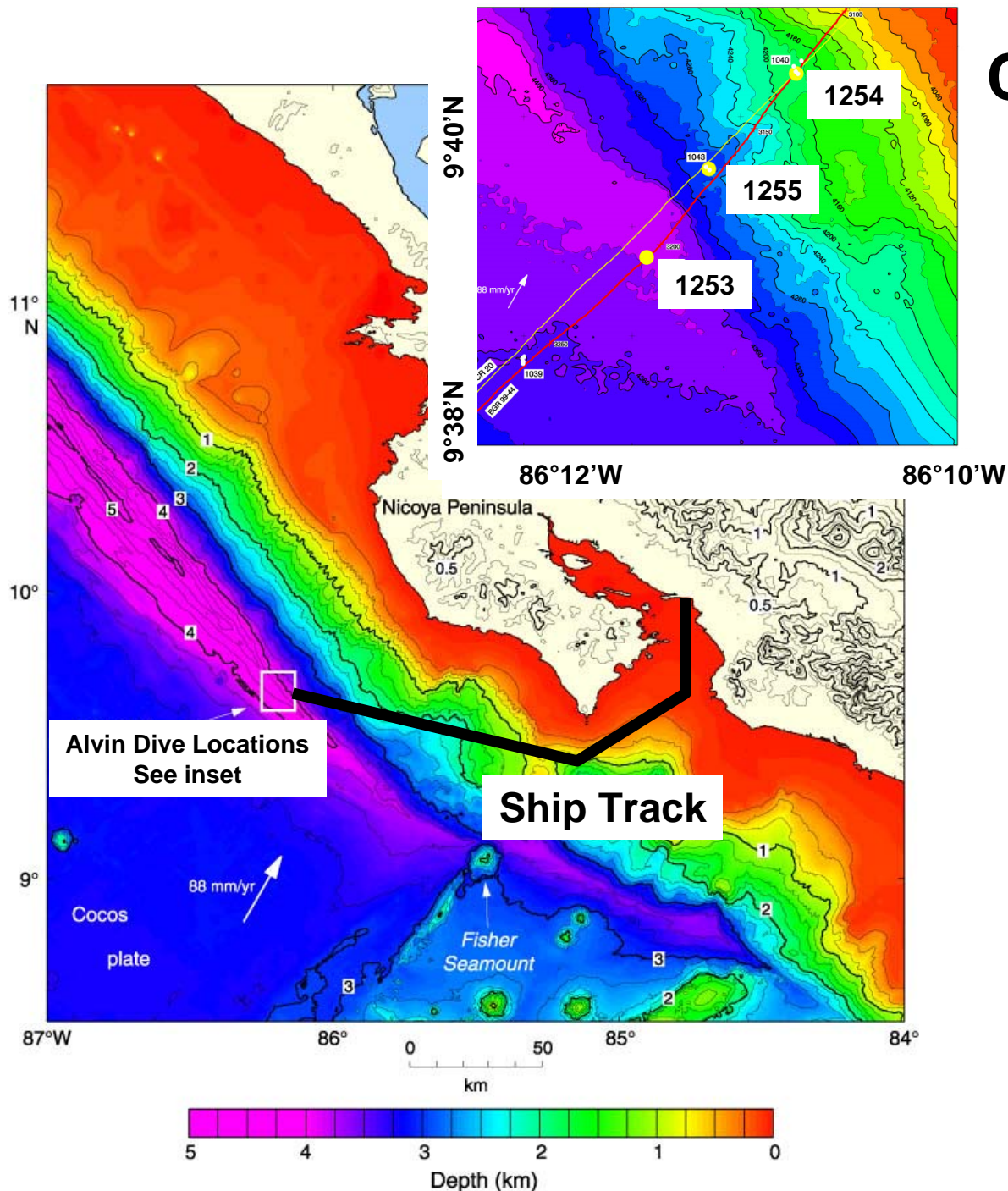
University of Alaska Fairbanks

Miriam Kastner

Scripps Institution of Oceanography

Evan Solomon

University of Washington



7 Dives:

- Recovered borehole instruments and data,
- Deployed borehole instruments,
- Recovered seafloor packages,
- Made measurements of fluid flow and heat flow.

Many Successful Operations

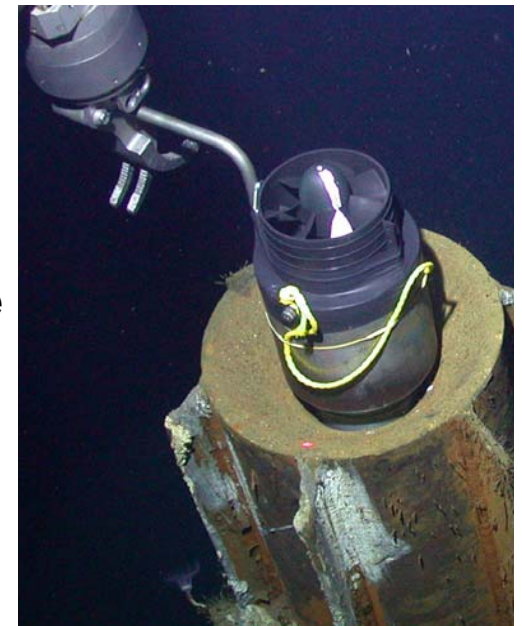
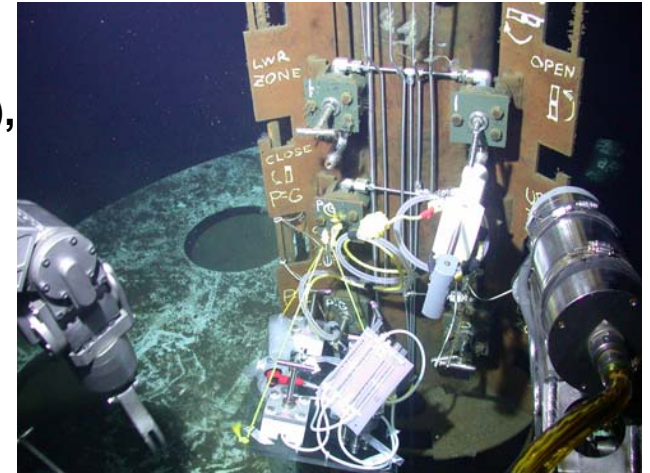
4370 m depth

Issues with:
Sonar and deep Homer/Transponder



Education and Outreach Efforts

- Participation of under representative groups (8 Women),
- Multi-national participation (US, German, Canadian),
- A range of backgrounds and expertise:
 - Undergraduate students (2)
 - Graduate students (3)
 - Post-Doctoral Fellows (3)
 - Teacher of Teachers
 - Ocean Science Bowl Coordinator
 - Writers (2),
- Phone calls to the submersible,
- A blog that reached 90 K-12 teachers in the Central CA area via the Monterey Bay Aquarium,
- A lesson plan centered on CORK science,
- Technical questions for the 2010 Ocean Science Bowl,
- Follow-up appearances to the classes that made a phone call and the Monterey Bay Aquarium, and
- Articles in non-scientific journals.



Lisa Levin

Atlantis/Alvin

February 21 – March 8, 2009

CR.ROCKS (Feb. 21-March 8, 2009)

Structure and Function of Authigenic Carbonate Ecosystems

16 days 13 ALVIN DIVES



Scripps Institution of Oceanography (Lisa Levin/Greg Rouse)

Cal Tech (Victoria Orphan)

Indiana State Univ. (Tony Rathburn)

Also: Temple Univ., Occidental College, USGS, Washington U.,

U. Costa Rica (H. Molina, R. Vargas, L. Vilchis)

HYPOTHESES

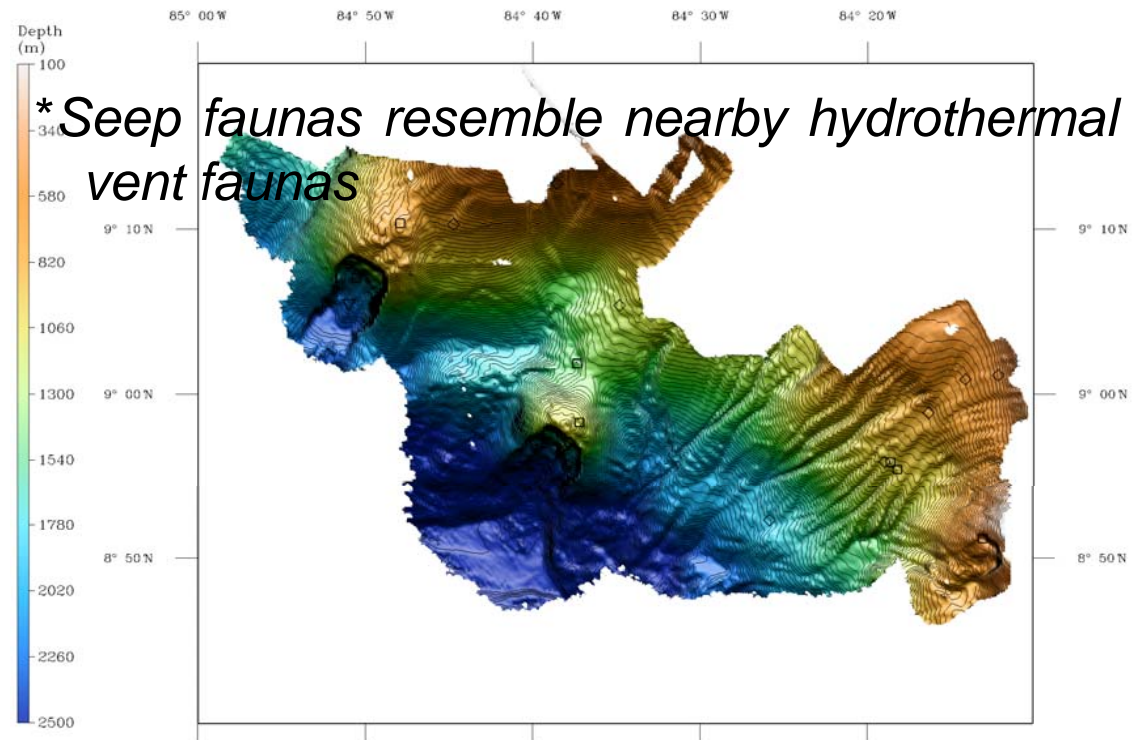
**Authigenic carbonate functions as a distinct ecosystem fueled by methane, with its own sources of (chemosynthetic) primary and secondary production*

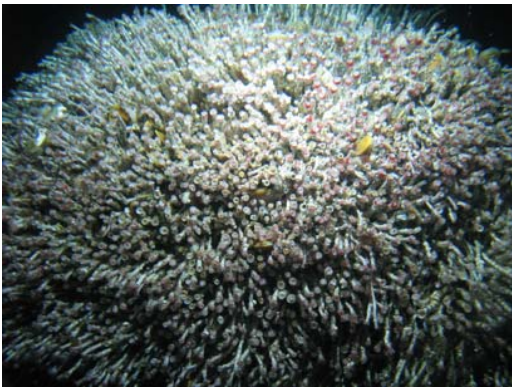
**Sessile carbonate microbes, protozoans and animals at seeps are taxonomically and evolutionarily distinct from the biota of surrounding seep sediments*



Sampling Sites off Costa Rica

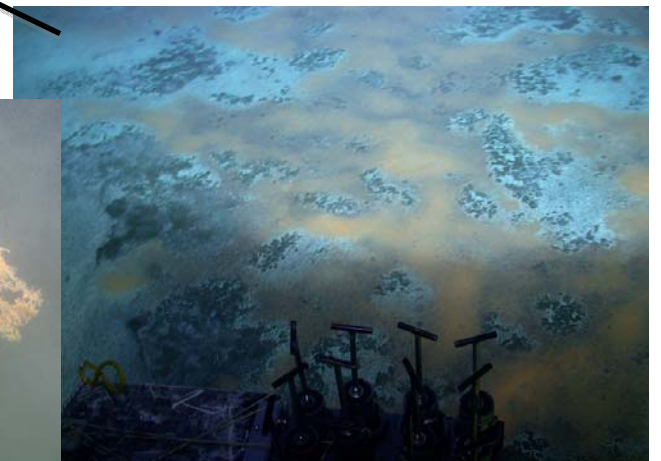
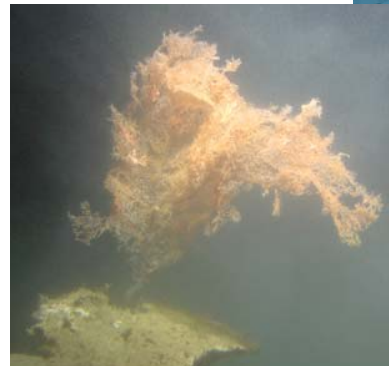
Mound 12
Mound 11
Jaco Scarp
Quepos Seep
Quepos Landslide





Habitats Studied

- Carbonate Rocks
- Mussel Beds
- Clam Beds
- Tubeworm Bushes
- Bacterial Mats
- Corals
- Wood

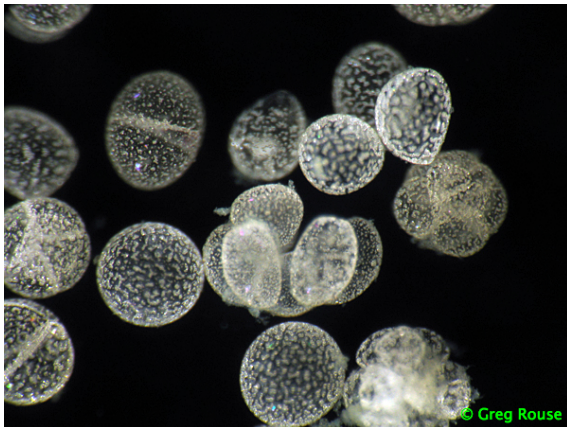


2009_02_24_21_09_43.jpg

Seep Yeti Crabs – Mounds 11 and 12



Thiomargarita sp.



Carbonate, Wood, & Shells
deployed to study substrate
preferences and early stages
of colonization and
succession

Highlights

Isotopically light
dorvilleid polychaetes
 $\delta^{13}\text{C} = -101\text{‰}$!!



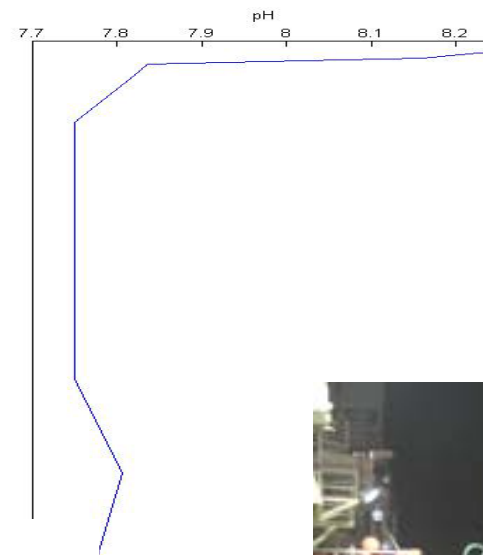
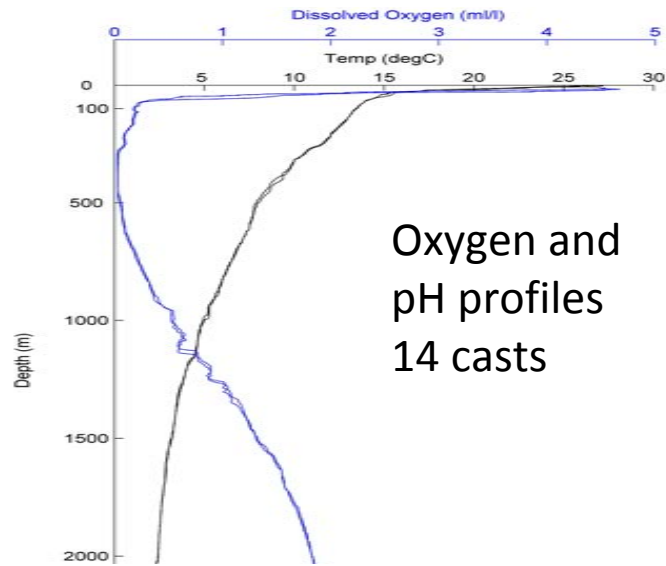
Foraminifera on
tubeworms



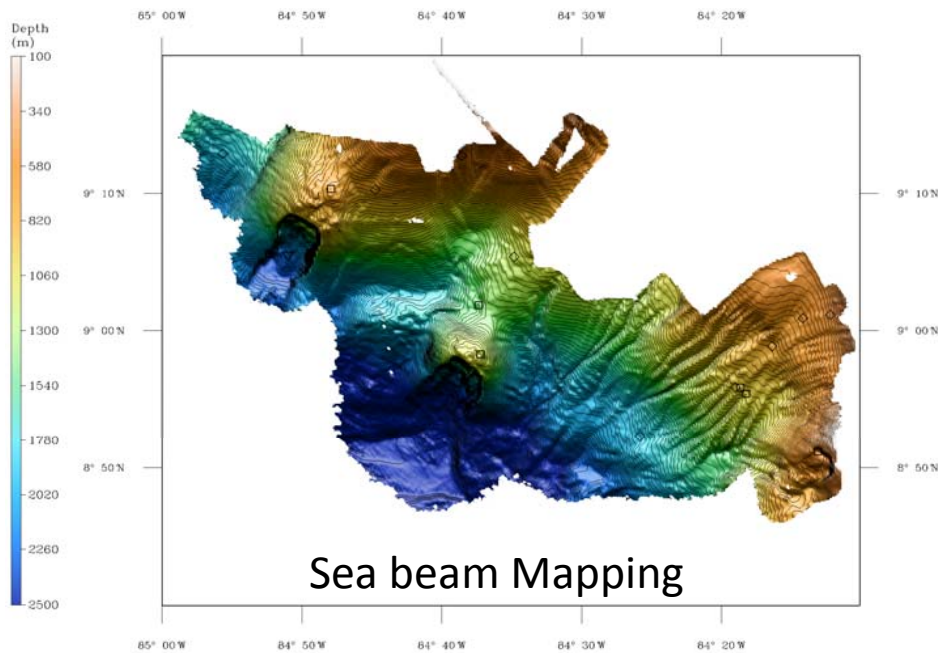
Calyptogena sp. 1 (dive #A4503)
sculpted with very distinct notch



Night Ops



Multicoring across the OMZ
22 drops

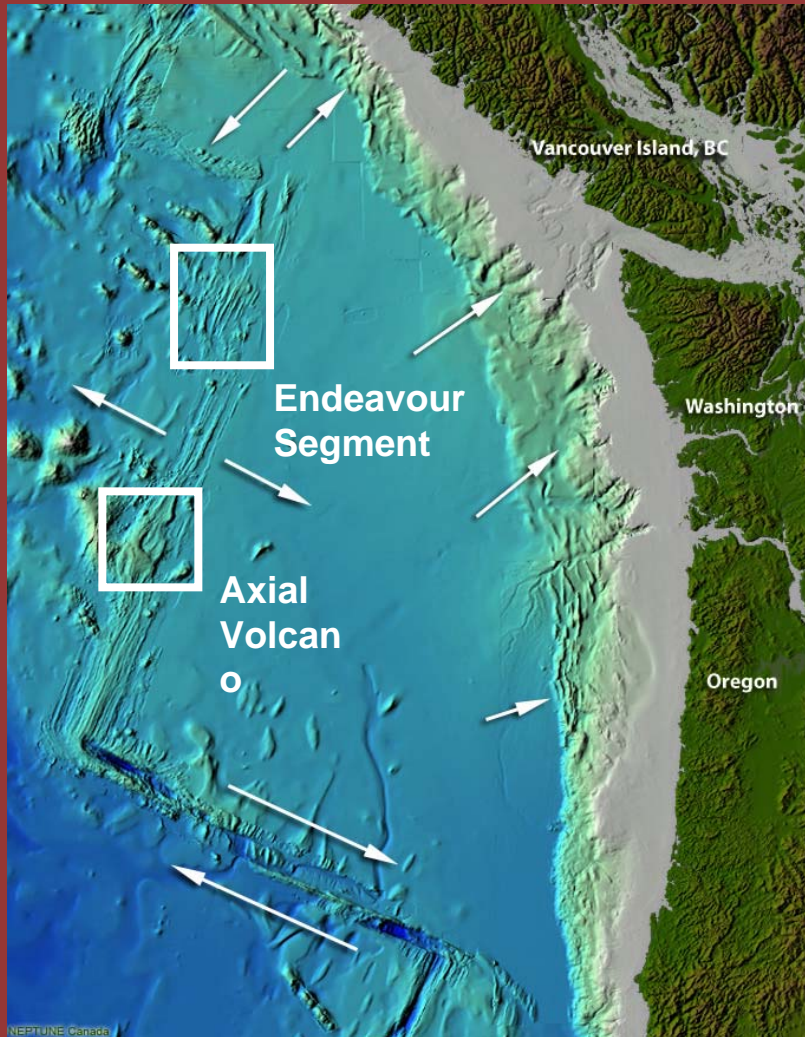


Jim Holden

Atlantis/Alvin

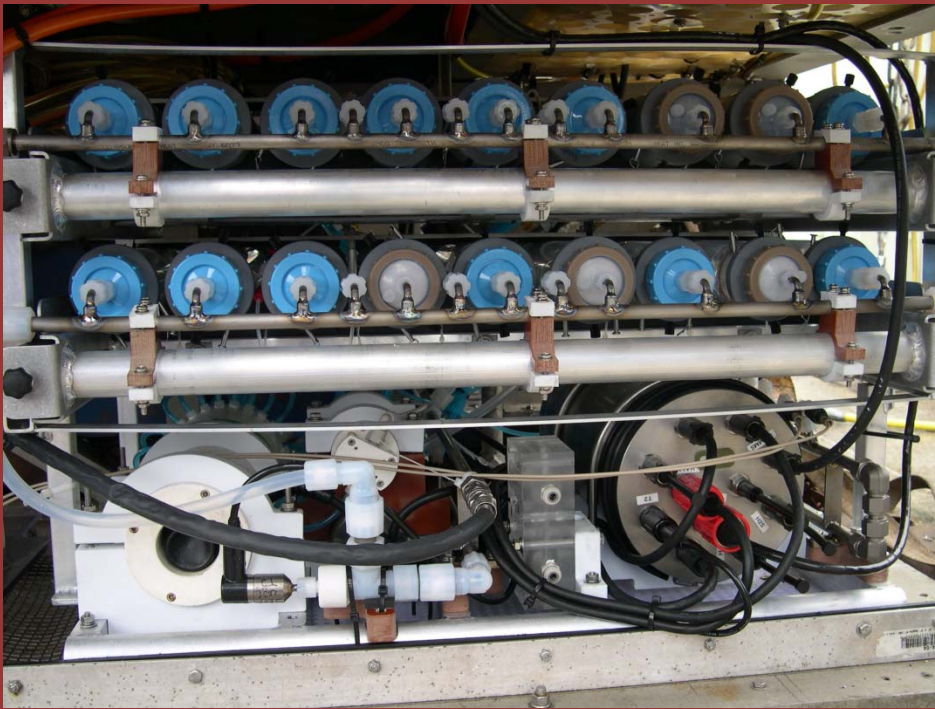
June 13 - 27, 2009

AT15-47 Cruise to Endeavour Segment & Axial Volcano, NE Pacific Ocean June 13-27, 2009



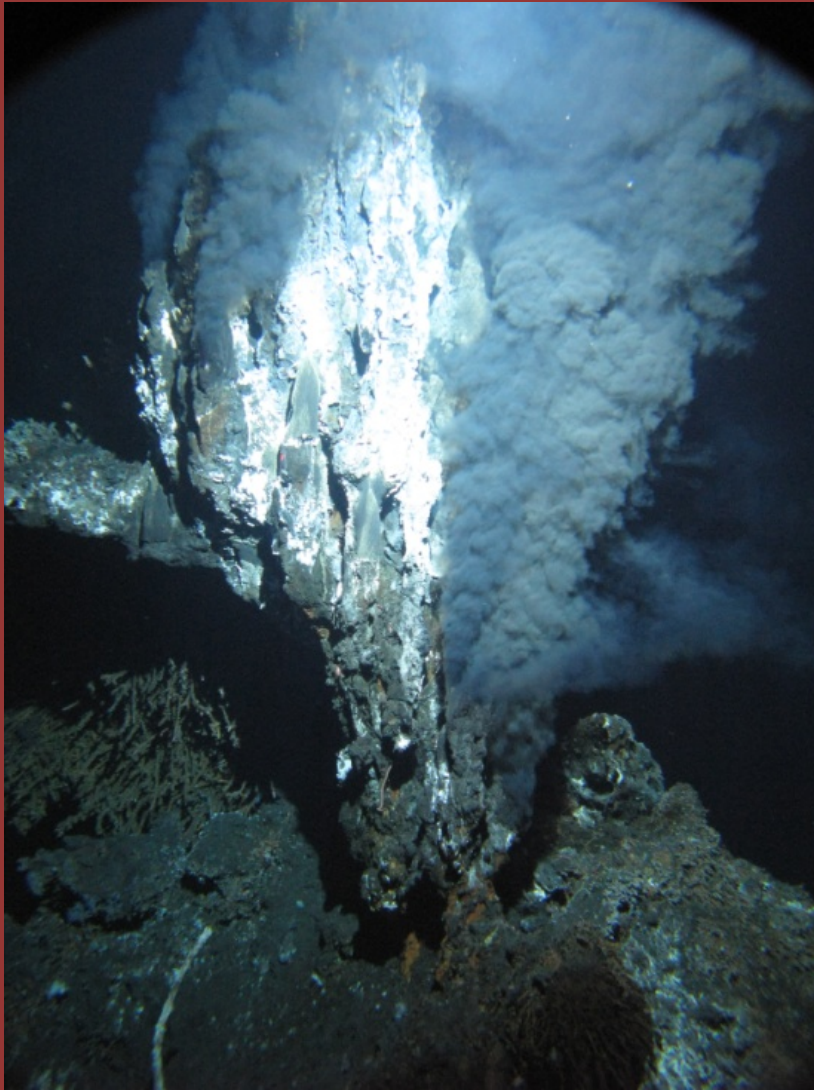
- 13 scheduled *Alvin* dives for 3 funded programs
 - Holden (UMass) et al.: 8 dives
 - Butterfield (NOAA): 3 dives
 - Lilley (UGA): 1 dive
 - WHOI engineering: 1 dive
- 12 dives completed
 - 1 dive lost to weather, 2 shortened
 - 8 dives at Endeavour
 - Main Endeavour: 5
 - Mothra: 1
 - High Rise: 2
 - 4 dives at Axial Volcano
- Overall, cruise very successful (Thanks!)

Hydrothermal Fluid Samples Collected for Geochemistry and Microbiology



- 136 total fluid samples collected
- 100 fluids collected using NOAA Hydrothermal Fluid Sampler with co-registered temperature meas. (see picture at left)
- 27 gas-tight fluid samples
- 8 major fluid samples
- 200 L using an *Alvin* elevator
- 2 McLane fluid samplers recovered after 1 year, 1 deployed and recovered at Endeavour for short-term study, 1 deployed at Axial until next summer
- 10 macrofauna samples

Sulfide Chimney and Deposit Studies, Basalt Samples



- 2 active sulfide chimneys recovered for detailed microbe-mineral-fluid interaction study
- 3 extinct sulfide samples collected
- 2 basalt samples collected
- Detailed heat and fluid flux analyses in the Main Endeavour and High Rise Fields

Andreas Teske

Atlantis/Alvin

November 22 – December 6, 2009

Microbial methane and sulfur cycling in hydrothermal sediments of Guaymas Basin

Andreas Teske, UNC Chapel Hill, and collaborators from
UNC Chapel Hill, MPI Bremen, Bremen University, Center for Geomicrobiology at Aarhus University,
WHOI, MBL, UGA

Questions: Microbial community composition and stratification:
16S rRNA and functional gene clone libraries, cultivations,
genomic sequencing of ecosystem DNA

Autotrophic vs heterotrophic *Beggiatoa*:
 ^{13}C uptake experiments with ^{13}C -labeled DIC and acetate,
and ^{13}C natural abundance; microprofiler analyses

Methane assimilation by anaerobic methane-
oxidizing consortia & others under different T regimes:
 ^{13}C -isotopic analysis of DNA and RNA, and lipids

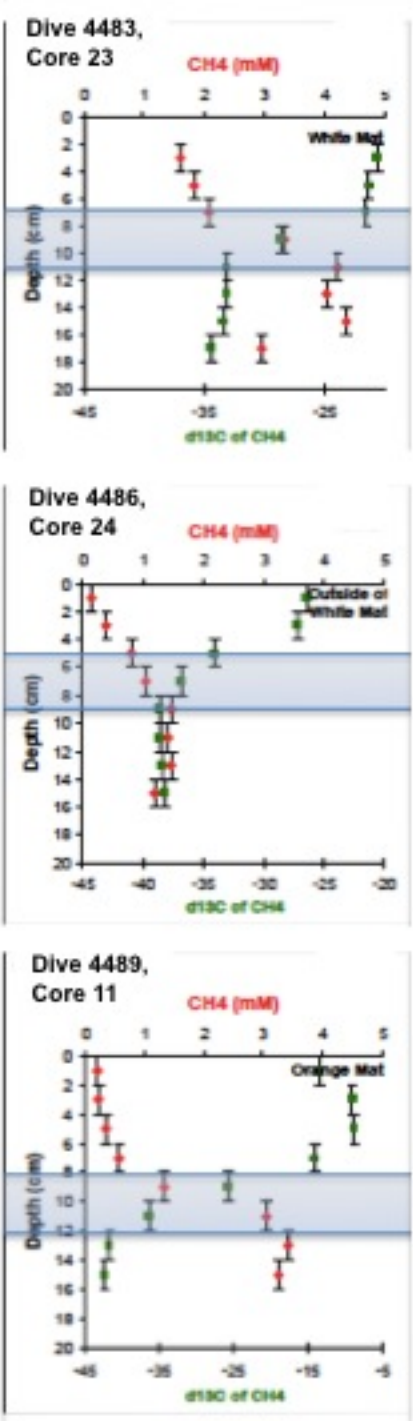
Carbon sources of uncultured archaea: CH_4 , DIC, VFA,
petroleum hydrocarbons, complex biopolymers
 ^{13}C -isotopic analysis of DNA and RNA; and lipids

In-situ geochemical gradients, metabolic zonation, and benthic
microbial activities: In-situ sulfate reduction rates, porewater gradients,
flux measurements, microprofilers for pH, O_2 , H_2S , T

Pressure and temperature response of microbial activities:
microbial activities in high temperature & pressure incubator

Two cruises:
RV Atlantis/Alvin
Dec 5 - Dec 18, 2008
Nov 22 - Dec 5, 2009

NSF Bio Oce.
0647633



Anaerobic CH₄ oxidation at different Temperature regimes: mcrA gene phylogeny

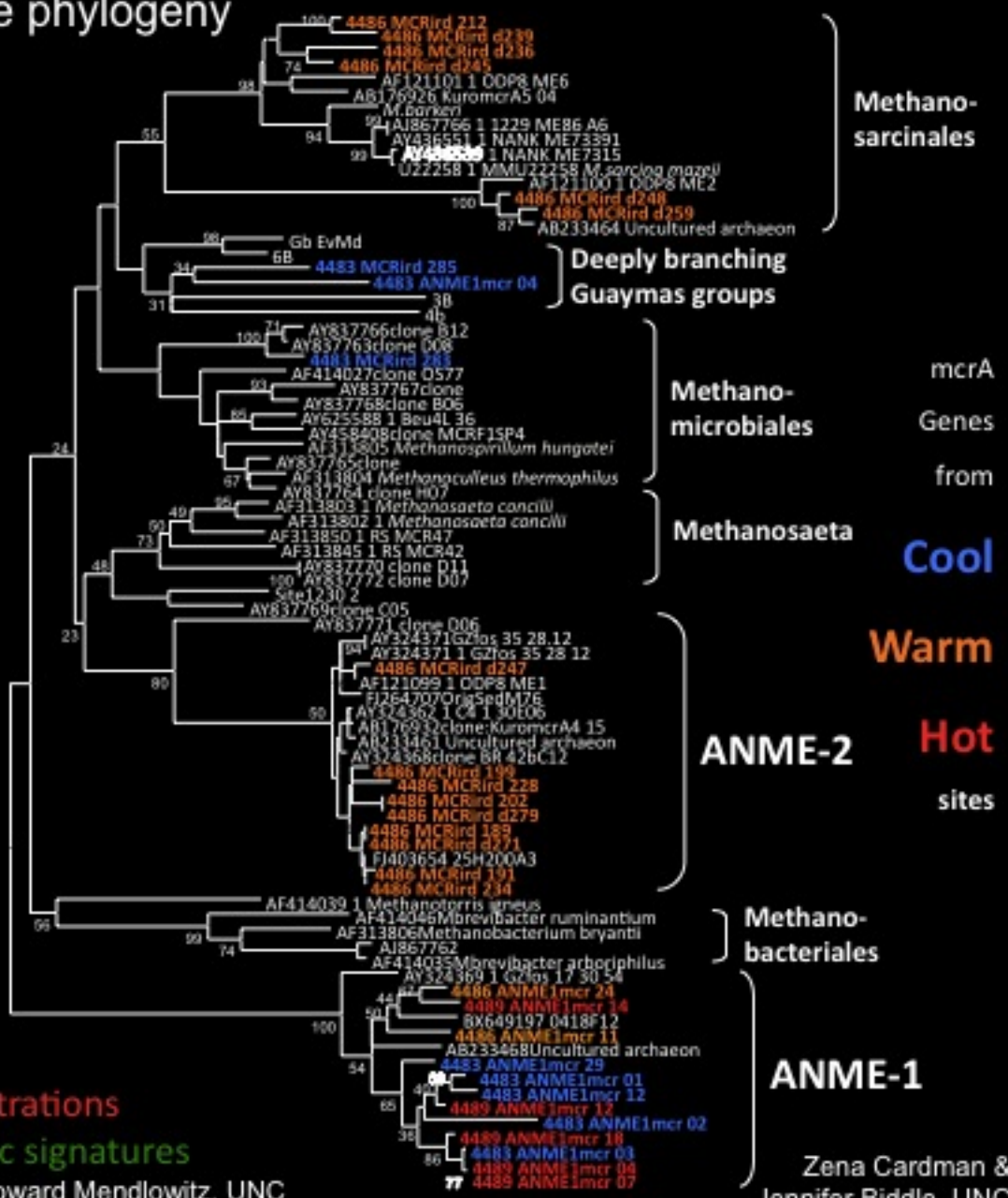
Top panel:
 cool T site
 (15-20°C)

Middle:
 warm T site
 (30-35°C)

Bottom:
 hot T site
 (70-90°C)

CH₄ concentrations
 δ¹³C isotopic signatures

Dan Albert & Howard Mendlowitz, UNC



Geochemical and microbiological analysis of microbial mats and their hydrothermal settings in Guaymas Basin: A few examples

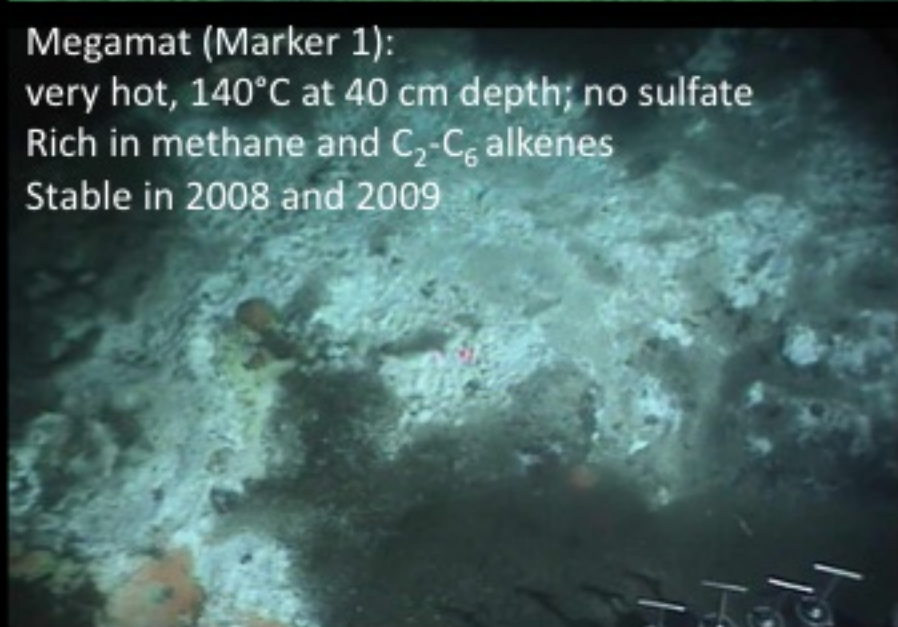
Yellow Mat (Marker 14)

Cool mat; 30°C at 40 cm depth
Up to 1 mM acetate
Low methane

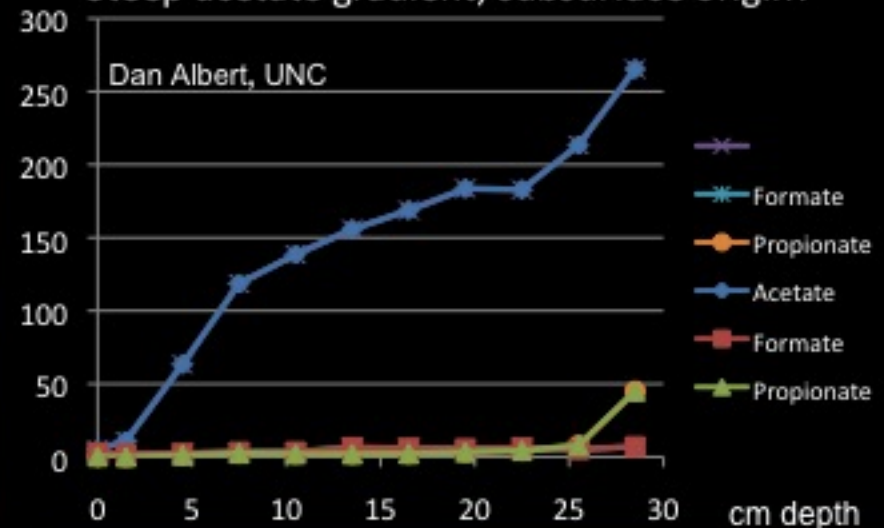


Megamat (Marker 1):

very hot, 140°C at 40 cm depth; no sulfate
Rich in methane and C₂-C₆ alkenes
Stable in 2008 and 2009

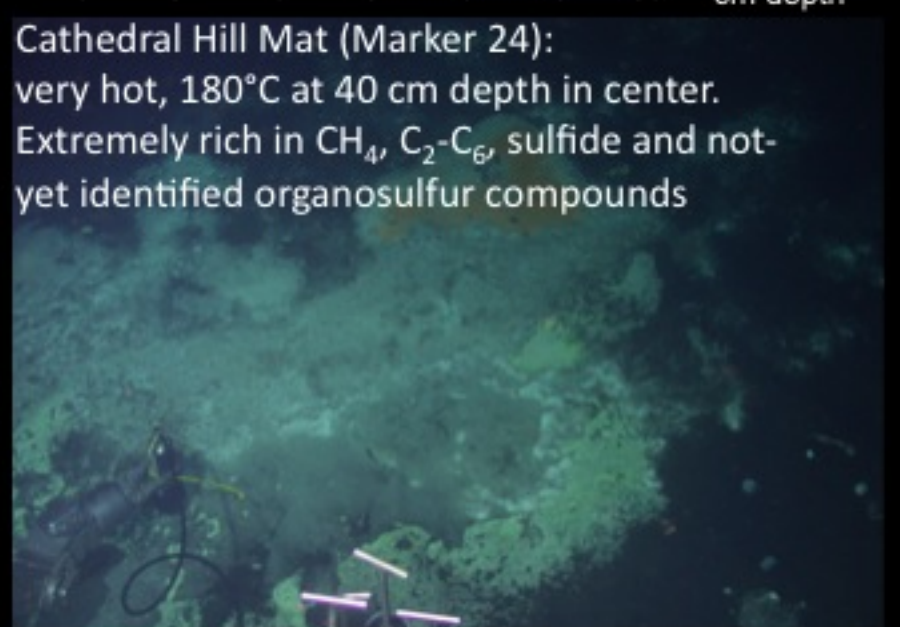


VFA (μM) in porewater at Megamat: Steep acetate gradient; subsurface origin?



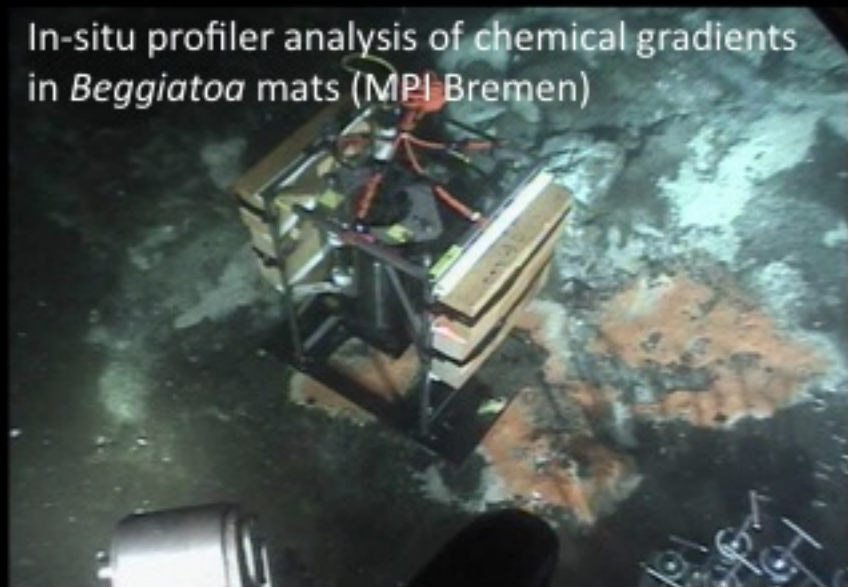
Cathedral Hill Mat (Marker 24):

very hot, 180°C at 40 cm depth in center.
Extremely rich in CH₄, C₂-C₆, sulfide and not-yet identified organosulfur compounds

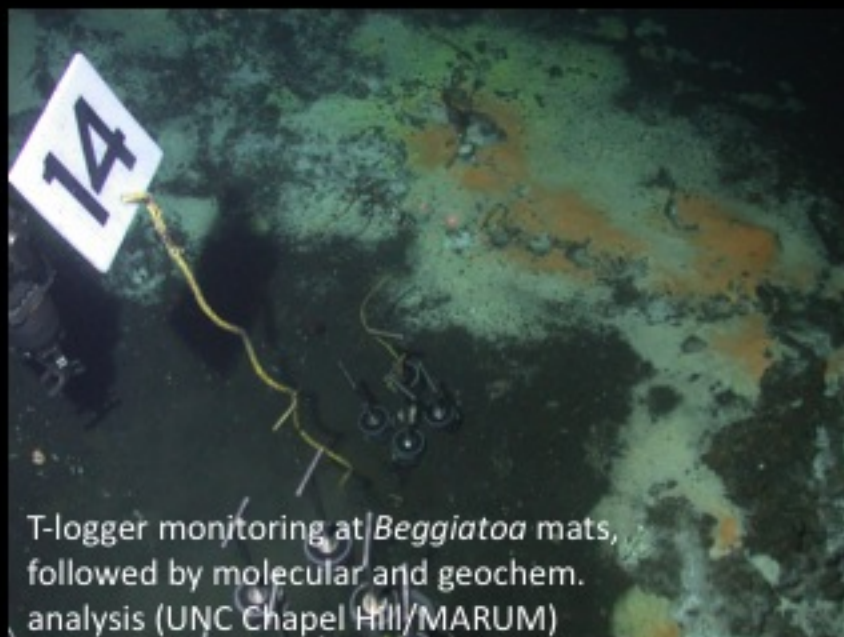
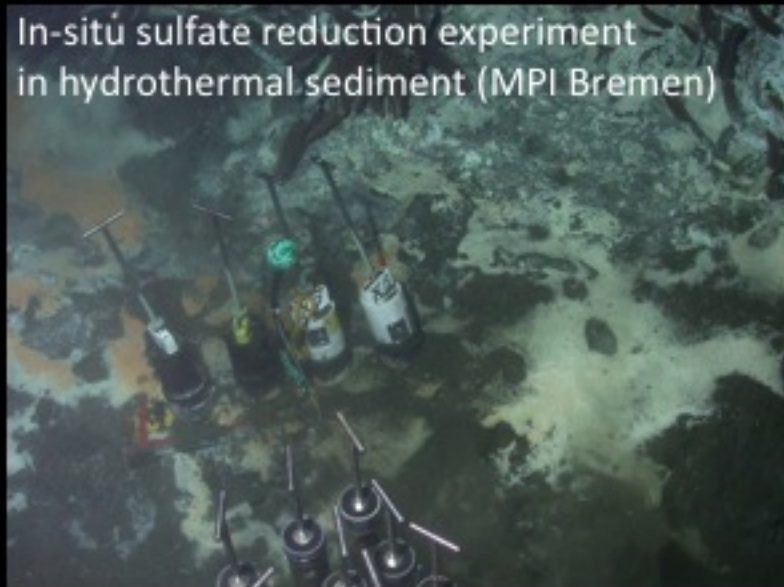


In-situ chemical microprofiles, subsurface temperature monitoring, and process rates associated with *Beggiatoa* mats

In-situ profiler analysis of chemical gradients in *Beggiatoa* mats (MPI Bremen)



In-situ sulfate reduction experiment in hydrothermal sediment (MPI Bremen)



T-logger monitoring at *Beggiatoa* mats, followed by molecular and geochem. analysis (UNC Chapel Hill/MARUM)

T-logger monitoring of hot mats near Cathedral Hill (UNC Chapel Hill/MARUM)

