DESSC Meeting

December 2007

Alvin Science User Reports

Richard Lutz
Tim Shank
Costantino Vetraini
George Luther

Jan 10 – Feb 5, 2007

Collaborative Research:
Integrated Studies of Biological Community Structure at Deep-Sea Hydrothermal Vents

AT15-15 R/V Atlantis / DSV Alvin (4297-4318)
10 January – 5 February

T. Shank, G. Luther, R. Lutz, C. Vetriani, and M. Tolstoy

The main scientific objectives of our program were to:

1) determine the post-eruptive character of hydrothermal activity, fluid chemistry, and nascent and pre-eruption biological assemblages.

2) examine the temporal and spatial changes in benthic communities (and their genetics) through coordinated *in situ* observations, sampling, and manipulative experimentation

3) correlate coincident and temporal changes in faunal community structure with variations in microbial community structure, *in situ* fluid chemistry, pH, and T°C

4) field test technical advances with regard to *in situ* chemical sensing.

Collaborative Research: Integrated Studies of Biological Community Structure at Deep-Sea Hydrothermal Vents

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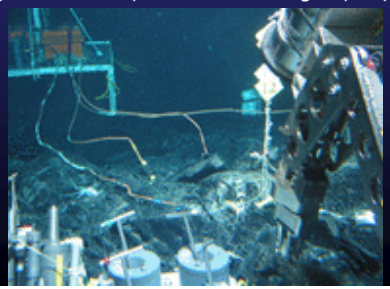
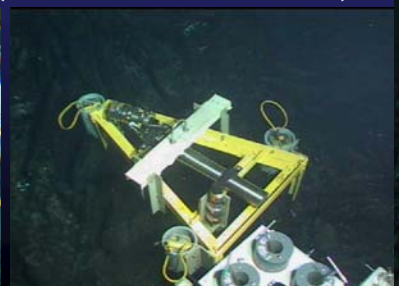
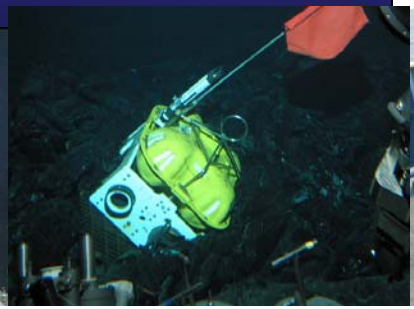
22 Alvin Dives
Integrative bio-chem-micro colonization expts (39 TAMS depl/recov; in-situ electro-chemistry)
High-definition imaging (high-res and stereo) systems documenting post-eruptive changes
Autonomous *In situ* electrochemical sensor (ISEA or "Insect": 1 recovery; 2 deployments)
Constructed/Utilized "Fish-Slurp" suction sampler
Imagenix mapping / nav processing (Ferrini et al., 2007)
Near-bottom magnetics from Alvin
Time-lapse camera imaging ("RatCam"; 2 deployments)
McLane™ large-volume water pump (4 deployments)
Tide Gauge (2 deployments)
Conductivity-Temperature-Depth (CTD; 3 surveys)
Ocean Bottom Seismometer (OBS; 9 of 11 recovered)
Towed-camera system (12 surveys) (Soule et al., 2007)

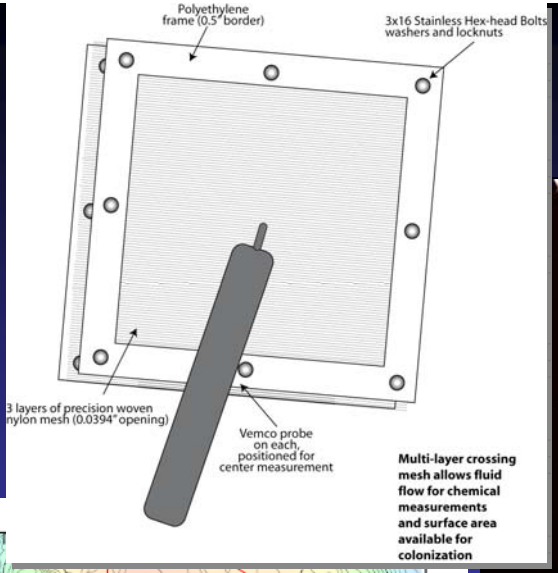
basalt, sulfide, water, micro- and macro-biological samples

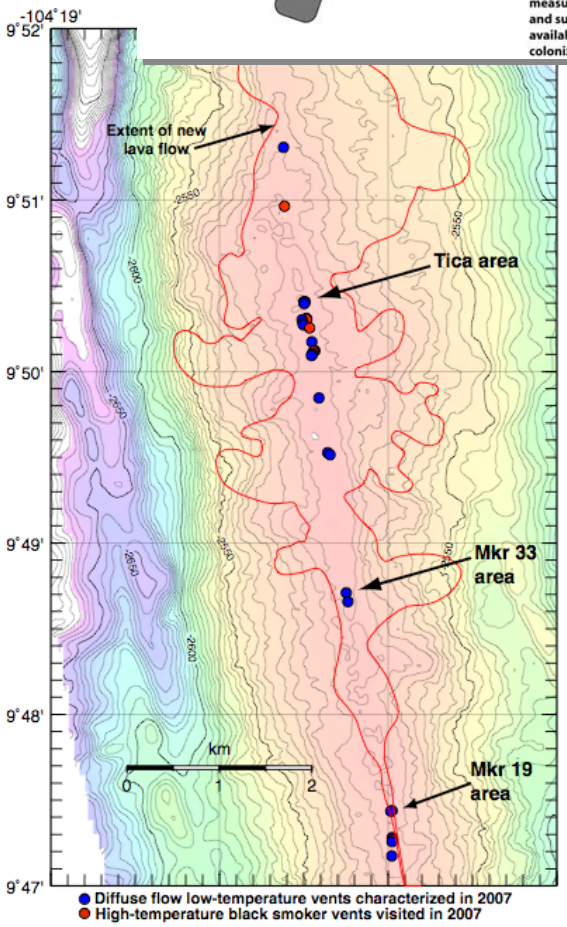


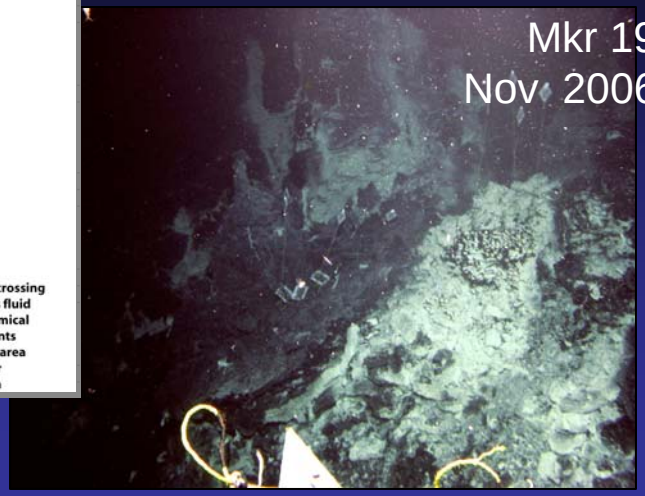


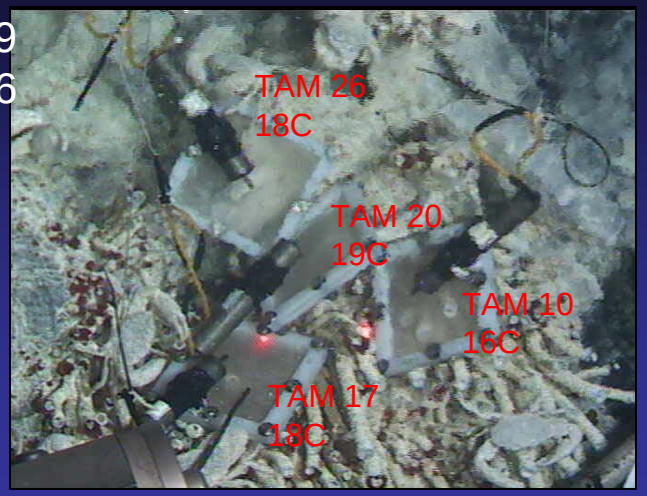


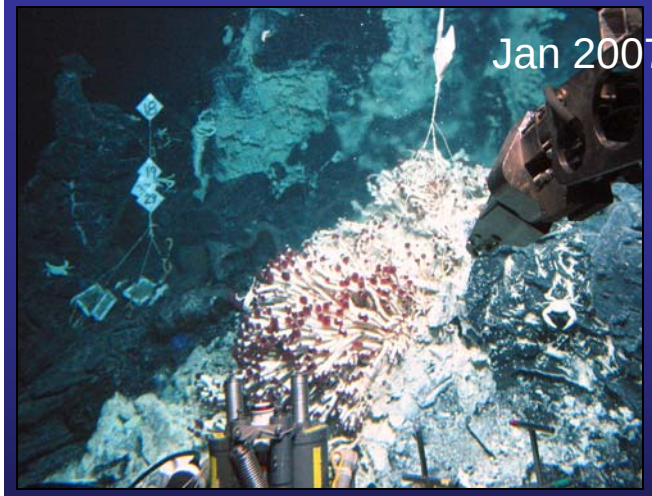
TAMS Integrated Expts

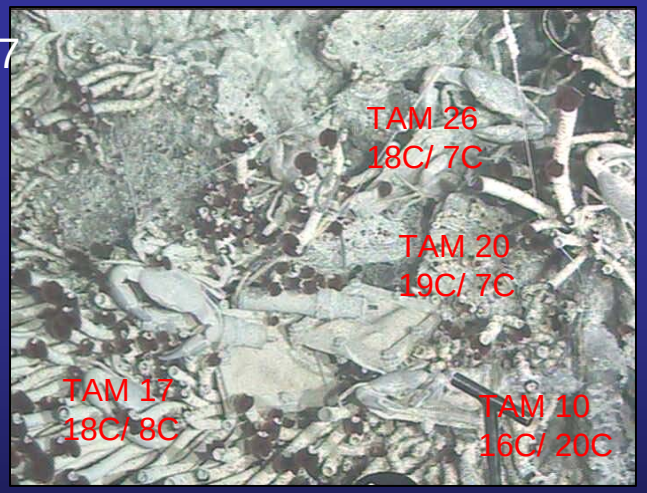












Temporal Autonomous Multidisciplinary Substrates

Microbial and faunal colonization coincident with electro-chemistry and temperature

Imaging Systems

High-definition Camera (offloadable)
- A wide angle HDTV (1920 x 1080 format) on starboard manipulator (see Lange presentation)

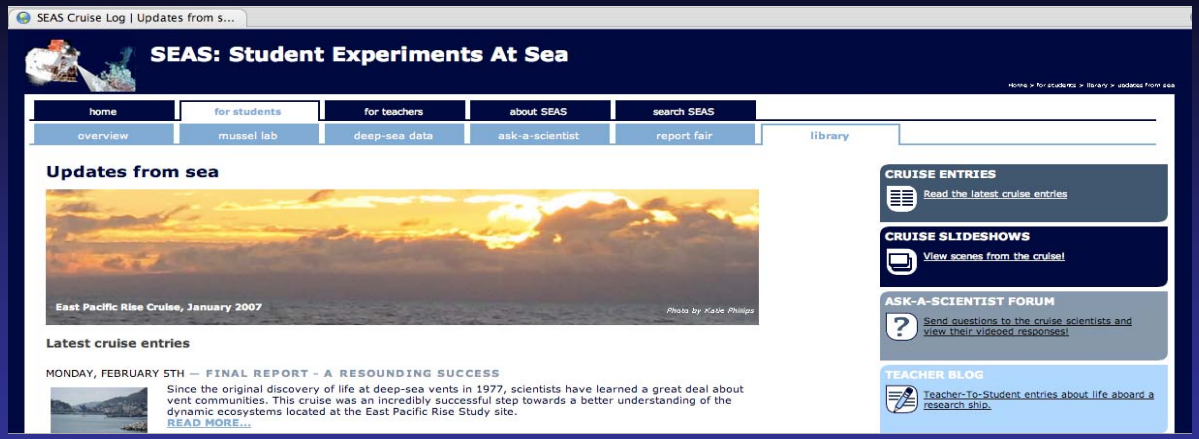
High-definition Stereo Camera System (for stereo quantification)
- wide angle 3D HDTV (1920 x 1080 format) on starboard manipulator (see Lange presentation)

Insight Camera
- The “Insight” camera was mounted downlooking on Alvin below the pilot’s viewport. (The trade-offs between the illumination of the strobes and the altitude of the submersible resulted in fewer useful image surveys or transects.)

Time-lapse Camera (DSPL DigiSeaCam:“RatCam”)
- 12 day deployment coincident with “Insect” deployment in post-eruptive colonization at Tica
- 4 day deployment at “fish hole” near the base of L vent
- Images (1/60 sec exposure at f-5.3) are at ~ 2 m elevation; Benthos 383 strobe illumination

TowCam (Night Program; 12 lowerings in 4 regions)
- ~1800 color digital 2048 x 1536 pixels) jpg images per lowering

Education and Outreach



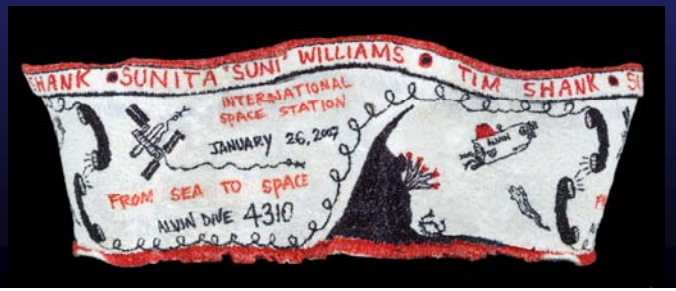
1. SEAS: hosted a Lexington Middle School teacher (Carolyn Sheild) and an Education and Outreach coordinator from the Ridge 2000 program (Eric Simms) participated in our cruise activities and provided daily teacher's log, images, video and essays, posted on the Ridge 2000 SEAS website.

2. GLOBE (http://www.globe.gov/): we initiated a partnership with Globe via R2K's FLEXE program. GLOBE is a large-scale, web-based, international science education program that joins students, teachers and scientists in studying Earth Systems Science. Ridge 2000's program FLEXE: From Local to EXtreme Environments features our coordinated student-scientist interactions.

3. NSF/RIDGE2000 - NASA communication: phone call from Alvin at depth to the International Space Station with a live feed answering questions from more than 40 elementary schools.

4. National Geographic magazine photographer documented our research for future publication.

5. High-definition video to be distributed to museums and aquariums.



David Valentine

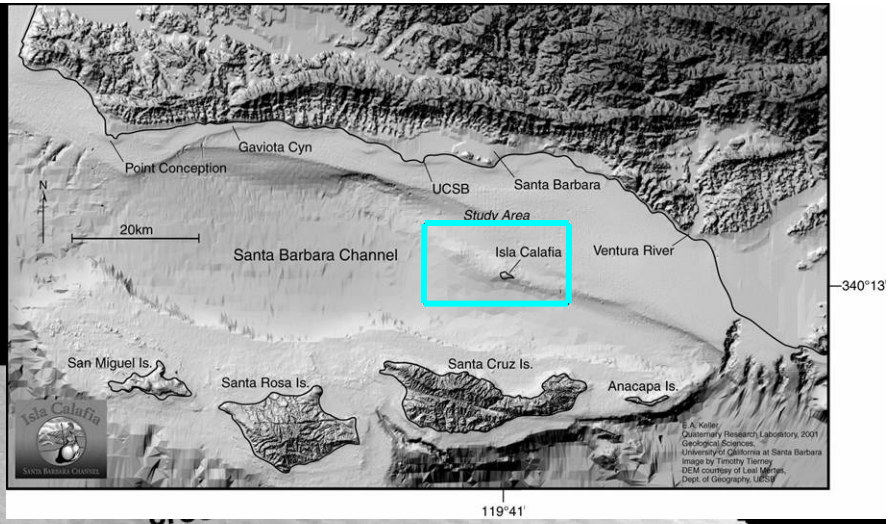
July 3-17, 2007

SEEPS ‘07 (Studies of the Ecology and Evolution of Petroleum Seeps)

- Dates: July 3-17, 2007
- Project: CAREER: Microbial Geochemistry of Natural Marine Gas Seeps – a Research and Education Plan (DL Valentine, PI).
- Vehicle used: Alvin
- Accomplishments:
  - i) Comparison of CH_4 oxidation rates in seeps ranging in depth from 80m to 800m.*
  - ii) Discovery and sampling of 2 extinct asphault volcanoes.*
  - iii) Quantified depth distributions of CH_4 turnover and methanotroph identity at dozens of sites along southern California margin.
  - iv) Testing, validation and intercomparison of in-situ mass spectrometers to depths greater than 1500m.*
  - v) Testing of novel pore water equilibration samplers.
  - vi) Comparison of microbial mat communities from several distinct seep environments.
  - vii) Participation and training for 14 undergraduate and 7 graduate students.

**Subject of subsequent slides*

Asphault Volcanoes



complex HIT

Isla Calafia

fold scarp

complex HIT
and subaerial erosion?

fold scarp

mound

Discovered and sampled 2
Extinct Asphault Volcanoes
(depths 150-200m)

mound

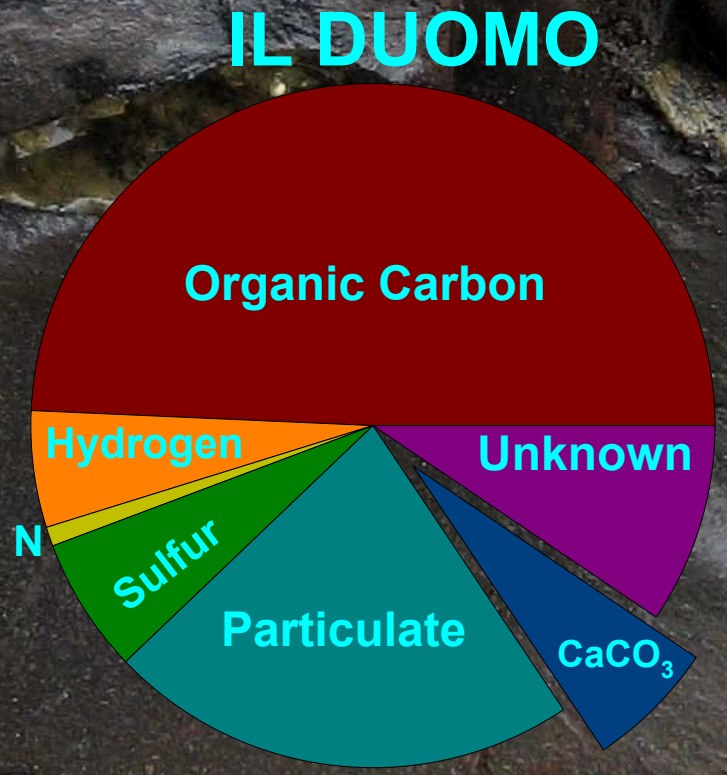
Dive Targets

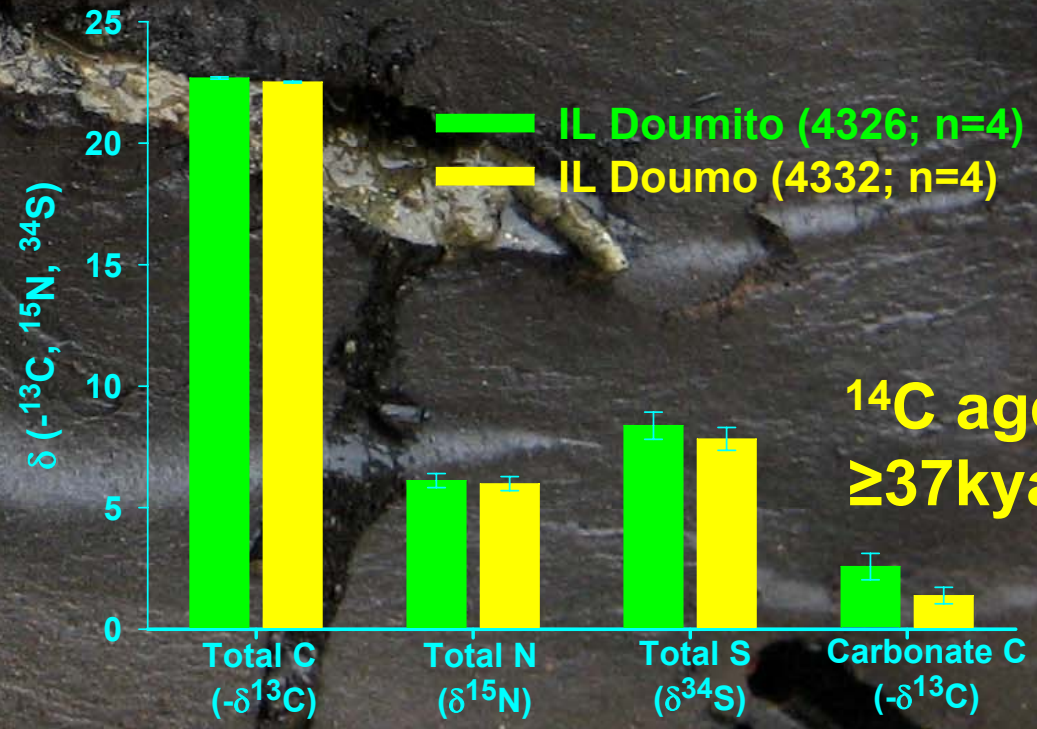
N

3km

Background image from Keller et al., 2007

Asphault Volcanoes: Composition





^{14}C age ≥37kya

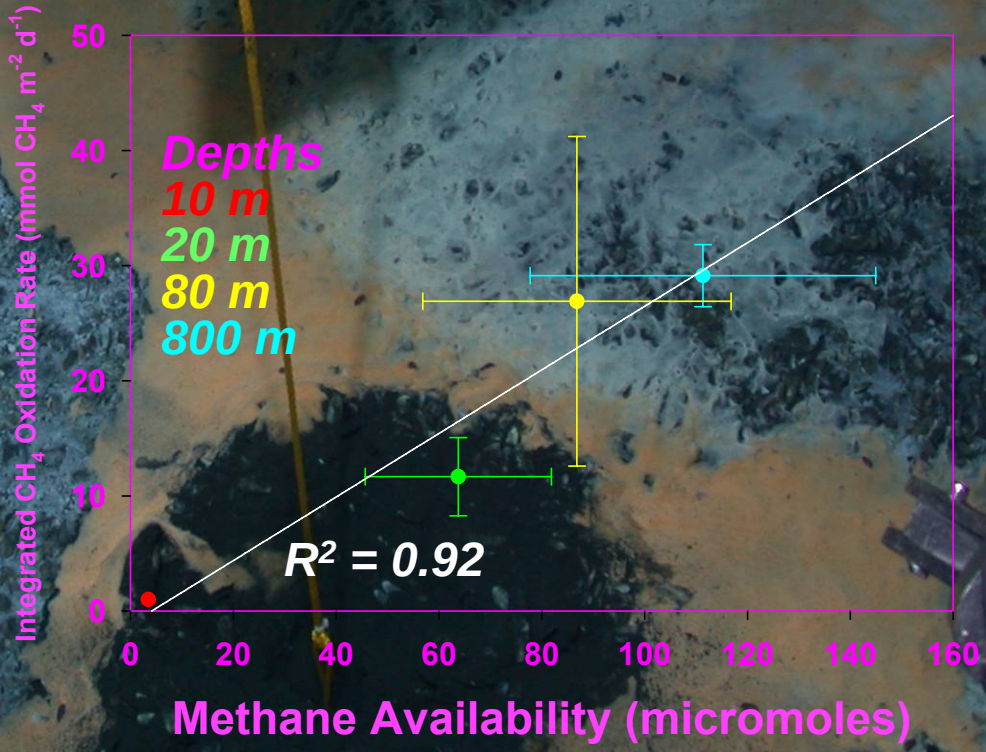
For more see Presentation: B53C-04

**In Collaboration with Chris Reddy*

Controls on Methane Oxidation in Seeps along a Depth Transect

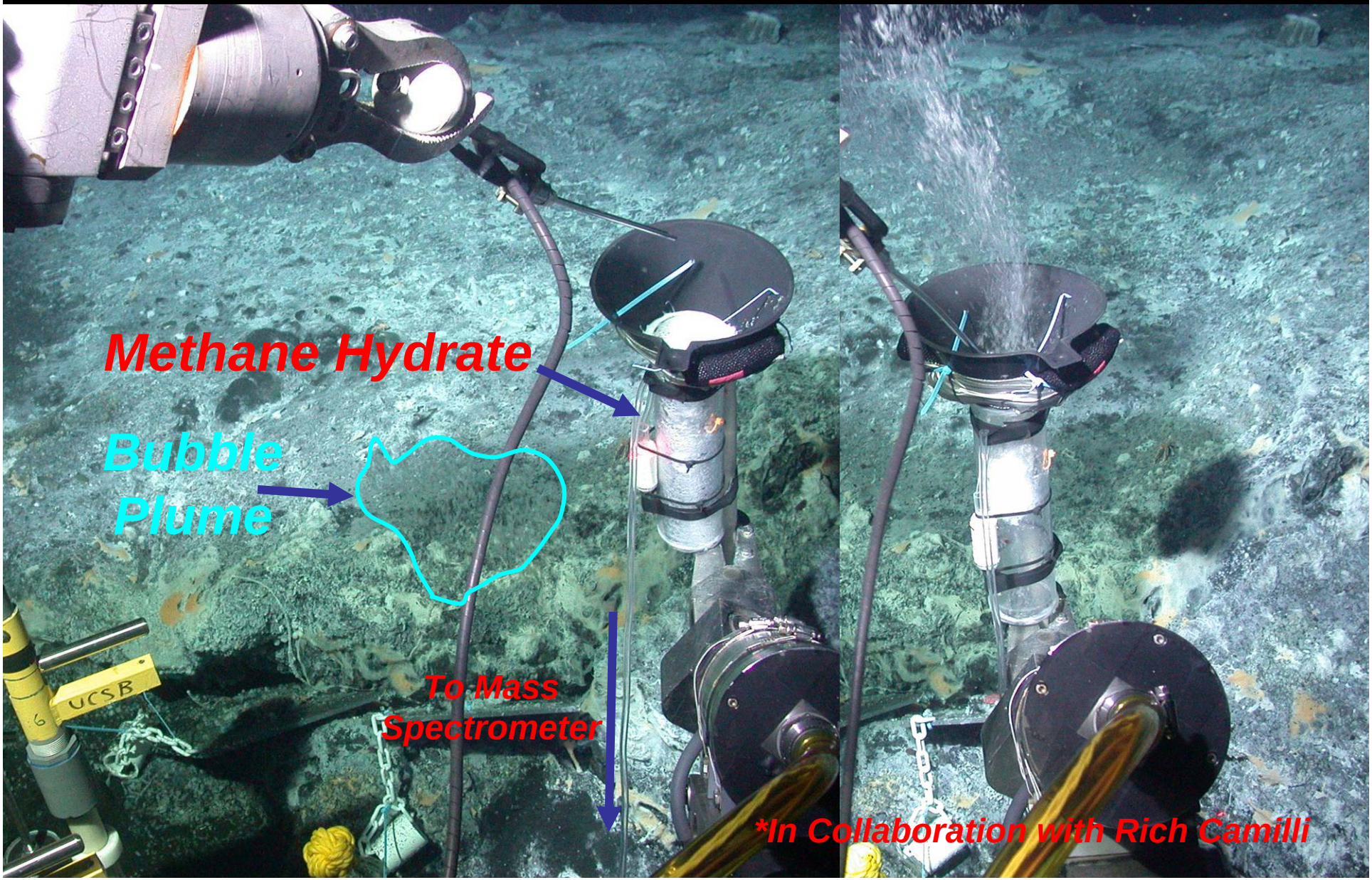
→ Seep dives from 80 to 800m depth.

→ CH_4 Availability and depth control oxidation rate.



*Work of Frank Kinnaman (see poster B43E-1652)

In-situ Mass spectrometric analysis of gas hydrate



Raymond Lee

Aug 26 – Sep 6, 2007

Thermal biology of vent paralvinellids

- PIs – Ray Lee Wash St. U; Peter Girguis Harvard U.
- Other participants – L. Levin SIO; M. Lilley U Wash; W. Ziebis USC; K Halanych Auburn; P. Yancey Whitman College
- 26 Aug – 6 Sept – 10 NSF funded Alvin dives
- Year 1 of 3 yr project

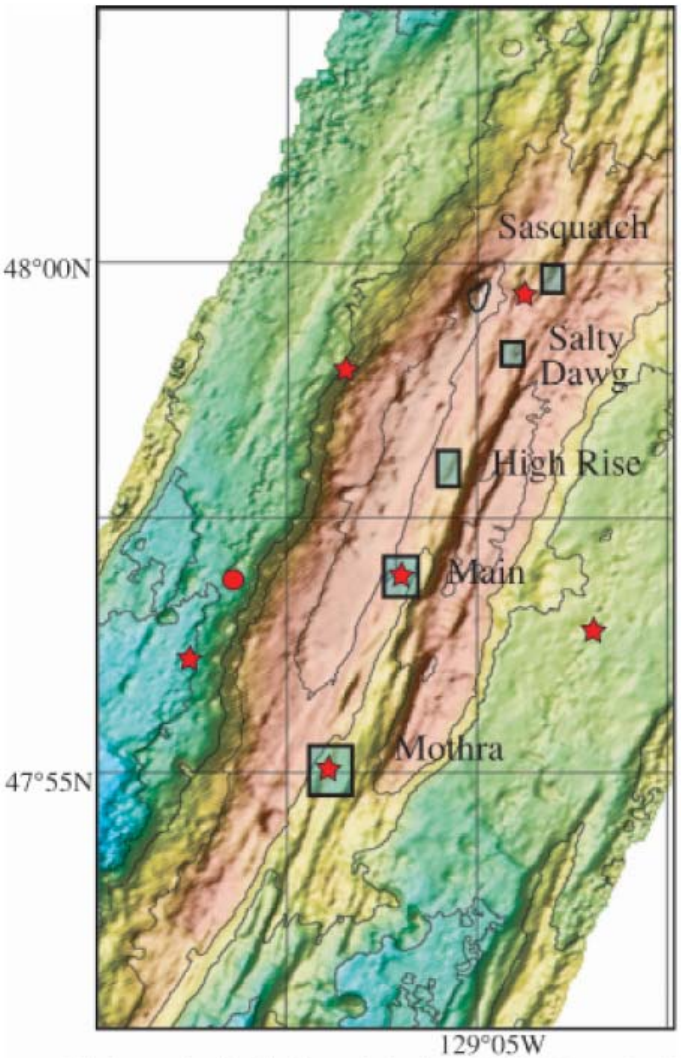
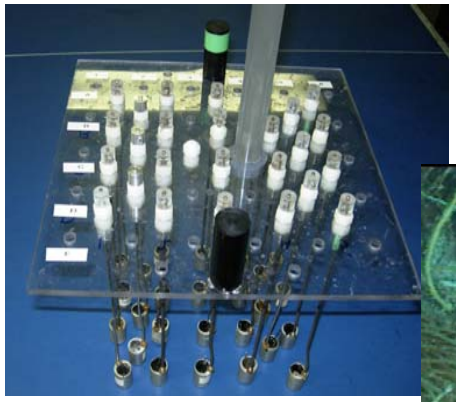
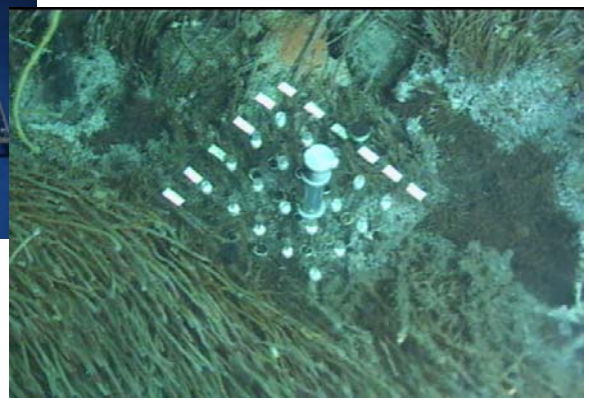
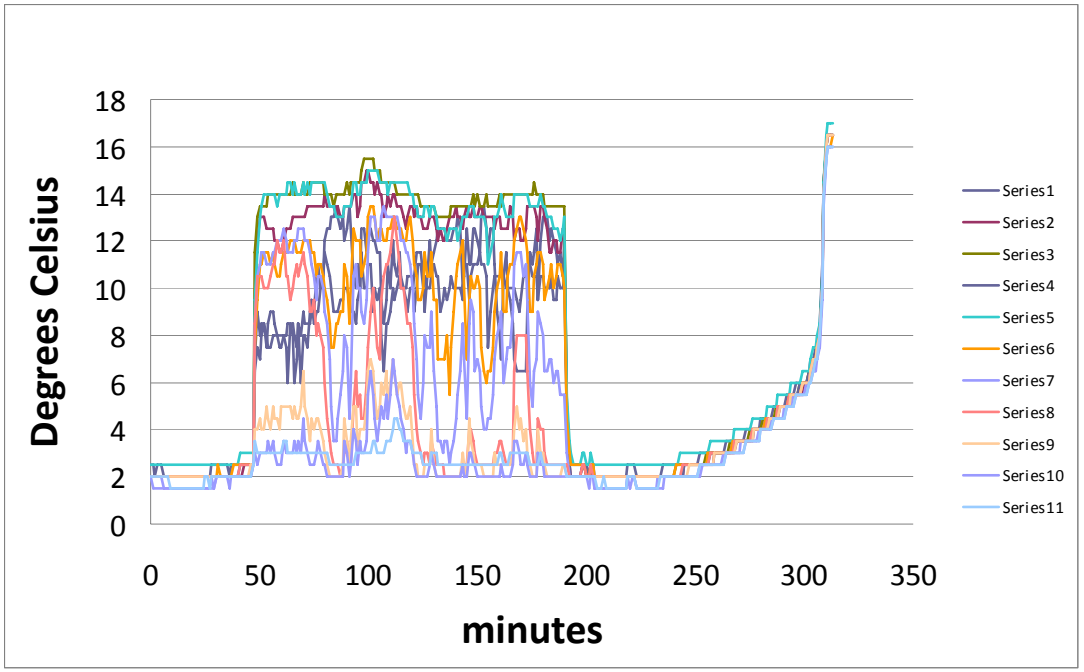


Figure 3. Close up of Endeavour showing five known hydrothermal fields. This study will dominantly focus on the Mothra and Main Endeavour fields, with only very limited dives in High Rise and Salty Dawg. Night operations will include CTD tow-yos north of Sasquatch and south of Mothra within the axial valley to explore for new vents. Red stars and single circle denote locations of in situ seismometers.

- Canadian clearance was late
- Suction sampling of biology with new sampler
- Pressurized incubations of animals on board ship
  - Lee – temp shock, temp pref, Y-chamber
  - Girguis – temp effects on molecular param.
    - Ridgeia expts
- Recovery/deployment of Kelley/Girguis microbial incubators
- Deployment of whale bone settlement expts Levin



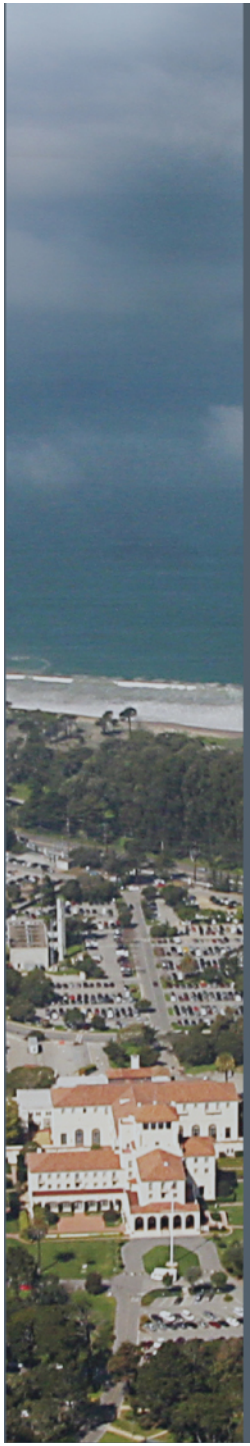




- Pushcores Middle Valley
- Girguis/Cordes tubeworm bush with C. Fisher Bushmaster
- Girguis in situ mass spectrometer
- Lee temperature array

Curt Collins

Sep 30 – Oct 6, 2007



NAVAL
POSTGRADUATE
SCHOOL

Hoke Seamount Mooring Recovery
DSV ALVIN Dive #4354

R/V ATLANTIS, Cruise AT15-24

30 September – 06 October 2007

Transit from Aberdeen, WA. to San Diego, CA. by way of Hoke Seamount

Dive Party: Pat Hickey- Senior Pilot; Marla Stone, NPS; Chris Miller, NPS

Cruise Objectives

Cruise/Research Objectives

Sea Beam Survey of Hoke Seamount-

successfully completed prior to DSV Alvin Dive

Sound Source & Acoustic Release recovery-

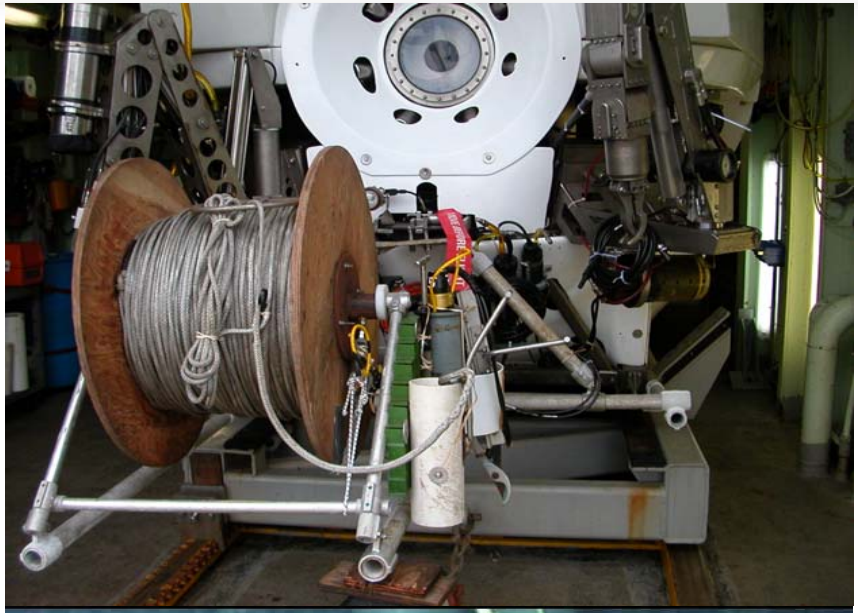
mooring deployed in Oct 2002, attempted recovery in Oct 2004
(swage socket failed, instruments fell to bottom in 800 m)
successful DSV Alvin recovery on 04 Oct 2007

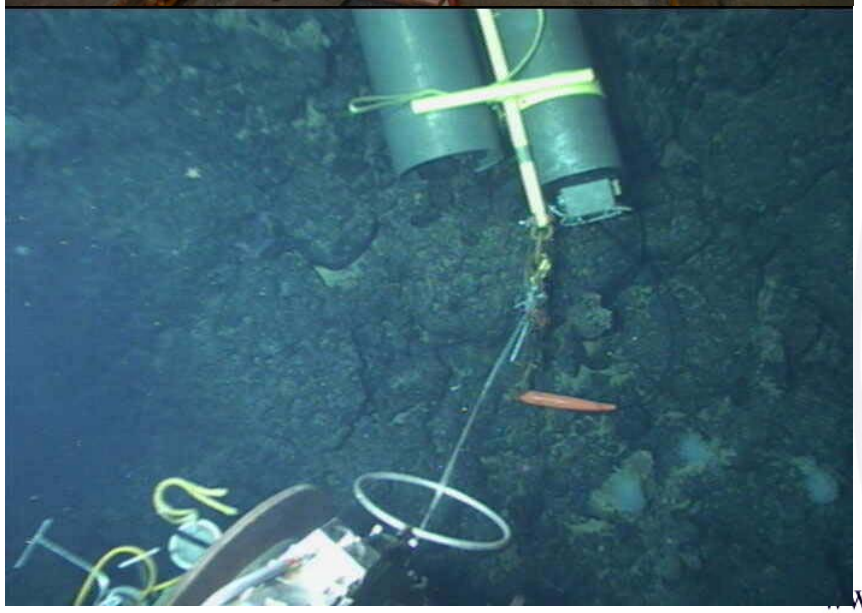
Mooring recovery

presently deployed mooring could not be located during descent
(Seabeam was left running)
dive time curtailed by weather
able to estimate approximate location during ascent using sonar

NAVAL POSTGRADUATE SCHOOL

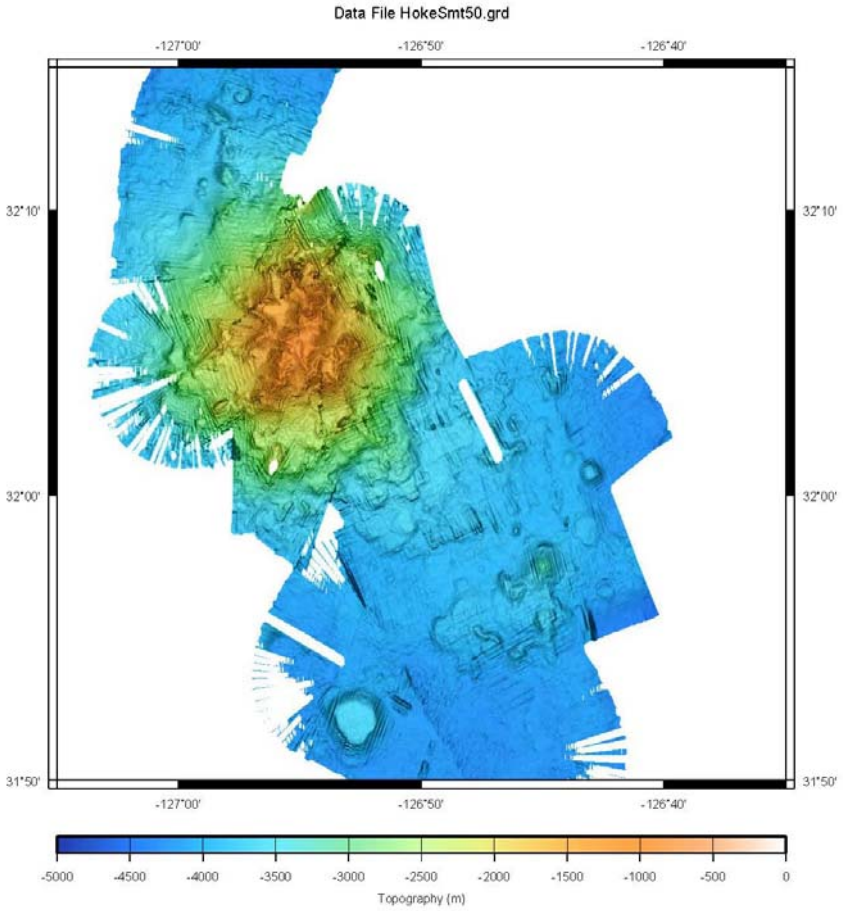
Equipment on Hoke Seamount





NAVAL POSTGRADUATE SCHOOL

Hoke Bathymetry



Failed Swage Fitting

Keir Becker

Sep 11-28, 2007

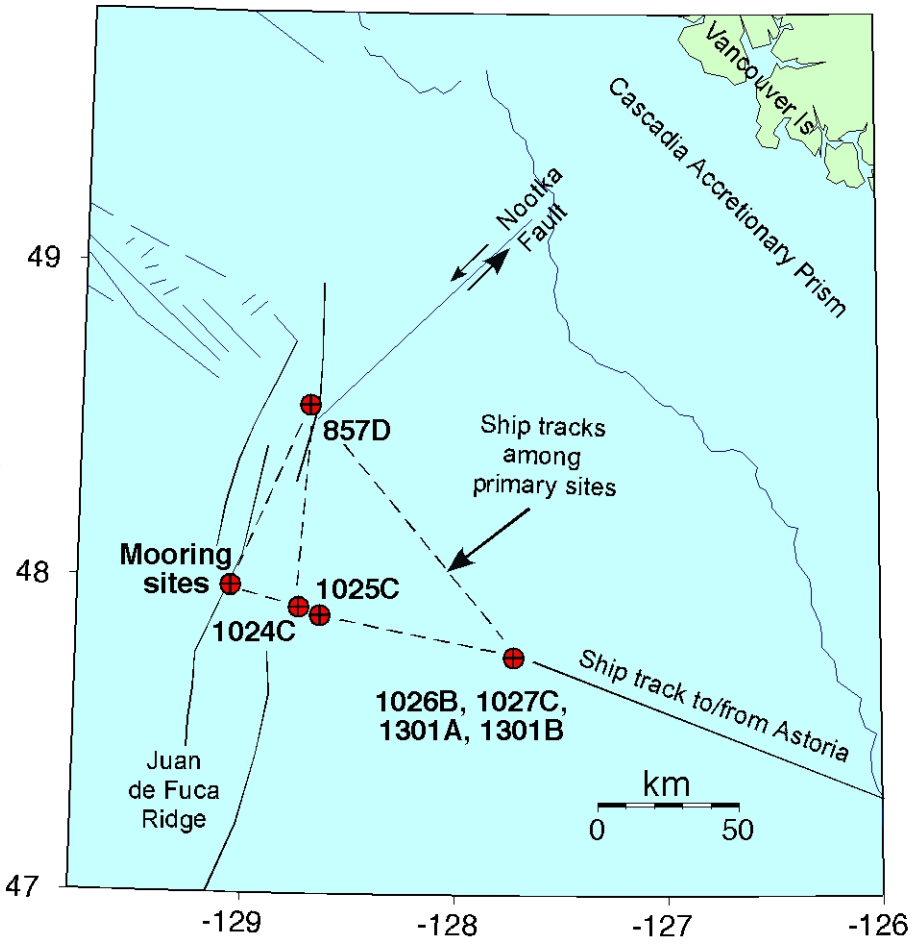
AT 15-23 Alvin Operations
11-28 Sept 2007, Juan de Fuca Ridge

Becker et al 12-dive program:

(a) 8 dives for routine data downloads and instrument servicing at 7 CORK observatories

(b) 4 dives for remedial wellhead cementing at 1301A/B CORKs

Di Iorio 3-dive program: survey, acoustic mooring recovery + redeployment at Dante on Endeavour axis

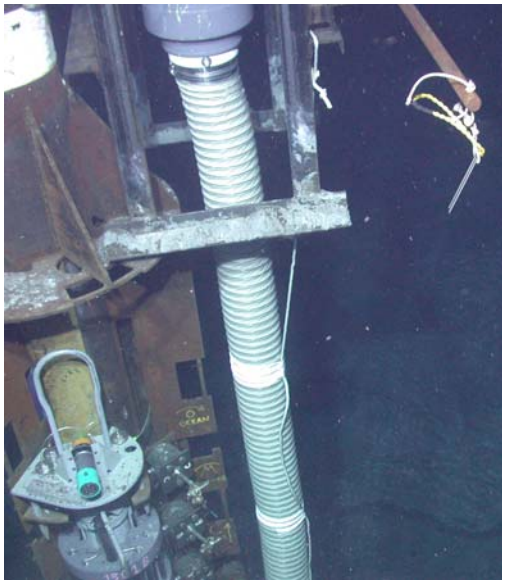


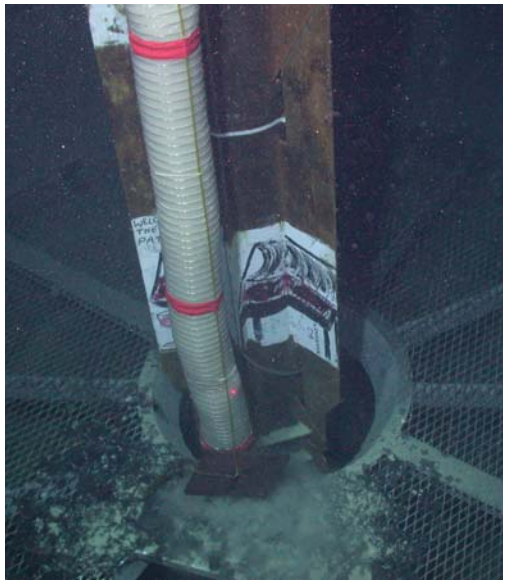
Four educators sailed; see http://www.joiscience.org/learning/atlantis

AT 15-23 Alvin Operational Summary

Despite one big issue - weather (next slide) - all primary objectives were achieved, thanks to good pre-cruise planning and flexible at-sea support from Alvin team and Atlantis officers and crew.

Just one highlight (right): successful delivery of five 55-gallon drums of cement to plug leaky wellhead at the 1301B CORK.
A key to this success was co-PI visits with Alvin team at port calls ~8 and 3 weeks pre-cruise, in addition to formal pre-cruise conf. call.





Special thanks: G. Wheat, H. Jannasch, P. Hickey, B. Strickrott, NSF

AT 15-23 Weather Issues

AT 15-23 lost 5 of 15 scheduled dive days, mainly to weather, or 1/3 of the dives for each program. (We regained a short dive on the transit day at site closest to port.) Is mid- to late-September a viable scheduling window at Juan de Fuca?

During 5 mid- or late Sept Alvin programs to Juan de Fuca CORKs since 1997, weather losses have totalled 17 of 57 dive-days, or 30%. If the 1997 program rescheduled to Oct is neglected, losses were 13 of 46, or 28%.