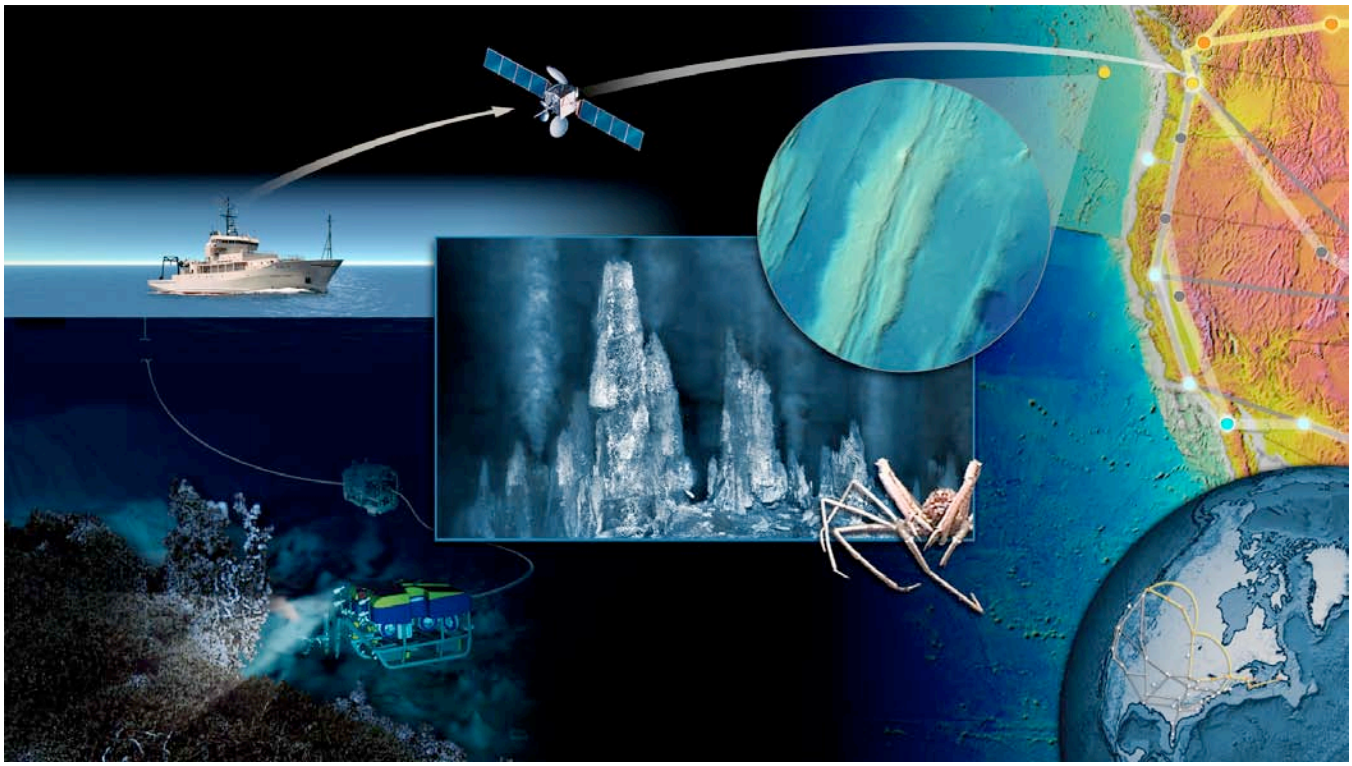
VISIONS05

Virtual Integrated Science For Interactive Ocean Network Systems Expedition R/V Thomas G. Thompson TN183-184

September 1 – October 4, 2005



Co-Chief Scientists
John R. Delaney & Deborah S. Kelley
University of Washington

jdelaney@u.washington.edu
kelley@ocean.washington.edu

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Participants

University of Washington

John R. Delaney	Co Chief Scientists
Deborah S. Kelley	Co Chief Scientists
Minhui Lin	Masters Student
Janet Beckman	Outreach
Mitch Elend	Oceanographer
Deborah Glickson	Ph.D Student
Andrew Barclay	Post Doc
Marv Lilley	Scientist
David Butterfield	Scientist
Kevin Roe	Oceanographer
Andrew Opatkiewicz	Masters Student
Will Wilcock	Scientist
Eric Olson	Oceanographer
Susan Lang	Ph.D Student
Ben Larson	Ph.D Student
DeeDee Meldrum	Scientist
Ginger Armbrust	Scientist
Rhonda Marohl	Oceanographer
Dave Robertson	UWTV Engineer
Peter Rummel	UWTV Research Channel
Charles Lake	UWTV Research Channel
Celeste Glende	UWTV Research Channel
Bill Martin	Science Support Technician
Robb Hagg	Science Support Technician

National Science Foundation

Alex Isern

University of Ottawa

Francoise Labonte

Woods Hole Oceanographic Institution (ABE)

Dana Yoerger	Scientist
Al Duester	Engineer
Andy Billings	Engineer

University of Oregon

Emile Hooft Scientist

Harvard University

Peter Girguis Scientist
Spence Nyholm Scientist

Scripps Institution of Oceanography

Alison LaBonte Ph.D. Student

SPAWAR

Barbara Fletcher Engineer

JASON 2

Andy Bowen	Expedition Leader (Leg 1)
Phil Forte	Expedition Leader (Leg 2)
Paul Tucker	
Vicki Ferrini	
Bob Waters	
Jonathan Howland	
Tito Collasius	
Dara Scott	
Tom Crook	
Steve Gegg	
Jim Varnum	
Casey Agee	

REVEL

Veronique Robigou	Director REVEL
Jo Dodds	Twin Falls, Idaho
Carol Dundorf	Hershey, Pennsylvania
Mary Goff	Central Point, Oregon
Theresa Pinilla	Stockbridge, Georgia
David Randle	AMNH, New York

University of Fairbanks

Geoff Wheat Scientist

Monterey Bay Aquarium Research Institute

Paul McGill Engineer

Wright State University

Jeff Smigelski

TN183-184 Cruise Summary

The VISIONS05 expedition was a highly interdisciplinary, complex cruise focused on the Endeavour Segment of the Juan de Fuca Ridge and the accretionary margin near the intersection of the Nootka Transform Fault and subduction zone off the west coast of Vancouver Island. The project was funded through the National Science Foundation, the W.M. Keck Foundation, University of Washington, WHOI, NOAA, and Neptune Canada. Because of the complexity of this mission the cruise included three legs, which involved two ship-to-ship transfers (R/V Atlantis to the R/V Thompson; F/S Frosty to the R/V Thompson) and a transfer by floatplane in Nootka Sound. During this program 16 *JASON* dives were completed with a total bottom time of 277 hours. Instruments either deployed or recovered included: 10 short-period and 3 broadband seismometers, 1 acoustic hydrothermal node (flow meter, an *in-situ* temperature-resistivity-hydrogen probe, and a heat flow probe), three *in-situ* flow-chemical sensors, three *in-situ* microbial incubators with temperature and hydrogen sensors and time-series fluid sampling capabilities, three microbial colonization experiments, three *in-situ* temperature-resistivity-hydrogen probes, two *in-situ* remote access fluid samplers, one *in-situ* particulate DNA fluid sampler, and one hydrophone. In addition, numerous fluid samples were taken, and limited biological and rock sampling and extensive imaging were completed.

The cruise was remarkably successful, completing ~99% of the goals initially planned. Highlights of the cruise included:

- The first live transmission of high definition video imagery from the seafloor and completion of three broadcasts ((http://www.visions05.washington.edu). The transmission was streamed from the R/V Thompson over the Galaxy 10R Satellite to the University of Washington (UW) campus. From the UW, imagery were seamlessly transmitted over Internet 2 and streamed as high definition imagery across the US, Canada, Australia and Tokyo. During the cruise there were >1 million hits on the web site. The broadcasts were also show live on the UWResearch Channel (http://www.researchchannel.org/visions05/multimedia.asp) and on the web and are still accessible online. The cruise also maintained an active web sight, providing a daily log and significant imagery (http://www.visions05.washington.edu).

- Intense field operations that resulted in recovery and redeployment of an extensive suite of instruments along the Endeavour Segment, sampling of water, sulfides and microorganisms in three of the five fields; recovery of all instruments from the Keck proto-Neptune observatory at the Nootka study area.

- The first use of an underwater “lightpost” that allowed stunning HD imagery to be taken of large sulfide sctructures.

- Completion of a very high resolution map (~ 5 m) of the Endeavour Segment using the autonomous vehicle *ABE* and SM2000 sonar system.

- The first *ABE* dives concomitant with *Jason 2* operations, allowing extremely efficient ship use.

- Continuation of the REVEL program, which included 5 new REVEL teachers and 2 mentors.

The success of this cruise is remarkable considering the difficulties faced due to weather (5 days lost) and numerous equipment problems (~3 days lost), which included 1) flooding of a pressure housing and subsequent fire in the housing of *Medea*; 2) failure of the winch system; and 3) failure of a fiber requiring

replacement of the tether between *Medea* and *Jason*. In addition, a faulty transmitter for the satellite required the Thompson to transit into Neah Bay early on in the cruise.

The following sections provide an overview of the major components of this cruise, followed by daily logs of events. A summary table of operations is provided in Appendix 1.

1.1 The First Live Streaming of High Definition video From Sea

The first live streaming of high definition video imagery from sea occurred during the VISIONS05 expedition (http://www.visions05.washington.edu). This event was technologically and operationally challenging because of high data rate transfers, transmission angle to the satellite, and because of weather considerations. This experiment was in part funded by the LOOKING PROJECT, a National Science Foundation program to examine mechanisms by which oceanographers can optimize their efficiency and effectiveness at operating a NEPTUNE-like (www.neptune.washington.edu) seafloor observatory via fiber optically connected instrumental arrays. As one element in that effort we chose an early test case of utilizing Band Width limited HDTV data streams from the deep-sea floor to illuminate the environment associated with submarine hydrothermal systems at a depth of nearly 2.3 km. Additional funds for this project were provided by a SGER grant for purchase of a ZUESS HD camera from Insite Pacific, and by NOAA, the KECK Foundation, and the University of Victoria. A high-speed satellite modem (20 Mbps), a KU-Band RF transceiver system and a Galaxy-10R satellite provided part of the technology to transfer imagery and voice live from sea.

During this program, a reliable 15Mbps IP satellite link was achieved for HD video transmission in addition to communications necessary for a live production (Figure 1). A separate 512Kbps bi-directional link to support network and internet access as well as IP phones was maintained during times when the high bandwidth link was not scheduled. At times the ship's heading precluded maintaining the link due to blockage of the dish by the ship's mast and/or stack.

During this program three live broadcasts were completed September 27, 28 and 29 from onboard the R/V Thompson, with two shows broadcast to the iGRID US119 conference. This project transported real-time HD video from the seafloor via satellite using HD broadcast encoders and IP Gateways. At the UW the decompressed video from the Ship was part of a live HD production in the studios of UWTV. The resulting program was distributed via several methods:

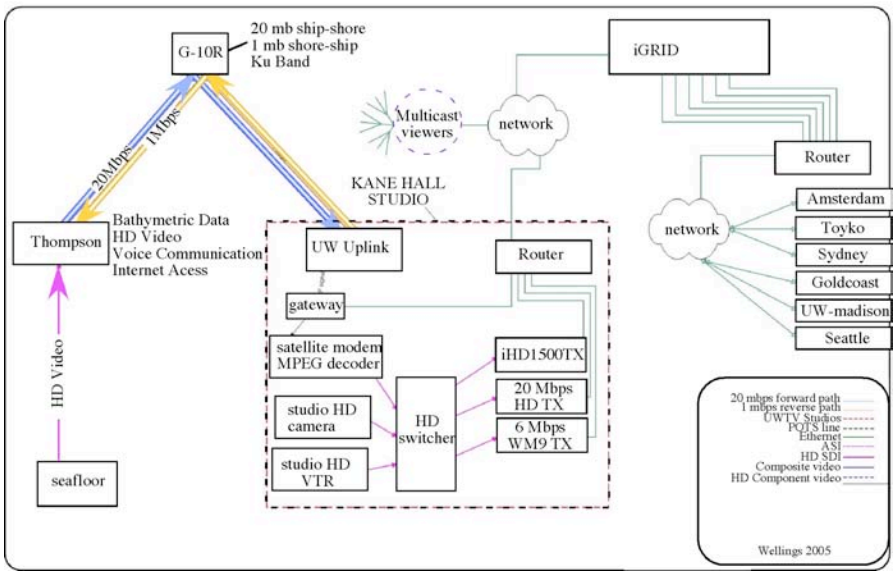


Figure 1. Flow chart of major components for the streaming of live high definition video from the seafloor, and for the production of live broadcasts.

1. Live HD video delivery to Calit2 UC San Diego (iGRID 2005 conference) from UWTV Studios, Seattle
    a. Uncompressed HD/IP – viewable in Kane Hall Studios (up to15 invited guests)
    b. Uncompressed HD/IP – viewable by iGRID 2005 attendees and demo participants at partner institutions in several countries
2. Live multicast HD transmissions
    a. MPEG2 1080 60i HD multicast (ip address to be published later) viewable using VLC (http://www.videolan.org/)
    b. Windows Media 9 HD 720p multicast
3. Live Television broadcast – Standard Definition
    a. Live broadcast via ResearchChannel – ch 9400 DISH500 network
    b. Available on some cable systems
    c. Viewed directly on Satellite G-10R. Contact info@researchchannel.org for downlink information
    d. Live multicast @ 233.0.73.29 viewable using VLC (http://www.videolan.org/)
    e. Live multicast in Windows Media Format at www.researchchannel.org

The program was highly successful with over 1 million hits on the web site during the cruise. Subsequent to the cruise, the shows were transferred onto DVD's and hundreds have been provided to the public.

1.2 JASON 2 Operations

JASON completed sixteen lowerings with a total bottom time of 277 hrs (Table 1: Appendix 1). This was a very challenging cruise for the vehicle because of intense demands related to drilling of active sulfide chimneys (Figure 2) and a very intense schedule for instrument deployments and recovery. Prior to the program *Medea* had been completely overhauled, rewired, and a thruster was added. During the first dive, a pressure valve failed, resulting in flooding of the main canister and a fire inside the pressure housing. The system had to be rewired to the old specs, exclusive of the thruster. In addition to the initial failure of Medea, the cruise was almost terminated because of the failure of the DYNACO winch system. After several hours of working on this system, and multiple phone calls to shore, the winch was eventually fixed. A third failure of the system occurred when a fiber was lost, resulting in termination of the dive and replacement of the tether between *JASON2* and *Medea*. A summary of dive statistics and locations are provided in Table 1. Bottom time is somewhat misleading because on many dives, *JASON2* transited to for several hours in the water to other work sites to avoid a 12-hour deck period for turnaround. On these dives, the elevators were routinely used to transport instruments and samples to and from the seafloor. Individual dive summaries are provided in Section 2.0**.**

1.2.1 JASON Engineering Day Testing of New LED Strobe/Camera

During Lowering 180, Jonathan Howland of the Deep Submergence Laboratory tested a new LED strobe/camera combination. The LED-based strobe is a prototype developed for use on DSL autonomous and remotely operated vehicles such as HROV. It is composed of 60 5 Watt Cyan LEDs, arranged to cast a circular even beam pattern on the sea floor. For the lowering 180 test, the strobe was mounted on *JASON*'s port swing arm, where it could be used in both the deployed and housed position.

The camera used for the test is a 12-bit CCD, developed in the machine vision industry. The significant part of the camera assembly is the telemetry component that uses a Camera Link to Ethernet translation device. Camera Link is a machine vision standard, used for data and control by hundreds of industrial and scientific digitial camera systems. The translation of the standard to ethernet means that with some relatively simple software development, the digital image data from the system is viewable and available for processing on the surface in near-real time. This provides a significant advantage over the consumer

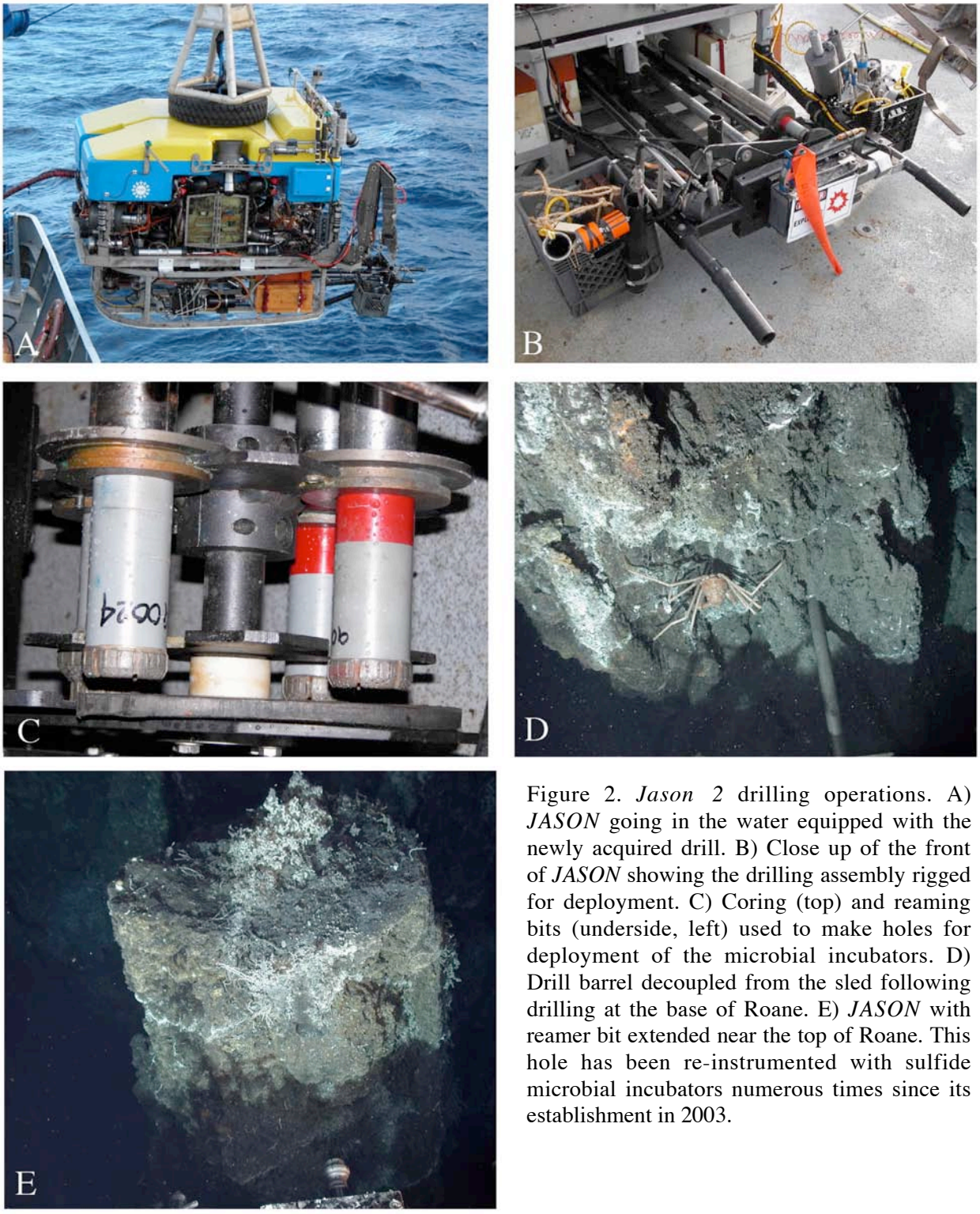


Figure 2. *Jason 2* drilling operations. A) *JASON* going in the water equipped with the newly acquired drill. B) Close up of the front of *JASON* showing the drilling assembly rigged for deployment. C) Coring (top) and reaming bits (underside, left) used to make holes for deployment of the microbial incubators. D) Drill barrel decoupled from the sled following drilling at the base of Roane. E) *JASON* with reamer bit extended near the top of Roane. This hole has been re-instrumented with sulfide microbial incubators numerous times since its establishment in 2003.

grade USB-based digital still cameras in common use. The camera was mounted on *Jason*'s basket. The strobe/camera combination test was successful. Several thousand digital images were collected. The synchronization of camera and strobe, and the efficacy of the Cyan LED lighting will be evaluated when the system is returned to the Deep Submergence Laboratory.

Table 1 *Jason* Dive Statistics

Lowering	Launch	Start Data	End Data	End/On Deck	Area
J2-165	9/5/2005 2:33	9/5/2005 4:15	9/5/2005 21:25	9/5/2005 23:05	Mothra
J2-166	9/6/2005 13:33	9/6/2005 15:13	9/7/2005 2:59	9/7/2005 4:45	Main Endeavour - Hulk/Crypto
J2-167	9/7/2005 15:36	9/7/2005 16:47	9/7/2005 23:57	9/8/2005 1:39	Mothra/Faulty Towers
J2-168	9/8/2005 3:29	9/8/2005 4:53	9/8/2005 9:59	9/8/2005 11:21	Mothra/Faulty Towers
J2-169	9/11/2005 6:40	9/11/2005 8:58	9/12/2005 8:32	9/12/2005 10:12	Nootka Seep
J2-170	9/12/2005 19:00	9/12/2005 20:19	9/13/2005 1:07	9/13/2005 2:54	Explorer Plate
J2-171	9/13/2005 18:04	9/13/2005 19:27	9/14/2005 3:18	9/14/2005 5:38	Main Endeavour - Hulk/Crypto
J2-172	9/15/2005 7:47	9/15/2005 9:06	9/16/2005 0:04	9/16/2005 1:50	Endeavour
J2-173	9/16/2005 11:01	9/16/2005 12:06	9/16/2005 12:37	9/16/2005 13:43	Nootka Seep
J2-174	9/17/2005 3:44	9/17/2005 5:11	9/18/2005 2:04	9/18/2005 4:40	Nootka Seep
J2-175	9/18/2005 23:52	9/19/2005 1:21	9/20/2005 3:36	9/20/2005 5:23	Endeavour
J2-176	9/21/2005 0:59	9/21/2005 2:28	9/22/2005 0:35	9/22/2005 2:11	Mothra/Faulty Towers
J2-177	9/22/2005 23:51	9/23/2005 1:23	9/23/2005 15:57	9/23/2005 17:22	MEF - Hulk/Gremlin
J2-178	9/25/2005 20:54	9/25/2005 22:11	9/27/2005 2:08	9/27/2005 3:35	Endeavour
J2-179	9/27/2005 16:37	9/27/2005 17:48	9/28/2005 13:11	9/28/2005 15:48	MEF - Hulk/Gremlin
J2-180	9/30/2005 20:26	9/30/2005 21:35	10/3/2005 2:50	10/3/2005 4:18	MEF, Mothra, S&M

16 Lowerings **Total Bottom Time: 277:20:50** **Total In Water Time: 328:19:37**

1.3 Mapping Efforts

1.3.1 EM300

The main mapping objective, using the EM300 multibeam sonar system, was full coverage of the planned NEPTUNE Canada cable route in support of the US-Canadian NEPTUNE Observatory effort (Figure 3). We successfully accomplished this goal, mapping all parts of the deep-water cable route that did not have prior coverage. These five surveys covered almost 350 km of trackline in water depths > 2000 m. In addition, we continued our ongoing segment-scale mapping effort near the Endeavour Segment and

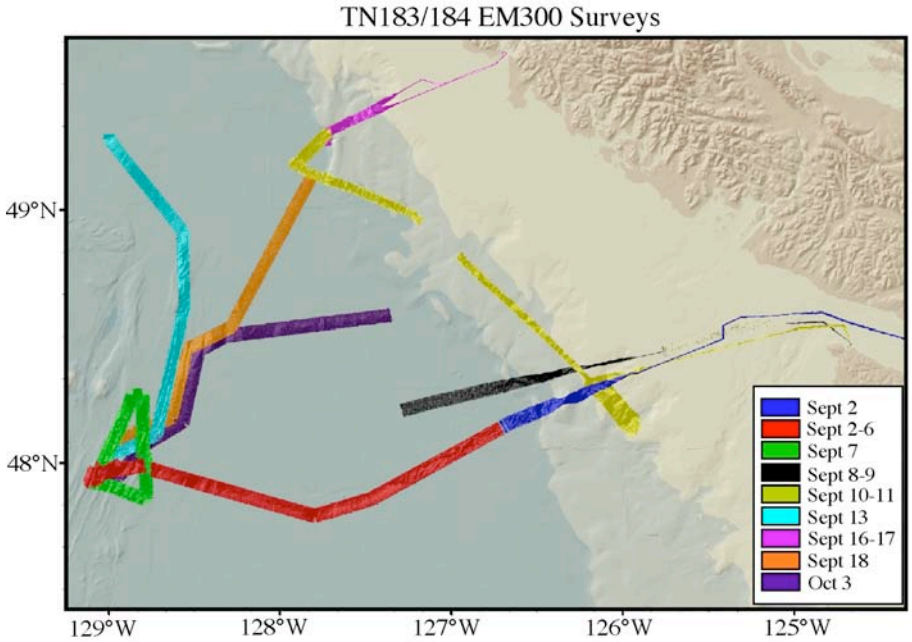


Figure 3. EM300 surveys completed during the VISIONS05 expedition.

Nootka and filled in some bathymetry along the Vancouver Margin. These surveys collected over 500 km of trackline. At the water depths of this survey, the system is generally able to resolve seafloor features of less than 50 m across. Due to the transit speed of some surveys, which induces additional noise, resolution may be limited to 75-100 m.

1.3.2 Autonomous Benthic Explorer - *ABE*

To obtain the highest resolution bathymetry possible of the Endeavour Segment, the Autonomous Benthic Explorer (*ABE*) was used on a series of 10 missions (Figures 4-6). The primary sensors for the cruise included *ABE's* multibeam sonar (SM2000), supported by *ABE's* navigation suite (long baseline transponders, RDI 300 khz Doppler navigator, and a TCM2 magnetic compass). Transponder locations for *ABE* and *JASON2* work are shown in Figure 7: coordinates for each transponder are provided in Appendix 2. *ABE* also logged water column data with two Seabird CT sensors, optical backscatter, and an eH probe. This cruise marked the first time that *JASON2* dives and *ABE* dives were synchronous. This allowed extremely efficient use of the ship and vehicle time. *ABE* performed remarkable well and the missions resulted in nearly complete coverage of the central portion of the Endeavour Segment. The resulting maps will be used to help route the cable and to site the Endeavour node for NEPTUNE Canada, to site, instruments, and to address basic science questions.

During the 10 dives, *ABE* covered 242 km of tracklines over 108 hours of survey time. The first dive did not gather any survey data because the vehicle was ballasted too heavy to follow the seafloor. *ABE* collected high quality data on all later dives, although one dive (*ABE* 164) was cut short when *ABE* became entangled in a floating line anchored to the seafloor. *ABE* was subsequently freed by *JASON 2*.

Figure 4. Left and middle image show *ABE* being launched while *JASON*2 was operating on the seafloor. Right image shows *ABE* entangled in an old mooring line ~100 m above the axial valley floor. The line was cut using *JASON 2* and was brought back onboard safely.

A key element of the cruise was coordinated operations with *JASON2*. Coordinating the schedules relied heavily on a newly developed anchoring system. Previously, *ABE* had operated in sequence with *JASON*2, with only one vehicle in the water at a time. During this cruise, both vehicles were in the water during most *ABE* operations. At the beginning of the cruise, *ABE* was launched between *JASON* dives, followed by launching of *JASON. ABE* surveyed until the batteries were depleted, then it would descend to the seafloor, anchor and shut down most of its power consuming systems. *ABE* surfaced subsequent to a prearranged reaching a prearranged deadline or when an acoustic code was sent after *JASON* had been recovered. By the end of the cruise, *ABE* was launched while *JASON* was still working on the seafloor, providing wide flexibility. One *ABE* recovery was made with *JASON* still working on the seafloor after *JASON* freed *ABE* from the floating line. Without the anchoring system, there would have been far more disturbance to *JASON* operations and fewer dive opportunities for *ABE*. A full *ABE* report is included in Appendix 3.

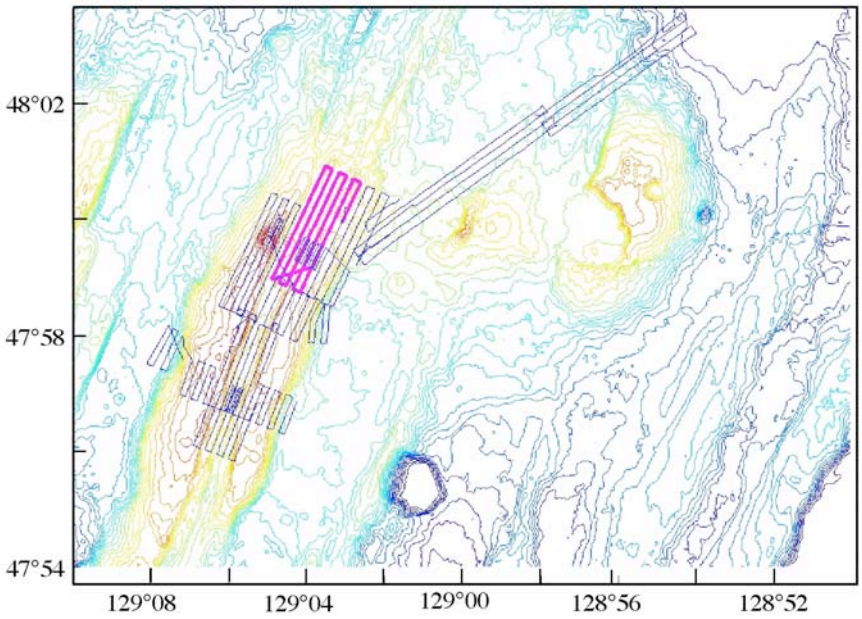


Figure 5. Summary of nine *ABE* missions (*ABE*157-165).

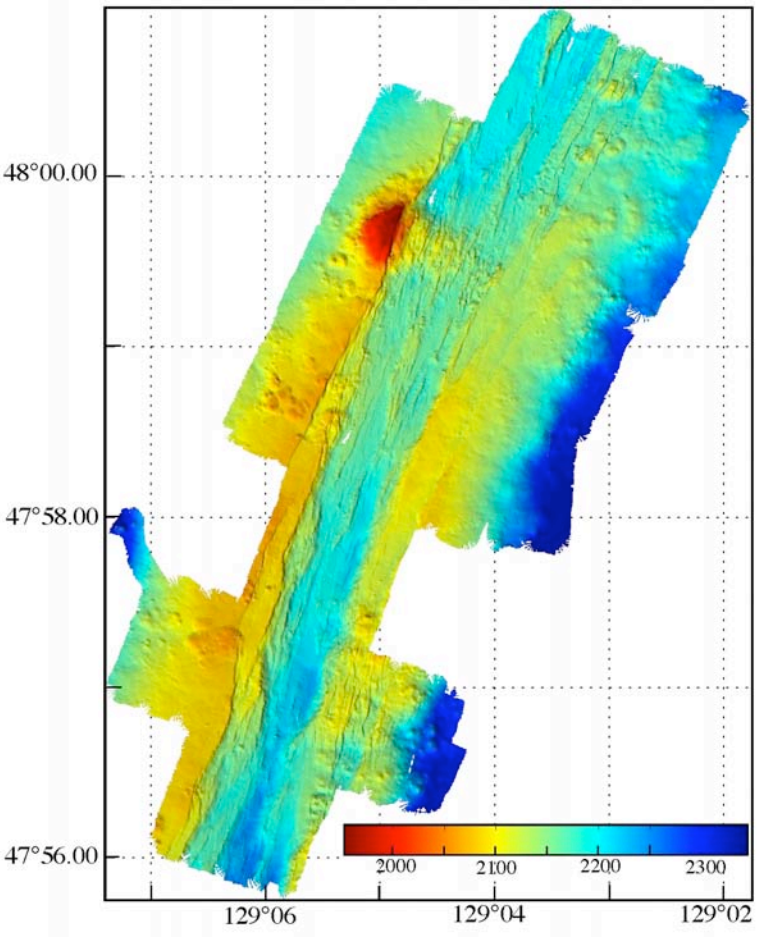


Figure 6. High resolution *ABE* bathymetry of the Endeavour Segment using the SM2000 sonar.

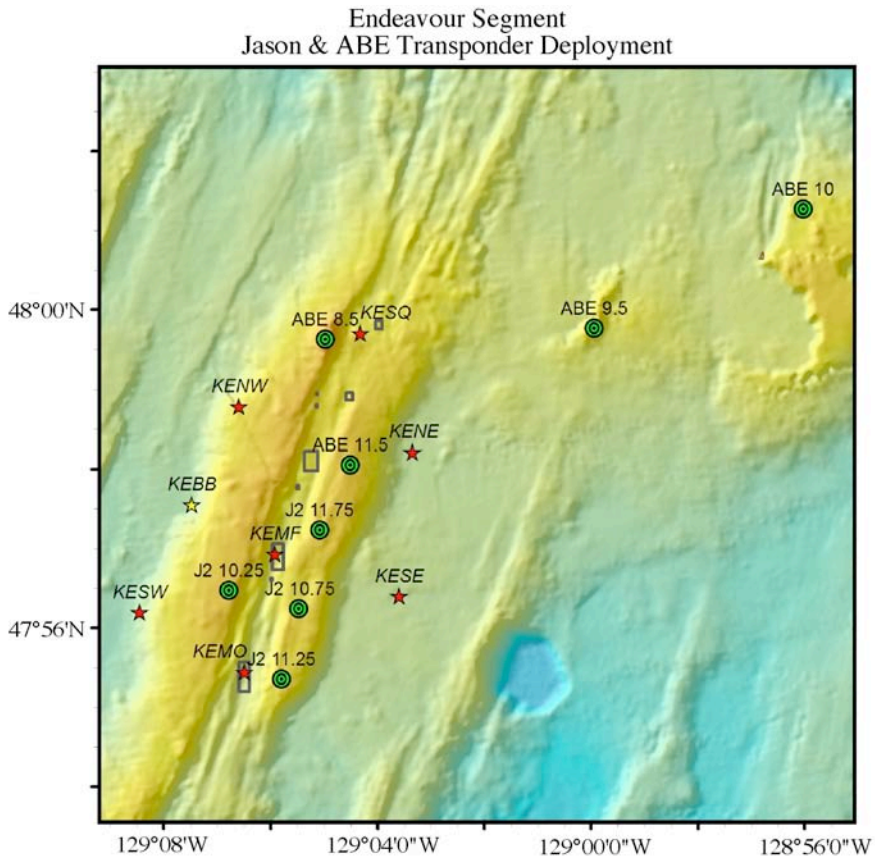


Figure 7. Transponder locations for *JASON* and *ABE* dives during VISIONS05. *ABE* transponders were cycled to obtain optimal navigation.

1.4 Microbial Incubators

The first 16 days of the VISIONS05 cruise were funded by the National Science Foundation RIDGE2000 program with the goal of deploying microbial incubators into the walls of active black smoker chimneys (Figure 8; Table 2). This experiment focuses on the initial quantification of 1) the upper temperature limit to life, 2) the kinds of microbes that inhabit the walls of active black smoker chimneys, and 3) the extreme environmental conditions under which they live. The prototype incubators include a 4-chambered barrel assembly that allows *in-situ*, continuous recording of 36 temperatures within the interior walls of mature, active hydrothermal chimneys. One chamber includes a sensor for continuous measurement of dissolved hydrogen (H_2), and two osmo samplers for coregistered time-series sampling of hydrothermal fluids in two of the chambers. A data-logging package is enclosed in a second titanium pressure housing that allows continuous measurements of temperature and H_2 to be stored for the duration of the experiment. Sterile mineral phases and synthetic materials are placed inside each chamber for colonization surfaces for microorganisms.

During the VISIONS05 cruise three second-generation incubators were deployed in two chimneys (Giraffe and Roane)(Figure 8) in the Mothra Hydrothermal Field, and two chimneys (Gremlin and Hulk) in the Main Endeavour Field. One of these instruments was recovered from Roane and from Gremlin (Figure 8), two instruments remain in place for a year-long deployment: they will be recovered during a 10-day Alvin program in August-September 2006. Leveraging time between the NSF and Keck-funded work allowed time-series incubation experiments to be completed. It also resulted in the first tracer experiment in which fluids where pumped into the chambers to examine conditions of fluid flow and microbial activity. Similar to our first program, testing of these second generation instruments was

extremely successful. For the first time in any vent system we were able to obtain *in-situ* colonization of microorganisms with co-registered measurement of temperature and time-series fluid compositions. Phylogenetic analyses are underway, however, clone libraries have already been completed and probes are being developed for analyses of key populations. This work is the focus of a master's project by a Kelley-Baross student (Min Lin). In addition to the fully instrumented microbial incubators, three "poor-man" incubators were deployed in the Mothra (Roane-top) and Main Endeavour Fields (Hulk).

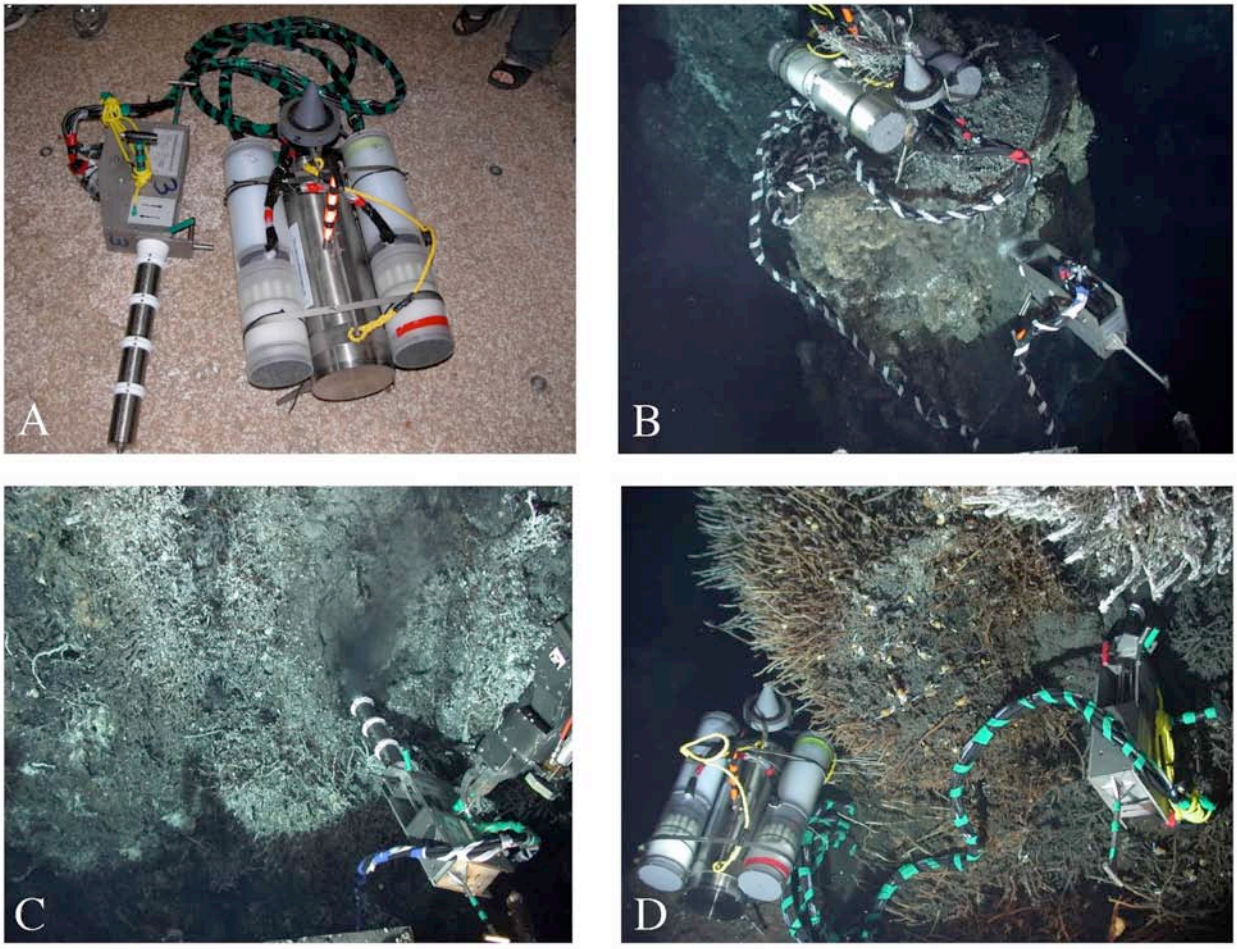


Figure 8. A) Microbial incubator rigged for deployment including two OsmoSamplers. B) Incubator in the top of Roane. C) Incubator being deployed near the top of Giraffe. D) Incubator in Gremin.

Table 2. Summary of Microbial Incubator Deployments

Site	Deploy Dive #	X Alvin	Y Alvin	Depth (m)	Alt (m)	Recov. Dive #	max T (°C)	H_2O major
Roane top SMI1	165	4158	3298	2272.6	6	178	98.7	M5044
Giraffe SMI2	168	4168	3304	2266.6	6	future	204	M5046
Gremlin SMI3	166	5034	6242	2200.9	0.8	179	139	M5045
Roane base P1	167	4164	3295	2277.2	3.9	180	14.6	
Hulk P2	165	5051	6269	2187	10.4	180	N/A	N/A
Roane top P4	180	4159	3291	2273	8.6	future		
Hulk SMI1 redp	180	5042	6261		10.5	tuture		

SMI1-SMI3 full microbial incubators; P1-P4 osmosamplers + hobo incubatoras; water taken with major bottles

1.5 Osmo Samplers

OsmoSamplers are continuous fluid samplers that use the osmotic pressure generated by a salt gradient through a permeable membrane to draw fluid into a small bore sample tubing (Figure 8). The rate that fluids were drawn into the small bore tubing (1.1 mm ID Teflon) was designed for about 0.5 ml/day at 2°C. This rate is twice as fast at 22°C. Enough sample tubing was deployed so that even a yearlong deployment with the osmotic membranes at 25°C will captured fluids fully within the sample coil. Most of the fluid sampling OsmoSamplers included an acid addition pump to keep reduced dissolved metals in solution and to minimize adverse affects of Mn and Fe oxidizing microbes. Similarly, OsmoSamplers were configured as a pump to deliver nutrients and/or tracers at a fixed rate into the insert. This was accomplished by attaching a small bore tubing filled with nutrients and/or a tracer to the saturated salt side of the osmotic pump. The rate of injection is the same as that used for collecting fluid samples.

OsmoSamplers were deployed with the fully instrumented inserts, temperature only inserts, and by themselves. Samplers were deployed for three-week and yearlong periods. (Table 3). Samplers were used to monitor the fluid chemical composition within sulfide structures, providing a measure of chemical evolution and a geochemical context for microbial growth and mineral precipitation. Samplers configured to inject fluids into the sulfide structures were used to pump isotopically (stable isotopes) l*ABE*led nutrients and/or a tracer. Nutrients were pumped into the formation to determine if they are incorporated into microbial cells, providing evidence for *in-situ* microbial growth. These nutrient solutions included a rare earth element as a measure of dilution of the nutrients within the insert, constraining local hydrologic conditions. The injector coils were designed to first inject a tracer solution followed by a nutrient and tracer solution. For short-term deployments, tracer filled the tubing from the coil of Teflon tubing to the point of egress. The coil of Teflon tubing was filled with the nutrient and tracer. For the yearlong deployments, the coil of Teflon tubing was designed to deliver only tracer for the first several months of the deployment followed by a solution of nutrients and tracer.

Recovered OsmoSamplers were immediately disassembled aboard ship, and the sample tubing was cut to provide ~0.5 ml aliquots, which were stored in 0.5 ml acid-washed microcentrifuge tubes. A 0.03 ml aliquot of selected samples was analyzed with a refractometer to define the beginning of the sample and to verify that the samplers and pumps worked properly. A complete suite of shore-based chemical analyses is scheduled for the Fall of 2005 to provide guidance for experiments to be deployed in 2006.

Table 3. OsmoSampler deployments during VISIONS05

Location	Insert	# Osmo Samplers	Intake position	Use	Duration	Recovered
Mothra	Insert 2	2	Chambers 1+3	Samplers (A)	year	No
Mothra	Insert 3	2	Chamber 3	Sample (A) and Inject	21 Days	Yes
Motha	Insert with T	2	middle	Sample and Inject	25 Days	Yes
Main	Insert 1	2	Chambers 1+3	Samplers (A)	23 Days	Yes
Main	Insert	2	middle	Sample and Inject	26 Days	Yes
Main	none + T	1	tip	Sampler (A)	year	No
Main	none	1	tip	Sampler (A)	year	No
Main	Insert 1	2	Chambers 1+3	Samplers (A)	year	No
Mothra	Insert with T	2	middle	Sample (A) and Inject	year	No

1.6 Keck Seismic Array

Three broadband seismometers (at Nootka, Explorer, and Endeavour) and nine short-period seismometers (three at Nootka and six at Endeavour) were recovered during the three legs of the Visions05 cruise (Figures 9-10; Table 4). One short-period datalogger at Endeavour (near Summit Volcano) had flooded and was not recovered. All three of the Nootka short-period seismometers and three of the Endeavour short-periods worked well; for two Endeavour short-periods (at Mothra and Main Endeavour), only the Y-component worked properly, and for another Endeavour short-period (KESW) a disk failure resulted in 79 days of data loss. The Explorer broadband worked well with the exception of occasional data loss as a result of lost data packets. Both Endeavour and Nootka broadbands recorded at 100 Hz, and recorded data for ~8 months and ~12 months respectively. The Nootka data were badly degraded due to dropped packets.

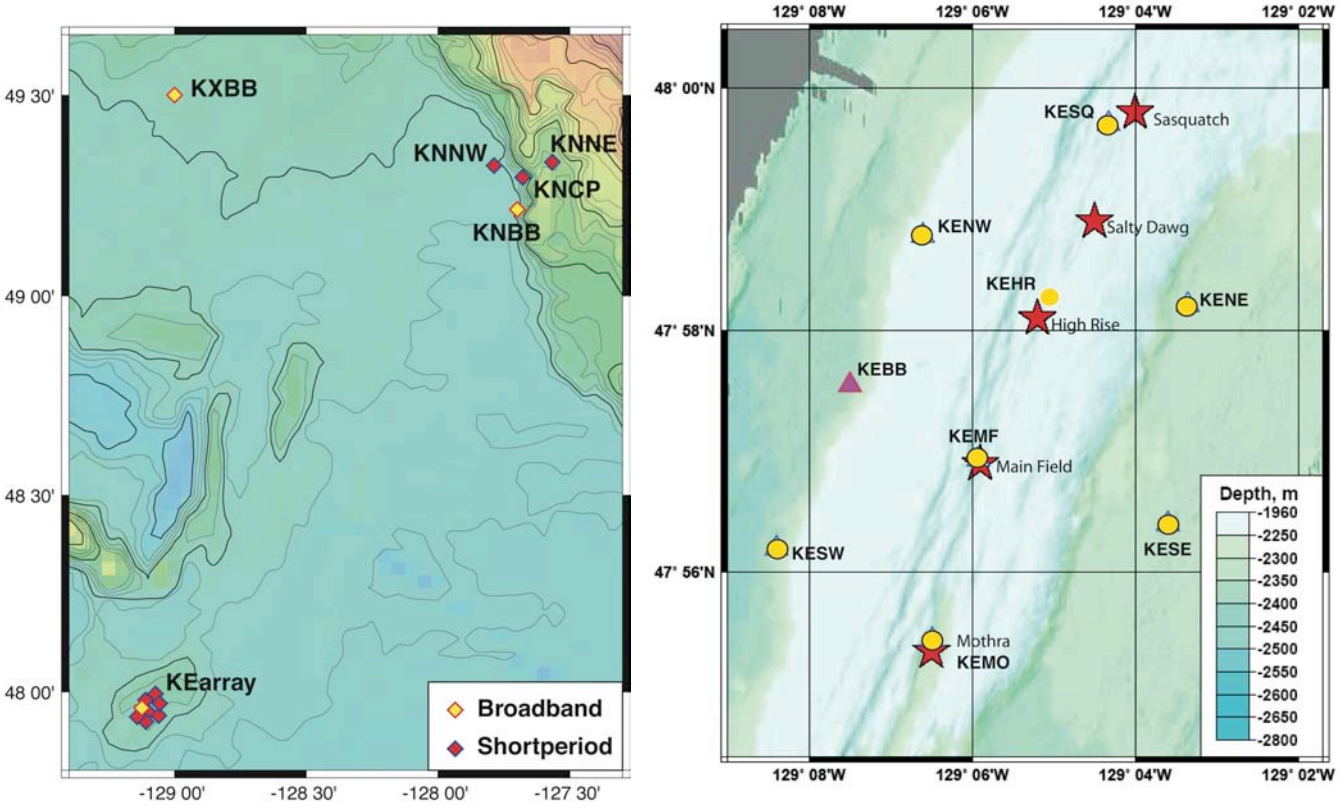


Figure 9. Seismic array funded by the W.M. Keck Foundation. A) Location of seismometers in the proto-Neptune Observatories at the Endeavour Segment (KEarray) on the Juan de Fuca Ridge, the Nootka Transform Fault (KNXX) on the Juan de Fuca Plate; and on the Explorer Plate (KXBB). B) Blow up of the KEarray on the Endeavour Segment. The yellow circles indicate short-period seismometers, the pink triangle is the location of the broadband seismometer on the western flank of the Endeavour.

The data recovered from the 2004-5 Keck seismometers were of generally excellent quality, with all of the recovered seismometers returning useful data. The short-period seismometers are mature and robust and with the exception of a few hardware-related problems they worked as intended. The broadband systems are newer and although all three seismometers recorded excellent data for some or most of the deployment, some development is required to solve a small number of specific and/or intermittent problems that are well documented and have been partially or fully diagnosed. This report focuses on the negative aspects of the instrument performance and is not intended to reflect the overall success of the experiment. While exhaustive on data-related issues, it does not

address other issues such as ship-to-datalogger communications, hardware performance and preparation, deployment or recovery procedures.

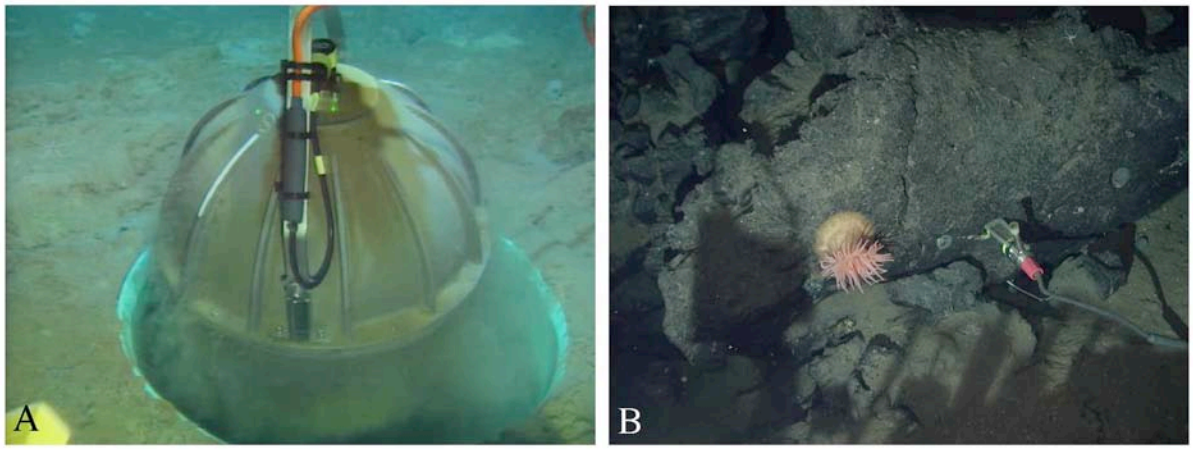


Figure 10. A) Broadband partially deployed in a caisson on the western flank of the Endeavor Segment. B) Short-period seismometer deployed just east of the Faulty Towers Complex in the Mothra Hydrothermal Field.

Table 4. Summary of instrument performance

Site	*Inst*	*Data start*	*Data end*	*Total Mb*	*Chans*	*Comments*
			Endeavour Array			
KESQ	c1	--	--	--	--	Flooded datalogger: not recovered.
KEMF	c2	8/2/04 (215)	9/6/05 (249)	26,296	Yz	Bad X, poor Z attributed to bad sensor.
KEMO	c3	7/31/04 (213)	9/5/05 (248)	26,324	xYz	Poor X and Z attributed to bad sensor.
KESE	c4	8/6/04 (219)	10/2/05 (275)	27,776	XYZ	
KENE	c5	8/5/04 (218)	9/19/05 (262)	26,958	XYZ	
KENW	c6	8/5/04 (218)	9/19/05 (262)	27,008	XYZ	Corrupted files in drive C on Z,2005108. Switched from drive A to B prematurely.
KESW	c7	8/6/04 (219)	9/26/05 (269)	22,069	XYZ	Corrupted B drive: data unreadable from 2004344-2005059.
KEBB	b11	8/3/04 (247)	3/14/05 (073)	11,729	ZNE	Corrupted files before AUG10; missing mass-position information; limited data return; 100Hz sampling;5-s-long data gaps.

Table 4 Con't

Site	*Inst*	*Data start*	*Data end*	*Total Mb*	*Chans*	*Comments*
			Nootka Array			
KNNE	c8	8/9/04 (222)	9/16/05 (259)	26,528	XYZ	Low-freq shifts attributed to connector pin corrosion.
KNNW	c9	8/9/04 (222)	9/12/05 (255)	26,225	XYZ	
KNCP	c10	8/9/04 (222)	9/11/05 (254)	26,175	XYZ	
KNBB	b12	8/5/04 (218)	8/25/05(237)	5,736	ZNe	Data badly degraded due to extensive n*4-s-long data gaps: E channel ~1/10 amplitude of N: 58% data loss: 100 Hz sampling.
KXBB	b13	8/7/04 (220)	9/12/05 (255)	11,481	ZNE	10-s-long data gaps attributed to dropped packets.

Notes: For channels, upper-case means worked well, lower-case means worked poorly, absent means no usable data.

1.7 *In-situ* Temperature-Resistivity-Hydrogen Probes

These instruments were developed with Keck funding to measure temporal changes in temperature, and chloride and H_2 concentrations (Figures 11-13). Chloride concentration is important because it reflects phase separation processes and serves as a "master variable" in hydrothermal systems. By knowing the changes in chloride concentration, reasonable estimates can be made of many other nonvolatile components. The Endeavour hydrothermal system exhibited relatively stable chemistry for at least 15 years, producing fluids with less chloride than seawater as a result of ongoing phase separation. In 1999, a magmatic event beneath the Main Endeavour vent field significantly altered the chemistry of the system and resulted in the chloride content of the fluids increasing significantly. These increases continue.

In 2004, a new four electrode probe was developed that would allow avoidance of oil as a pressure compensation medium. This required development of a seal between the metal electrodes and the ceramic insulator capable of withstanding ambient pressure without allowing water to leak past the electrode. This new electrode system uses an inner titanium cone surrounded by a gold sleeve. This combination is press-fit into the ceramic with the malleable gold forming the seal.

The H_2 sensor is based on the principal that the metal palladium is very permeable to H_2. By combining palladium with gold (50/50), an alloy is produced that is permeable to H_2 and capable of withstanding the harsh chemical conditions of hydrothermal vents. The H_2 sensor consists of a tubular piece of alloy, supported by a porous ceramic rod, connected to a sensitive, stable pressure sensor by a section of capillary titanium tubing. As no other gases are able to cross the membrane, the internal pressure of this measuring device is dependent only upon the hydrogen concentration in the fluid to which it is exposed.
In 2004, three temperature-resistivity-H_2 probes were deployed in the Main Endeavour field at the Hulk, Sully and Bastille sulfide structures. A similar instrument was deployed at the Hot Harold sulfide structure in the Mothra vent field (Figure 11).

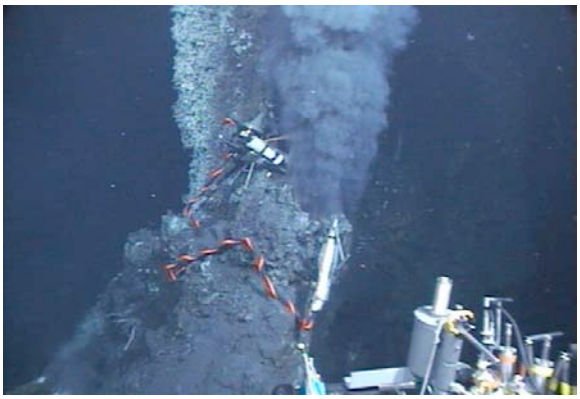
During the VISIONS05 cruise, new versions of the temperature-resistivity-H_2 probes were deployed in Hot Harold, Gremlin, Sully, and Hulk structures (Table 5).

Table 5. Volatile samples & T-R-H_2 probe deployments

Sample ID	Vent Field	Sample Site	Temp
J165-GT5	Mothra	Incubator drill hole at Roane	92°C
J166-GT17	MEF	Incubator drill hole at Hulk	139°C
J175-GT5	Sasquatch	Chimney orifice at Pico	288°C
J176-GT15	Mothra	RTH orifice at Hot Harold	318°C
J176-GT9	Mothra	RTH orifice at Hot Harold	318°C
J177-GT5	MEF	RTH orifice at Gremlin	324°C
J177-GT10	MEF	RTH orifice at Gremlin	324°C
J177-GT17	MEF	RTH orifice at Sully	355°C
J179-GT17	MEF	RTH orifice at Gremlin	324°C
J180-GT5	MEF	Orifice above incubator at Hulk	320°C

The T-R-H_2 probe in Hot Harold was deployed on Dive 176 (Figure 11). This T-R-H_2 package was deployed in the 'time honored' notch at this 318ºC vent. An ICL loop was positioned on the ICL cone of the data logger to verify proper operation of the instrument.

Figure 11. Hot Harold deployment of the sensor housing



Overview of the RTH setup at Hot Harold

The T-R-H_2 probe in Sully was deployed on Dive 177 atop this 356ºC vent in the Main Endeavour field (Figure 12). Since 2000, the Sully vent has been the most instrumented structure for temperature-resistivity studies on this ridge segment and it has the most extensive temperature record. An ICL loop was positioned on the ICL cone of the data logger to verify proper operation of the instrument.

Figure 12. Deployment of the sensor in Sully

Overview of the RTH setup at Sully

The T-R-H_2 probe in Gremlin was deployed on Dive 179 (Figure 13). This structure, located at the south eastern base of the Hulk, had not been instrumented prior to this cruise. The sensor package was deployed on the slope of this 326ºC vent subsequent to reaming the hole. An ICL loop was used with the data logger to verify proper operation of the instrument. A subsequent visit to the site revealed approximately 6 inches of new chimney growth only a few hours later.

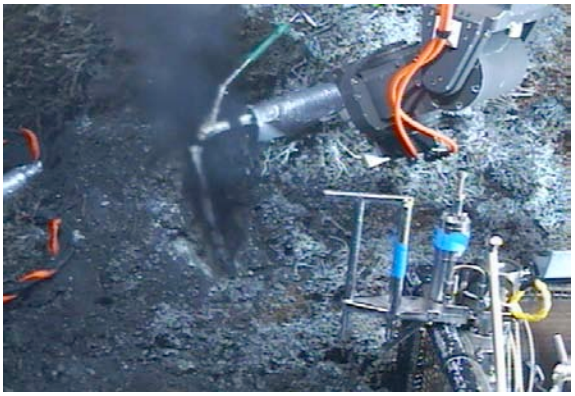


Figure 13. Deployment of the sensor in Gremlin

New chimney growth several hours later

These instruments will be recovered by *Alvin* in the summer of 2006.

1.8 *In-situ* Fluid (McLane RAS) and Particulate DNA (PPS) Samplers (McLane)

The objectives of the time series fluid and microbial sampling were to be able to link changes in temperature, fluid chemistry, microbial community structure, and seismic activity over a period of several years at selected sites within multiple vent fields on the Endeavour segment (Figure 14). There are many investigators working together on this project, and the contributions of Dave Butterfield, Kevin Roe, and Andrew Opatkiewicz are specialized in the area of fluid and particle/microbial sampling from hydrothermal vents. Susan Lang is working on organic chemistry of vent fluids and also supported the sampling effort. These tools are designed for coordinated microbial and chemical sampling in either a time-series mode (using the McLane Remote Access Sampler (RAS) and PPS) or a spatial exploration mode (Hydrothermal Fluid Sampler (HFA) aka The Beast). The objectives of this program are to monitor with as much detail and precision as possible the changes that take place in both high-temperature and diffuse, warm vents and then relate those changes to microbial processes and seismic or volcanic influences on the hydrothermal system.

The major field experiment began in the summer of 2003 with the installation of a combination fluid and microbe sampler (McLane RAS and PPS) in the MEF and a second fluid chemistry sampler at Clambed. Those instruments were recovered in June, 2004, and a large part of the chemical analysis has been done. The samples from the Hulk site show a very uniform chemistry throughout the year, while the samples from Clambed show high variability terminated by a total clogging of the instrument after 23 weeks. Over the summer of 2004, we tested the RAS and PPS and did a short-term deployment near Hulk during the Western Flyer/Tiburon cruise. In September, 2004, the experiment continued with a deployment of the RAS/PPS at the same site on the SW side of Hulk and the second RAS (chemistry only) sampler at a diffuse vent approximately 15m east of Cuchalain structure in the Mothra field.

In September 2004, an integrated RAS and PPS sampler were deployed on the SW side of Hulk and a second RAS sampler was deployed at a diffuse vent approximately 15 m east of the Cuchalainne complex in the Mothra field. The RAS instruments take one sample per week for 48 weeks, and PPS (microbial) instruments take one sample every two weeks over the same 48 week period. Temperature is recorded at 15 minute intervals at each site with a mini-temperature recorder attached directly to the intake. The

Hydrothermal Fluid Sampler (the Beast) was used to collect fluids and particles from vents while simultaneously measuring the temperature of the fluid. For this program, the Beast was used to map the spatial variability of temperature and composition around the time-series deployment sites, and to take replicate samples of DNA from controlled sites. This study is designed to assess the temporal dimension of fluid chemical and microbial composition, and collecting samples at discrete time points is a valuable approach in hydrothermal monitoring. It is also a good complement to the sulfide microbial incubator work.

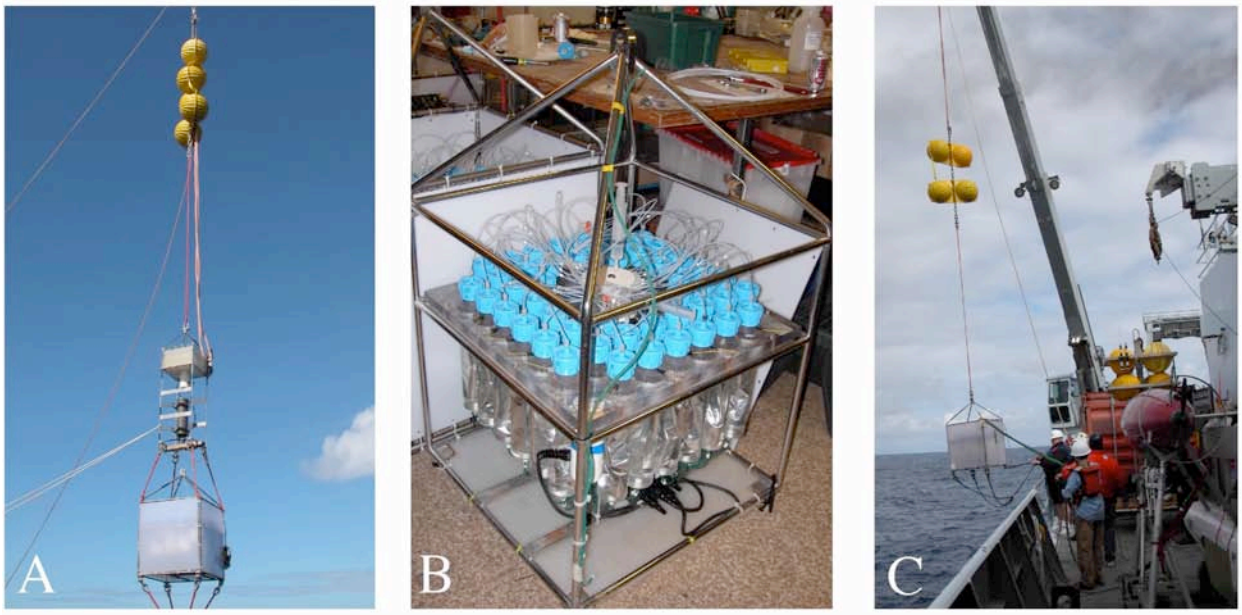


Figure 14. A) RAS and particulate DNA sampler going in the water for deployment at the diffuse flow site near the south face of Hulk. B) RAS in the lab being readied for deployment. C) Recovery of a RAS that was deployed in the Mothra Hydrothermal Field in 2004. D) RAS deployed in a diffuse flow site on the eastern flanks of the Faulty Towers Complex, Mothra Hydrothermal Field. This instrument will be recovered during and Alvin program in 2006.

To a large degree, the high-priority fluid sampling objectives for this cruise were met. The RAS time-series sampler from Mothra was recovered on the first *JASON* dive (165) on September 5th. Thirty of the forty-eight weekly samples were filled, with no apparent reason why the other 18 samples did not fill. The temperature recorder was recovered and processing of the samples went well. This RAS was cleaned, tested, and prepared for another deployment. After a delay from a stuck pull-pin, the RAS/PPS combination from SW Hulk was not recovered until September 13 on *JASON 2* Dive 171. All 48 fluid samples and 24 preserved DNA samples were successfully recovered. Most of the filters for DNA collected from a volume of 3.0 liters, making this our best ever time-series deployment at a diffuse vent. The temperature recorder for this instrument was unfortunately lost en route to the surface in spite of being secured on top of the RAS instrument.

All recovered instruments were cleaned, tested, and prepared for re-deployment. During Dive 176, a RAS instrument was deployed at the base of The Tower in the Faulty Towers complex, located south of the incubator/drillhole on Giraffe. The HFPS was used to collect water samples at the site, but there was a problem in the setup of the temperature sensors, so the temperature data obtained by HFPS was not useful. Also during Dive 176, we used HFPS and the high-temperature probe to document the site of the 2004-5 RAS deployment near Cuchalainne, taking samples from where the intake nozzle had been placed the year before.

During Dive 177, the RAS/PPS combination was again deployed at the SW Hulk site. This vent is only about 10 meters from the Gremlin site drilled this year and outfitted with an incubator and temperature-resistivity-hydrogen probe. Using the HFPS a suite of fluid/particle samples was collected 1) at the position of the intake, 2) at another site of similar temperature about 50 cm away, and 3) at a third site that was slightly warmer (50-65°C). A major sampler was taken at a newly formed hot vent (237°C) created when the ROV dug into the sulfide during sampling/setup operations. Although this sampling was not exhaustive, good replicates were obtained for chemistry and microbiology, and a hot source fluid for the diffuse vents could be clearly identified. HFPS worked well in spite of a nearly broken temperature probe, and the RAS/PPS site near Hulk was documented quite well.

Both RAS instruments were programmed to start on October 15, 2005 at noon UTC and sample every 6 days, finishing on July 24, 2006. The PPS sampler for DNA will start on October 21, 2005 at noon UTC and sample every 12 days, finishing on the same day. Mini-temperature recorders were attached to both intakes.

1.9 Nootka Hydrology, Fluid Chemistry and Seismicity

The Nootka study site is located at the convergence of the Nootka transform fault and the Cascadia subduction zone off the west coast of Vancouver Island (Figure 15). This area is a sediment-rich, tectonically active zone where compression of the sediments coupled with active faulting promotes the expulsion of methane-rich fluids from the sediments, resulting in the development of small seeps. In 2004, with funding from the Keck Foundation, this area was instrumented with a broadband seismometer, three short-periods, an acoustically-linked buoy (funded by the NSF on a grant to WHOI), a hydrothermal acoustic node (see below), and several instruments for measuring fluid flow and chemistry) (Figure 15).

As part of the W.M Keck program and with funding from the National Science Foundation, instruments were designed and fabricated at the Hydrogeology and Tectonics Studies (HTS) laboratory at Scripps Institution of Oceanography to make use of naturally occurring seeps for collecting and measuring fluids. Flow at a seep is focused through Chemical Aqueous Transport (CAT) and Optical Tracer Injection System (OTIS) meters by pushing a funnel-like collection chamber into the sedimented seep. A chemical tracer is injected into the flow line and collected/detected downstream or upstream of injection point as it moves with ambient flow either down into, out of the seep, respectively. Flow rate is determined from CAT meter results by measuring concentration of the tracer collected, and from OTIS meter results by measuring delay time between injection and detection of a pulse of tracer.

During the Keck program, several CAT meters were deployed at the Cascadia subduction zone near the Nootka fault. In addition the recently developed OTIS meter was deployed with a suite of instruments that included a temperature-resistivity probe, a heat flow probe, data logger developed at University of Washington, and an acoustic modem from Woods Hole Oceanographic Institution (Figure 15). This package, l*ABE*led the Hydro-node was an exciting collaborative effort that allowed real-time transmission of chemical, thermal and seismic data collected at the seafloor to be relayed from a full water column buoy to a satellite and transferred to a land-based computer. A WHOI seismometer was also transmitting

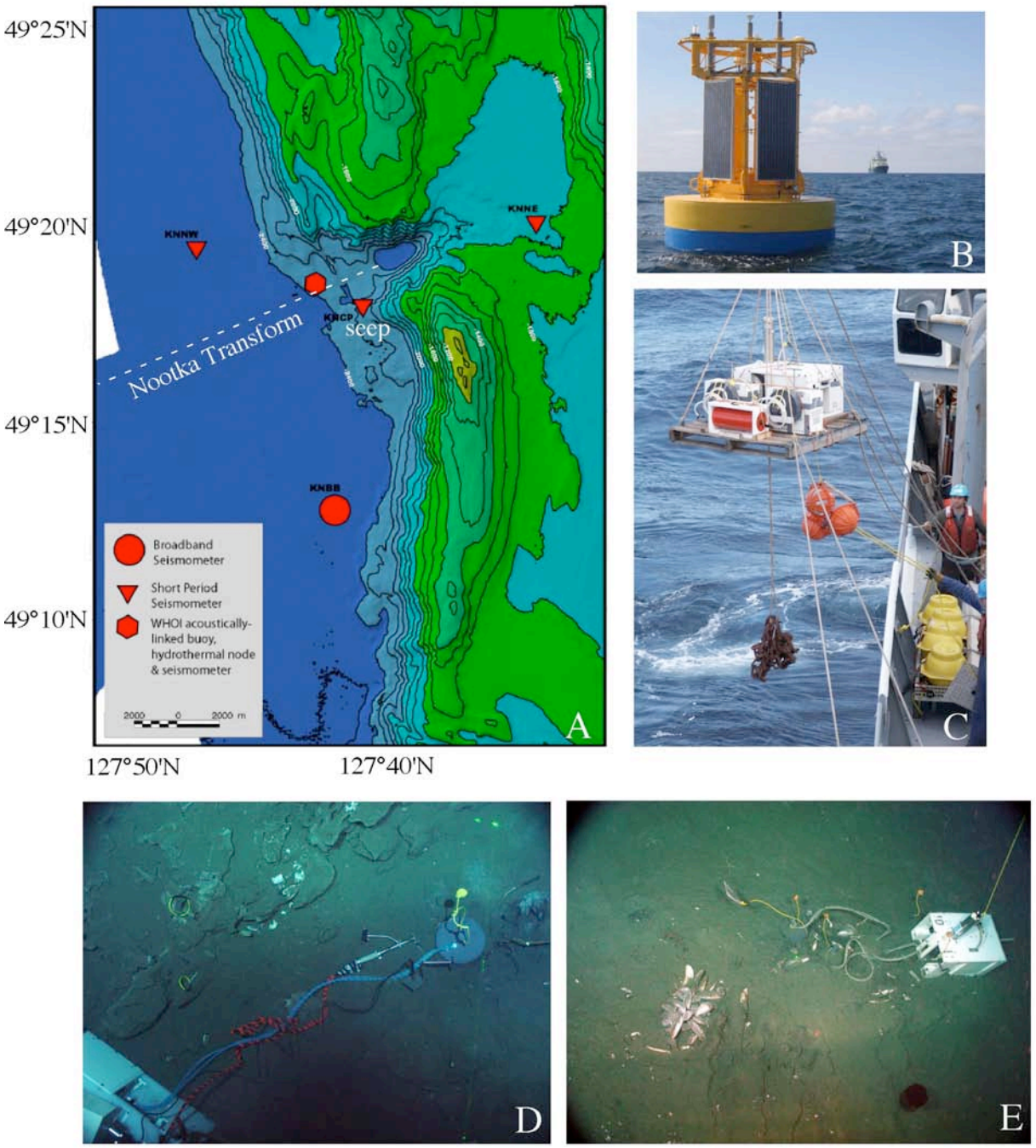


Figure 15. A) Location of the Keck-funded proto-Neptune Observatory near the intersection of the Nootka Transform Fault and Cascadia subduction Zone. Also shown are the locations of a Keck broadband seismometers and short-period seismometers, and an acoustically-linked buoy funded by NSF and fabricated by WHOI. B) WHOI buoy and Atlantis. B) Hydrothermal node being deployed at a seep site on the margin. C) Hydrothermal node deployed showing the temperature-resistivity hydrogen probe, OTIS flow meter head at a small seep. Data were transmitted to the buoy by an acoustic modem and from the buoy to shore by satellite. E) Flow-chemical sensor at a small seep hosting clams. All instruments were recovered during the VISIONS05 cruise.

data from the Nootka site back to WHOI for analysis. Equally important to a long temporal record of concurrent measurements, is the spatial coverage of these measurements.

During this cruise, five CAT meters were recovered that had been placed at multiple seeps around the area and two CAT meters from a mud volcano located west of the margin along the Nootka Transform Fault. These meters collected fluids for chemical analysis in addition to flow rate information over the last year. All seismometers and the hydrothermal node were recovered during the VISIONS05 cruise: the WHOI buoy was recovered on a prior cruise.

1.10 Flow Cytometer

In addition to the field experiments, a goal of this cruise was also to test out a The goal of the research conducted by Rhonda Marohl and Ginger Armbrust was to use a new high-speed flow cytometer (InFlux, Cytopeia) to detect, identify, and sort microbes collected from surface waters and from the hydrothermal vents. This research was conducted by Rhonda Marohl and Ginger Armbrust from the UW: it was the first time that they had taken the flow cytometer on board a ship. Therefore, much of their work was designed to test the capabilities of the instrument at sea. Surface samples were collected with a bucket, 5 m samples with a pump system, two depth profiles to either 150 m or 500 m with the CTD/rosette, and diffuse flow samples with the major samplers. All samples, except the diffuse flow samples, were analyzed with 488 nm excitation. Populations of interest (based on light scatter and fluorescent characteristics) were sorted into growth media or into RNA-later for lab-based molecular analyses. The diffuse flow samples were fixed and will be analyzed in the lab using UV excitation.

1.11 REVEL: Immersion of Educators in Sea-going Research

The REVEL Project is a national, professional development program designed to immerse science educators in real, cutting-edge research in planetary and ocean sciences. Based on the belief that the planetary ocean system offers a superb contextual basis for capturing the interest of students and the public, teachers and researchers collaborate to foster enthusiasm in mathematics, physics, chemistry, and biology using compelling real world examples from earth and ocean sciences. The ultimate goal of REVEL is to develop inquiry-driven educators who can build a community of environmentally aware students.

The REVEL Project 2005 program selected four K-12 grade teachers and a seagoing mentor from both coasts and land-locked states (Georgia, Idaho, New-York, Pennsylvania and Oregon). From September 16 to October 4, they sailed and collaborated with scientists on the VISIONS-5 expedition. During their sea-going research work they shared their experience studying hydrothermal vent systems along the Endeavour Segment of the Juan de Fuca Ridge with a large audience through the web (http://ocean.washington.edu/outreach/revel and www.visions05.washington.edu). During the research cruise, the REVEL Project received an unprecedented 850 questions. In addition, the teachers contributed to the first High Definition Web Broadcasts from the seafloor and the sea to land on September 28 and 29, and answered questions from students at the UWTV studio. As part of their seagoing experience they selected a research question to investigate and presented their results in front of a scientific and maritime audience as scientists do.

The research questions that the teachers focused on covered the use of seismometer data to track whales, undersea mapping, making photo mosaics of previously unexplored sulfide chimneys, and a study of group interaction among the personnel on board. Over the next school year, they will ponder their research work and distill compelling themes that will be introduced in their classroom teaching. After their research sea-going experience and through the next 24 months, these educators will share their expertise with their school boards, schools, classrooms, colleagues and local communities as well as at national and regional conferences.

2.0 SUMMARY OF OPERATIONS

September 1, 2005: Thursday

The R/V Thompson left from the University of Washington at 1030 after awaiting news on a crewman who had developed an abscessed tooth. The Thompson passed through the Hiram M. Chittenden Locks and conducted a dunk test of *JASON* II near Shipshape Bay off of Shilshoal. After a successful test of *JASON* II, the Thompson headed for the Strait of Juan de Fuca to Endeavour.

September 2, 2005: Friday

The Thomas G. Thompson continued its 200-mile transit from the Strait of Juan de Fuca to the Endeavour Segment. The weather was fair and the ship made good progress, although swell waves left over from past winds caused the vessel to pitch and roll. Late in the afternoon (1530), the Thompson did an at sea transfer with the R/V Atlantis. Marvin Lilley transferred to the Thompson, and a Chinese scientist Huaiyang Zhou was transported to the Atlantis. The Thompson arrived on site at the Endeavour in the evening and conducted an ~ 10-hr program deploying four transponders to cover the Mothra and Endeavour Hydrothermal Fields, and surveying them in.

2.1 September 3, 2005: Saturday DIVE 165

JASON Dive 165 in Mothra Field. Today was scheduled to be the first *JASON* dive with the goal to 1) make up to 4 experimental holes in diffuse chimneys in the faulty Towers Complex of the Mothra Hydrothermal Field, 2) deploy two *in-situ* microbial incubators and colonization experiments, 3) recover a short-period seismometer from ~ 50 m east of the complex, and 4) recover a Remote Access Sampler (RAS) from a diffuse flow site in Cuchalainne. This would be the maiden dive for the newly designed Medea system that was modified in Seattle to include two thrusters fro vehicle direction. Prior to the dive an elevator was deployed about 80 meters away from the Faulty Towers complex with two microbial incubators. *JASON* was scheduled to pick them up as needed during the dive.

The dive started at ~0900 under fine conditions with clear skies. However, very early on in the dive there were sever electrical problems with Medea, which progressively worsened with depth. At around 500 m there was a significant power spike to *JASON* 2, resulting in total loss of power to the vehicle. *JASON* and Medea were brought back to the surface and recovered on deck. Upon inspection of Medea it was found that a pressure valve had leaked on the main pressure housing for Medea. Seawater leaked into the pressure housing and a small fire ensued that was hot enough to fuse aluminum to the inside of the titanium housing. The *JASON* team immediately went to work to try and solve Medeas problems by converting it back to the old absent of the thrusters. They worked throughout the day and into the evening rewiring Medea, testing electronics and hydraulic systems. During this time, a CTD was used to take background water samples away from the vent systems and to get a sound velocity profile for improved navigation. The CTD was conducted at 19:54-2117 at 47°55.9929N, 129°09.0170W. Seven bottles were tripped for background water.

While Medea was being worked on, four transponders were deployed to the north, up by Summit Volcano for *ABE* mapping effort. It took ~ 10 hrs to lay the transponders and survey them in (Figure X).

September 4, 2005: Sunday DIVE 165 2nd Try

JASON Dive 165 in Mothra Field. The goal of the dive was to 1) recover a short-period seismometer ~ 50 m east of the Faulty Towers complex, 2) deploy two microbial incubators in the diffusely venting chimney Roane, 3) deploy two colonization experiments in chimneys other than Roane, 4) take a gas-tight and major sample in the venting hole, and 5) recover a RAS sampler at the Cuchalainne complex about 200 m to the south.

JASON went into the water at ~1900 and reached the bottom at 2115 near the seismometer C2. At 2123 the corehole seismometer is recovered and stored in the basket. A dummy plug (#119) is placed in the

hole at 2131 to keep it clean and for easy recognition when J2 returns to deploy a replacement seismometer. The data logger package is recovered at 2142 and *JASON* begins to transit to the elevator which is 87 meters away at a heading of 177°. Using the seismometer as a benchmark, the navigation is off from 2004 by about 15 m south of our original target.

The elevator is reached at 2156 and the seismometer and data logger are safely stored adjacent to the elevator. *JASON* begins recovery of the sulfide microbial incubator and data logger with two osmo samplers attached. At 2234 *JASON* begins the transit to the east face of the Faulty Towers complex. During the transit the vehicle looses site of the bottom for a few minutes and ends up on the west side of Faulty Towers near the west face of Phang. J2 slowly crabs around the south end of the complex and works its way north so that the incubator can be safely stored in a sedimented area just northeast of the 300°C smoker Hot Harold. The storage site is reached at 0033 on September 5th, and the instrument and data logger are stored.

September 5, 2005: Monday DIVE 165 con't

The first drilling target is at the 22 m tall edifice called the Tower. This site is chosen so that the drill can be tested out and a 'dumb' incubator deployed. A site is chosen on the east face of tower that is about 17 m above the seafloor. The reamer bit is used for this initial hole with the hole initiated at 0125. Drilling stops at 0213 and an attempt is made to deploy the dumb incubator. Problems are encountered, however, because in an effort to disturb the site as little as possible, the area around the hole was not cleared of tube worms. Because of this it was not possible to reacquire the hole with the dumb incubator and after several attempts the site was abandoned. At 0309, J2 moves to begin drilling on the south face of Roane.

Roane is easily found and the prior incubator site is revisited at 0312. A titanium tube placed in the hole during the Alvin 2004 field effort is issuing clear fluids with black smoker material partially encasing it. Tube and palm worms have colonized the new growth. A temperature probe place partway inside the tube measures a temperature of 98.6°C. The tube is removed so that the hole could be cleaned out by drilling for deployment of the incubator.

The reamer bit is engaged and *JASON* slowly drives forward to reenter the hole. At 03:51 drilling begins in the hole. The hole is drilled to a depth of 20 cm at 05:04 and the drill string is slowly backed out. During this operation, the drill stalls and becomes stuck in the hole. It appears that during this process the barrel has become decoupled from the mount. J2 attempts to pull the barrel assembly out of the hole using the manipulator, but this does not work so J2 repeatedly backs away from the face or Roane and the drill string pulls free at 05:39. The drill string is stored and a major and gas tight water sample is taken. The major sample likely pretripped. Water sampling is complete at 06:10 and *JASON* and Medea crab around the east face of Faulty Towers to retrive the incubator left by Hot Harold. At 0654 the incubator, data logger and osmo samplers are retrieved and J2 and Medea head back to Roane for instrument deployment.

The incubator barrel assembly was first deployed with not much difficulty, and the then the data logger and osmo sampler were placed on the flat top of Roane. The instrument set up was very similar to that of the 2003-2004 experiment except that the 4th chamber was intentionally left out of the hole. This was done to enrich for a certain organism believed to require a high-energy environment where seawater and hydrothermal fluid mix turbulently. The deployment was completed at 0714, followed by *JASON* opening the incubator to allow vertical flow of fluids through the chambers. This exercise was completed at 0517. The deployment site was imaged and then J2 and Medea repositioned to go back to the elevator for its release. Because of the decoupling of the barrel assembly, the drill could not be used to make a second hole. The elevator was reached at 0750, and the short-period seismometer and data logger where safely stored on the elevator at 0816. The burn-wire to release the elevator failed, and *JASON* had to manually pull the pin to free the elevator from the weights.

Following release of the elevator, a short survey of the surrounding geology was completed (allowing the elevator to reach the surface and be recovered onto the Thompson. This area is characterized by partially sedimented lobate and sheet flows. During the survey DP was lost for a brief time and *JASON* was brought up into the water column for safety. At 1158 a transit ~ 200 m to the south was begun to retrieve the Remote Access Sampler (RAS) at a diffuse flow site in Cuchalainne. The RAS came into view at 12:59 and temperatures were measured around the intake of the RAS sampler prior to recovery. The maximum temperature measured was 13°C. Marker T5 placed to mark the site where the intake nozzle was so that the same site can be sampled in the future for time-series studies. The nozzle and MTR were placed inside the RAS for safe keeping and at 1349 the pull pin was released to send the RAS to the surface.

While waiting for the RAS to hit the surface and be recovered, a survey of the geology around Cuchalainne was conducted. The diffuse vent site and bacterial mats around the base of Bat Tower were imaged at 1356 and an imaging transect up the northeast face of the tower was completed. The small steep-sided pinnacles around Marker G were also imaged. The dive ended at 1425.

Inspection of the recovered KEMO seismometer showed that the logger had recorded data for the entire deployment but only the y-channel (along axis of hole) worked well. Both the x- and z-channels have no to low sensitivity and large amplitude minute spikes that have a different shape from last year's data.

Fluid-Micro summary: A major sample (J2165-MB1) was taken in the 2004 drillhole near the top of the stump at Roane at 12:49 on 9/5/05 (virtual van frame 534), temperature was 98.6°C. A gas-tight sample was taken here at 13:01. The first RAS was recovered from Mothra. This RAS (in sequence it is RAS-14) was found at 19:59 UTC on 9/5/05. The intake did not appear to have moved from the location where it was put a year ago, and was still in a small spot with diffuse flow. Video and photos were taken to document the instrument. At 20:21 we took temperature measurements around the intake and found a range from 14.2°C at the end of the temperature recorder to 2.9°C about 2 inches back along the outer edge of the protective Ti pipe over the intake tube. At 20:30 we placed the small anchor weight of marker T5 directly on top of the intake to mark the spot so we could return and sample on a future dive. Our heading during these operations was roughly 230°C. We had a clear view of the intake tube when it was picked up, and there was no clogging, just some limpets and small tube worms that had colonized the polypro line attached. At 20:46, the intake was stowed on top of the RAS for recovery, and at 20:49 the stainless steel release pin was pulled with no difficulty and the RAS ascended. RAS14 arrived at the surface about 32 minutes later about 30 meters off the stern of the ship. The mini-temperature recorder (#3197) was recovered. A colony of tubeworms had grown on the polypro line attached to the intake/MTR, and more worms were attached to the intake tube, so we have a good record of tubeworm temperature/chemical conditions during settling and initial growth.

In the lab, we quickly cleaned and dried the tops of the sample tubes and filter holders, removed the hold-down bars, and sequentially removed each bag from its cylinder. After removing the bag, the depth to the water surface in the cylinder was recorded as a volume measurement. We cross-check this volume by carefully measuring the volume of fluid removed from the bags. Of the 48 bags, 30 were full and of very uniform volume (close to 450ml), while 18 were nearly empty, containing less than 10 ml. There was no apparent reason why this was so, and there was no clear pattern to the empty bags. Even with these bags missing, a reasonable time series for the year was obtained. After putting all the bags on ice and in the refrigerator, the filters were processed by removing the intake line, placing on a vacuum flask, rinsing with a small volume of deionized water, and suctioning dry. The filter was then placed in a Petri slide, covered and allowed to air dry for several hours. Filters were then packaged and put in the freezer for storage.

Once all of the bags and filters were secure, we processed the major sampler taken from the reamed drill hole at Roane on the first dive. It appeared to be a good sample. Next, we launched into processing the RAS water samples. For every sample, we collect six required sub-samples and up to five optional sub-samples. Marv Lilley analyzed methane and hydrogen by GC on all of the samples. We measured pH, alkalinity, ammonia, silica, and hydrogen sulfide on board. Complete processing of the samples took place over three days.

2.2 September 6, 2005: Tuesday DIVE 166

At 0634 *JASON* went into the water for Dive 166 at the Main Endeavour Field. The goal of the dive was to 1) drill into or near the large edifice called Hulk in the northern part of the field for insertion of a microbial incubator, 2) drill 1-2 other holes for colonization experiments, 3) recover the short-period seismometer near Grotto (C2 Homer #91) and replace the homer, 4) recover the RAS and particulate DNA sampler from the diffuse flow field south of Hulk, and 5) recover a hydrophone from Puffer. Prior to *JASON* going into the water an elevator was deployed that had an *in-situ* microbial incubator on it, room for the

As *JASON* approached bottom it transited over sedimented lobate flows towards Homer 91 at Grotto. The homer came into view at 0834. When *JASON* was transiting in the water column the seismometer plug fell out of the front basket. The data logger was recovered at 0834, and after repositioning a bit the short-period was recovered at 0849. Because the safety plug had been lost, a colonization experiment was sacrificed to plug the hole at 0852.

Following the successful recovery of the seismometer, *JASON* transited northeast to the elevator. The data logger package was attached to the snaphook on the elevator and the short-period stored. This was finished at 0957. *JASON* then transited towards the RAS near the south face of Hulk (Homer # 15). Much of the area between the elevator and Hulk is characterized by moderately sedimented sheet and lobate flows-as Hulk is approached a series of old, extinct sulfide structures where encountered as well as significant, large pieces of sulfide talus shed off of Hulk.

Subsequent to transiting between the notch of Crypto and Hulk, the RAS was found at 1120. *JASON* recovered the nozzle and temperature recorder and then tried to pull the release pin from the shackle attached to the weights. The shackle was not stainless steel, however and the pin had rusted and corroded such that it could not be removed. This task was abandoned for a future dive when a knife could be taken down to cut the line. At 11501, *JASON* started its transit back to the elevator to retrieve a homer (#92) to place at the incubator site, soon to be drilled. Homer #92 will eventually be placed at the seismometer site KEMF to replace Homer # 91.

A survey was conducted around Hulk to find a suitable drill site for the incubator experiment. In the notch between Cypto and Hulk, near the south face of Hulk a black smoker was found at 1219 with a dense covering of tube worms, palm worms, limpets and snails. At 1304 a temperature of 243.3°C was measured at the black smoker. The area was surveyed with the temperature probe and temperatures up to 158°C were measured. This site was abandoned at 1327 as a potential drill target because it was too hot for placement of the incubator data logger.

Near the eastern end of the notch between Crypto and Hulk a small, knobby mound was found at 1339 that had a nice black smoker on it at the northeast portion of the edifice, and a dense covering of tube worms, palm worms, limpets and snails. Except for the east face of the mound, there was significant diffuse flow coming out of the structure. To the east begins an area of extinct chimneys. At 1304 a temperature of 320°C was measured at the black smoker. After crabbing around the east face of the structure, a site on the north side of the mound, about 1 meter away from the chimney was chosen as a good site for drilling and installation of the incubator.

Drilling started at 1443 and proceeded rapidly with an ~18 inch hole completed by 1530. The reamer bit was then used to finish enlarging the hole. This exercise was completed by 1608. A temperature of 139°C was measured at the tip of the hole and it was marked by homer # 92. A major and gas tight sampler were taken and then *JASON* transited to the elevator to pick up incubator # 3 for insertion into the hole. Installation of the incubator went very smoothly and this operation was completed by 1755.

JASON transited to the east face of Hulk to drill a site for placement of a colonization experiment. A drill site was found about 10 m up on the structure adjacent to some large flanges covered by extensive tube worm communities. Drilling started at 1838 and went quite rapidly. There was significant pore space in the chimney, promoting rapid advancement of the drill. Drilling was completed at 1903 and the coring bit was switched out with the reamer bit. Similar to other drilling operations during this leg, the reamer bit decoupled from the drill assembly and the core barrel had to be physically removed from the hole with *JASON* and stuffed back into the drill sled. The colonization experiment was deployed and an attached osmo sampler was placed to the left of the experiment on top of one of the flanges. The flange is heavily colonized with long, brown tube worms and has a small pagoda-shaped, low lying flange on its top. The experimental site was imaged for a few minutes, completing the operation at 2054. This marked the end of the die and *JASON* returned to the surface following release of the elevator. *JASON* was on the surface at 2234 and recovered on deck.

2.3 September 7, 2005: Wednesday DIVE 167 and 168 MOTHRA

JASON went into the water at 0837 for Dive 167, with the goal of completing drilling efforts in Mothra and deployment of incubation and colonization experiments. *JASON* reached bottom at 1047 east of Faulty Towers and drove to the elevator, which was "floating" with only one leg touching the bottom. After securing the elevator into a more easily accessible workspace, *JASON* recovered the incubator to carry it over to Faulty Towers for deployment. The incubator was stored a few meters from Hot Harold at 1055.

JASON transited to the lower south face of Roane to start drilling. Drilling started at 1132 and coring was completed at 1235, with reaming beginning at 1249. At 1401 the reamer bit was slowly pulled out of the hole. During this process, however, it decoupled and *JASON* had to try and fly the bit out of the hole. *JASON* pushed the bit back into the drill sled, then prepared to take a major and gas tight sample from the very weakly venting hole. The major sample looks like it pretripped while straightening the nozzle so that it could go into the hole. The blue gas-tight bottle was recovered from the basket and triggered at 1455. The temperature inside the hole was only 14.6°C, so it was decided to use this site as a colonization experiment rather than sulfide-microbial incubator. Because the reamer bit had decoupled, another hole could not be drilled during this dive. During a discussion about what to do, *JASON* moved downslope a few meters and recovered a titanium tube that had been placed for one year inside the upper hole in Roane, which had been dropped on the first dive. It was partially filled with sulfide and anhydrite. A small piece of a chimney immediately adjacent to the drill site was removed and recovered at 1527.

The colonization experiment was deployed at 1537, followed by the osmo sampler at 1552. Because another incubator had to be deployed, the sled had to be recovered. Prior to recovery of the vehicle, the drill sled was acoustically released at 1410. The confirmation command was received, but the elevator had not released. *JASON* drove to the platform and upon inspection of the vehicle, it was noticed that the release mechanism had failed. *JASON* removed the release pull pin at 1455, dropping the weights and releasing the elevator. *JASON* followed the elevator up, leaving the bottom at 1457, and reaching the surface at 1703.

2.4 September 7, 2005: Wednesday Dive 168 MOTHRA

The weather was worsening and the dive was rushed prior to transiting to Neah Bay. *JASON* went in the water at 2130 with the goal of completing a final drill hole in Mothra and deployment of the 3rd microbial incubator. The bottom was reached at 2156 and *JASON* transited to the east face of Faulty Towers to choose an appropriate drilling site. On the way *JASON* passed over lobate flows and old sulfide logs/talus. The east face of the complex was rapidly found and both the Tower and Giraffe were chosen as potential drill targets.

After looking at Tower, the structure Giraffe was chosen to attempt drilling with *JASON* high up on the structure. *JASON* snuggled up against the structure and used its two manipulators to get better anchor points. The coring bit made contact with the face of tower at 2237. Drilling progressed rapidly with an ~19 inch hole achieved by 2328. The barrel assembly was rotated for entry with the reamer bit and the barrel was advanced: reaming was completed by 2353. There was significant fluid flow out of the hole, with the highest temperature measured of 204°C. *JASON* got pulled off of the structure, following temperature measurements and had to reacquire its position.

September 8, 2005 Thursday: Dive 168 con't and Transit to Neah Bay

A major sample was taken from the orifice at 0015. This was to be followed by a gas-tight, but the yellow gas tight bottle was dropped upon removal from the basket. *JASON* then went to the base of the base of the Tower and Giraffe to look for the bottle. After some digging around in a very large clump of tubeworms at the base of the chimneys, the gas tight was recovered and *JASON* again reacquired position to get a volatiles sample. The bottle was triggered at 0034

JASON then drove to the north end of Faulty Towers, adjacent to the 300°C smoker called Hot Harold and recovered the microbial incubator and data logger/osmo sampler assembly at 0044. *JASON* then proceeded back to the drill site at Giraffe for installation of the incubator. A small notch at the saddle between Giraffe and the Tower was chosen as place for deployment of the data logger package. Because of the limited reach of the cables, this was about the only option for deployment. However, the notch was to small, so *JASON* broke off a bit of a small parasitic chimney to enlarge the stow site. The logger was wedged in, but it was feared that the front of the logger was in too high of temperature flow so an attempt was made to move the logger into a safer position. During this process the logger fell back through the notch to the west side of the Giraffe/Tower structures. A brief attempt was made to deploy the incubator chambers, but the cable was too short because of the data logger placement.

It was realized that the data logger-osmo sampler package had to be redeployed in a more accessible and safer position. *JASON* placed the barrel assembly down by the notch between Giraffe and the Tower for safe-keeping. *JASON* crabbed around the east face to the west face to pick up the data logger and redploy it. There was some juggling of Medea and *JASON* to get a good position to work on the west face, but the data logger and osmo sampler were found. Eventually the logger was placed back into the notch and *JASON* and Medea moved back into position to work the east face again. *JASON* picked up the incubator assembly and after a lot of maneuvering successfully deployed the incubator in the drill hole at 1452. Because of worsening weather and plans to transit to Neah Bay, *JASON* immediately left the bottom to return to the surface at 1459.

During the day the seismologists worked on the cause of the bad data from KEMO and KEMF. Initial concern is that the sensors were too far out of level to record data - the green pitch lights did not come on for KEMF and KEMO in 2004 deployments. However, results for 2003-2004 shows that the sensors recorded good data irrespective of the status of pitch light at deployment. If the sensor pitch is bad then it should be the x- and not the y-channel that is off level. The seismometer KEMO was tested on board for 3 hours – the ship was level to within 1°. The data clearly shows the same problems as on the seafloor.

Corehole leveling is not the source of the problem. The two sensors at KEMF and KEMO are new ones (so is KENE) and so it seems likely they are faulty. However, Tom Van Zandt at GEOSense reports they were made in the same production run as the older ones and tested twice, once just after manufacture and once just before delivery. Another less likely possibility is that the problems are related to faulty ASI (analog signal input) boards in the loggers. The bottom line is that there are no working short period seismometers to refurbish for replacement dives.

On Thursday night, the R/V Thompson set sail for Neah Bay. With a broken satellite amplifier and impending bad weather at the Endeavour Segment, Kelley and Delaney decided to head towards land, spare parts, and calm waters. Neah Bay, home of the Makah Native American Tribe on the northwestern tip of the Olympic Peninsula, was an ideal location. Once our 14-hour transit ended, immediate work began to fix the satellite. The *JASON* 2 crew took advantage of the good weather to take the drill sled off and replace it with a sampling configuration, a job that takes up to 24 hours. The science party worked on their samples, analyzed data, prepared instruments for the next deployment, and enjoyed the ability to use their cell phones again.

The seismologists verified that the leveling lights will run for at least 22 hours (that is when they stopped checking) so this gives more flexibility to work with seismometers on long dives.

September 9th Neah Bay to Barkely Canyon

Due to the tides, the ship stayed at Neah Bay until Friday afternoon. The change in sea state was felt almost instantly. Large swells from off shore storms rocked the ship and made our transit to the Nootka Fault Zone much less pleasant. To avoid the worst of the bad weather, 6 hours was spent surveying the seafloor south of Barclay Canyon for the Neptune Observatory proposed cable route. The 200 km^2 EM300 survey produced high-quality data at 50 m resolution and filled in a small gap left from a previous mapping effort off the coast of Vancouver Island in November 2004.

The seismologists tested the delay of the GPS signal through the tether. It is 45 micro-seconds. The underwater plugs were also tested and worked fine – they need to be tested before each dive.

September 10 Nootka

Thompson arrives on site late at the Nootka work area. The elevator was deployed for recovery of the instruments that have been down on the seafloor for the past year.

2.5 September 11, 2005 DIVE 169

We had a long night, with the dive starting at midnight. The goals of the dive were to recover the hydronode, CAT flow meter, BPR pressure sensor, and two short period seismonuments from Nootka seep site and vicinity.A long time was spent finding the elevator and a floatation package that was made to carry a large hydronode back up. Even though both items had homers on them they had drifted far to the SE on the way down - the float went down fast, but the elevator was missing a weight on its platform and went down very slowly. This resulted in painful searching on the seafloor.

After 2.5 hours of looking we found the floats about 220 meters away and brought them back to the hydronode, located with homer #17. The resistivity, heat flow probes and fluid flow chamber were buried, and appear to have remained in the same position throughout the year despite our worry that on the soft sedimented slope the heavy electronics package set next to the seep might pull the sensors loose. Biologic activity at the site was minimal. The few tubeworms at the site had deceased, and the spot of bacterial mat present a meter away from sensors last year is no longer evident. This is not unexpected considering satellite transmission of results from all three sensors showed undetectable flow rates. When returning to the laboratory, chemical analysis of fluids captured in Chemical Aqueous Transport (CAT) meter coils also onboard the hydronode will possibly confirm the low flow rates. After probes were

tucked inside the electronics box, floatation assembly was hooked to the hydronode and the assembly was released to float to the surface.

By late morning we were still at the stage of carrying the elevator 550m back to the NW to the site of the hydrology instruments and loaded two smaller packages, a stand alone CAT flow meter, CAT #6, which was deployed in a small, but lively, clam and gastropod patch, and a Bottom Pressure Recorder (BPR) that was sitting at marker J. These were easy to find, however securing them to the elevator for recovery proved to be much more difficult than unlashing them from the shipping pallet on which they'd been deployed. Again, results from both CAT#6 and BPR will be determined back in the laboratory.
Then the elevator was carried to the first seismonument site, KNCP. We picked up the monument and the logger very easily. However, we had difficulties hooking the data logger on to the elevator; the polypro cord handle on top was braided double and too thick for the latch in the hook to be able to snap back up. It was left balanced in the hook pulled down by the weight. Then the monument was placed on the elevator and it was released. The entire seismonument operation took 42 minutes.
JASON waited till the elevator had reached the surface and was on board. Once on deck the seismonument clock was synchronized with the GPS clock and was slow by 0.295/0.296 seconds. Disks A,B, and C were full and there was space to write on disk D. The batteries were good at almost 14V.

This was followed by a long underwater transit of *JASON* to KNNW. Once there, the monument was placed on the porch of the ROV. Then the logger was hooked onto the porch. Unfortunately the hook had been installed on front edge of the porch and the logger was turned upside down to hook it in. During this process the homer beacon on the logger hardhat became partially detached and was pulled off – the logger-to-sensor cable was also caught in the claw during this process. So some rough treatment of the logger. Ballast weights from the milk crate were dropped on the seafloor and the logger anchor weights were then lifted into the milk crate. This site came up on the ROV. On bottom time was 1:15; operations were a bit slow due to pilot-in-training. Once on the seismonument was found to be in good state. The logger is 1.149 sec fast and disks A-C are full, D is currently being written.

The data from both these seismometers look good. We see lots of interesting activity in this region including many earthquakes of reasonable size within an aperture distance of the array, and plenty of whales.

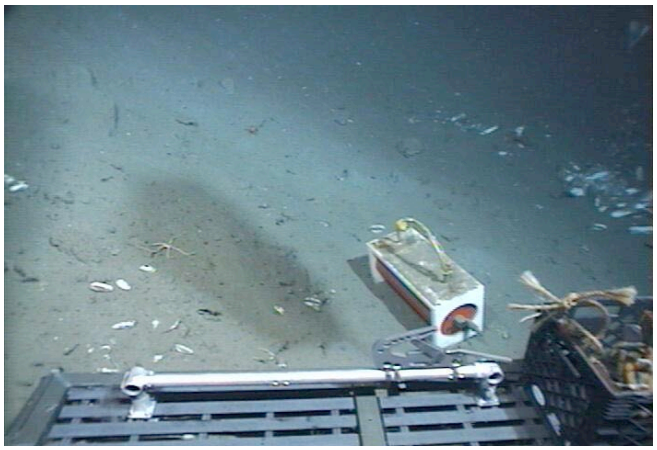
Summary of events:

Time	Event	Vvan entry #
06:30-07:30	Float assembly, elevator, *JASON*2 deployed	3317
08:58	Reach bottom	3346
09:07	hydronode at homer 17 spotted	3367
09:09	looking for float assembly , homer 16 200m	3373
11:43	found float to the SE, bringing back to hydronode	3697
13:09	pulling resistivity probe out	4022
13:13	pulling heat flow probe out	4035
13:17	pulling flow chamber	4054
13:43	releasing hydronode	4154
13:48	grabbed homer 17	4166
14:17	float package at surface	4245
16:32	found elevator	4356
18:32	drop elevator at homer 22 CAT6 BPR site	4452
19:15	BPR picked up	4561
19:55	CAT 6 picked up	4659
21:04	Arrive at seismonument, KNCP, w/ elevator	

21:10	Picked up monument
21:12	Picked up logger
21:46	Elevator released
23:50	Elevator on deck
23:57	Start transit to seismonument, KNNW
07:18	Arrived at seismonument, KNNW
07:50	Seismonument recovery underway
08:33	*JASON* on its way up carrying the seismonument
10:23	Seismonument on deck

Both KNCP and KNNW recorded good data on all 3 channels. There are plenty of local earthquakes.


Left image: Hydronode with sensor probes stretching out to the right. Right image: Flow chamber, resistivity and heat flow probes placed in seep site




Left image: Bottom Pressure Recorder (BPR) near large clam site. Right image: Chemical Aqueous Transport (CAT) meter being recovered from small clam site

2.6 September 12, 2005: Monday DIVE 170

The goal of this dive was to recover Explorer Plate broadband seismometer KXBB. The will provide the flexibility to attempt the servicing of the Endeavour broadband KEBB in one dive since the logger from KXBB can be refurbished for this purpose.

JASON went in the water just after noon (local time). On reaching the bottom, the ROV flew over the caisson to pick up the elevator and returned with the elevator to the data logger. There was a lot of rust around the data logger frame indicating that the anoxic sediments can corrode stainless steel. The ROV plugged into loggerand got an immediate ground fault. Communications were then reestablished. The logger was found to be alive and full of data but no time sync was obtained – it was later learned that 1 pulse per second signal was not making it down the cable. After unplugging the ROV, the schilling arm failed and the logger was lifted on its side. The cable was also pinched but appeared okay. After unplugging the sensor, the logger module was hooked to the elevator with a snap hook. Homer # 24 was acquired and the ROV left for the caisson arriving at. The vacuuming of the beads went very quickly (if only we could say the same for seafloor) and the sensor was removed from the hole at within about a half hour of arriving at the site. Three staples were removed from the cable – the first got stuck in the Schilling arm and was used as a probe to find other staples. The elevator was released at without incident and after picking up the sensor and dropping some weights the ROV left the seafloor. Everything was secured on board by 8 PM. KXBB appears to have recorded 13 months of good 50 Hz data but includes 1-2 10 second gaps every ten minutes or so (not necessarily synchronous on all three channels)

2.7 September 13, 2005: Tuesday DIVE 171

High definition video dive on Main Endeavour Field. Dive **J2-171** started at MEF on 9/13/05 at 1105. The light-stand elevator was put in ahead of the dive. At 1340 *JASON* began the transit from the light-stand elevator, where the HD camera was tested, to the RAS mooring to cut it loose. Arrived at the RAS/PPS at 20:58. At 21:12, the mooring line was cut and RAS/PPS was on the way to the surface. The MTR was stowed on top of the RAS when it left the bottom. The mooring passed quite close to Medea, as seen on Medea's camera just after the line was cut. The MTR did not make it to the surface, so the intake line may have gotten snagged on something after leaving the bottom. The mooring arrived at the surface about 40 m off the starboard quarter, and was recovered with no difficulty. The dive continued with other activities, including high-definition video of the area near the RAS site and the Gremlin incubator/instrument site. *JASON* was back on deck at 05:37 on 9/14/05. Processing of the RAS/PPS went well. All samples were recovered with full volume. Most PPS samples filtered 3 liters of fluid for DNA. Unfortunately the temperature data was lost with the MTR.

September 14, 2005: Wednesday

A significant portion of this day was spent on dealing with winch problems. The winch had been acting up on prior dives with level wind problems These problems had worsened and prevented the vehicle launch. In the morning the elevator was launched to with gear for the broadband and *ABE* was launched after lunch. During the afternoon and into part of the evening, the *JASON* group worked very hard to get the winch fixed, with numerous phone calls to shore. After an 3-4 hour delay, just before a decision was made to explore the possibility of going into shore to get the DYNACON representative out, the winch was fixed and *JASON* predive check out commenced.

2.8 September 15, 2005: Thursday DIVE 172

The dive started just before 0100 (local time) with the goal of servicing the Endeavour broadband seismometer, KEBB. The new logger module went down with a float package of one 17" glass ball, a benthos transponder and a 100 lb weight and ended up nearly 400 m from the site. Moving it to the site of the old logger proved awkward because the long anchor required flying well above the seafloor. The elevator was also sent down to recover the old module and the float package and was also moved to the logger site. After clipping the float package to the elevator, the new logger module was moved closer to the old one and the drop weight was disconnected by pulling pull-pins. After an unsuccessful attempt to inspect the caisson (too much sediment thrown up), the ROV plugged into the old data logger. Logger is in TOM8 status (i.e., it is not logging but is in a low-level status). Only disks A and D have data and it

appears to be 100 Hz. The data stream from the sensor makes no sense – it appears to be talking at a different baud rate. Attempts to change the baud rate for communications from the ship fail because the logger requires a baud rate of 9600. An attempt is made to send down an executable to reset the sensor but it only succeeds in freezing logger. After a phone call with Wilcock in Seattle and some thought, the decision is made to recover both loggers and return later. After unplugging the ROV, the old logger is secured to the elevator by a snap hook (it hangs off the bottom) and recovered at 2 PM. The elevator is sent back down for the new logger is recovered again just after 6 PM. The ROV is on board by 8 PM.

The sensor was time synced on deck. The Endeavour broadband KEBB recorded 8 months of data at 100 Hz and does not appear to suffer from frequent data gaps.

2.9 September 16, 2005: Friday DIVE 173

This was a short bounce dive to recover Nootka short period KENE. The ROV was launched just after 4 AM, found the homer just over an hour later. The seismonument was placed on the porch and after some trouble getting the logger clipped into a snap hook, the ROV was came back and was recovered 2.5 hours later after launch. At the time of the dive, it was noted that the location for this instrument was 38 m away from the location logged in 2004. The new location is 127° 34.0034', 49° 19.9983'. At the time is was noted that this location should be good to within 5-10 m but subsequent conversations with the *JASON*-II navigators suggest that the accuracy may be significantly worse. This instrument recorded good data.

After the completion of this dive the ship steamed to the mouth of Nootka Sound for the transfer of scientists for the 2nd leg. Two Kenmore air Otter's we used to bring scientists too and from Seattle. It was a beautiful day and members of the crew and science party who were not on watch and involved in transfers took advantage of the Zodiac to go for joy rides. Late in the afternoon the ship left for the Nootka seep site for a long dive that would recover instrumentation at the seep and then transit 10 km south to recover the Nootka broadband seismometer.

2.10 September 17, 2005: Saturday DIVE 174

The ROV and an elevator were launched at about 9 PM on September 16. The elevator was located and moved close to Homer # 22. The ROV went to Homer # 33 the site of a double CAT (flow meter and sampler), obtained samples of clam shells, took some pictures, closed the valves on the sampler after some effort, dug out the CAT, placed the flow collectors into the CAT and secured them with bungee cords. The ROV then headed back over the elevator to CAT 13 at marker 1, picked up the CAT, shut of the valve (disconnecting a hose in the process), secured the flow collector in the CAT and transported it to the elevator where it was secured. The ROV then headed to the Homer # 21, passing over the double CAT, where two CATs were recovered that were never deployed. These were taken to the elevator and after some effort were secured with bungee cords. The double CAT was now transported the elevator and secured to float underneath. After securing the homers, the elevator was released at 5:30 AM after a 1 hour wait for daylight.

After the elevator was recovered and secured, the ROV left at 7AM for the 6.5 hour transit to the Nootka broadband site, KNBB. The elevator needed for the broadband recovery reached the bottom at 2:20PM but it took over 80 minutes to find – the direction obtained for the Homer were useless. After removing weights the elevator was moved to a site just east of the logger. The logger was found to be in low power mode and the sensor was spitting out gibberish just like KEBB. The logger was attached to the elevator with a snap hook. It then took only an hour to vacuum out the glass beads from the caisson, remove the sensor, remove the staples and place the sensor on the porch. The elevator was then released and both ROV and elevator were back on board the ship by 9:40 PM.

2.11 September 18, 2005: Sunday DIVE 175

We transited to the Endeavour overnight. After moving transponders in the morning, *ABE* was launched after lunch. After launching an elevator with two short-periods, Dive 175 went into the water above site KEKE at 1700 with the objective of replacing 3 short-periods the KENE, KESQ, and KENW sites, surveying a potential cable node site, and recovering 2 major and 2 gas-tight samples from Sasquatch. The dive needs to leave the bottom by 2000 tomorrow or else *ABE* will be floating on the surface.

After fining the elevator, two hours were requited to install the new short-period at KENE and to secure the old short-period and the old homer to the elevator. Both lights were flashing on the new sensor, which was inserted only 6" into the hole (the same as last year). For this dive the new Homers are attached to the hard hats and we used Homer # 58 at KENE – the original plan was to use the other short period at this site but we changed plans because this unit had a long anchor and might be harder to carry to site KESQ. The second short period was removed from the elevator before the elevator was released. By 11 PM the elevator was on board and the ROV left for the cable node site.

The node survey started at 0200 and was completed at 0400. Although *ABE* had correctly identified a 'flat spot' on the ridge that bounds the eastern side of the axial valley, the terrain was very rough. It is dominated by pillow basalts with diameters <1 m and there is only a thing veneer of sediment.

Site KESQ was reached just before 0600 and it was immediately noted the old logger was sitting on the seafloor. It must be flooded. The new short period with Homer # 54 was installed. The sensor was inserted 10" in the hole but only the roll light was flashing. The old logger is very heavy – it is presumably completely flooded. There are discussions about sending down an elevator to get the old logger but this is risky since the lithium batteries may have given off fumes and the unit may be over-pressured on the deck. Since the sensor is needed for future deployments an attempt is made to break the cable by twisting and pulling with the two manipulator arms. This is successful and the sensor is placed in the fluid sampling basket. After picking up the old homer, the ROV leaves for the Sasquatch vent field at 0830.

September 19, 2005: Monday DIVE 175 cont

The ROV drops down to the seafloor a couple of hundred meters from the vent site and encounters talus, pillow basalts and sheet flows with increasing amounts of hydrothermal sediment towards the vent field. The active vent structure is located and has changed significantly since last year and includes new chimneys. After moving away and re-approaching to get good high-definition pictures a chimney is decapitated for sampling. The temperature of the fluids is 287.6°C and two major samples and two gas-tight samples are collected in 30 minutes. After collecting a sulfide sample and dealing with some teather management issues, the ROV moves north and finds a second active structure that was sampled before. Excellent high-definition video is obtained and the vehicle leaves for the seismometer site KENW just after 0030 PM

The ROV reaches site KENW just before 5 PM and the elevator is launched with a short period seismometer. To everyone's relief the logger is floating. An hour is spent at the elevator waiting for Medea, securing the homer that was recovered at KESQ, and removing the new seismometer. The new sensor is installed 8" into the hole, but only the roll light flashes. Some adjustments are made to the position of the new logger so that the cable is not taught. The new Homer # 67 is tested and it works. The old homer detaches from the salmon weight and so has to be held in the arm. The old logger and sensor are taken to the elevator. It proves difficult to secure the old logger to the elevator because the front porch is out and cannot be retracted. Once this is done, the sensor is secured to the elevator and the sample bottles the ROV. The elevator and ROV are on board soon after 2200 and the ship dashes off to recover *ABE.*

2.12 September 20-21, 2005 Tuesday DIVE 176

JASON goes in the water at 1259 at Mothra. The goal of this dive was to deploy one temperature-resistivity probe, deploy a RAS, take fluid samples, conduct a geologic survey from Faulty Towers to Stonehenge, and use the light stand and high def camera to image.

JASON reached bottom and immediately sighted the light stand and RAS (02:28). We attempted to move the light stand further north, but it was too heavy to carry all the way to Faulty Towers (03:13). J2 drove NW to Faulty Towers with the res probe, gas tights, and major samplers. We passed thickly sedimented lobate flows before coming into oxidized old sulfides and hydrothermal sediment and reaching the south end of FT, near Roane (03:38). Collected some imagery of the sulfide insert at Roane, new growth of Finn, and the black smoker at base of Roane (03:52). We decided to try and put the res probe in small black smoker, took the temperature of the black smoker – highest measured was 313.4°C (03:56), and looked for a stable place to put the data logger. The selected site had a temperature measurement of 5.5°C (04:11). This site was abandoned after the logger fell over in the soft sediment repeatedly, and J2 moved to Hot Harold as the next res probe deployment site (05:41). Hot Harold was knocked over with the temperature probe and then measured at 317.1°C (05:50). The black major sampler was fired (finished at 05:55), black gas tight was fired (completed at 06:05), and white gas tight was fired (finished at 06:08). The temperature-res probe wand was deployed in Hot Harold and the data logger was placed in the saddle between the black smoker and the taller chimney (07:08). The ICL loop was placed and recorded good data (07:20).

JASON transited back to the light stand and realized that the Doppler was not tracking forward or backward movement. We reached the light stand (08:04) and carried the light stand about halfway to FT, but it was too heavy to carry the whole way. To lighten J2 and carry the light stand, we dropped the black major, black gas tight, and white tight at the C3 seismometer site (Homer #11) (08:47). Instead of going back to the light stand, we collected the RAS and moved it to the sulfide apron near the NE end of FT (09:51). We began to look for an area of good diffuse flow, using the high temp probe. A Beast sample was attempted but not taken (10:38) and the search for a good diffuse site continued. It was decided to place the RAS intake valve in diffuse flow (11:02). The RAS was located, and redeployed nearer to the diffuse flow without disturbing the other instruments already in place at FT (11:25), and the RAS intake valve was placed (12:23). The Beast was used to collect 4 samples in two different locations, finished sampling at 13:03, and temperatures were taken.

Next we began a geology transect of Mothra from FT to Stonehenge (13:28). We drove along the western valley wall to Crab Basin, imaged Gwenen, and drove around the rest of the field attempting to map the sulfide-basalt contact (14:17).


Continuing south, *JASON* traversed lobate flows, collapse basins, old sulfides, and fissures. We reached Cuchalainn at 14:43, identified chimneys at Marker G, and headed east to the tubeworm patch at marker T5, site of last year's RAS deployment (15:08). Temperatures at the site ranged from 1.6 to 14.7°C.
The Beast collected four samples, ending at 15:53. We then continued our geologic transect, collecting high def imagery from the lava lake east of Cuchalainn and up the fissure leading to the chimneys (16:57).

We turned south to Stonehenge and reached Spikes, the northern chimneys, at 17:10. We located Plug M1 and attempted to find the bubbling vent from last year, but were unsuccessful (17:40). We then explored the rest of Stonehenge and relocated Marker E, deployed in 2003 with poor navigation (17:56). The structure was imaged in high def (18:10), then we headed back to the light stand. On the third try, J2 successfully picked up the light stand and transited back to the sulfide ramp NE of Hot Harold (19:47). It was left there and eventually relocated to illuminate the west face of FT (20:50). Soon after, the light stand got stuck. J2 flew around imaging the west face, Hot Harold, and new chimney. It took until 23:37 to free it, and the movement had lifted sediment and decreased visibility. While waiting to clear, it was decided to pick up the water bottles at C3 and release the elevator. At this time, telemetry to the vehicle was lost (00:24) and began to surface. It was later determined that one of the fiberoptic cables snapped. The elevator was released at 00:27, but the water bottles were not recovered. Power was restored to J2 before it came on deck.

Off bottom: 9/22/2005 0:35
End of dive: 9/22/2005 2:11

2.13 September 22, 2005 Thursday DIVE 177
JASON goes in the water at 1654 with HFPS on board for sampling in MEF at the site of RAS15 on the southwest quadrant of Hulk, near the Gremlin site. This dive is configured as a very long, multi-purpose dive to install instruments, take samples, and replace seismometers. The dive started by going to the instrument elevator about 100 meters north of Hulk (x,y,z 5034,6035,2199), and carrying the elevator down to where the RAS was dropped. The elevator was dropped once along the way and then picked up again. We placed the elevator east of the gap between Hulk and Crypto at 03:30 and found the RAS/PPS mooring at 03:50 (frame 17370). The drop anchor pull-pin was out at 04:01, and carried the RAS/PPS by the line above the PPS starting about 04:20. The mooring was placed near the deployment site at 04:50 (frame 17503). At 05:12, we began taking water samples with the Beast. The first set of samples was taken at the spot where the intake nozzle has been and would be put again for the coming year. We took 3 water samples, 3 replicate filters for DNA, and one GFF for organics for Susan Lang. Next we moved the intake to the top of a 20cm tall cone about 1 meter south of the first spot and took piston 5 and a DNA filter. Temperatures were very similar between the first two sites. For the third site, we moved *JASON* and changed the heading from west (250) to roughly north 020° and on the edge of the flange rather than in

the middle. Temperature was higher in this spot, and we collected just one water sample (Tavg 50°C) due to time constraints. (Note: the event log is incorrect; this was sample 14, not 24). We finished sampling with the Beast and moved the mooring closer to the site starting 07:20 (frame 17870). It took until 08:05 to get the intake line off the frame and get the intake settled in a good position in the vent. The area of 25degree water was very small, so it was difficult to decide on exactly where to place the intake. After we finished placing the intake/temperature sensor (which has a small piece of syntactic foam with "85" on it), we backed up to look at the site and found that there was now a smoker at this site, so we decided to sample it with a major sampler (J2-177-MB1). We measured 237°C in the new orifice, which we think was made by *JASON* poking into the sulfide while sampling on this dive. The heading while sampling the smoker was ~348 and we were looking right at the RAS/PPS intake. We made one more check of the intake, measured 17.2°C at the intake and left it alone. At 08:45 on 9/23/05 we moved to pick up the MAV current meter deployed a few meters away from the RAS/PPS site in 2004. The MAV tube is l*ABE*led 53. (This is Susan Hautala's instrument, and was left on board the ship at the end of the cruise so she could process the data on the next cruise.) The MAV recovery was easy and we were on the way to stow it in the elevator at 08:57. At 08:47, we started taking a very large volume filter sample of ambient bottom water for Susan Lang. The pump was turned off while working at vent sites or when lots of particles were stirred up. By the end of the dive, 38.8 liters had passed through the filter, which was frozen for organic analysis. The MAV was stowed on the elevator at 09:20 (frame 18204).

At 09:40 one of the RTH instrument pigs was taken off of the elevator and *JASON* started moving back toward Gremlin/Homer 92. We arrived back at Gremlin at 10:02. At 10:22, measured 321.4°C in the smoker that is the target for the RTH probe. At 10:28, took the blue gas-tight. At 10:31, took the orange gas-tight. At 10:37, started trying to place the RTH probe in the vent. At 11:41, the pig was stable and the RTH probe was in the vent, and an ICL reading showed that temperature was working, but got zero on the hydrogen reading and a "bad reading" for resistivity. At 11:47, started moving back to the elevator. Noted that RAS/PPS got some propeller wash from *JASON* while working at the Gremlin site. Reached the elevator at 12:09, picked up a res probe pig, started moving *JASON* toward Sully, homer 23, and arrived there at 13:27. At 13:54, measured 354.2C with the high-T probe. Took yellow gas-tight at Sully at 14:01. The pig was placed down on basalt and the probe was in the vent by 14:11. At 14:21, the ICL loop picked up data from the probe, getting 355C temperature and 0.595 resistivity, so probe looked good. At 14:26, started moving toward the north side of Puffer to pick up a hydrophone. The hydrophone was on board *JASON* at 14:41. *JASON* then returned to Sully and recovered Homer 23 at 15:18. At 15:57 on 9/23/05, *JASON* left the bottom to **end dive J2-177** with the Homer and the hydrophone on the front porch (frame 19057). *JASON* was back on deck at 17:22. There was a lot of the dive plan still left to accomplish, but weather kept us out of the water for the next 48 hours.

September 23, 2005 Friday
Dive 177 ends at 1223. Plans were made for the follow-on dive, which was to focus predominantly on cycling the seismic array. The weather significantly deteriorated with gusts of 29 knots.

September 24, 2005 Saturday
This was a weather day with high winds and sea state preventing dive operations. The doors were secured and the transfer at sea was postponed until Monday. The seas were also too bad to launch *ABE* so this was a down science day.

2.14 September 25, 2005 Sunday DIVE 178
The objective of this dive was to complete the seismic work at sites KEBB, KESW, and KESE. At about 1300, the elevator was launched at the KEBB site with a seismonument for KESW and the rigging to recover the broadband if necessary. This was followed shortly by the broadband logger module with a single 17" float and a tracking relay. Shortly after 1500, the ROV impacted the seafloor at full descent speed –it hit soft sediments and as a result of all the mud we picked, dust clouds continually interrupted

the work at KEBB. The ROV found the broadband sensor plug in its bucket fairly quickly. A homer had been bought down to temporarily mark the site but the weight came off when it was lifted out of the bucket. After confirming that the caisson was properly buried (it could not be found), the ROV went to the elevator, temporarily attached the buoyant homer, and moved onto the float package. The weights were released and the logger module float package moved to the elevator where the float package was released and hooked into the elevator. The logger module was then moved to the sensor plug where it was set down at 1800.

The next few hours were frustrating; there was a problem with the Kraft arm and the master had to be replaced, and we had to take off repeatedly to unwind wraps in the cable caused by the rotation of Medea. We finally plugged in the sensor followed by the ROV at 21:30 PM. The logger and sensor were talking but the sensor was acting strangely. The sensor thought it was 2041 and was only sending packets of a small fraction of data (10-20%) – we verified that packets were not being dropped. The masses were locked and so we centered the masses. The time was reset manually and while it may have received the GPS package to set the time, no timing package was received back. The sensor was left in place in the hope that it would record useful data. After unplugging and removing wraps, the seismonument was removed from the elevator, the homer was secured as well and possible and the elevator released just after midnight.

September 26, 2005 Monday DIVE 178 con't

While the elevator was rising, the seismonument was lost off the front of the porch and the sensor pulled out. The ROV pilot was unwilling to secure it with the manipulator for fear that the ROV would be negatively buoyant in the event of a vehicle failure – for some inexplicable reason a 35 lb weight that had been placed on the drawer was left in place. It was decided that a new seismonument should be sent down at KESE. Shortly thereafter the ROV dropped the short period logger. After recovering the elevator, it took about well over an hour to pick up the logger. At 0600 the ROV reached KESW and the elevator was released – it landed 10 m in front of the vehicle. The dropped logger and sensor were secured to the elevator and the replacement new seismonument was picked up. The seismonument was swapped out in a fairly awkward operation that involved lifting the new one over the old unit (rather than deploying it to one side). After acquiring the old monument, the old logger was set down on the cable in a dust storm and this yanked out the sensor. It took a while to secure everything to the elevator. Before releasing the elevator, we returned to the new seismometer (Homer # 13) and adjusted its position so the lights blinked. The azimuth looking down the sensor barrel with the lights in front was 212°. The elevator was released at 1030 and was back on board by 1230. At this point the ROV left for Mothra to recover a sulfide insert and the water samples.

At 23:36 on 9/26/05, the two gas-tights and the major sample collected on dive 176 were recovered into the large basket on the front porch of *JASON*. This dive ended and came on deck just before the personnel transfer between leg 2 and 3, so there was no time to process the major before leaving the ship. It was labeled and put in the walk-in refrigerator. Dive 178 ended with *JASON* on deck at 03:25 on 9/27/05.

At the end of the second leg, there was some concern about the RAS/PPS near Hulk being disturbed or moved by all of the ROV activity centered on Gremlin. RAS/PPS anchor is about 10 m from Gremlin, bearing 195-210°. The plan was to check on the intake to make sure that it was still installed correctly in diffuse flow.

2.15 September 27, 2005 Tuesday DIVE 179

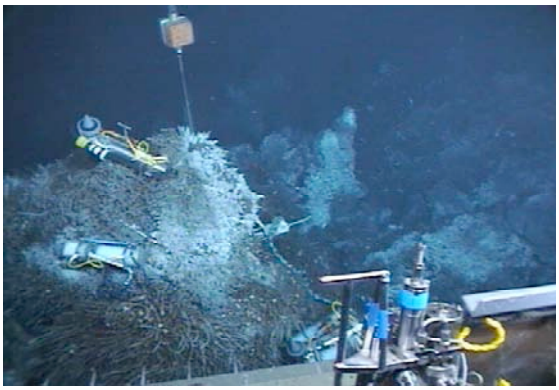
During **J2-179**, the light stand elevator was put next to RAS/PPS on 9/27/05 at 19:02 for the purpose of getting high-definition video of Hulk for the HDTV broadcast. *JASON* approached the RAS/PPS site

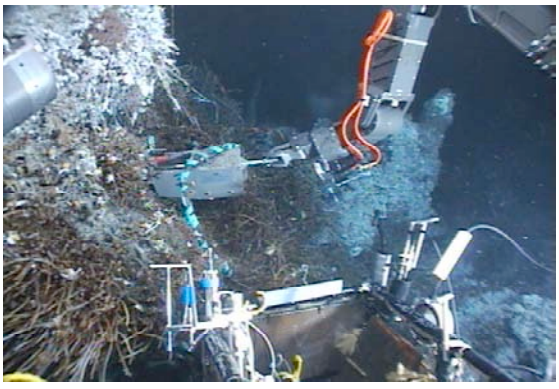
during the rehearsal show on 9/27 at 21:35, and appears to have a pretty close look near the intake with the science camera (22464).

September 28, 2005 Wednesday DIVE 179 cont

Jason goes in water at 0937, at coordinates 47.8939N by -129.1645W. *JASON* began by heading towards the light elevator that is sitting on the seafloor below *Medea*. After finding the light elevator and assessing its stability, we removed the weights and began moving the elevator towards the south of Hulk near the fissure, about 70 m away from Gremlin. Winding past the south edge of Hulk, the RAS came into view and the leg of light elevator became stuck on a rock. After the leg was freed, we brought the light elevator towards Hulk, with Marker H in view and the RAS in sight. Eventually, the light stand was positioned on top of marker H. At that point, 2 weights transferred from light stand to J2. Then, we began by flying up to get a look at a flange and a little smoker in that area. NOTE: Homer 92 was also in view while working in this area, as well as an RTH package. At 1330 local time, rehearsal started for the HD broadcast. During the broadcast, we started up the side of Hulk on a fissure along side possibly part of the plumbing structure. The edifice was dotted with multiple small smokers. At 22:52 *JASON* time, we removed weights from the light elevator and released it.

JASON transited to the resistivity probe at Gremlin. (near where the old RTH package T 29 is). After locating the site, we reamed the hole and placed the probe by a smoker. We also collected a gastight from this site. We then found and moved the equipment elevator to the southeast end of Hulk (it landed 23m away from homer 92 at Gremlin). We picked up and deployed a low temperature osmo sampler and at Gremlin in a tubeworm clump about 30°C. We then experimented with test wand (material test for DD Meldrum). We then went to the top of Gremlin to check the "pig" via the ICL to make sure it is working correctly (it did work well, and read 325.8). After going back to where we were, we made it to diffuse flow and took framegrabs. Then, we went to the incubator located in Gremlin (47.95019904N by -129.0970562W) and struggled to recover it from the structure. Finally, on 09-28-2005 at 10:00 *JASON*time we removed it from the drillhole. Many teflon seals were damaged but the incubator was intact. We did manage to close the holes on the incubator. Then we went to the elevator and swapped the old incubator for the new one. We also placed a new osmosampler and the RES probe on the porch of J2. The surge, however, was building and that made positioning the RES probe near incubator hole challenging. Because of the difficulties, the decision was made to bring *JASON* up 100 meters to see if the swell and surge would die down. On 09-28-2005 at 14:35 the decision was made to recover *JASON* due to foul weather. *JASON* Dive 179 ended at 0849 on 09-28-2005.



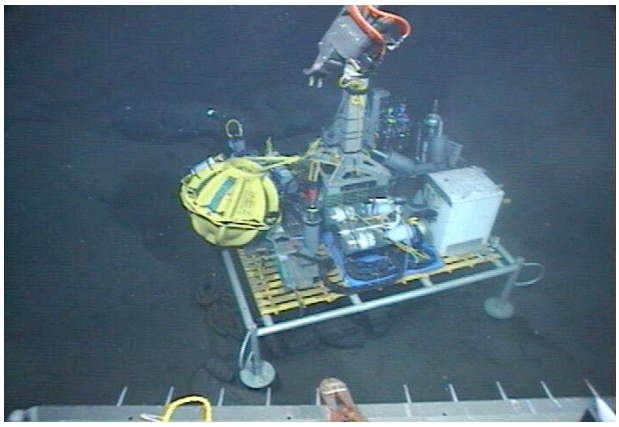


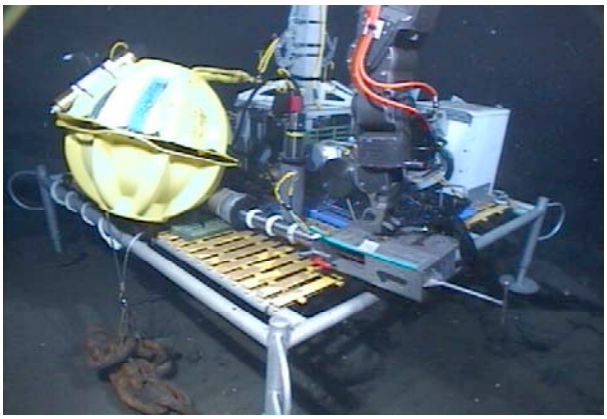
Left Image: Res probe, osmosampler, and microbial incubator #3 at Grimlin. Right image: Microbial incubator #3 recovery

September 29, 2005 Thursday Weather Day
Late in the evening the weather cleared enough so that *ABE* could go back in the water to begin mapping the Main Endeavour area in high resolution. During the early morning *ABE* became entangled in a polyprop line on the western axial valley wall just north of the Main Field.

2.16 September 30, 2005 Friday DIVE 180
The launch of *JASON* was postponed because of poor sea state but at 1326 *JASON* was able to go back into the water with the first goal to rescue *ABE*. *ABE* was trying to drive forward but the line had gotten caught and thread down the length of the vehicle. After much discussion, *JASON* drove up the length of the line, which terminated at a broken end. *JASON* cut the line by *ABE* and followed the line down to its termination. *JASON* placed a few pieces of talus spaced out over the line to hold it to the seafloor and prevent other vehicles from becoming entangled. Following the freeing of *ABE* and fixing the line, *JASON* came 200 m off the bottom so that *ABE* could be brought safely onboard.

With *ABE* safely onboard *JASON* operations commenced. At ~ 2030 the strobe being developed for the hybrid 11,000 m vehicle was tested. The test went very well. Following the test, *JASON* again came off bottom to await the arrival of an elevator. At 2136, *JASON* reached bottom again and resumed the field test of the green strobe. Following the test, *JASON* transited to the elevator which was filled with water bottles, makrers, a seismometer, and bio box. *JASON* arrived at the elevator at 2306 (X = 5124 Y = 6339) and picked up the elevator to move it closer to the work area near Hulk. The elevator was dropped at X = 5069 Y = 6271 and the microbial incubator to be deployed on the east face of Hulk was removed.

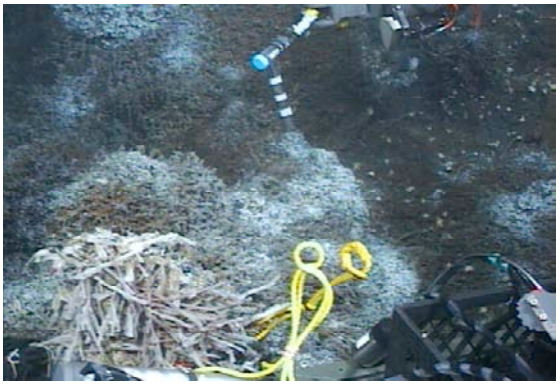




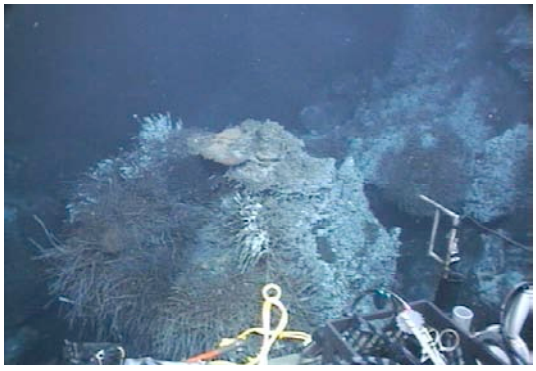
A marker and materials test (DD Meldrum) was also placed on the front porch. and *JASON* headed off towards Gremlin and Hulk.

October 1, 2005 Saturday DIVE 180 cont
JASON went up the steep east slope of Hulk marked by an array of dead chimineys and reached Gremlin at 0042 (X = 5045 Y = 6253). Marker Z and a temperature probe were deployed at near the top of Gremlin and the mate rials test (canister with light green capped vials).

JASON crabbed around the side of Gremlin to deploy another materials test on the southern side of Gremlin. *JASON* probed around in an area of diffuse flow, with temperatures up to 19°C recorded and the materials test was deployed at 0103 (PST) 0803 GMT (X = 5046 Y = 6248 Z = 2201 A = 7.9 m)



JASON then transited to Hulk and surveyed an area to deploy the poor mans incubator near where the real full incubator was to be deployed (X = 5044 Y = 6259 alt = 15 m Z = 2187 26161 frame grab). So that the sulfide incubator could be deployed more easily, the poor mans incubator was positioned on a small platform just above where the sulfide incubator was going to be deployed.



Just below the poor mans incubator a poormans incubator was pulled from the previously drilled hole and the microbial incubator that had been in Roane, was redployed into Hulk hdg 282.9 X = 5042 Y = 6261 alt = 10.2 depth = 2188)

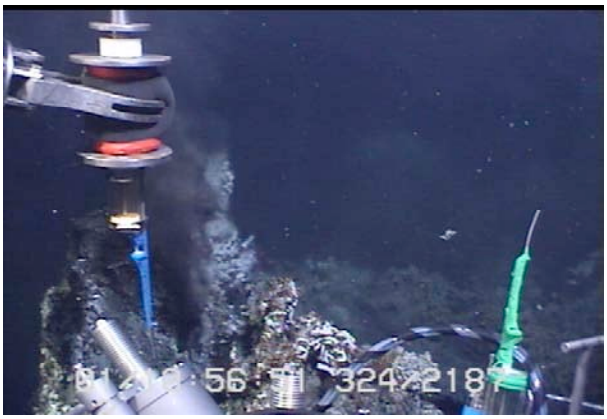
Incubator deployed in Hulk at 0237 0210 PST Hdg = 277 X = 5042 Y = 6261 a = 9.8 z = 2189 FG 26839)

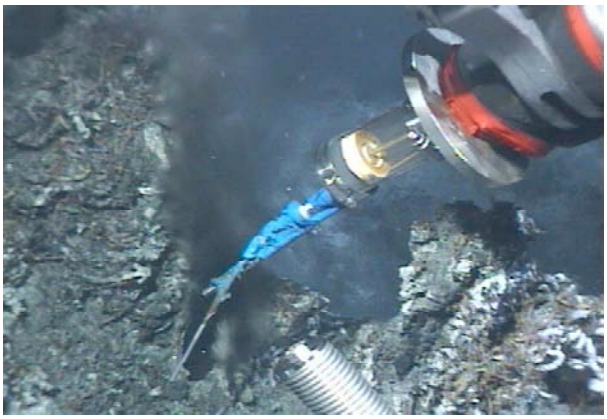
Following the successful installation of the microbial incubator the “poor mans” incubator was removed from its holding platform and *JASON* transited back to the elevator to deposit the poormans incubator

Incubator just prior to final insertion into Hulk.

Final insertion in Hulk.

At 0305 two majors, a gas tight bottle, 2 of Wheat’s squeeze samplers, and an osmosampler were recovered from the elevator and placed on *JASON*,s front porch for follow-on sampling. *JASON* then headed back towards Hulk for continued work. *JASON* spent some time at a small black smoker by where th einsert was placed and tried to truncate a small sulfide structure and get a sample (0340 X = 5044 Y = 6256 alt 14; hdg 324). The top portion of this small orifice on Hulk was broken off and at 0345 (1045 GMT) a temperature of 320.5°C was measured. Following the temperature measurement, there was a trial of one of Wheat’s squeeze samplers at this orifice.





The first test was only partially successful and so a second squeeze sample was tried using a different manipulator. During positioning of the second squeeze sample, the ship pulled *JASON* off station (0417 gmt) and the ship moved 100 m off station. *JASON* managed to get back to the site and take the second squeeze sampler. Location is 47°57.0103’N, 129°5.8221’W, x,y,z 5045,6256,2187. At 0554 the area was relocated and *JASON* enlarged the orifice on the sulfide structure for ease in sampling. After some repositioning the sampling of the green squeeze sample was complete (0601 logger X = 5040 Y = 6267 Hdg 350 alt 13). Following this the blue gas tight sample was taken. The osmosampler was then obtained and the titanium sheath placed in the orifice and the osmosamplers were placed on the backside of the chimney in an area covered in tubeworms. A macrofauna sample was also taken at this site and placed in the biobox (0725). Following completion of the work at Hulk, exploration began to find a place for sampling of diffuse fluids with the majors. The discrete single bottle was fired at 1414 (5047 6250 al 4.6

hdg 352) and a second bottle was fired with completed sampling by 1422 (x = 5047 Y = 6250 hdg 352 alt 4.6)

JASON left this site at 0728 to transport the materials back to the elevator (bearing 064; 21 m). On the way some high def shots were taken of a flange.
At the elevator the fluid samplers, sensors, and biobox were removed from the platform and at 0830 a short period seismometer was recovered from the elevator. With the seismometer onboard, *JASON* began the transit to Grotto (Homer 91: 0842). *JASON* easily reached the site at 0930 and the dummy plug that was to be used for a poor mans incubator was removed (X = 4914 Y = 6093). The seismometer was easily deployed and homer 91 was recovered onto the vehicle and it was replaced by Homer 97. Following the replacement of the Homer, a test was completed of the new strobe system for the hybrid (1004) while *JASON* was transiting back to the elevator. *JASON* hovered around the elevator until it was released and recovered on the surface (it reached surface at 1100; 1800 gmt). The elevator was recovered on deck at 1127.

At 1149 *JASON* began a long transit down to Mothra to complete deployment of a poor mans incubator in Roane, seismometer etc. At 1643 *JASON* reached the work area and transited towards Homer 11, east of the Faulty towers complex by the short-period seismometer. On bottom *JASON* waited for the elevator to reach the bottom so that work could commence. The elevator landed south of Faulty Towers so *JASON* began its transit to the south. It reached the elevator at 1736 and loaded a short-period onto the front porch and transited back to Homer 11. An attempt was made to secure Homer 11 onto the elevator, but the clip holding the line onto the weight had broken and the homer was lost. At 2042 *JASON* began a transit to Roane arriving at 2048.

At 2056, the dummy plug was removed from the top of Roane and a poor mans incubator was placed in the hole with a Hobo that was set to take temperature readings every 30 minutes (x= 4159 Y = 3291 alt = 8.39 Z = 2282 hdg = 21) .

Poor mans incubator in deployed in Roane

Poor man sheath pulled from the base or Roane

Following deployment, *JASON* moved to the base of Roane to pull out the poor mans incubator and replace it with the microbial battery. When the incubator sheath was recovered it was covered in white filamentous bacteria (2220 hr).

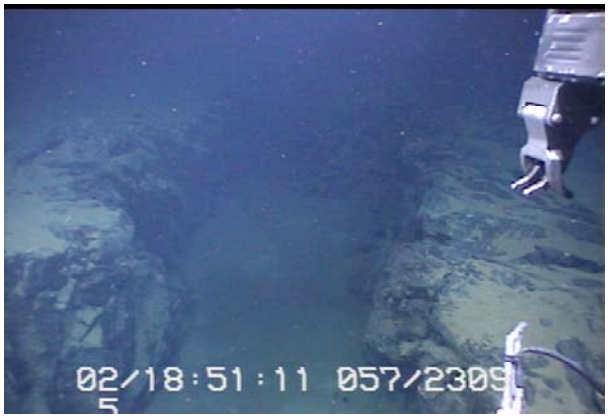
JASON rotated to the left of Roane to conduct high definition imaging of the structures: a complete HD transect was completed of Finn with very nice imagery obtained of the macrofaunal communities. A good sulfide sample was taken of a young orifice near the top of Finn and placed in the biobox (2348) and

a corresponding tube worm sample was taken near the site. A temperature of 306.6°C was measured in the orifice. *JASON* then crapped to the northeast around the base of the Tower and found the RAS that have previously been deployed there. A relay transponder had been dropped at this site with a homer. This was recovered and taken back to the elevator. The poormans incubator recovered from Roane was placed onto the elevator.

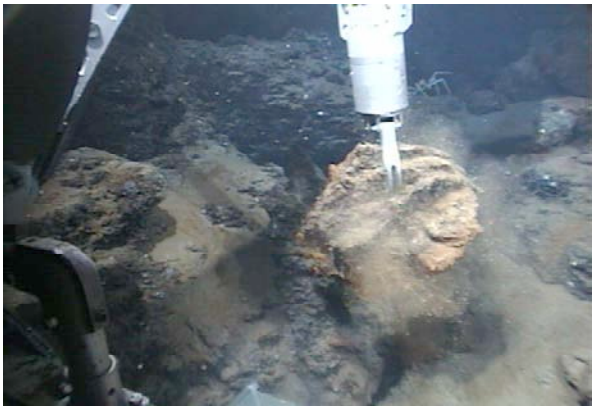
October 2, 2005 Saturday DIVE 180 cont

The elevator was released at 0200. While *JASON* waited for the elevator to be recovered, the ship moved off station again. The elevator was sent back with a seismonument and *JASON* drove to pick it up (0813 X = 4527 Y = 3956). From the elevator *JASON* began a long transit east of the flanks to the shortperiod site KESE. *JASON* reached the seismonument at 0900. The mooring line on the data logger broke and the data logger was left hanging by the cable to the seismonument. At 0907 the new seismonument was deployed, both lights were flashing, and the old seismonument was recovered. The new Homer at this site is Homer 96. The homer was working when *JASON* left the deployment site. *JASON* then transited back to the elevator to offload the old seismometer. Water sampling bottles were removed from the elevator for sampling at Mothra. The elevator was released. While waiting for the elevator to surface and be recovered *JASON* explored around the area and collected two small basalt samples of a sheet flow (1052 X = 7812 Y = 5252 Z = 2309).

JASON spent some time wandering around and tracing out a well developed fissure (1149 X = 7891 Y = 5284 Z = 2308 Hdg = 58. At 1228 the elevator reached the surface and *JASON* resumed work.



After the seismonument was in position, we traveled northwest to the Main Field, and examined an extinct sulfide field to its south. The seafloor was imaged along the way from this extinct field to the Smoke and Mirrors (S&M) cluster in the main field. At 1616 during transit, *JASON* recovered a large oxidized piece of sulfide (X = 4933 Y = 5711 Z = 2205 hdg = 285).



Another sample was taken at 1441 (X = 4917 Y = 5728 Z = 2193). At 1700 hr, *JASON* reached the strucuter S&M in the Faulty Towers complex and began imaging the structure. From there *JASON* spent a significant amount of time doing detailed image work on the east side of S&M and along the fault. The dive lasted as long as possible to still make to port on time. *JASON* came off the bottom at 1950. Clean up operations took place overnight to recover the transponders Eight transponders were recovered and it too nearly all night to bring them back onboard.

October 3, 2005 Monday
At 0700 (7 am) this morning we left our research station. We steamed north and then plotted a course along a line towards Vancouver Island on one last data-gathering mission. The ship's EM300 sonar was used to map the seafloor along the proposed NEPTUNE Canada cable route. Once the map was made Ginger Armbrust ran a quick CTD down to 150 m to collect more water for the flow cytometer and we headed for home

October 4, 2005 Tuesday
The R/V Thompson arrived home in port.

Appendix 1: Thompson VISIONS05 Operations Summary:

Date	Operations	Comments
9/1/05	Transit from Seattle to Endeavour Segment, Conducted Em300 survey across Barkley slope and possible cable route, across flank ODP sites.	Conducted dunk test of *JASON* in Puget sound, transferred off crew member with abscessed tooth
9/2/05	Transferred Marv Lilley from Atlantis to Thompson at 1730 east of Endeavour Segment. Arrived on site and deployed four transponders for *JASON* 2 work at MEF and Mothra.	Surveyed in four transponders for ~ 10 hrs.
9/3/05	***JASON* Dive 165** in Mothra Hydrothermal Field to begin drilling and incubation program. *JASON* goes in water at ~ 0900. At about 500 m problems encountered with ground faults on Medea, power hits to J2. J2 goes dead, recovered Medea and J2 at 1124. A CTD conducted at 19:54-2117 at 47°55.9929N, 129°09.0170W. Seven bottles were tripped for background water.	Leak in valve in new Medea housing that drives new thrusters causes fire inside housing. Medea power/communication system transitioned back to original design. Lay north transponder net fir *ABE* work and survey in while Medea is being worked on.
9/4/05	Medea is tested separately early in the morning to check out system. Elevator is deployed east of C3 short-period seismometer. **Dive 165** in Mothra Field. J2 goes in water ~1900. Recovered short period seismometer and recovered microbial incubator from elevator to begin work at Faulty Towers.	***ABE* Dive 157** goes in water at ~0530 north of Summit Volcano. The vehicle acts heavy and will not come off the bottom. Eventually at 1400 it lifts off and surfaces.
9/5/05	Dive 165 work continues, deployed microbial incubator in Roane, two water samples taken at hole. RAS is recovered from Cuchalainne that was deployed in 2004. *JASON* left bottom at 1425.	Drill string decouples while completing Roane hole.
9/6/05	**Dive 166** begins at 0634 in MEF. Short period seismometer recovered from Grotto, recovered RAS & PPS from Hulk, and drilled at Gremlin. Fluids at black smoker was 320°C 1 m away. Completed second hole in Hulk on east side for deployment of poor-mans incubator. *JASON* recovered at 2234.	Temperature in drill orifice was 139°C.
9/7/05	Dive **167** on bottom at 1047 in Faulty Towers. Drilled hole in base of Roane with a temperature of 14.6°C. Poor mans incubator deployed. *JASON* is rapidly recovered and turned around for another dive. Dive 168 goes back into the water at 2130 and completes hole in Giraffe and installation of year-long microbial incubator high up on east face. Temperature of 204°C measured.	Drill string decouples while drilling at base of Roane, *JASON* is recovered. Weather forcast was for high winds so the decision was made to transit in to Neah Bay.
9/8/05	*JASON* works into early morning to get incubator deployed in Giraffe. Was recovered on deck at 1449 and the Thompson begins transit to Neah Bay. Arrived in Neah Bay in the late afternoon for switch our of transmitter component. Worked on transmitter until ~2230, transferred crew off	Departed Endeavour to Neah Bay due to bad weather and need for transmitter parts. The drill sled for *JASON* was switched out under calm seas in the bay. Significant rewiring done to accommodate seismometers, beast, Spawar, and ICL's.

Date	Operations	Comments
9/9/05	Stayed in Neah bay until afternoon to complete work on *JASON* and transfer of drill and work sled. In late afternoon began transit to Barclay mapping site Continued transit to map site on the south end of Barkely Canyon, then transited to Nootka	Weather is improving but still large swells.
9/10/05	Arrived on site at Nootka for recovery of the short-period seismometers, and hydronode, finished node	
9/11/05	After finishing the node we transited to Explorer	
9/12/05	Arrived on site at Explorer for recovery of broadband; broadband gets recovered on deck ~ 1930, will head south to Endeavour	
9/13/05	Arrive on site at Endeavour HD test and *ABE* in water for 3rd dive for long run east ***JASON* Dive 171**	
9/14/05	Level wind on winch broken, J2 gets in around midnight	
9/15/05	Broad band dive on Endeavour flank..bad old logger ad new logger, doing 2 elevator runs to recver both of them, *ABE* doing north dive, will be up at 4 pm. Datas logger logged 8 months of data (Aug to March). Steamed to Nootka ***JASON* Dive 172**	
9/16/05	Arrived at Nootka very early morning ~ 3:30 am did a bounce dive to recover last seismonument. Steamed into Nootka sound, then back out to tow of margin to recover last of Aly's instruments (4 of them), and the broadband seismometer. Worked on recovery of instruments ***JASON* Dive 173**	**Start of Leg 2.** Two personnel transfers by Kenmore float plane lasted most of the day,
9/17/05	Recovered BB seismometer, all of Aly's instruments and last short-period, ~ 2100 began transit/EM300 mapping to Middle Valley then to southwest transponder for *ABE*	
9/18/05	Got to SW *ABE* transponder and recovered and redployed that transponder to north for final dive to finish north stretch of *ABE* map. *ABE* went into the water about noon, followed by J2 **Dive 174** to seismometers.	
9/19/05	J2 dive to NE seismometer, central seismometer, sasquatch, and NW seismometer. Central seismometer logger flooded, picked up all four *ABE* transponders, redeployed survey through the evening **Dive 175**	
9/20/05	Continued survey of *ABE* transponders, ~ 1300 launched elevator and RAS/PPS at MEF, then light stand and RAS at Mothra.	
9/21/05	**Dive 176** starts in late afternoon in Mortha. T-R-H2 probe is deployed at hot Harold, elevator gets caught, telemetry dies so *JASON* is brought back to the surface. The telemetry came back on part way but, but the decision is made to replace the tether between Medea and *JASON*. .	
9/22/05	*ABE* comes up at 1530, **Dive 177** planned, blowing 20 knots. *JASON* goes into the water at 1700	

Date	Operations	Comments
9/23/05	*JASON* continues work in the MEF – deployment of the RAS and PPS at Hulk, significant diffuse fluid sampling with the Beast, the MAV current meter is recovered, 2 gas tight samples and T-R-H_2 probe deployed at Gremlin but was not working, Gas tight is taken at Sully, and T-R-H_2 probe deployed, Homer 23 was recovered- *JASON* on the surface ~ 1100.	
9/24/05	Weathered out	
9/25/05	*ABE* was launched and an elevator was deployed near KESW. ***JASON* Dive 178** in water at 1330. Broadband seismometer is serviced as is the south west shorperiod seismometer.	
9/26/05	**Transfer 2** at sea from the Frosty late in the evening. Rough seas make for a difficult transfer initially. Had the incubator from Gremlin onboard.	**Start of Leg 3.** Processing of microbial incubator from Gremlin occurred as soon as the transfer was complete.
9/27/05	**Dive 179**, *JASON* in water at 0937 in MEF. Dress rehearsal for next day formal show.	
9/28/05	HD show weathered out so completed the show from inside of the J2 van.	
9/29/05	HD show, continued to be weathered out so conducted show inside the main lab onboard the Thompson. Weather continues to improve.	
9/30/05	During early morning *ABE* becomes stuck. **Dive 180** starts in MEF to rescue *ABE*. Rescued *ABE* in the afternoon after it got caught in an old Alvin transponder line. *JASON* begins work in the Main Field.	Weather improved.
10/1/05	Continuation of dive. Deployed a microbial incubator in Hulk, tried out Wheats squeeze samplers, sampled a gas-tight at Hulk, and deployed an osmo sampler at Hulk. Took diffuse samples and recovered some macrofauna, deployed a new seismometer south of Grotto. Transited down to Mothra late in the evening.	
10/2/05	Retreived poor-mans incubator from Roane and deployed new one near top of Roane, collected new growth from Finn, imaged Finn. After leaving Mothra, transited to KESE and recovered, and redployed the seismometer. At MEF conducted HD work at S&M and adjacent cliff	
10/3/05	Early morning final transponders are recovered. Thompson leaves station ~ 0700 to complete some extra EM300 mapping for Neptune Canada.	CTD was completed on way out down to 150 m to collect samples for flow cytometry work
10/4/05	Thompson arrives in port ~ 1200.	

Appendix 2A Transponder Locations

XPN	X	Y	Z	UTM X	UTM Y	LATITUDE	LONGITUDE	F
A	3846.6	5275.9	1888.6	491556.56	5309787.77	47 56.48102	129 06.78369	10.25
B	5965.9	6688.9	1895.0	493674.56	5311197.51	47 57.24351	129 05.08328	11.75
C	5473.5	4846.5	1958.5	493180.77	5309356.39	47 56.24930	129 05.47835	10.75
D	5073.1	3202.8	1951.1	492778.82	5307713.82	47 55.36232	129 05.79961	11.25
E	5140.7	8663.7	1904.5	492853.13	5313172.51	47 58.30916	129 05.74537	8.5
F	6719.6	8048.8	1911.7	494428.38	5312556.11	47 57.97735	129 04.47855	9.5
G	8899.4	11598.1	1993.6	496606.30	5316102.36	47 59.89264	129 02.72959	10.0
H	7234.4	13341.0	1993.9	494946.89	5317845.82	48 00.83316	129 04.06550	11.5
J	*6670.2*	*8196.8*	*1906.6*	*494379.22*	*5312704.10*	*47 58.05721*	*129 04.51818*	*11.5*
K	*6095.9*	*11117.4*	*1789.2*	*493809.12*	*5315624.17*	*47 59.63324*	*129 04.97897*	*8.5*
L	12379.2	11376.9	1916.1	500077.61	5315880.24	47 59.77328	128 59.93758	9.5
M	17271.3	14165.1	1982.6	504955.55	5318669.52	48 01.27786	128 56.01242	10.0
N	6764.3	8213.4	1911.8	494473.16	5312720.60	47 58.06617	129 04.44268	11.5
P	9691.7	14671.9	1997.3	497398.05	5319174.59	48 01.55135	129 02.09389	8.5
Q	15402.1	18612.7	2086.3	503089.35	5323114.16	48 03.67791	128 57.51217	11.5
R	*5756.7*	*4304.8*	*1932.7*	*493462.99*	*5308814.57*	*47 55.95698*	*129 05.25113*	*10.0*
S	*3560.0*	*4746.9*	*1894.0*	*491269.55*	*5309259.40*	*47 56.19555*	*129 07.01364*	*11.5*

Appendix 2B Transponder Locations deployment dates

ID	date	*latitude*	*longitude*	*depth*	*frequency*
A-J2	2005-09-03	47 56.48102	-129 6.78369	1888	9.0/10.25
B-J2	2005-09-03	47 57.24351	-129 5.08328	1895	9.0/11.75
C-J2	2005-09-03	47 56.2493	-129 5.47835	1958	9.0/10.75
D-J2	2005-09-03	47 55.36232	-129 5.79961	1951	9.0/11.25
E-*ABE*	2005-09-20	47 58.30916	-129 5.74537	1904	9.0/8.5
F-*ABE*	2005-09-20	47 57.97735	-129 4.47855	1912	9.0/9.5
G-*ABE*	2005-09-20	47 59.89264	-129 2.72959	1993	9.0/10
H-*ABE*	2005-09-20	48 0.83316	-129 4.0655	1994	9.0/11.5
J-*ABE*	2005-09-06	47 58.05721	-129 4.51818	1906	9.0/11.5
K-*ABE*	2005-09-03	47 59.6332	-129 4.97897	1789	9.0/8.5
L-*ABE*	2005-09-03	47 59.77328	-128 59.93758	1916	9.0/9.5
M-*ABE*	2005-09-03	48 1.27786	-128 56.01242	1982	9.0/10
N-*ABE*	2005-09-03	47 58.06617	-129 4.44268	1911	9.0/11.5
P-*ABE*	2005-09-14	48 1.55135	-129 2.09389	1997	9.0/8.5
Q	2005-09-18	48 3.67791	-128 57.51217	2086	9.0/11.5
R-*ABE*	2005-09-27	47 55.95698	-129 5.25113	1932	9.0/10.0
S-*ABE*	2005-09-27	47 56.19555	-129 7.01364	1894	9.0/11.5

Appendix 3: Sonardyne Homer Locations

NAME	TYPE †	MARKER	HOMER	DATE	LATITUDE	LONGITUDE	DEPTH
KEMO	SP CH	C3	11	?*	47.9241	-129.1082	2285
KNNE	SP SM	C8	10	?	49.3335	-127.5665	1815
Spare			54	7/02			
Spare			92	7/02			
KEMF	SP CH	C2	91	8/02*	47.9489	-129.0988	2202
KESQ	SP CH	C1	88	8/02*	47.9951	-129.0721	2158
KNCP	SP SM	C10	90	8/02	49.2956	-127.6787	2254
KXBB	BB	B13	93	8/02	49.4998	-128.9999	2370
KENE	SP CH	C5	13	1/03	47.9702	-129.0559	2330
KENW	SP CH	C6	12	1/03	47.9797	-129.1101	2160
KNNW	SP SM	C9	13	1/03	49.3250	-127.7882	2461
Spare			50	6/03			
Spare			22	7/03			
Spare			67	7/03			
KESE	SP SM	C4	87	12/03	47.9400	-129.0600	2341
KESW	SP SM	C7	97	12/03	47.9366	-129.1409	2381
KEBB	BB	B11	20	12/03	47.9592	-129.1248	2378
KNBB	BB	B12	96	12/03	49.2160	-127.6992	2488