LADDER-3 Cruise Report

R/V Atlantis Cruise AT15-26
November 10 to December 3, 2007

Science Participants: Lauren Mullineaux (Ch. Sci.), Andreas Thurnherr, Lou St. Laurent, Matthew Schwartz, Chip Breier, Sabine Gollner, Brian Hogue, Skylar Bayer, Ken Decoteau, Paul Fraser, Eric Howarth, Ingrid Kolar, Zinfeng Liang, Susan Mills, Angel Ruiz-Angulo, Nika Stagliçic, Jonathan Stewart, Carly Strasser, Benjamin Walther

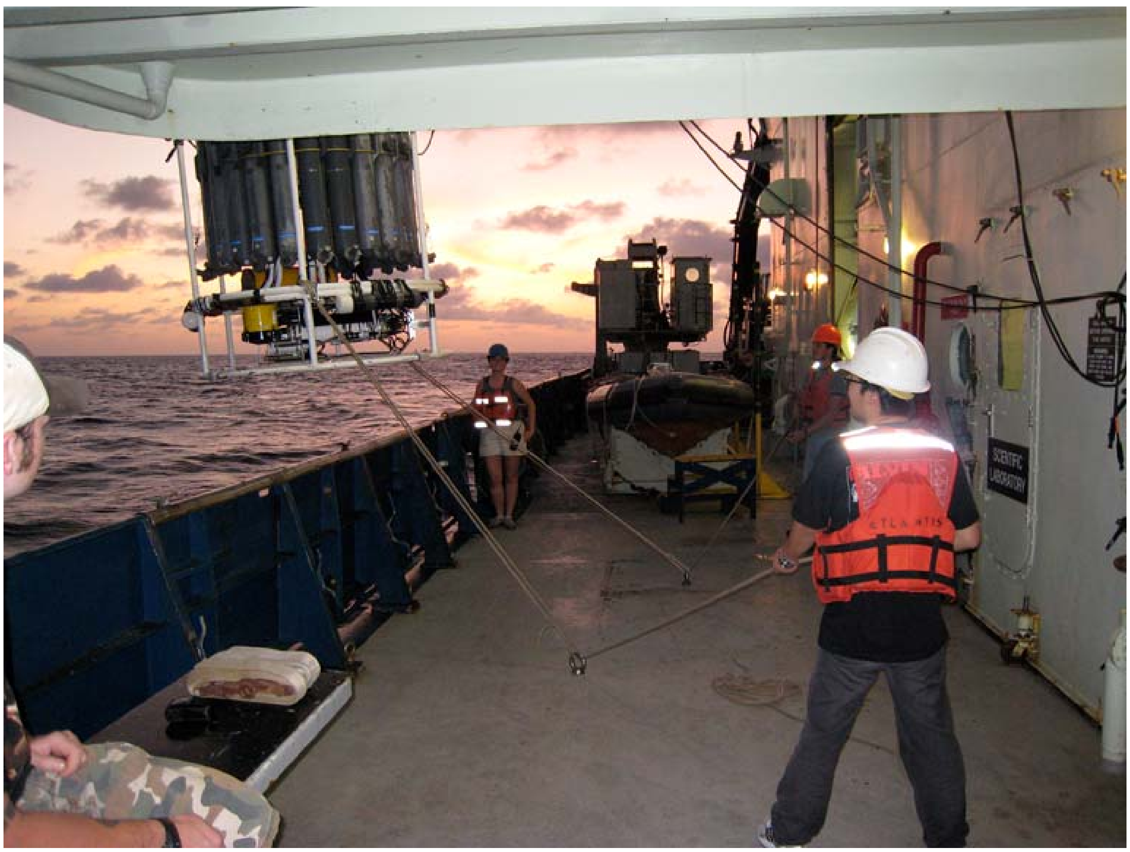

Photo by A. Thurnherr

Acknowledgements: The success of the LADDER-3 cruise would not have been possible without the excellent support of the crew and officers of *R/V Atlantis*, the team of Alvin pilots and engineers, and the SSSG technicians. Funding by NSF Grants OCE-0424953, OCE-0425361, and OCE-0727402 is gratefully acknowledged.

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1 Overview

1.1 The LADDER Project

LADDER-3 is the final cruise of a series of three as part of the LADDER project. The earlier cruises, LADDER-1 and LADDER-2 , occurred in October 2006 and December 2006 to January 2007, respectively. The LADDER project aims to address the following questions:

1. What are the mean and temporally varying flows in the vicinity of a mid-ocean ridge crest, and what is their spatial structure and coherence?
2. What is the magnitude of the diapycnal diffusivity near the ridge crest?
3. How rapid is lateral dispersion, and how effective is lateral homogenization by eddy diffusion near the ridge crest?
4. What are the influences of advection and eddy diffusion on the maximal dispersal distance of vent species with given larval life spans?
5. What are the effects of ontogenetic changes in larval behavior (i.e., vertical positioning) on species' dispersal distances?
6. How are the probabilities that larvae will be lost from the ridge system influenced by topography and flow? Might the axial summit trough inhibit off-axis transport of larvae, and serve as a conduit between habitable vent sites?

In order to address these questions, an observational program was carried out near the crest of the East Pacific Rise between 9°10′N and 9°50′N (Figure 1.1). Activities were `round-the-clock' (Table 1.1) and included submersible and shipboard operations:

Plankton Pumps & Sediment Traps (Sections 2.1 and 2.2). The spatial and temporal distributions of larval invertebrates are investigated by sampling with plankton pumps and sediment traps near the seabed and at the height of the neutrally buoyant hydrothermal plumes. The samples will be used to quantify larval abundances with respect to potential barriers to dispersal (e.g., the axial summit trough walls, or lateral offsets in the ASCT) and distance from potential source populations.

Colonization Experiments (Sections 2.3 and 2.4). Colonization experiments conducted with Alvin in order to quantify the influence of larval supply on recruitment, and monitor changes in recruitment as the new (post-eruption) vent communities mature.

Physical-Oceanography Moorings (Section 3.1). Seven moorings equipped with 15 current meters and 2 velocity profilers were recovered after a year-long deployment in order to determine the velocity field near the EPR crest.

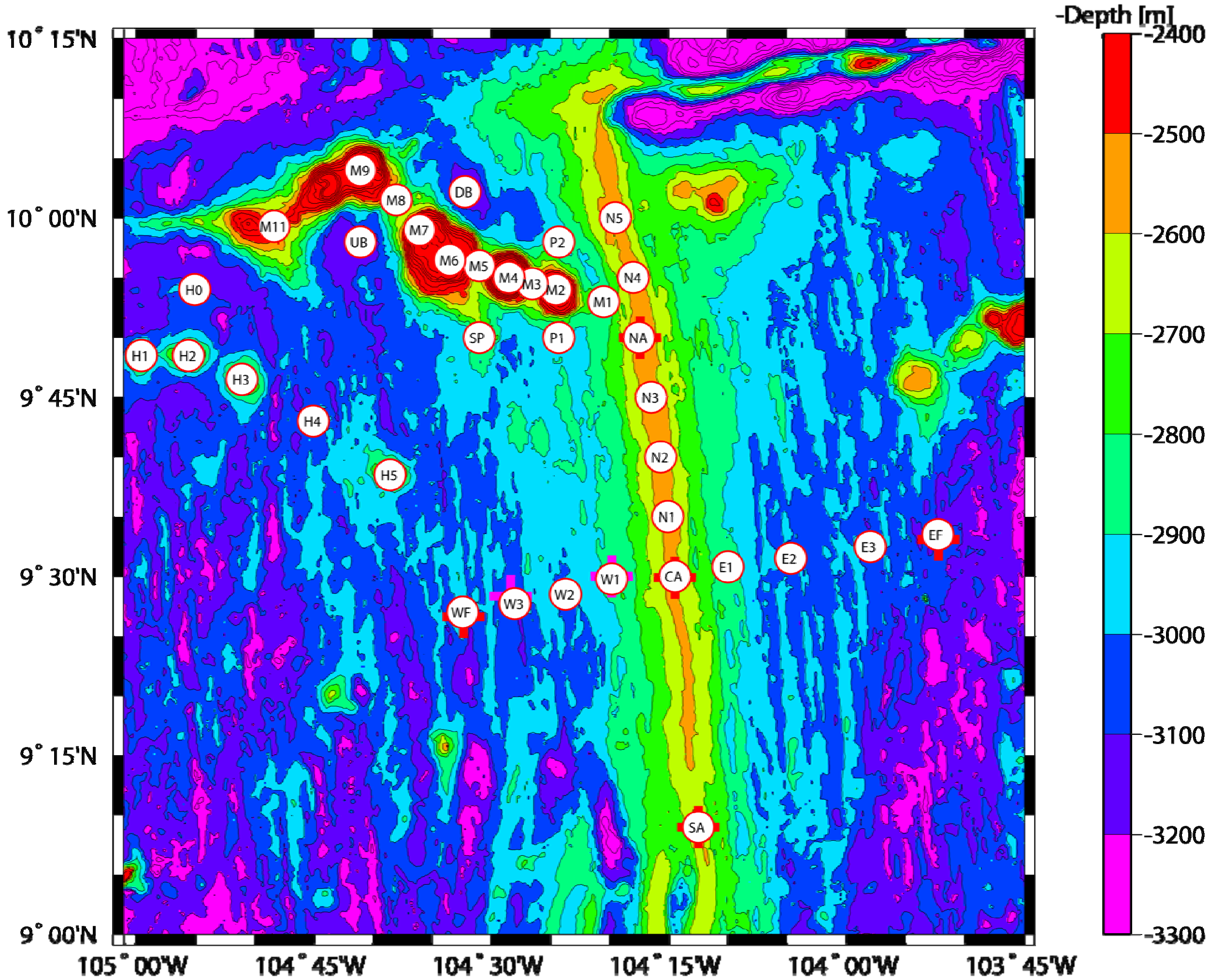


Figure 1.1. Station locations of the LADDER-3 Physical Oceanography (including microstructure profiling) work. Red and magenta crosses indicate moorings with regular current meters and velocity profilers, respectively.

CTD/LADCP Survey (Sections 3.2 to 3.4). A CTD/LADCP survey was carried out in order to determine a quasi-synoptic snapshot of the hydrography and velocity field in the region of the current meter array and along the Lamont Seamount chain.

1.2 Other Projects

Other complementary projects were carried out during the cruise by independent investigators with funds outside the LADDER project:

Microstructure Profiler (PI's St. Laurent and Thurnherr, Section 4.1). A survey using a deep microstructure profiling system (DMP) was coordinated with the CTD/LADCP deployments, carried out at night, and occasionally during daytime, along the EPR axis and on the flanks. The objective was to investigate mixing in the deep ocean in the region of a fast-spreading ridge. The sampling program consisted of examining both the microstructure and finestructure of ocean mixing. Miscrostructure is on a scale of centimeters to millimeters and finestructure is on the scale of meters. The Microprofiler measures the turbulence and mixing rates on the microstructure scale and the lowered acoustic Doppler profiler measures those of the finestructure. These measurements yield direct estimates of turbulent dissipation rates and finestructure parameters. The measured dissipation rates will be used to improve circulation and climate models.

Nutrient chemistry (PI Schwartz, Section 4.2). The objective of this project is to collect water samples from the portion of the water column known as the oxygen deficit zone. This region is ~500-900 m below the ocean surface and is marked by a significant decrease in dissolved oxygen concentrations due to respiration of organic matter (OM). One of the ways that OM is consumed is via a process called denitrification in which nitrate (NO_3) is transformed in dinitrogen gas (N_2). Analysis of the concentrations of inorganic nutrients (including nitrate) and dissolved N2 in these samples will allow me to see just how much denitrificaton is occurring in these waters and to determine whether the mixing between various oceanic water masses in this region of the eastern tropical north Pacific alters the rate of denitrification.

Particulate chemistry (PI Breier, Section 4.3). This is the first at-sea deployment of a new oceanographic tool, a suspended particulate rosette (SUPR) sampling system capable of rapidly filtering 25 large water volume samples (> 100 liters per sample) for suspended particulates during a single CTD cast or moored deployment. This instrument is part of an in-situ chemical analysis package that will allow us to investigate the question of how iron- and manganese-rich, hydrothermal plume particles affect seawater chemistry and to what extent these particles fuel microbial activity in deep-sea hydrothermal plumes.

Hydrothermal Vent Meiobenthos (PI Bright; section 4.4). The aim of this meiofauna project is to study the present status of the meiobenthic community shortly past eruption and to follow the succession of colonization and development of communities. Cruise activities included collection of meiofauna from different natural substrates, from the water column at various heights above the bottom, and from off-axis sediments. Additionally, meiofauna settlement devices were deployed and recovered. A complementary project on development of *Riftia pachyptila* was also conducted. The aim of this project is to study the infection process, growth, and developmental processes in *Riftia pachyptila* symbiosis as well as cell kinetics in symbiont-containing and symbiont-free host tissue. Cruise activities included recovery and re-deployment of tubeworm settlement devices, and recovery of basalt from warm vents to collect small tubeworms.

Table 1.1. Schedule of activities during the LADDER3 cruise

Date	Day Ops	Dive Objectives	Divers	Night Ops
13-Nov	depart Manzanillo, transit			
14-Nov	transit			
15-Nov	9-10: microprofiler, recover SA, CTD/LADCP			9-50: CTD/LADCP, microprofiler
16-Nov	9-50: Recover Trap-L1, Deploy Pump_L15 & L16			9-50: CTD/LADCP, microprofiler
17-Nov	9-50 AD4366	P vent, position pump, 8 sandwiches, slurp limpets, box limpets	Susan, Ben	9-50: CTD/LADCP, microprofiler
18-Nov	9-50, AD4367, Recover Pump_L16 (L15 delayed)	P vent, recover 7 sandwiches, deploy 15, benchmark survey, Niskins	Lauren, Angel	9-50: CTD/LADCP, microprofiler
19-Nov	CTD/LADCP, microprofiler, Recover Pump_L15 & WF			CTD/LADCP, microprofiler
20-Nov	CTD/LADCP, microprofiler, Recover W3 and W1			CTD/LADCP, microprofiler Deploy Pump_L17 & L18
21-Nov	9-47, AD4368, V-vent	V-vent, recover 15 sandwiches, slurp limpets, collect mussels	Lauren, Nika	CTD/LADCP, microprofiler
22-Nov	9-50, AD4369, Recover Pump_L17 & L18	Tica, recover 16 sandwiches/blocks, deploy limpet condos, benchmark survey	Susan, Xinfeng	9-50: Deploy Pump_L19 (with SUPR) and Pump_L20, CTD/LADCP,
23-Nov	CTD/LADCP, microprofiler, Yo-Yo at seamount site DB			CTD/LADCP, microprofiler
24-Nov	CTD/LADCP, microprofiler			CTD/LADCP, microprofiler
25-Nov	9-30, AD4370, K vent, Recover Trap_L2 and CA	K-vent, recover 15 sandwiches	Carly, PIT	CTD/LADCP, microprofiler
26-Nov	9-50, AD 4371, Recover Pump_L19 (with SUPR) & L20	Tica: check pump, recover 8 sandwiches & blocks, recover limpet condos; Tica/Alvinella: 1 sponge, 3 TACs, 2 rocks	Susan, Matt	9-50: Deploy Pump_L21 (w/SUPR) & L22, CTD/LADCP, microprofiler
27-Nov	9-50, AD4372	Sketchy: recover 10 sandwiches, 1 sponge, 3 TACs, 2 rocks, explore to S	Andreas, Skylar	9-50:CTD/LADCP, microprofiler
28-Nov	CTD/LADCP, microprofiler, deploy Trap_L3			CTD/LADCP, microprofiler
29-Nov	CTD/LADCP, microprofiler, Recover EF			CTD/LADCP, microprofiler
30-Nov	9-50, AD4373, Recover Pump_L21 & L22	Ty/Io: Position Trap_L3, collect hi-T limpets at Biovent, Perseverence; at Eastwall 4 sponges, 2 pumps, 2 rocks, sample off-axis	Chip, Lou	CTD/LADCP, microprofiler
1-Dec	CTD/LADCP until 1100			Transit to Manzanillo, arrive Nov. 3

2 Larval Studies

[Mullineaux, Mills, Strasser, Walther, Staglicic, Bayer]

2.1 Plankton Pumps

Figure 2.1. Deployment of McLane plankton pump, using anchor-first method of lowering on wire (photo by S. Mills)

We used high-volume water samplers (McLane WTS-xxx),) to collect larvae of vent species and other plankton near the ridge. The samplers were equipped with 50-L pump heads, and 63 µm mesh filters. Pumps were deployed on pairs of moorings, one located within the axial trough near an active, colonized vent and the other on the ridge flank, 1 km to the East (Table 2.1). On each mooring, one pump was positioned at 3 m above bottom (mab), and another at 75 mab, roughly the height of the neutrally buoyant plume. The bottom depth of the on-axis mooring was 2505 m, and the off-axis mooring was a little deeper at 2530 m. The set of two moorings (four pumps) was deployed four separate times, each in roughly the same location at Tica vent and 1km E. The pumps sampled for 24 hrs, except in cases when the battery drained early (Table 2.2). We deployed the pumps as much as 72 hours in advance of the scheduled initiation of sampling, in order to optimize ship time use by the CTD/LADCP group.

We lowered the pump moorings from the ship's 3/8" hydrowire, in order to position them precisely on the seafloor. An Edgetech acoustic release was attached at the end of the wire, hooked into a pear ring at the top of the uppermost float on the mooring. An Alvin relay transponder was attached to the wire ~17 m above the release. As the mooring was lowered (at speeds up to 35 m/min depending on sea state and mooring configuration), we tracked it using the DVLNAV program. The moorings were released from the wire when the bottom weights were roughly 100 m above bottom (~2350 m wire out). For the moorings in the axial trough at Tica, we checked the position by submersible before the pumps started. In some cases, the wire-drop position was fine, in others, the sub respositioned the mooring to a suitable nearby location.

We recovered the pump moorings during Alvin dives, in order to use ship time efficiently and to ensure the submersible was available to use the mechanical release if necessary. All of the moorings released when interrogated and were recovered quickly at the surface. Rise times for the pump moorings were 38 min, with the exception of L19 and L21 with the SUPR attached, which took 46 min. All of the pumps returned good samples, although some did not continue through the full 24-h scheduled duration (Table 2.2). Samples were processed immediately in the cold room, and transferred directly into 95% EtOH (no freshwater wash) in 250-ml bottles.

Table 2.1. Plankton pump moorings in paired deployments at Tica vent and 1 km East, LADDER-3 cruise 2008. Date and Time in GMT. Location from wire-drop position or renav Alvin observation (**bold**). Bottom depth at Tica = 2505 m, at 1 km E = 2530.

Mooring	Site	Deployment		Recovery		Lat		Lon		X	Y
		Date	Time	Date	Time	deg	min	deg	min	m	m
L15	Tica	15-Nov	19:31	19-Nov	18:37	**9**	**50.406**	**104**	**17.501**	**4578**	**78166**
L16	1 km E	15-Nov	22:57	18-Nov	18:01	9	50.418	104	16.955	5579	78187
L17	Tica	19-Nov	2:53	21-Nov	10:38	**9**	**50.434**	**104**	**17.507**	**4567**	**78216**
L18	1 km E	19-Nov	23:57	21-Nov	13:08	9	50.404	104	16.971	5550	78162
L19	Tica	21-Nov	6:03	25-Nov	17:06	**9**	**50.430**	**104**	**17.507**	**4568**	**78209**
L20	1 km E	21-Nov	2:00	25-Nov	18:22	9	50.411	104	16.969	5553	78174
L21	Tica	25-Nov	2:35	29-Nov	19:10	9	50.409	104	17.503	4575	78170
L22	1 km E	25-Nov	20:09	29-Nov	17:20	9	50.390	104	16.950	5588	78135

Table 2.2. Plankton pump samples from paired mooring deployments at Tica vent and 1 km East, LADDER-3 cruise 2008. Date and Time in GMT. Bottom depth at Tica = 2505 m, at 1 km E = 2530.

Mooring	Pump			Sample start		Duration	Volume	Comments
	ID	SN	mab	Date	Time	s	L	
L15	Paul	9660	3	18-Nov	17:30	86401	41505	
	John	2114	75	18-Nov	17:30	77251	37113	low battery
L16	Ringo	9664	3	17-Nov	15:30	86401	41505	
	George	2116	75	17-Nov	15:30	59879	28774	obstruction
L17	Paul	9660	3	21-Nov	15:50	86401	41504	
	John	2114	75	21-Nov	15:30	86401	41505	
L18	Stu	2116	3	21-Nov	15:30	86401	41505	
	George	2115	75	20-Nov	15:30	71125	34172	low battery
L19	Paul	9660	3	25-Nov	15:30	86401	41505	
	John	2114	75	25-Nov	15:30	86401	41505	
L20	Stu	2116	3	25-Nov	15:30	86401	41505	
	George	2115	75	25-Nov	15:30	84559	40620	low battery
L21	Paul	9660	3	29-Nov	15:30	86401	41505	
	John	2114	75	29-Nov	15:30	86401	41505	
L22	Stu	2116	3	29-Nov	15:30	86401	41505	
	George	2115	75	29-Nov	15:30	52412	25190	low battery

2.2 Sediment Traps

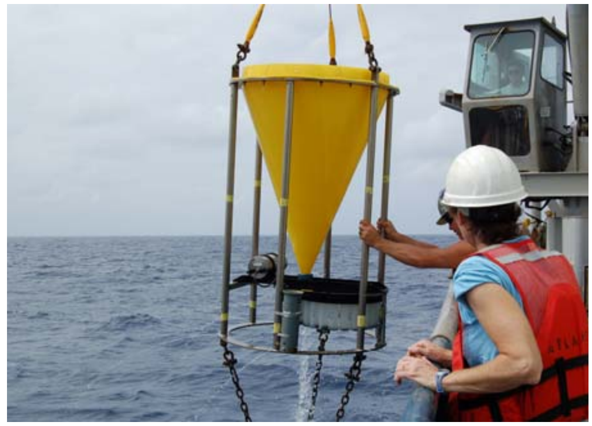


Figure 2.2. Recovery of sediment trap on LADDER3. Collected material is visible in white cups below cone (photo by S. Bayer)

We investigated larval supply by collecting larvae in 5 McLane Parflux sediment traps suspended above the seafloor. The traps were attached to physical oceanography moorings NA, CA, and EF, and to two other moorings, TrapL1 and TrapL2 (Table 2.3). A RCM-11 current meter was positioned directly above each trap so that hydrodynamic effects on trapping efficiency could be evaluated.

Each trap collected particulate material into 21 jars that rotated under the trapping cone every 14 d, 18 h and 22 m. This sampling interval was chosen to coordinate with the fortnightly tide. The jars had been filled with DMSO in a concentrated salt solution, to serve as preservative. On recovery, sample jars were removed from the sediment trap and transfered to the cold room. These samples will be split into subsamples for larval, chemical and mineralogical anlyses.

An additional sediment trap mooring, Trap_L3, was deployed during LADDER3, intended for recovery in Fall 2008 (Table 2.3). The mooring was configured similarly to Trap_L1 and was located in the axial trough near Sketchy vent (Figure 6.1). It was programmed to sample on the same interval and phase as the previous traps. The Aanderaa RCM11 current meter was also programed for the same sample interval as instruments on previous deployments.

Table 2.3. Summary of McLane Parflux sediment trap deployments and recoveries. Traps deployed in 2006 (GMT) started sampling on November 2006 at intervals of 14 d, 18 h, 22m (14.765278 d), and ended 23 Sept. 2007. TrapL3 started sampling on 6 Dec. 2007 at same interval. All trap moorings located in axial trough except EF on flank. Positions are from renav Alvin observation (**bold**) or ship's GPS (EF).

Trap	S/N	Deploy Date	Recover Date	Site	Lat deg	Lat min	Lon deg	Lon min	X m	Y m	Bottom dep, m	Trap dep, m	Height mab
NA	12055-03	4-Nov-06	27-Nov-07	Ty/Io	**9**	**49.982**	**104**	**17.437**	**4695**	**77384**	2505	2475	
CA	12055-01	9-Nov-06	24-Nov-07	K vent	**9**	**29.878**	**104**	**14.496**	**10084**	**40326**	2568	2475	
EF	12055-02	2-Nov-06	29-Nov-07	Flank	9	33.090	103	52.270			2990	2000	
TrapL1	11649-08	4-Nov-06	16-Nov-07	Sketchy	**9**	**50.028**	**104**	**17.436**	**4697**	**77469**	**2505**	2501	4
TrapL2	11649-07	8-Nov-06	24-Nov-07	K vent	**9**	**29.823**	**104**	**14.483**	**10107**	**40225**	**2570**	2566	4
TrapL3	12055	28-Nov-07		Sketchy	**9**	**50.018**	**104**	**17.442**	**4686**	**77450**	**2506**	2501	5

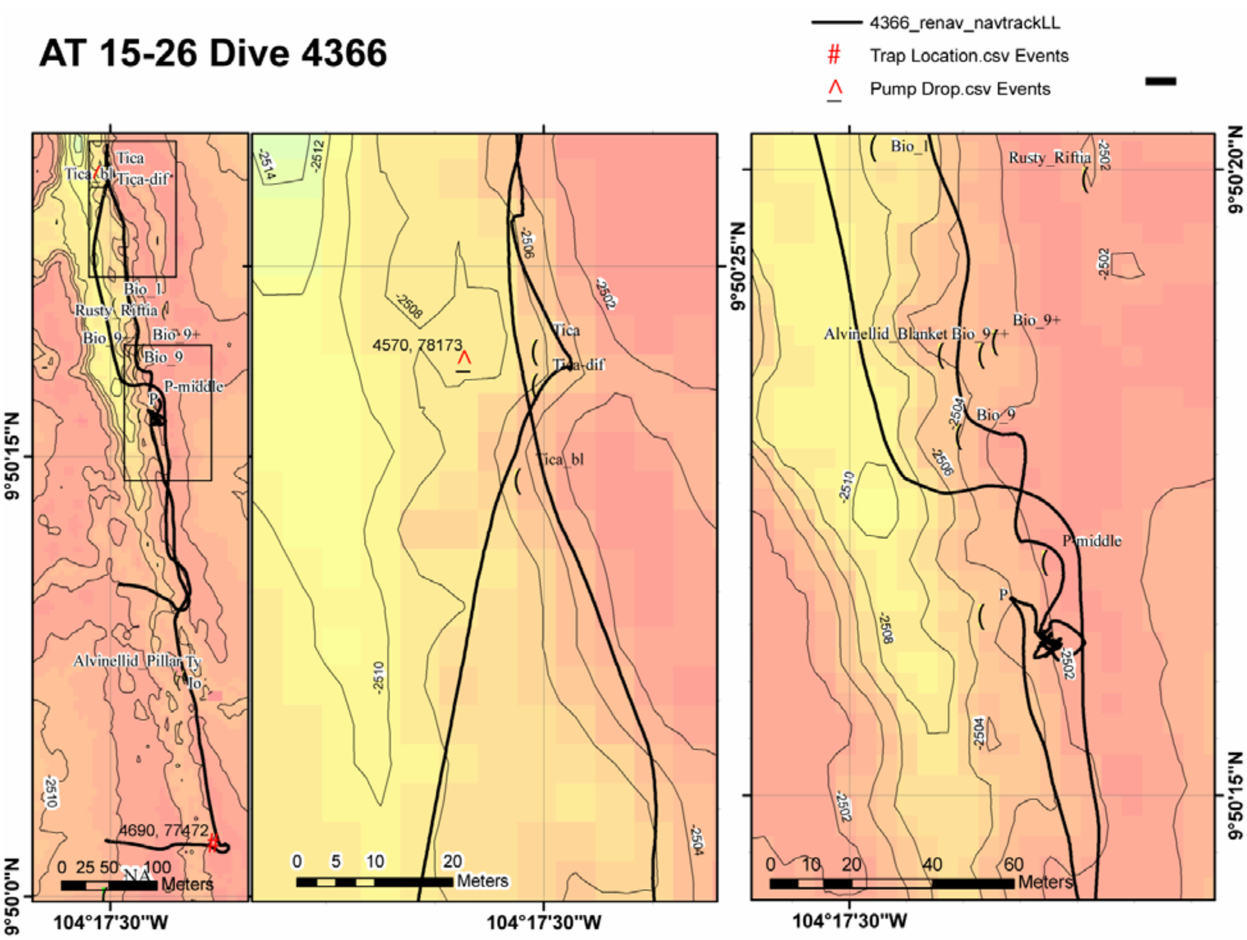
Figure 2.3. Sample jars from sediment trap on Trap_L1 mooring recovered during LADDER3 cruise. Note large shrimp (orange object) in jar 10.

2.3 Alvin Dives

2.3.1 Dive Summaries

Alvin Dive 4366, 17 November 2007
Port Susan Mills, Stbd Benjamin Walther, Pilot Bruce Strickrott

We began the dive by locating and releasing trap mooring L1. We transited north to the location of pump mooring L15, N of Tica. It had landed in a good position, so we left it and went back south to P Vent to recover 8 sandwiches and 3 HOBOs for Lauren Mullineaux and deploy and recover 3 TASCs and 1 sponge for Monika Bright. We also collected basalt samples from the *Tevnia* and periphery for Monika and from *Tevnia* and limpet areas for Lauren. We slurped limpets for Lauren and then transited south to Marker 28 area and then off-axis so Bruce could chase down a couple of grounds. There we triggered all Niskins for Matt Schwartz before leaving the bottom.



Renavigated dive-track diagram by Chip Breier

Alvin Dive 4367, 18 Nov. 2007
Port Lauren Mullineaux, Stbd Angel Ruiz-Angulo, Pilot Mark Spear

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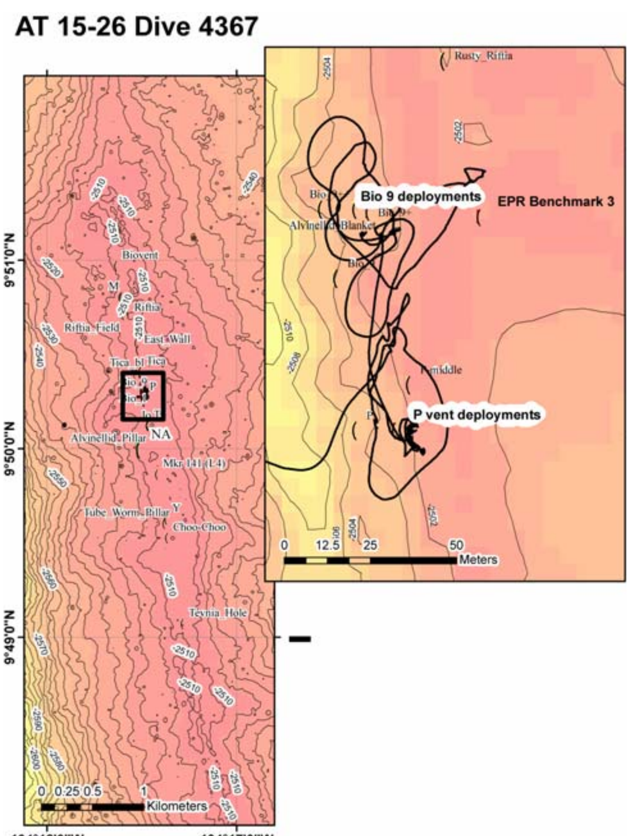
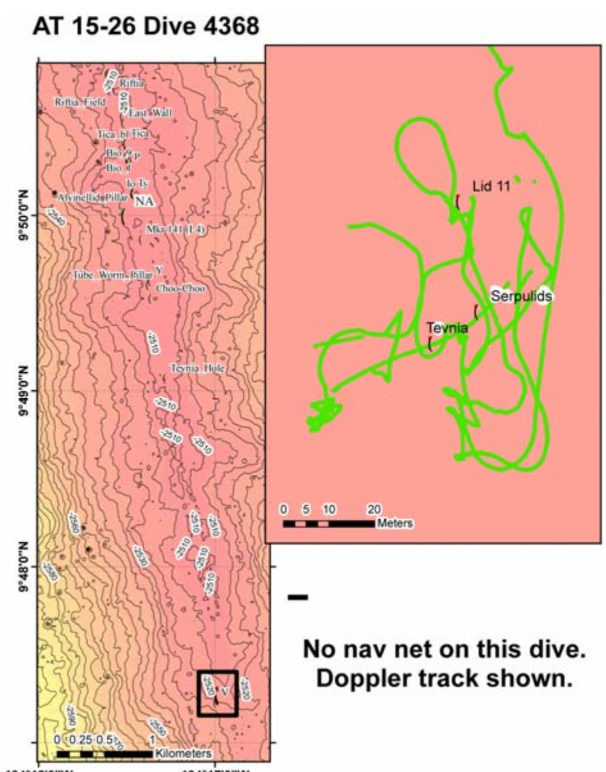
We dove on P vent to deploy 15 sandwiches and recover 7. The high-T site no longer had much real estate with high temperatures, so we deployed the high-T blocks up in the upper tubeworm patch. Dave Caron had an experiment up there (we need to notify him). Then we recovered 2 from the low-T site and deployed 5. Temperatures were only a few tenths of a degree elevated from ambient. We recovered 5 from the mid-T site, and all but 1 of those were in near-ambient temperatures. So we deployed the mid-T blocks at the former high-T site. To do so, we had to move the sponges because they would have tangled. They were placed on top of the tubeworm clump where max temperatures were 10 C. Since time was short, we didn't try to collect limpets, although I expect that the upper tubeworm clump has Ctenopelta. We then spent ~1.5 hr trying to find the Bio9 meiofauna experiments. We stopped at the Benchmark 3 when we stumbled across it and recorded nav for 2 min at a heading of 000. Finally we found the periphery meiofauna sponges. We were out of time and power, so we collected the sponges and took a pelagic pump but didn't get a rock. We never found the alvinellid meiofauna experiments.



Renavigated dive-track diagram by Chip Breier

AD4368, Date: 21 Nov. 2007
Port Lauren Mullineaux Stbd Nica Staglicic, Pilot: Bruce Strickrott
Launch Position: V-Vent 9° 47.28′ N, 104° 16.98′ W

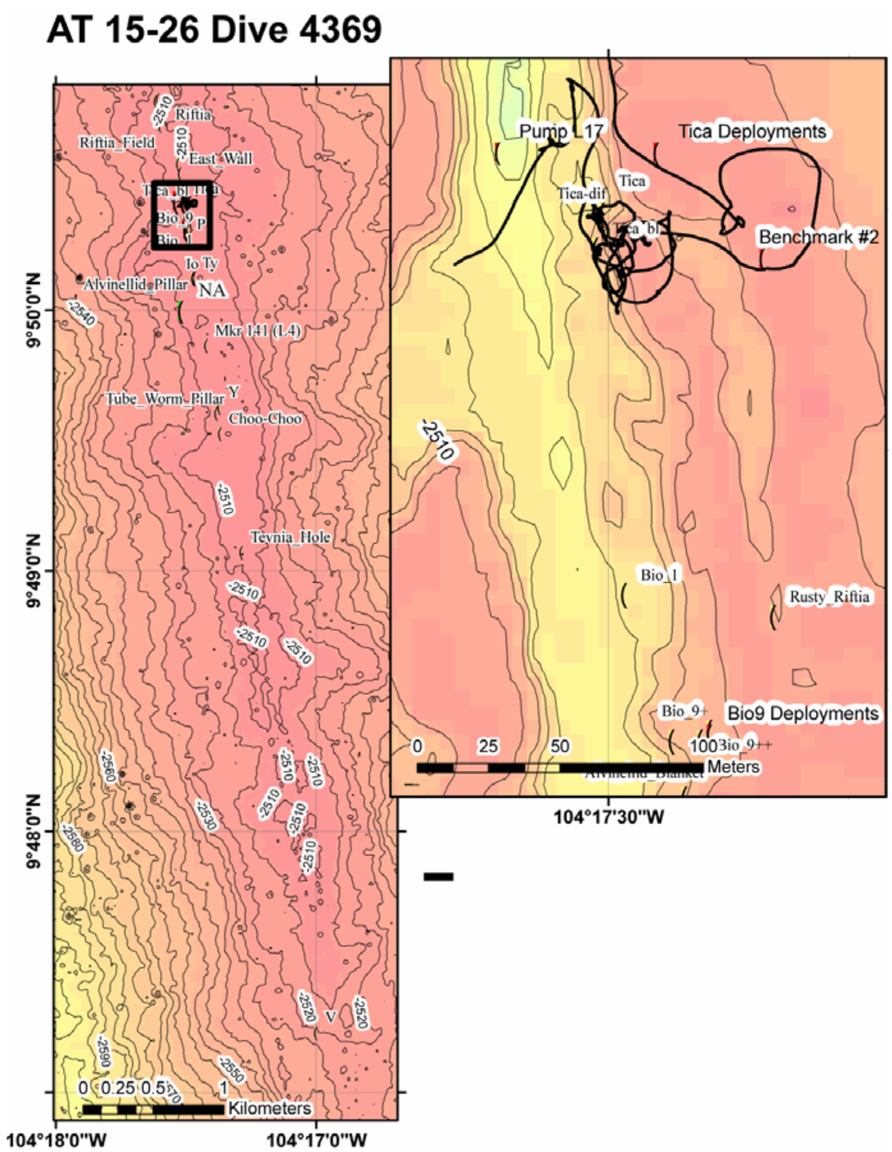
We dove at V-vent; there was no need to survey in the sub because a net was already here! We dropped down right on the vent and found the Tevnia patch with marker LW. We recovered 5 sandwiches from the Tevnia patch, needing to move several times and dig some to find the last 3. At these established sites, handle extensions with syntactic floats would be useful. We also recovered 4 sandwiches at the nearby mussel bed, but abandoned the 5th (we were lucky to find even 4). During the sandwich recoveries, we also collected tubeworm tubes, both Riftia and Tevnia, and rocks to get limpets. And slurped with the pelagic pump, vacuuming a rock for limpets (Bruce said this worked, but I didn't see the sample to confirm). We found the serpulid field after looking around a bit (it was S of the other sites, but we had been following XYs that showed it NE). All 5 sandwiches were easy to see and collected quickly. Then we moved to the smoker to image limpets on it. We could indeed see them, but knocked the top 1 m of smoker off when we tried to sample them with the pump hose. So we returned to marker LW for more limpet collecting, in order to have sufficient numbers for the Tevnia condo experiment (on surface we found we had a diverse mixture of L. elevatus, and 2 beaded species, probably L. tevnianus and L. pustulosus). The pilot noted a strong current to the W(?) during the dive that made maneuvering difficult. Toward the end of the dive, we tripped the Niskin bottles, got a reading of ambient temperature, and collected a rock in the trough, away from the vent. Good video of alvinellids, limpets and crabs.



Dive-track diagram by Chip Breier

Alvin Dive 4369, 22 November 2007
Port Susan Mills, Stbd Xinfeng Liang, Pilot Mark Spear

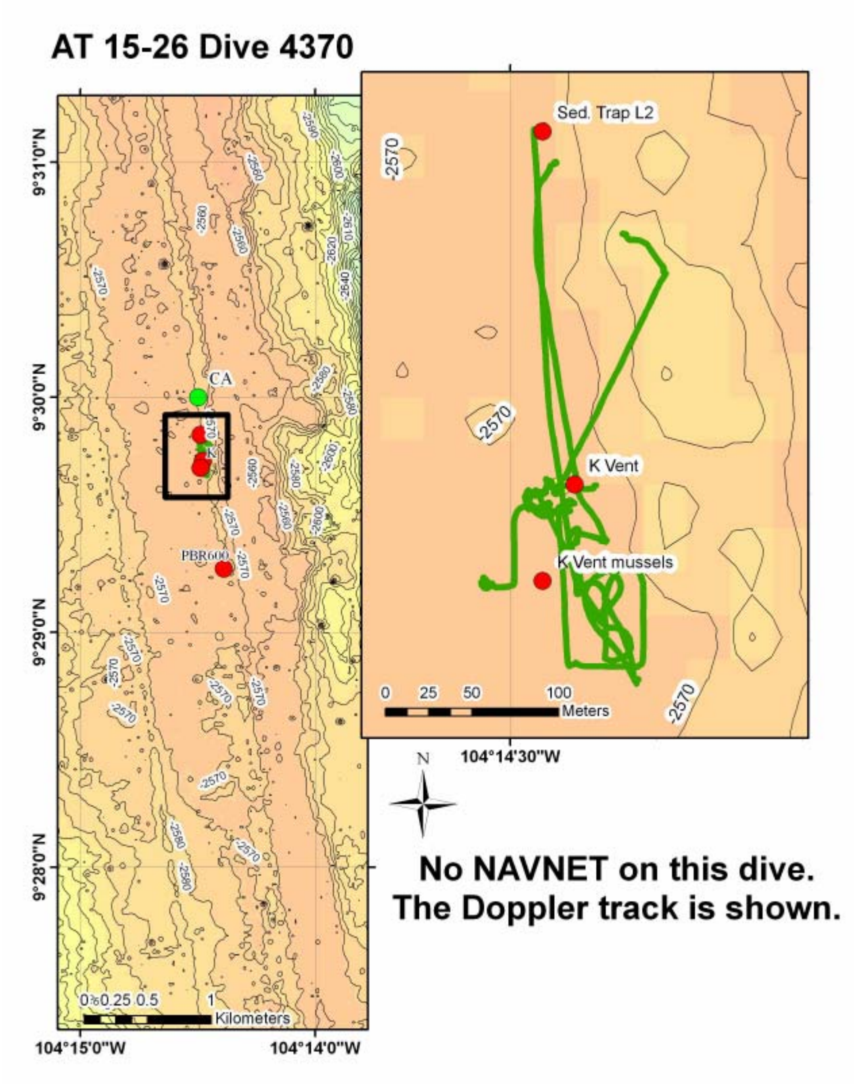
We began the dive by locating pump mooring L17 in the ASC, just north of Tica. We transited south to Tica, where we deployed five limpet condos, three in warm temperatures and two in cool temperatures. We did a video transect over the Mullineaux sandwich/block deployments and then went back and collected five sandwiches, three blocks and one HOBO each from the low- and intermediate temperature sites. We also collected one sponge each from *Alvinella* and periphery sites, plus pelagic pumps and natural community samples, for Monika Bright and deployed new sponges in their places. Then we drove to EPR Benchmark #2 to collect LBL data for Dan Fornari. We drove north along the eastern wall of the ASC for the last ten minutes before driving off-axis to drop weights.



Renavigated dive-track diagram by Chip Breier

Alvin Dive 4370, 25 November 2007
Port Carly Strasser, Pilot Bruce Strickrott /PIT Bob Waters

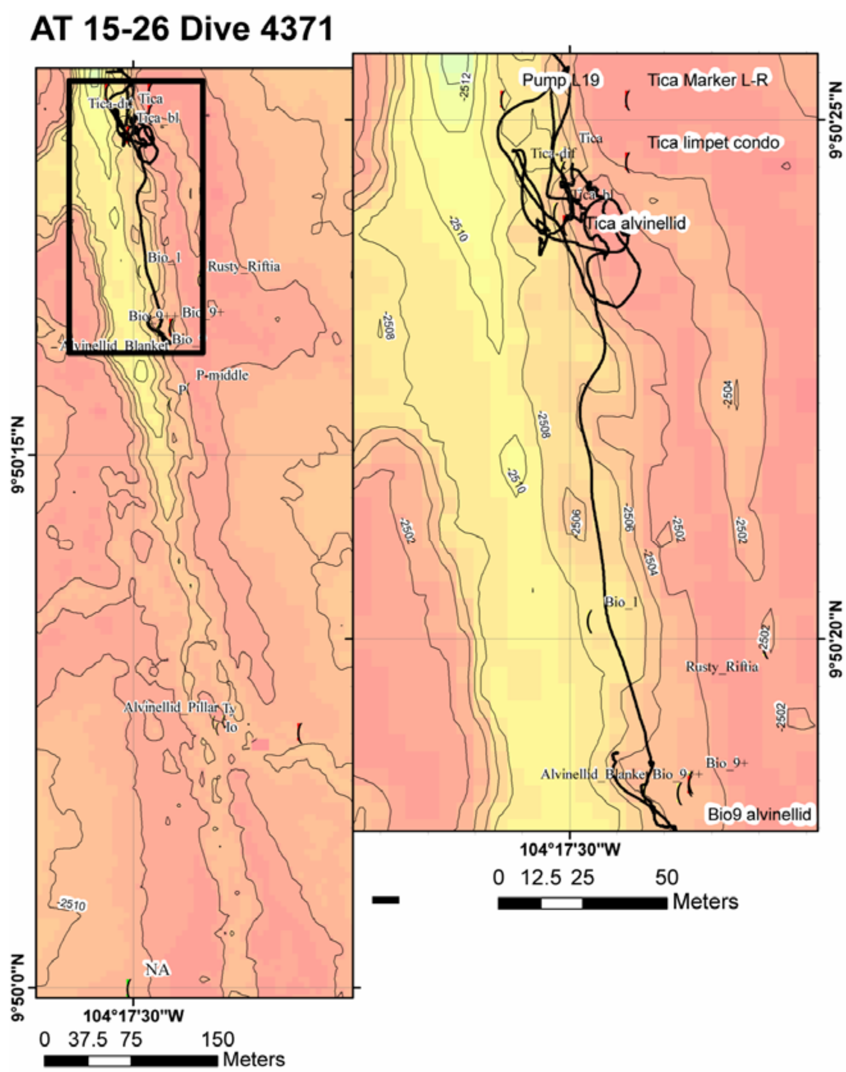
We began the dive by locating K-vent at 9 30. We collected 5 sandwiches at the base of the sulfide "mushroom" structure but could not locate the HOBO. We also found 4 sandwiches on the bottom that had fallen from the top of the structure, including HOBO L09 from LADDER 1. We were only able to recover 2 of the 4 sandwiches successfully; the remaining two were in a crack inaccessible to the ALVIN. We recovered 1 sandwich from the top of the sulfide structure, but did not locate the HOBO left at the top of the structure. We began trying to locate the mussel patch but were called away to release trap mooring L2. We transited north to release mooring L2. We then returned to locate the mussel patch. We located the mussel patch and recovered 5 sandwiches and one HOBO. We fired the five niskin bottles at the mussel patch and surfaced.



Dive-track diagram by Chip Breier

Alvin Dive 4371, 26 November 2007
Port Susan Mills, Stbd Matt Schwartz, Pilot Mark Spear

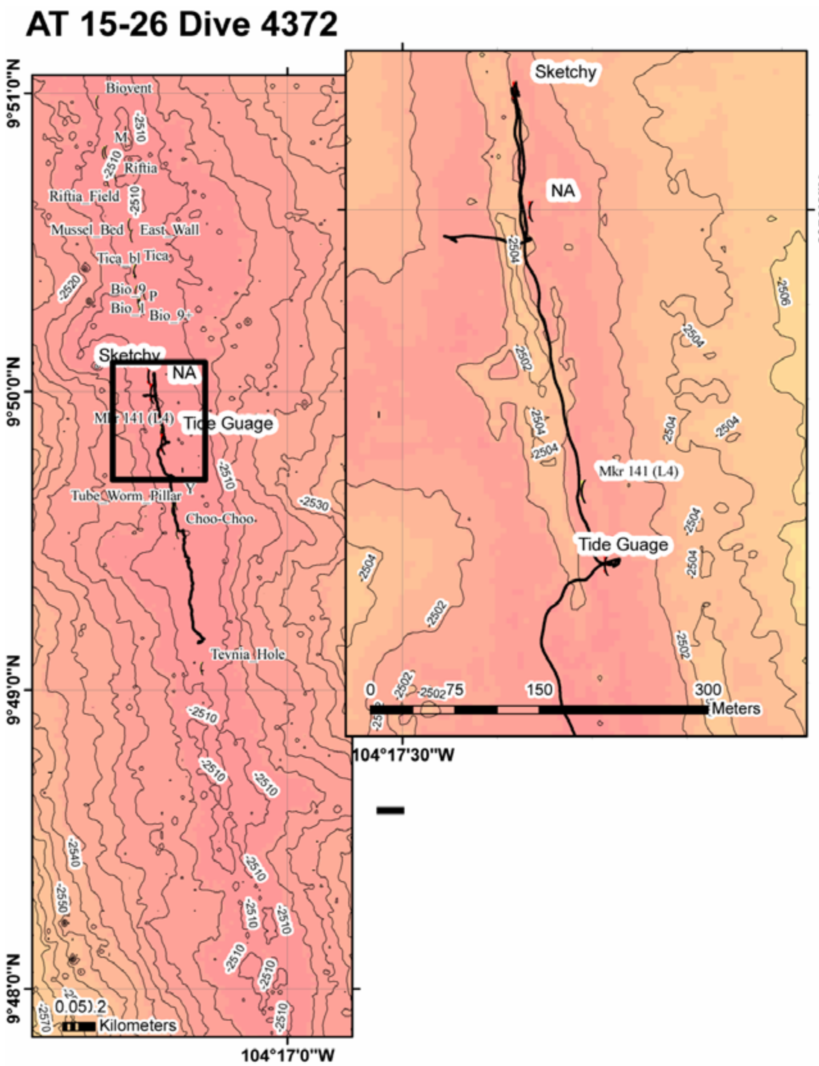
On the descent we triggered two niskins at ~1000 mab and the remaining five at ~75 mab for Chip Breier. Once on the bottom, we sighted Pump Mooring L19 in the ASC N of Tica. We moved to Tica Marker L-R and recovered 5 sandwiches, three basalt blocks and a HOBO temperature probe from the high temperature *Tevnia* site. While there we also recovered three TASCs and deployed another three, plus a rope with three babytraps above and to the right, as well as collecting a pelagic pump sample and natural sediment for Monika Bright. We then moved to the limpet condo site and recovered all five limpet condos. Afterward we located periphery sponge #60, recovered it and replaced it with another, plus collecting a pelagic pump sample and natural sediment for Monika Bright. We then went looking for Stefan Sievert's "crab spa" and found it still active. Finally we went to Bio9 periphery and collected a rock there as well as several rocks in the ASC north of Bio9.



Renavigated dive-track diagram by Chip Breier

Alvin Dive 4372, 27 November 2007
Port Andreas Thurnherr, Stbd Skylar Bayer, Pilot Bruce Strickrott

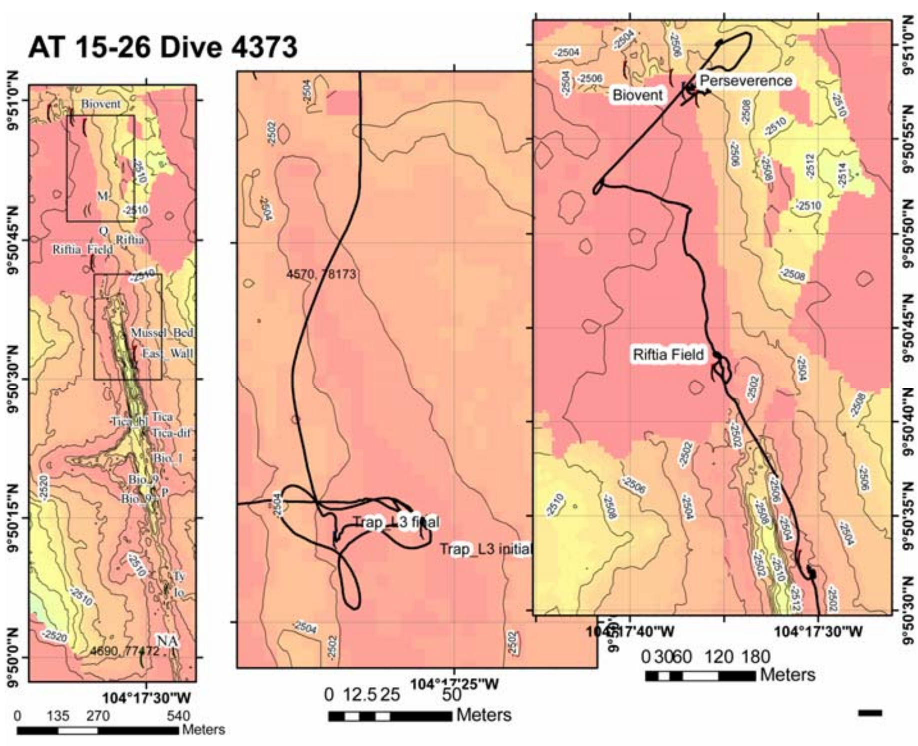
Once on the bottom we started at the NA Mooring and surveyed its surrounding topography. Next we headed south to Sketchy and recovered 10 sandwiches, 2 hobos, one sponge and three TASCs. We deployed one new sponge and three new TASCs. Next we headed south to the tide gauge, retrieved it, and continued to explore further south. We stopped at Finn, which was still very active and showed a large amount of *Tevnia* with very few *Riftia*. We collected a few limpet rocks from the site and continued exploring south. We checked out Arches, which was also still active with *Tevnia*. Afterwards we stumbled across a new very small diffuse flow site. We headed further south still and broke off a piece of basalt rock. Then we found a "Dumbo" octopus and recorded its interaction with Alvin (both video and photos). Right before our ascent back to the surface we fired off 5 Niskins off axis for Matt Schwartz (4 were successful, 1 malfunctioned).



Renavigated dive-track diagram by Chip Breier

Alvin Dive 4373, 30 November 2007
Port Chip Breier, Stbd Lou St Laurent, Pilot Mark Spear

On the descent we triggered 1 niskin at ~1000 mab and 1 niskin at ~75 mab for Chip Breier. Once on the bottom, we sighted Sediment Trap Mooring L3 on the eastern flank at the edge of the ASC S of Ty/Io. We repositioned Sediment Trap Mooring L3 to the center of the ASC (10 meters W). We moved north to Monika Bright's East Wall meiofauna site, passing by P vent in transit. At the East Wall meiofauna site we recovered 4 sponges, deployed 4 new sponges, and measured temperatures at the deployment locations. We also collected 2 pelagic pump samples, 2 rock samples with natural communities, several live mussels and dead riftia. We then moved N to the Riftia Field area looking for >15°C discharge areas to collect limpet communities from. After looking unsuccessfully for 20 minutes, finding discharge no greater than 10°C, we continued N to Biovent again looking for >15°C discharge and limpets. After searching around the base of Biovent we found a crevice with 14.2°C discharge; this was the highest temperature we found. We collected two rock samples from this site which was in broken terrain, with scatted mussels, crabs, and small areas of low temperature discharge. We then went to Perseverance, looking for similar discharge. After looking unsuccessfully in the Perseverance pit for 20 minutes (maximum diffuse discharge temperature 6°C) we finally found a crack with 11.6°C discharge just outside the perimeter of Perseverance pit. We collected 2 rocks from this location which had 2 to 3 small tevnia growing from it as well as a few crabs. At this point we were low on power so proceeded W to the flank, fired the last 3 niskins for Matt Schwartz, dropped weights and ascended.



Renavigated dive-track diagram by Chip Breier

2.3.2 Hydrothermal Site Description

Susan Mills and Lauren Mullineaux, 04 Dec. 2007

1. 9º 50-51′ area

Biovent

- Found only low temperature (<15º C), diffuse flow vents with scattered mussels, limpets and crabs.
- Visited during dive 4373 at ~1942 - 2005 GMT (position from renav: X4369, Y79188, Z2503)

Perseverance

- Large shallow bowl with low temperature (<12º C) diffuse flow. *Tevnia*, limpets and crabs present.
- Site located on LADDER2. Revisited ~2030-2045 GMT Dive 4373 (position from renav: X4401, Y79194, Z2507)
- *Monika Bright TASCs and sponges were deployed here on LADDER2, not recovered on LADDER3.*

Riftia Field

- Observed no signs of diffuse flow, also low density of crabs and other fauna.
- Visited the area on Dive 4373, ~1830-1855 GMT.

East Wall

- No vigorous diffuse flow; large accumulations of mussel shells and tubes of *Riftia*; also on higher parts of East Wall some patches of mussel shell and tubes of *Riftia* that appear to be in original place and have not been covered with lava; also some patches with apparently live mussels *Bathymodiolus thermophilus.* LoT probe up to 2.8º C.
- Visited on Dive 4373. X4567.29, Y78401.9, Z 2500m, renav position for Live Mussel Site
- *Deployment site of Monika Bright's devices in patch of dead shells, tubes, live mussels and peripheral basalt during LADDER-3*

Tica

- Still very active area of diffuse flow, many patches of *Tevnia* and small *Riftia* mixed in, also scattered single medium-sized mussels and numerous limpets on rocks adjacent to diffuse flow areas. Temperatures up to ~30º C measured in *Tevnia* patches. No live alvinellids observed in former alvinellid area. Lots of bythograeids and galatheids.
- Visited on Dives 4369 & 4371. X4581, Y78161, Z2512.5, renav position for Marker L-R site
- Sievert Marker F (AD4301), diffuse flow chimney south of Tica, noted as still active, AD4371
- *Deployment site of Monika Bright's devices in Tevnia (marker L-R, former Mullineaux deployment site) and adjacent low flow and peripheral basalt area, replaced on LADDER-3*

Bio 9 area

- Smokers still active. Small diffuse flow areas with patches of *Tevnia*

- Flew by on AD4366, no temperatures or close-up images recorded
- Monika Bright devices were placed here on LADDER-2, one out of the two recovered on LADDER-3, but the second not found

P Vent

- Smoker still active. Small diffuse flow area with patches of *Tevnia* and small *Riftia*, temperatures up to ~22º C recorded in diffuse flow.
- Visited on AD4366 & 4367. Marker L-O, X4629 Y77922, Z2507, AD4367
- *Deployment site for Mullineaux colonization sandwiches from RESET and LADDER 1, 2 & 3 cruises;*
- *Deployment site of Monika's devices in Tevnia area and on peripheral basalt.*

Ty-Io area

- Smoker is now extinct. Numerous small areas of diffuse flow still exist, small *Tevnia* areas and localized amphipod swarms.
- Visited on AD4366 & 4373.

Sketchy

- Site has cooled to ambient (maximum temperatures recorded were <3º C) and no live *Tevnia* were observed on dive AD4372. Relatively narrow fissure with submersible access at 180 degrees, then turning to 150 degrees to manipulate experiments.
- Former Mullineaux Deployment site, marker L-S (renav position 1658 GMT Dive 4372: X4680 Y77521, 2506m
- *Deployment site of Monika's devices in former Tevnia patch and adjacent peripheral basalt.*

Finn(?)

- Many *Tevnia* and few *Riftia* present, described as large site with lots of diffuse flow). Fauna on rock collections made on that dive suggest temperatures up to at least 22º C.
- Noted as still active on AD4372 ((target 34 from that dive). Note that renav coordinates from that dive (X4777, Y76893, Z2504) do not match coordinates noted on LADDER1 (X4706, Y77331), but pilot (Bruce) thought it might be that site.

2. 9º 46' area (all from AD4368)

Marker 31

- Large diverse site with *Tevnia* and some small *Riftia*, lots of discrete patches of fauna. Observers (AD4368) noted several markers, but did not see any deployed experiments. No sampling done.
- Visited AD4368, X5508, Y72699, Z2504 - 2506

V Vent smoker

- Smoker still active with large healthy *Alvinella* colonies.
- Visited AD4368, X5523, Y72372, Z2510

V Vent - Marker L-W

- Pre-eruption community, with large mussel beds, some *Tevnia* patches and serpulids. Temperatures as high as 28º C noted in *Tevnia* area.

- Visited AD4368,X5528, Y72367, Z2508
- Mullineaux LADDER 2 deployment site, but no remaining experiments.

3. 9º 30′ area (AD4370)

No navigation net in place, so coordinates are from previous cruises.

K Vent sulfide, Marker X-6

- Structure little changed from previous observations. Maximum temperatures recorded were ~10º C (at base) and ~6º C (on top).
- Visited AD4370, X10105, Y40051, Z2559
- Mullineaux deployment site, LADDER 1 & 2, recovered all experiments except for two settlement surfaces (inaccessible) and two HOBOs (L-12 & L14, not found).

Mussel patch, Marker L-T

- Area of sparse mussel cover. Maximum temperature recorded was 2.3º C.
- Visited AD4370, X10127, Y39983, Z2564
- Mullineaux deployment site, LADDER 1 & 2, no remaining experiments

2.4 Colonization Experiments

The main objective of our colonization project was to recover a set of colonization surfaces that had been deployed in 2006 during the LADDER-1 cruise. Most of these surfaces were stacked plastic plates (10 cm on a side), called sandwiches; the remainder were basalt blocks. Sets of surfaces were at 5 different vent sites, P vent (9° 50.276′ N, 104° 17.475′ W), Tica (9° 50.404′ N, 104° 17.498′ W), Sketchy (9° 50.056′ N, 104° 17.445′ W), V vent (9° 47.266′ N, 104° 16.975′ W), and K vent (9° 29.731′ N, 104° 14.488′ W). At each vent, 3 different thermal habitats had been identified when we initiated the experiments after the eruption: high-T (> 10°C, or inhabited by tubeworms), medium-T (4-10°C) and low-T (2-4°C; inhabited by suspension-feeders). We attempted to recover 5 replicate sandwiches and a HOBO temperature recorder from each habitat, except at Sketchy where only the tubeworm and low-T habitats were evident. Recoveries were successful other than a few exceptions (Table 2.4). At Tica, we also recovered 3 replicate basalt blocks from each habitat.

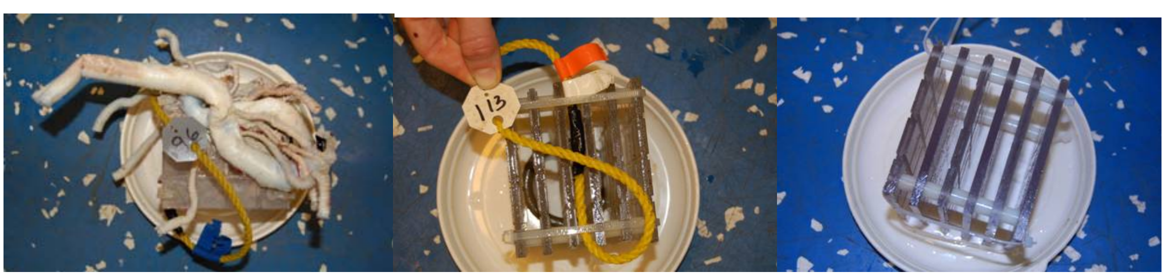


Figure 2.4. Examples of colonization sandwiches recovered on LADDER3 from three different habitats: high-T tubeworm (left), 4-10°C (middle), and 2-4°C (right). (Photos by L. Mullineaux, S. Mills, S. Bayer)

Colonists on the plates were, in general, typical of residents of the surrounding habitat (Figure 2.4). We were particularly interested recruitment patterns of the gastropod *Ctenopelta porifera* (Figure 2.5), which we had not observed at the 9°50′ vent sites prior to the 2006 eruption.

We deployed an additional set of sandwiches at P-vent in the three habitats. They were positioned in the same three habitat types as previous deployments, but the `tubeworm' cluster was positioned up above the previous site in suitable temperatures >10°C (at Marker 21) and the 4-10°C cluster was positioned where the `tubeworm' cluster had been placed on LADDER2. These sandwiches are due to be recovered in Fall 2008.

Figure 2.5. *Ctenopelta porifera*, a gastropod recruit on colonization sandwiches recovered on LADDER3 (photo by S. Mills)

Table 2.4. Recovery and deployment of colonization surfaces (sandwiches and basalt blocks) during Alvin Dives on LADDER3 cruise. Habitats are Lo-T (2-4°C, inhabited by suspension feeders), Mid-T (4-10°C, inhabited by mussels in older communities) and High-T (>10°C, inhabited by tubeworms).

Vent	Habitat	*Marker*	*X* (m)	*Y* (m)	*Depth* (m)	Sand (n)	Block (n)	Hobo (ID)	Dive(s)	Date(s)
Recover										
P vent	2-4°C	L-O	4628	77921	2509	5		L15	4366, 4367	17, 18-Nov
	4-10°C	L-O	4626	77923	2508	5		L10	4367	18-Nov
	tubeworm	L-O	4626	77925	2508	5		L11	4366, 4367	17-Nov
Tica	2-4°C	L-R	4585	78169	2513	5	3	L01	4369	22-Nov
	4-10°C	L-R	4589	78164	2511	5	3	L03	4369	22-Nov
	tubeworm	L-R	4581	78161	2512	5	3	L08	4371	22-Nov
V vent	suspension	L-W	5553	72385	2507	5		L07	4368	21-Nov
	mussel	L-W	5541	72378	2510	4		L02	4368	21-Nov
	Tevnia	L-W	5543	72378	2510	5		L06	4368	21-Nov
K vent	suspension	X-6	10098	40055	2563	5			4370	25-Nov
	mussel	X-6	10118	39991	2563	5		L13	4370	25-Nov
	sulfide top*	X-6	10098	40055	2563	3		L09	4370	25-Nov
Sketchy	2-4°C	L-S	4681	77521	2506	5		L04	4372	27-Nov
	tubeworm	L-S	4681	77521	2506	5		L05	4372	27-Nov
Deploy										
P vent	2-4°C	L-O	4632	77916	2508	5		L10	4367	18-Nov
	4-10°C *	L-O	4630	77917	2509	5		L11	4367	18-Nov
	tubeworm	21	4628	77921	2507	5		L15	4367	18-Nov

* 2 had fallen down, Hobo was from LADDER 1

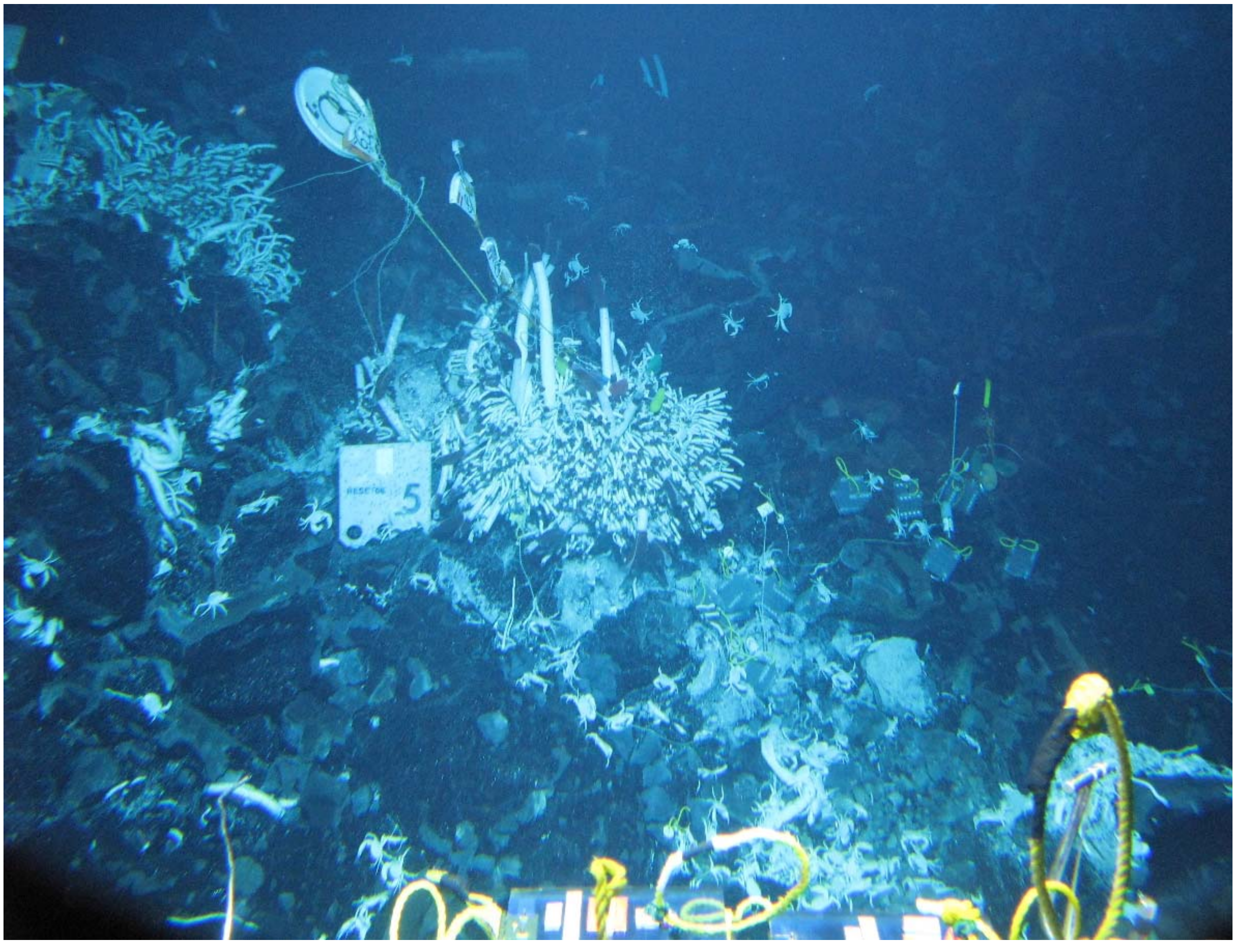


Figure 2.6. P-vent deployment of colonization sandwiches and Hobos, showing cluster in tubeworm habitat (upper left), mid-T habitat (center, below *Tevnia*), and low-T habitat (right). Dive 4367, Alvin heading 047.

3 Physical Oceanography

3.1 Mooring Operations

[Hogue, Fraser, Thurnherr]

3.1.1 Overview

During the LADDER-3 cruise one of the primary objectives was the recovery of the sub-surface mooring array. The array consisted of 7 moorings. Two flank moorings on the east and west sides of the EPR axial summit (EF&WF), three axial summit moorings (NA,CA, & SA), and two McLane moored profiler (MMP) moorings(W1 & W3). The EF mooring was located at 09 33.182 N 103 53.296W and was made up of three RCM-11 current meters and one McLane sediment trap. The WF mooring was located at 09 26.557N 104 32.438W and had three RCM-11 current meters. The NA mooring that was located at 09 50.00N 104 17.50W and the CA mooring, which was located at 09 29.80N 104 14.48W, were both designed similarly having one sediment trap and three RCM-11 current meters on each mooring. The SA mooring that was located at 09 09.00N 104 12.50W and also had three RCM-11 current meters for instrumentation. The W1 mooring located at 09 29.818N 104 19.786W and the W3 mooring located at 09 28.305N 104 28.943W were both occupied by a single MMP for the lone data collecting instrumentation.

All of the instrumentation on the mooring array worked as expected and full term with the exception of the MMPs and one of the RCM-11s. The MMPs did record full term but after looking at the data after recovery it seems that the MMP from the W1 mooring showed signs of some problems from 23 August 2007 until the recovery of the mooring, which resulted in false readings of depth. It appears that the profiler might have been ballasted light and this was causing an increase in battery current draw on all the downward profiles and once the battery dropped to 10.1V and below the sensor data became unreliable. Further diagnosis has to be done to find out why the profiler behaved the way it did. The MMP on mooring W3 seems to have had a similar problem with being ballasted too lightly causing excessive battery drain, but only causing the profiler not to reach its maximum depth. It appears that from 04 April 2007 until recovery of the W3 mooring, the profiler starts to fall short of its intended maximum depth by 180-200 meters. All other data on W3 seem to be reliable and the only impact being that the profiles are shorter than they were intended. On the EF mooring one out of the three RCM-11's was found flooded when the mooring was recovered (Table 3.1). After discovering it was pressurized from the inside with seawater, the instrument was slowly decompressed by loosening the nuts on the lower part of the load frame which the instrument was housed in for deployment on the EF mooring. Inspection of the electronics and components inside the pressure case seem to indicate that the instrument had flooded during or shortly after deployment. This conclusion was reached because the amount of corrosion of the aluminum chassis within the pressure case was extensive enough to have dissolved the aluminum wherever it was in contact with any other type of metal.

s/n	loc.	interval	time on	time off	temp. setg	#channels	# words
150	EF	20 min.	10/27/2006 19:00	11/30/2007 4:07	Arctic	4	117136
152	flooded	20 min.	10/27/2006 19:00		Arctic	4	flooded
154	NA	20 min.	10/27/2006 19:00	11/27/2007 20:07	Arctic	4	116442
155	CA	20 min.	10/27/2006 19:00	11/25/2007 22:06	Arctic	4	115878
157	SA	20 min.	10/27/2006 18:00	11/15/2007 21:28	Arctic	4	112946
158	WF	20 min.	10/27/2006 19:00	11/19/2007 2:36	Arctic	4	114176
161	NA	20 min.	10/27/2006 19:00	11/27/2007 20:07	Arctic	4	116442
163	SA	20 min.	10/27/2006 18:00	11/15/2007 21:28	Arctic	4	112946
339	CA	20 min.	10/27/2006 19:00	11/25/2007 22:06	Arctic	6	172632
343	WF	20 min.	10/27/2006 19:00	11/19/2007 2:36	Arctic	6	170094
366	NA	20 min.	10/27/2006 18:00	11/27/2007 20:07	Arctic	6	173496
367	L1	20 min.	10/27/2006 18:00	11/17/2007 17:57	Arctic	6	169080
368	SA	20 min.	10/27/2006 18:00	11/15/2007 21:28	Arctic	6	168264
369	WF	20 min.	10/27/2006 19:00	11/19/2007 2:36	Arctic	6	170094
370	EF	20 min.	10/27/2006 19:00	11/30/2007 4:07	Arctic	6	174498
371	CA	20 min.	10/27/2006 18:00	11/25/2007 22:06	Arctic	6	172650
373	L2	20 min.	11/3/2007 2:00	11/25/2007 0:46	Arctic	4	112596

Table 3.1. RCM-11 current meters recovered during LADDER-3.

3.1.2 Mooring Recovery Operations

The recovery operations were done without any problems and were conducted along the starboard rail just forward of the starboard crane. The NA, CA, and SA moorings were designed with a single acoustic release (ORE model 8242) and functioned properly in regard to communicating with them and releasing from the anchor on the first release command sent to them. The WF, EF, W1, and W3 moorings were designed using a dual release setup that has been a common practice for the last few years as a fail safe: in the event one release has failed the other can be released. Once again, all of these releases communicated without a problem and released on the first release command sent. After the mooring floatation reached the surface, the ship moved into position with the bow into the wind and having the top floatation coming down the starboard rail. With the floatation at the starboard rail a 3 ton snap hook was secured into the frame of the 3 ball float, and the line attached to it with a soft eye on the opposite end was hooked on to the starboard crane hook. The crane then raised the block up to the crane boom until the point where the 3 ball float was equal to the starboard rail and was tied off to a cleat and secured, having the mooring secured to the ship. The snap hook was then removed from the crane's hook and a 4ft sling was used on the crane hook to lift the 3 ball float and the string of glass balls up to the crane boom where the mooring was once again secured to the starboard rail and half of the string of glass ball floatation was removed from the mooring. The second half of the string of floatation was then removed in the same manner and now the top section of wire rope was secured to the starboard rail. At this point the crane hook was secured and a Gifford block that had been mounted on the crane boom was utilized. A long tag line was wound with a minimum of 8 wraps around the capstan head on the starboard side of the main deck just forward of the crane, the line then passed through a block secured to a steel deck eye, from there the line went up to the block hanging from the starboard crane and then down to the top of the wire rope. The moorings were then retrieved using the capstan to haul in the wire and when an instrument came up to the height of the starboard rail from the water it was stopped off and removed out of the mooring and the wire rope from the upper section was then attached to the section below it and the recovery would then continue until the lowest section of the mooring, being the acoustic releases, was out of the water and then safely lowered on to the deck.

3.2 CTD

[Thurnherr, Liang, Schwartz, Stewart, Ruiz Angulo]

3.2.1 CTD Operations

The CTD used during LADDER-3 was a SeaBird SBE 9-plus mounted on a SBE-32 rosette with 18 Niskin bottles, connected to a SBE-11 deck box. Rosette positions 18-24 were left empty to allow mounting the LADCP battery with hose clamps, because no brackets had been supplied. In addition to the pressure sensor, the CTD was equipped with dual pumped C/T sensor pairs, a SBE-43 oxygen sensor, Wetlab transmissometer & fluorometer, a Seapoint Turbidity Sensor (hereafter called STS) and, for the first 4 casts, a Benthos PSA-916 altimeter. The altimeter was removed after station 4 because it did not work. (CTD altimeters often do not work reliably when run in conjunction with LADCP systems.) Height above bottom was monitored on a Knudsen echosounder, using a Benthos 12kHz pinger mounted on the rosette. Since the fluorometer is rated to a maximum depth of 3000m, it was removed for casts exceeding that depth (stations 5, 6, 26 & 27). The transmissometer data were processed but not checked. Because of problems with the STS during early casts, the SSSG instrument was replaced by Thurnherr's spare (intended for the DMP) on cast 11. While the cause of the problem was eventually traced to wet connector, rather than a faulty STS, Thurnherr's instrument was left on the rosette because it was found to be significantly more sensitive.

CTD casts were carried out at the stations shown in Fig. 1.1. In order to avoid long LADCP data gaps near the seabed, the CTD was generally turned around 30-40m above the seabed. With the exception of "DB" and "UB," each station location was occupied between one and four times. Where possible, an attempt was made to re-occupy a station at different phases of the semi-diurnal tide, as determined by a tidal analysis of data from the SA current meters, which were recovered on the first day of the survey (see below). 13-hour yoyo casts below 1500m were carried out at "DB" (cast 27) and "UB" (cast 32). The "DB" yoyo extended to within ~30m of the seabed but the "UB" yoyo did not exceed 3000m, because the fluorometer had been left on the rosette.

The CTD data were processed with SeaBird software and checked after every cast. Both 1m and 1s bin-averaged files were generated; the latter are used for LADCP data processing. See data DVDs for CTD instrument configuration files, as well as processing scripts and parameters.

3.2.2 CTD Station Notes

001	altimeter not working
002	altimeter not working
003	altimeter not working
004	altimeter not working
005	altimeter removed for remainder of cruise; fluorometer removed for cast
006	fluorometer removed for cast
008	STS problems
009	STS problems
010	STS problems
011	Thurnherr's spare STS installed (left for remainder of cruise)
013	acquisition re-started at bottom of cast => files 013 & 013b fluorometer bad in upcast
014	STS problems
020	STS problems
025	CTD turned around early due to time constraints
026	fluorometer removed for cast
027	13-hour yoyo (data files _1 .. _13); fluorometer removed for cast
032	13-hour yoyo (data files _2 .. _13; 1st data file does not have suffix)
037	files acquired as 040 & later renamed => erroneous info in headers
040	CTD aborted and restarted with same station number
044	CTD data problems (see README on data DVD); downcast STS data are bad
045	STS very spikey
049	CTD data problems (see README on data DVD)
052	CTD data problems (see README on data DVD)
053	CTD data problems (see README on data DVD)

3.2.3 CTD Sensor Calibration

Both C/T sensor pairs had been pre-cruise calibrated in June 2007. Calibration information is provided on the data DVDs. Visual inspection did not reveal a significant difference in the noise levels of the two temperature sensors. The per-station median temperature differences recorded during the downcasts are ~2e-4degC without any apparent trend. This value is taken as the temperature accuracy. The per-station downcast median salinity differences, on the other hand, increase approximately linearly with station number from -7e-4 at the beginning of the survey to 1e-4 at the end, implying a trend of 1.5e-5 per station (Fig. 3.1). The salinities from the secondary sensor pair are noisier than those from the primary sensor pair.

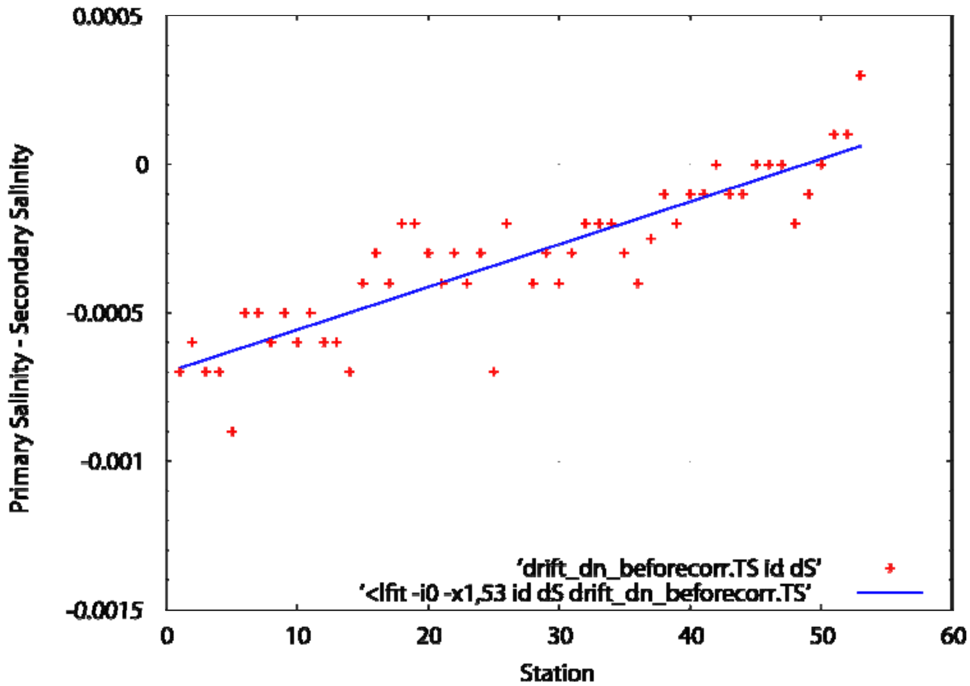


Figure 3.1. Median per-station salinity differences between the two CTD salinities.

In order to calibrate the CTD salinities, (usually 6) samples were taken on nearly all CTD casts. The samples were spaced throughout the water column between 200m and the seabed. They were analyzed in batches of 24 (corresponding to a full crate of sample bottles) on a Portasal salinometer. Each sample was analyzed until three consecutive salinity readings within 0.001 were obtained. Due to problems with the temperature in the analysis lab the first 4 crates yielded inconsistent results. After the lab temperature was stabilized to within ~1degC the results improved markedly. For the analysis presented here, only crates 5-9 (stations 21-44), all analyzed by Xinfeng Liang, are used. From a total of 118 samples, 22 were visually identified as outliers and discarded, leaving 96 valid samples from 21 stations.

The distributions of the differences between the Portasal samples and the corresponding CTD-derived salinities from both sensor pairs are characterized by single modes, standard deviations of ~0.002, and median CTD-sensor biases of 8.0e-4 and 5.0e-4 for the primary and secondary CTD salinities, respectively.

Because of the trend observed in the per-cast differences between the two CTD salinities, it was decided to investigate salinity sensor drift in the Portasal data, using station number as a proxy for time. Linear regressions between the median per-station differences between the Portasal and the corresponding CTD salinities yield slopes of -3.2(3.3)e-5 per cast and -4.7(3.2)e-5 per cast, respectively (standard deviations in parentheses). An independent check based on deep T/S properties on the 1.65degC potential isotherm yields corresponding drifts of -3.0(0.6)e-5 per cast and -4.2(0.6)e-5 per cast, i.e. consistent with the Portasal data. Over 50 casts, these latter drift slopes imply an increase in the primary-minus-secondary CTD salinities of 6e-4, which is close to the observed value.

Applying a full trend and bias correction to the salinity data resulted in tighter deep T/S properties west of the EPR crest, but increased spreads on axis and in the east. A detailed geographical analysis revealed that the T/S properties in the H* stations as well as at P1 and SP (all of which were occupied toward the end of the survey) are subtly different from those at the remaining stations west of the EPR. Thus, there is no firm evidence for a drift in the primary CTD salinity. The apparent drift in the secondary salinities, on the other hand, is real and could be corrected for, but this is not necessary, because the secondary salinities are noisier than the primaries.

In summary, the best salinities can be derived from the primary sensor pair, which is biased high by about 0.0008. The accuracy of the corrected CTD salinities is approximately 0.002.

No accuracy information is available for the pressure sensor. No attempt was made to calibrate the data of the auxiliary sensors.

3.3 LADCP

[Thurnherr, Ruiz Angulo, Stewart]

3.3.1 LADCP Data Acquisition

The velocity profiles measured during the Atlantis Cruise AT1526 were obtained using two identical RDI WorkHorses 300 [kHz] ADCP heads mounted on the CTD rosette. The following instruments setup remained unchanged throughout the cruise.

Number of depth cells	28
Length of depth cells	8 [m]
Blanking distance	0 [m]
Coordinate system	radial beam
Pinging setup	staggered pings every 1.5/2.0 [s]
Ambiguity velocity	2.5 [m/s]

Following the typical configuration of dual-headed LADCP systems, the down-looker was used as the master and the up-looker as the slave. The three ADCP heads provided by WHOI (Dan Torres) were used at the stations as showed in Table 3.2. The instrument with serial number 7877 and used as up-looker during cast #045 (as requested by Dan Torres) showed a clear problem with one of the beams. Once the instrument was on deck, the "beam test" was performed, failing for beam #3. The dysfunctional instrument was replaced by the previous ADCP used for the remaining casts.

CAST #	Up-looking	Down-looking	Comments
001- 050	1411	4897	
51	7877	4897	uplooker one beam dysfunctional
052 - 053	1411	4897	

Table 3.2. Cast number and the corresponding ADCP serial numbers.

The fuse of one the two LADCP batteries (yellow) blew while mounting it, before starting the casts. The older battery (red) was used instead until after the first "yo-yo" profile (station #027). After 13 [hrs], the battery was completely drained and it was not possible to re-charge it. Afterwards the fuse of the spare battery was replaced and the batteries were swapped. For the second "yo-yo" (station #032) at "UB" the LADCP system was configured so as to delay pinging for 6 [hrs] after being deployed, thus avoiding a complete discharged on the battery.

The data from cast #008 were bad because the instruments pinged for less than 1 [min]. From cast #008 to cast #015 the battery presented difficulties while charging. Recalling previous failure on the cables, the "octopus" cable was replaced by a spare. After the cable was replaced, the battery charged properly every time. After station #049 the files were left on the memory of the down-looker ADCP since downloading the data failed. The computer was reset and the serial ports were tested using the spare ADCP head. The cause of the malfunction was eventually traced to a dysfunctional communications cable, which was replaced. The bad cable was labeled as "damaged". Stations #051 to #053 were completed as usual after the cable was replaced and the remaining data were downloaded.

3.3.2 LADCP Data Processing

The data processing from all LADCP casts was done with the LDEO software package, version IX_4, using bottom tracking, GPS and SADCP data to constrain the barotropic component of the flow. As an improvement, a new "loadrdi.m" for 3-beam solutions was implemented. Most of the casts were done while the ship was in DP mode and differences in the order of few meters were noticed between the cast deployment and the recovery positions. The figures resulting from the data analysis show no indications of significant problems. On this cruise turbulent microstructure and hydrographic and velocity fine-structure data were obtained simultaneously (see DMP section).

3.4 Tidal Analysis

[Ruiz Angulo, Thurnherr]

Individual velocity profiles from the deep ocean are often dominated by the tides, which also "contaminate" hydrographic profiles. In order to remove the tidal component it is necessary to repeat stations at different phases of a tidal cycle. Due to the periodicity of the tides it is possible to predict their temporal variability. For this cruise, the repeat stations were planned for different tidal cycles. Pawlowicz et al (2002) developed the T_TIDE software package, which was used to predict the tides. The data for this analysis were obtained from the recovered CMs (current meters) deployed in November 2006 at the SA station: 9 09.0 N, 104 12.5W, on the summit of the EPR. The CM measured the zonal and meridional velocity components at a fixed location every 20 minutes. By looking at the temporal variability of the currents the tidal component was extracted by fitting sinusoidal functions weighted with the significant constituents of well known tides. Assuming that the variability of the tides is homogeneous over the ridge, the extracted parameters from analysis of the current meters were used to predict the tides for the rest of the cruise (See Figure 3.2]). The current meters recovered at CA and NA show good correspondence with the currents previously recovered at SA, supporting the previous assumption. (Reference: Pawlowicz P., Beardsley B., Lentz S., 2002. Classical tidal harmonic analysis including error estimates in MATLAB using T_TIDE, Computers and Geosciences, 28 929-937)

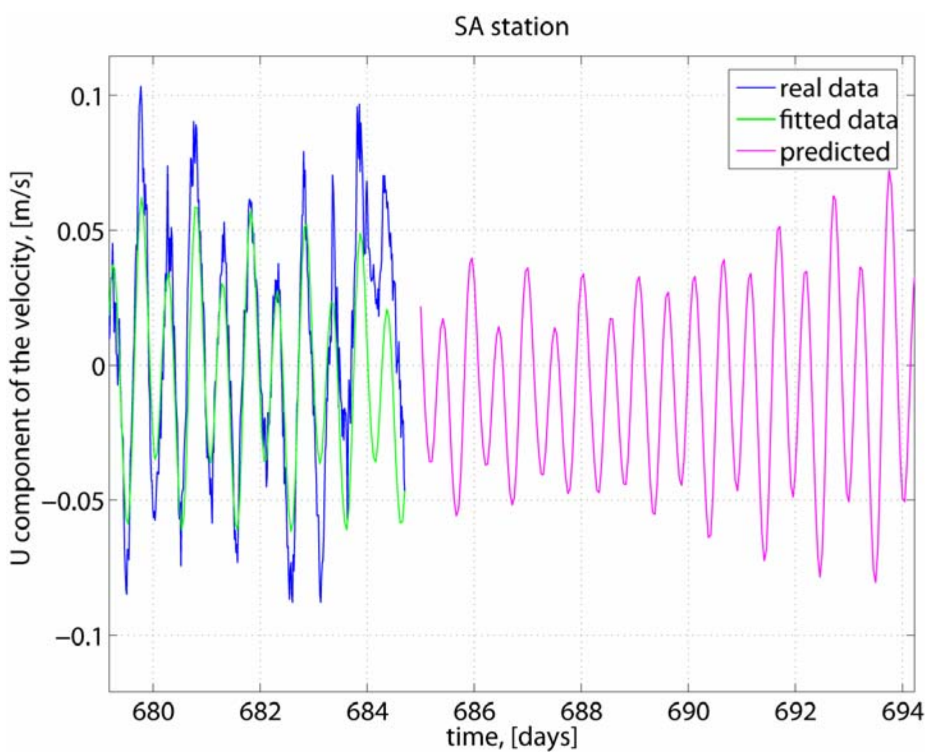


Figure 3.2. Tidal fit and prediction based on a current meter from the SA mooring. The data extracted from the CM are shown in blue, the corresponding fit in green, and the resulting prediction in magenta.

4 Other Projects

4.1 Microstructure Profiler

[Lou St. Laurent]

The FSU Deep Microstructure Profiler (DMP), was used extensively during LADDER-III as a primary component of the physical oceanography program. Two matching profiling systems were used during the cruise to complete 41 profiles of turbulent microstructure and hydrographic finestructure. All profiles were done with simultaneous deployments of the CTD/LADCP system, and a total of 31 different stations were occupied at least once. By all measures, the operation was successful, producing data of great value to the ocean science community interested in the physical processes acting along the East Pacific Rise.

The FSU DMP systems (Fig. 4.1) were built by Rockland Scientific International, and were based on the Rockland VMP5500 design. These instruments were initially used during the GRAVILUCK field program along the Mid-Atlantic Ridge in 2006. Work during that program resulted in several modifications to the instrument's design; specifically the weight release and an LED interface for signaling the profiler's recording activity. These modifications greatly improved the reliability of the instrumentation. By way of comparison, our work during GRAVILUCK resulted in 15 profiles in during a cruise of roughly the same length as LADDER-III. Our productivity during this present project was not limited by the instrument's performance, but rather by the limitation of operating the profiler with a 3-person team; consisting of L. St. Laurent, E. Howarth, and K. Decoteau. Our operations were conducted mostly at night, between the hours of 2100 and 0600. The Bosun and deck crew of the Atlantis provided considerable assistance to our operation. The efforts of these folks were significant, as most were working extra hours on top of their day-shift commitments. Additional support of our operation by CTD/LADCP-watch personnel A. Thurnherr, M. Schwartz, J. Stewart, A. Ruiz and X Liang was also invaluable.

The DMP system is autonomous, and requires special deployment and recovery operations relative to those routinely used for cabled instruments (e.g., the CTD). On deck, a custom carriage is used to move the DMP unit to-and-from the ship's crane. Operations require 5 personnel. One person is needed for operating the lifting rig, while the 4 others handle the profiler as it was being lifted from-and-to the carriage. During deployment, the ship holds position until the profiler is submerged. After profiler deployment, the ship stands off 300-500 m before conducting a CTD/LADCP deployment. The profiler sinks to the programmed depth, drops weights, and returns to the surface. For recovery, the ship slowly approaches the floating profiler. A profile to 3000 m takes roughly 3 hours, including time for deployment, the profiler's decent, return to the surface, and recovery to the deck. The profiler is then programmed for the next deployment. In general, a new deployment 45 minutes after recovery was possible.

DMP profiles were cataloged using the same numbering system as used by the CTD/LADCP station plan. A listing of DMP deployments by station number is given in Table 4.1. The names of each station location, date, time, longitude, latitude, and depth are given. With the exception of station 1, all profiles were conducted to full depth, typically to within 50-m of the depth given by the Knudsen echo sounder. In all profiles, parameters measured include the microstructure for shear, temperature, and conductivity. These are used to estimate turbulent dissipation rates, and mixing rates. A map of stations occupied in the physical oceanography survey is shown in Fig. 1.1.

Of the 41 profiles, 3 profiles were problematic. Profiles for stations 21, 30, and 39 all show a problem with the instrumentation, resulting in a corrupted data file. The first two incidents occurred while we were using DMP S/N 010, "Vader." The first incident was likely related to the failure of the connector to the turbidity sensor. This incident rendered the DMP's turbidity circuit unusable for the remainder of the cruise. As such, data files after station 21 do not have records of turbidity. The 2nd incident with Vader that occurred during station 30 was not traceable to any obvious electrical problem. After this incident, we switched to using DMP S/N 008, "Vito." This system showed the same problem during station 39, again with no obvious cause of an electrical problem. We continued to operate Vito for the rest of the cruise, and did not see a reoccurrence of the problem. However, this problem is, as of yet, unresolved for both instrument systems. The corrupted data files from these profiles will be analyzed after the cruise. I am hopeful that the data can be salvaged.

Aside from these 3 incidents, the DMP systems performed very well during the cruise. All data were of excellent quality, and have been preliminarily processed. While a more thorough analysis is needed, we believe the turbulence measurements have revealed several interesting aspects of the mixing characteristics near the East Pacific Rise. First, our measurements show that the helium plume along the ridge axis can have an interesting turbulence signal associated with turbidity, as seen as stations N1 and N3 (Figs. 4.2 and 4.3). Our data show that the kinetic energy dissipation rate (epsilon) is often enhanced in the Helium plume, extending from 100- to 150-m above the bottom. We believe these are the first ever observations of such turbulence signals, and so the result is quite exciting.

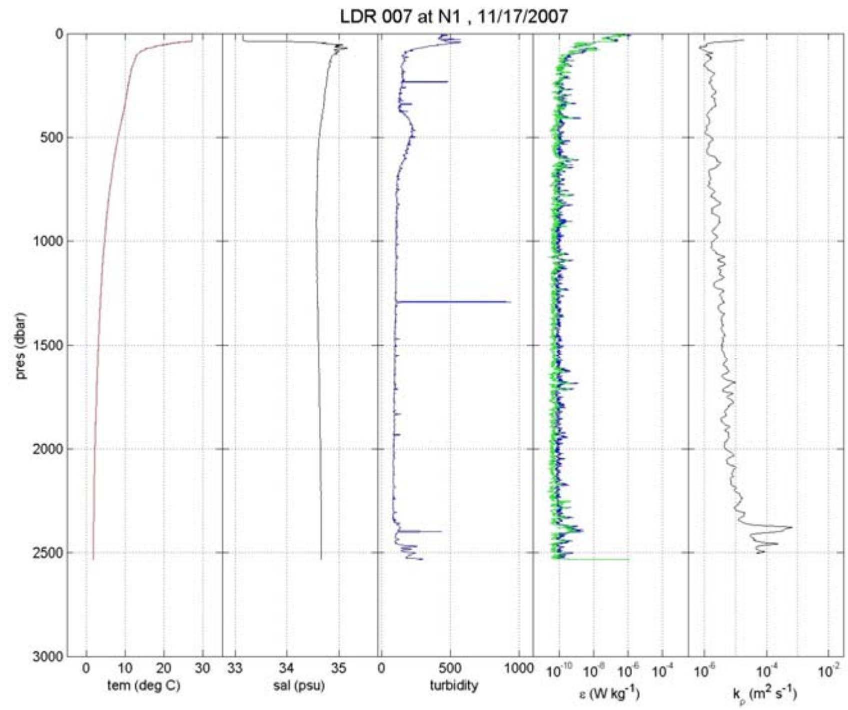
The second result deals with the general level of mixing on- and away from the ridge axis. This was the primary motivation for our mixing study, as the tracer experiment during LADDER-I and II indicated that enhanced levels of mixing were acting somewhere in the general region to the west of the ridge. Our survey was intended to examine where this mixing might specifically be occurring. The primary result seems to be that mixing in the area on and around the "Lamont" seamounts is the likely hotspot for mixing activity in the region. Figs. 4.4 and 4.5 show data from M7 and M8, documenting the generally enhanced turbulence levels and diffusivities below 2000-m depth. The depth interval around 2500 m was specifically relevant to the mixing of the tracer in the release experiment. A more thorough analysis is needed to ascertain whether the spatially variable turbulence levels we observed support the mixing rate estimated from the tracer evolution. However, it appears quite plausible that the diffusivities we have found could account for the tracer mixing.

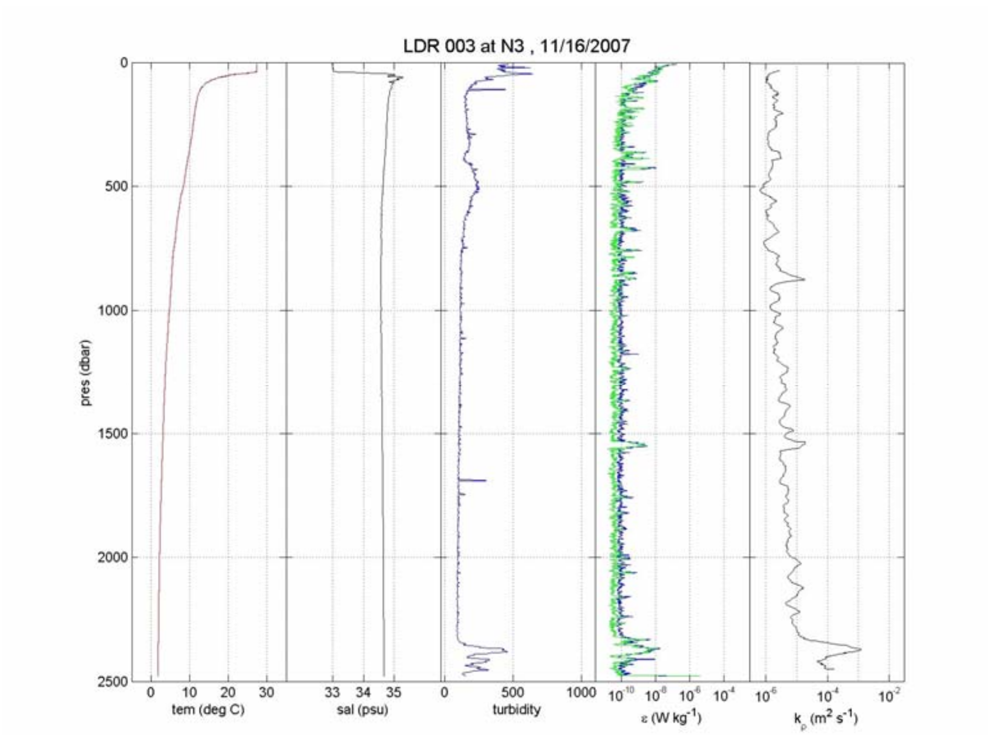
The abyssal layer below 2000-m is interesting, in that it is very weakly stratified. The energy dissipation levels we observe in this layer, while enhanced, are not particularly large when compared to oceanic regions of strong abyssal mixing. It appears that the combination of moderately enhanced dissipation levels combined with very small buoyancy gradients gives rise to large diffusivities of the same order as estimated by the tracer experiment, O(1 cm^2/s).

station	name	date	time	lon	lat	depth	instrument	notes
1	NA	20071116	322	-104.292	9.833	2525	Vader	first dive, to 500 m depth
2	NA	20071116	611	-104.292	9.833	2525	Vader	
3	N3	20071116	919	-104.275	9.750	2550	Vader	
4	NA	20071116	1240	-104.292	9.833	2525	Vader	
5	E2	20071117	241	-104.078	9.525	3095	Vader	
6	E3	20071117	631	-103.967	9.542	3045	Vader	
7	N1	20071118	56	-104.252	9.583	2565	Vader	
8	N2	20071118	357	-104.262	9.667	2555	Vader	
9	M1	20071118	741	-104.342	9.883	2800	Vader	
11	M8	20071119	158	-104.633	10.025	2665	Vader	soft bottom hit
12	M7	20071119	158	-104.600	9.983	1700	Vader	
13	M5	20071119	806	-104.517	9.933	2500	Vader	
14	M4	20071119	1101	-104.475	9.917	1720	Vader	
16	WF	20071120	56	-104.540	9.450	2920	Vader	
18	W2	20071120	648	-104.395	9.475	3015	Vader	
19	W1	20071120	1011	-104.330	9.497	2790	Vader	
21	M3	20071121	817	-104.442	9.908	2565	Vader	data file is corrupted, turbidity connector failed
23	M7	20071122	423	-104.600	9.983	1700	Vader	no turbidity here after
24	M5	20071122	703	-104.517	9.933	2500	Vader	
25	M3	20071122	956	-104.442	9.908	2565	Vader	
26	M3	20071123	903	-104.442	9.908	2565	Vader	
27	DB	20071124	117	-104.537	10.037	3135	Vader	
28	M8.2	20071124	429	-104.602	10.030	2650	Vader	
29	M8.1	20071124	723	-104.620	10.012	2620	Vader	
30	M9	20071124	1029	-104.683	10.067	1900	Vader	data file is corrupted, hard bottom hit
33	CA	20071125	1024	-104.242	9.500	2585	Vito	first profile w/ Vito, used for all remaining
35	W2	20071126	336	-104.395	9.475	3015	Vito	
36	WF	20071126	703	-104.540	9.450	2920	Vito	
38	H3	20071128	240	-104.850	9.775	2740	Vito	
39	H1	20071128	603	-104.992	9.808	2393	Vito	data file is corrupted
40	H0	20071128	1134	-104.917	9.900	3045	Vito	
42	H5	20071129	320	-104.642	9.642	2385	Vito	
43	H4	20071129	651	-104.750	9.717	3060	Vito	
44	H2	20071129	1243	-104.925	9.808	2150	Vito	
45	EF	20071130	16	-103.872	9.558	3045	Vito	
46	E1	20071130	438	-104.167	9.513	2815	Vito	
47	N3	20071130	839	-104.275	9.750	2550	Vito	
48	M2	20071201	35	-104.408	9.900	1940	Vito	
49	M6	20071201	339	-104.558	9.942	1975	Vito	
50	P1	20071201	647	-104.405	9.833	2945	Vito	

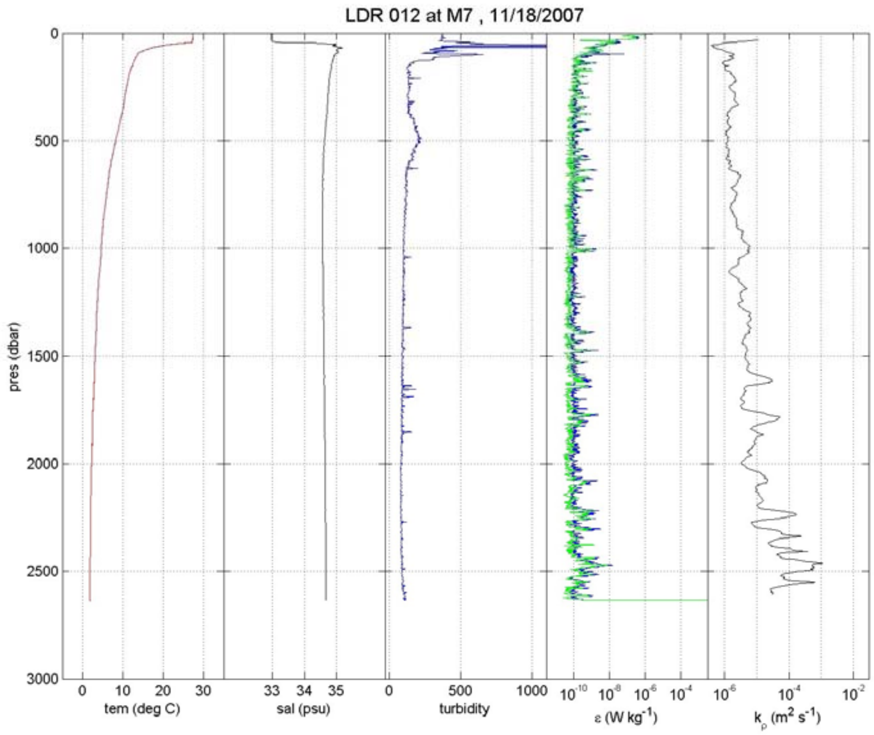
Table 4.1. Summary of DMP deployments.

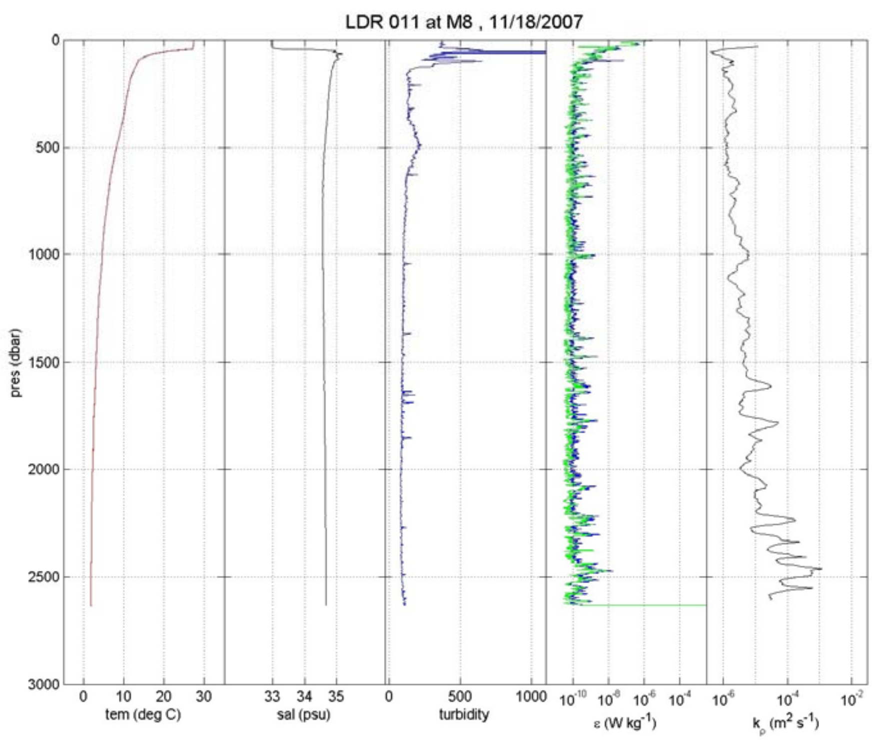
Figure 4.1. The FSU DMP system. (Photo by S. Mills)





Figures 4.2 and 4.3. DMP data from stations N1 and N3, showing the relation between the turbidity signal of the He plume (near 2400-m depth), and associated levels of enhanced energy dissipation (epsilon) and diffusivity (k_{rho}).





Figures 4.4 and 4.5. DMP data from stations M7 and M8, showing enhanced energy dissipation (epsilon) and diffusivity (k_{rho}) along the Lamont seamounts.

4.2 Water Column Denitrification

[Matt Schwartz]

Water column denitrification rates throughout the LADDER 3 study region will be assessed from samples collected for N_2/Ar analyses, with associated characterization of dissolved inorganic nutrients (NO_3, NO_2, NH_4, and PO_4). Water column samples were collected from Niskin bottles affixed to the CTD rosette sampler, as summarized in Table 4.2. Note that CTD casts not included in Table 4.2 were not sampled for water column denitrification parameters.

The majority of samples were focused in and around the oxygen deficit zone (ODZ) observed throughout the region at a depth of ~300-800 m . A secondary turbidity maximum was normally observed within the ODZ at a depth of ~400m. This feature is likely detrital organic mater (OM) transferred from the overlying photic zone; respiration of this OM is responsible for the drawdown in dissolved oxygen and provides the substrate for any denitrification occurring in the water column.

Samples were also collected from the oxic water column above and below the ODZ, as well as from a persistent oxygen inflection feature observed at a depth of approximately 1100 m (±25 m). In limited cases, secondary ODZs were observed above or below the primary ODZ; these zones were normally sampled for denitrification parameters.

Samples for N2/Ar analysis were collected first from all Niskin bottles. These samples were allowed to overfill 7 mL glass-stoppered test tubes and were quickly inoculated with 50 µL of saturated ZnCl solution before the stopper was emplaced and the samples stored in the shipboard refrigerated unit at a temperature of ~3°C.

Nutrient samples were filtered through combusted GF/F filters and divided into two 40 mL aliquots in acid-washed 50 mL centrifuge tubes. Filtered nutrient samples were placed immediately into the shipboard -80°C freezer units and will be stored in the -20°C walk-in freezer until being retrieved in January 2008, when RV *Atlantis* returns to San Diego, CA.

All samples will be analyzed at University of West Florida. N_2/Ar samples will be analyzed using a membrane inlet mass spectrometer (MIMS) system and nutrient levels will be determined using standard wet chemical spectrophotometric methods. These analyses will be performed during January-March 2008.

Table 4.2. Water column denitrification sample summary

CTD cast		Station		Niskin		Sample ID	
number	Date	ID	depth (m)	bottle	depth (m)	N_2/Ar	Nutrients
001	15-Nov-07	SA	2575	1	bottom	1	1
				2	2000	2	2
				3	1300		
				4	1000	3	3
				5	800	4	4
				6	700		
				7	500	5	5
				8	400	7	7
				9	200		
				10	100	6	6
				11	10	8	8
006	17-Nov-07	NA	3050	1	2975	9	9
				2	2200		
				3	1400		
				4	1000	10	10
				5	800	11	11
				6	700	12	12
				7	500	13	13
				8	400	14	14
				9	300	15	15
				10	200	16	16
ALVIN	17-Nov-07			1	bottom	17	
				2	bottom		
				3	bottom		17
				4	bottom	18	
				5	bottom		18
009	18-Nov-07	M1	2801	1	2775		
				2	2000	19	
				3	1300		
				4	1100	20	
				5	900	21	
				6	700	22	
				7	500	23	
				8	200	24	
				9	100	25	
015	19-Nov-07	M1	2850	1	2821	26	
				2	2000	27	
				3	1300	28	
				4	900	29	
				5	700	30	
				6	500	31	
				7	400	32	
				8	300	33	
				9	200	34	
019	20-Nov-07	W1	2782	1	2742		
				2	2000		
				3	1300		
				4	900	35	19
				5	800	36	20
				6	700	37	21
				7	500	38	22
				8	400	39	23
				9	200	40	24
021	21-Nov-07	M3	2610	1	2452		
				2	2000		
				3	1300		
				4	1100	41	25
				5	900	42	26
				6	800	43	27
				7	700	44	28
				8	500	45	29
				9	300	46	30
				10	200		
024	22-Nov-07	M5	2464	1	2426		
				2	1000	47	
				3	800	48	
				4	700		
				5	500	49	
				6	400	50	
				7	200	51	
027	23-Nov-07	DB	3130	1	3080		
				2	2500		
				3	2000		
				4	1300	52	
				5	1080	53	
				6	900	54	
				7	700	55	
				8	500	56	
				9	300	57	

CTD cast		Station		Niskin		Sample ID	
number	Date	ID	depth (m)	bottle	depth (m)	N_2/Ar	Nutrients
029	24-Nov-07	M8.1	2635	1	2610		
				2	2000		
				3	1300		
				4	1074	58	
				5	900	59	
				6	700	60	
				7	500	61	
				8	300	62	
				9	200	63	
037	27-Nov-07	SP	2740	1	2706		
				2	2000		
				3	1300		
				4	1300	64	31
				5	1100	65	32
				6	700		
				7	700	66	
				8	500		
				9	500	67	33
				10	400	68	
				11	300	69	34
				12	250	70	
				13	200		
				14	200	71	35
				15	100	72	
043	29-Nov-07	H4	2978	1	2962		
				2	2000		
				3	1300		
				4	1100	73	
				5	800	74	
				6	700	75	
				7	500	76	
				8	300	77	
				9	200	78	
044	29-Nov-07	H2	2150	1	2118		
				2	1300		
				3	1127	79	36
				4	900	80	37
				5	700	81	38
				6	500	82	39
				7	400	83	40
				8	300	84	41
				9	200		
049	1-Dec-07	M6	1965	1	1957		
				2	1700		
				3	1300		42
				4	1000		43
				5	500		44
				6	200		45
050	1-Dec-07	P1	2880	1	2820		
				2	2000		
				3	1300	85	
				4	1000	86	
				5	800	87	
				6	700		
				7	500	88	
				8	300	89	
				9	200	90	
051	1-Dec-07	P2	2900	1	2843		
				2	2000		
				3	1300	91	
				4	1100	92	
				5	900	93	
				6	700		
				7	500	94	
				8	300	95	
				9	200	96	

4.3 Suspended Particle Rosette Sampler

[Chip Breier (in collaboration with Brandy Toner and Chris German landside)]

This cruise was the first at-sea deployment of a new oceanographic tool, a suspended particulate rosette (SUPR) sampling system capable of rapidly filtering 24 large water volume samples (> 100 liters per sample through 37 mm 1 μm polycarbonate filters) for suspended particulates during a single CTD cast or moored deployment (Figure 4.6). In addition to being able to rapidly collect many samples at a time, the SUPR sampler is designed to be compatible with *in situ* optical analysis techniques we are currently developing back in the laboratory. Being able to collect samples when and where we choose, and eventually being able to carry out a portion of the analysis underwater in their natural environment, will allow us to investigate these fundamental questions, *"How do iron- and manganese-rich, hydrothermal plume particles affect seawater chemistry and to what extent do these particles fuel microbial activity in deep-sea hydrothermal plumes?"*

On this cruise, Lauren Mullineaux provided us the opportunity to deploy the SUPR sampler on her pump moorings. The SUPR was first deployed on 23 November on pump mooring L19 which was moored near Tica (9° 50.42′ N 104° 17.51′ W); the SUPR sampler was 75 m above the bottom. The sampler was programmed to collect a time series of 24 filter samples with the first starting at 1200 GMT on November 24 and the last starting at 1200 GMT on 26 November. Each sample was programmed to filter as much water as possible in a 1 hour interval. The SUPR sampler was recovered on the morning of 26 November and for its first at-sea deployment did very well. Eight of the samples filtered over 50 liters and two over 115 liters – these samples were highly loaded with particulate – proving the system can operate as intended in a deep sea hydrothermal plume environment.

a) b)

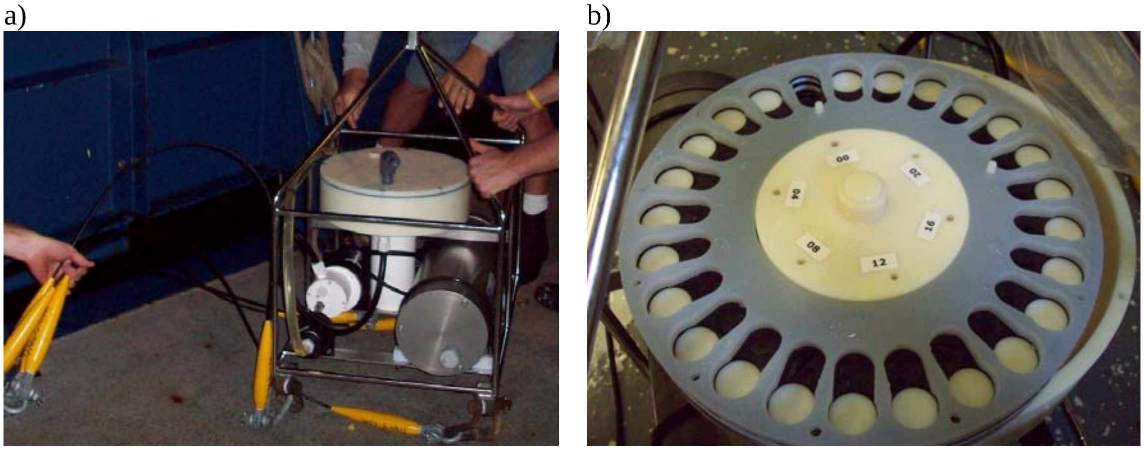


Figure 4.6. The a) SUPR sampler contains a b) rotating filter rosette driven by a stepper motor. The water inlet and outlets, and future optical sensor and dosing ports, are stationary. Fused silica windows will be added to the current filter rosette to complete the optical design.

In addition to a proof of concept, we will use these particulate samples to take an unprecedented look at the mineralogy and biogeochemistry of non-buoyant hydrothermal plume particles – using a combination of laser Raman, micro-scale high energy x-ray absorption spectroscopy, and bulk and trace elemental analysis. In support of this work water samples were collected by Alvin in the neutrally buoyant plume near the SUPR sampler during the time series deployments – as well as in the upper water column. These water samples with be analyzed for dissolved trace elements and used to estimate the fraction of vent fluid in the nonbouyant plume during this sampling period.

4.4 Hydrothermal Vent Meiobenthos

[Monika Bright, Sabine Gollner and Ingrid Kolar, University of Vienna, Austria]

Deep-sea hydrothermal vents are globally wide-spread extreme environments located at the mid-ocean ridge system of the largest mountain chain on Earth. Driven by *in situ* primary production via chemosynthesis, a special vent fauna thrives under highly fluctuating conditions along a gradient of temperature and toxic chemicals such as hydrogen sulfide. Meiofauna – the small-sized animal and protist community – of the 9^{o}50'N East Pacific Rise region is a prominent component of all known vent communities there and has been found in low diversity and low abundance. As the volcano of this region erupted early 2006 and destroyed most of the living beings there, this gives us the unique opportunity to study the sofar completely unknown successional patterns of meiobenthos. Using artificial settlement devices and control natural collections in a variety of benthic locations with and without vent flux in the axial summit collapse trough, as well as in the pelagial on moorings, we will investigate the temporal and spatial hydrothermal vent communities over a time course of about 6 months to 3 years post eruption. This study on succession, the non-seasonal, directional continuous pattern of colonization and extinction will include the description of new species, the identification, and quantification of the specific meiofauna communities of selected hydrothermal vent habitats in terms of species richness, diversity, and abundance in conjunction with an assessment of the abiotic conditions as well as of the bacterial abundance and particulate organic matter measurements serving as food for this exclusively primary consumer community. In addition, this study will include the search for vent meiobenthic species in the pelagial in the vicinity the 9^{o}50'N EPR region. This study will be the first of its kind and will lead to a better

Figure 4.7. Meiofauna colonization substrates, held by Sabine Golner (photo by X. Liang)

understanding of the processes and underlying mechanisms of vent meiofauna succession.

In order to get an overview on the present meiobenthic communities in November/December 2007, we followed two approaches: deployments and recoveries of artificial substrates (Tables 4.3 and 4.4) and natural basalt substrate collections (Table 4.5). The natural substrate collections will be used to estimate the occurrence of meiobenthic species at specific sites and temperatures. These will be compared with the artificial substrate collections for which abundance, biomass, species richness, and several diversity indices will be calculated. The artificial substrates deployed during the LADDER 1 cruise in October/November 2006 and LADDER2 cruise in December 2006/January 2007 were recovered. Whenever possible, water samples were collected in pelagic pumps directly above the experimental substrates (Table 4.5), and examined for meiofauna.

Upon assessment of the present vent and off-axis communities, we chose to concentrate on the following habitats at the LADDER1 cruise: Alvinella *pompejana* community on black smoker from Bio9 (in 2007 collapsed), *Tevnia jerichonana* communities from Tica, P-vent (both in 2007 a *Tevnia/Riftia pachyptila* mix community), Sketchy (in 2007 a dead *Tevnia* community), *Tevnia/Alvinella pompejana* mix community from Tica (in 2007 a *Tevnia/Riftia pachyptila* mix community), empty tubes of *Riftia pachyptila* and empty shells of *Bathymodiolus thermophilus* communities from East Wall, and peripheral basalt communities from Bio9, Tica, Sketchy, P-vent, and East Wall. Artifical substrates were recovered and redeployed at each of the sites (except for Bio9: no new deployments due to collapse) in order to study the long term colonization. All these artificial substrates will remain to continue long term studies.

Artificial substrates (sponges) deployed on moorings during LADDER 1 to study the distribution of vent meiofauna, were all recovered during LADDER 3. The sponges had been attached to the current meters on the SA, CA, NA, WF, EF, W1 and W2 moorings (Table 4.6).

In addition, samples for studying the microbial community were also collected. All artificial substrate collections were done in collaboration for Markus Weinbauer (CNRS-UPMC, Villefranche-sur-mer, France) in order to estimate the microbial abundance on the artificial substrates.

A related study on the development, growth and cell kinetics of the tubeworm *Riftia pachyptila* was conducted at the same time as the meiofaunal investigation. The aim of this project was to study the infection process, growth, and developmental processes in *Riftia pachyptila* symbiosis (giant tubeworms) as well as cell kinetics in symbiont-containing and symbiont-free host tissue. For studying developmental processes, we recovered and redeployed tubeworm artificial settlement devices (TASCs) from *Tevnia jerichona/Riftia pachyptila* aggregations at Tica, Sketchy, and P-vent. We additionally deployed 3 TASCs at the site Tica.

Table 4.3. Deployments of Meiofaunal Experiments: Devices are TACSs (tubeworm artificial settlement cubes = babytraps) and Sponges (meiobenthic artificical devices = plastic kitchen sponges) with piece of bucket lid with number, MB, and Austrian flag for identification

date	dive	site	x	y	z	Hdg	latitude	longitude	description	#device
26/11/2007	4371	Tica	4581	78159	2509	135	9°50.403	104°17.499	peripheral basalt community	89
22/11/2007	4369	Tica	4573	78157	2510	94	9°50.401	104°17.503	*Alvinella*/*Tevnia* community	85
26/11/2007	4371	Tica	4571	78176	2512	53	9°50.411	104°17.504	*Tevnia* community	86, 87, 88
26/11/2007	4371	Tica	4571	78176	2512	53	9°50.411	104°17.504	*Tevnia* community	98
22/11/2007	4369	Tica	4569	78167	2512	26	9°50.407	104°17.506	peripheral basalt community	84
17/11/2007	4366	P-Vent	4629	77916	2508	76	9°50.270	104°17.472	*Tevnia* community	80, 81, 82
17/11/2007	4366	P-Vent	4631	77915	2509	57	9°50.270	104°17.471	peripheral basalt community	83
27/11/2007	4372	Sketchy	4679	77524	2506	149	9°50.058	104°17.445	*Tevnia* community	92, 93, 94
27/11/2007	4372	Sketchy	4679	77524	2506	149	9°50.058	104°17.445	peripheral basalt community	95
30/11/2007	4373	Eastwall	4566	78401	2500	114	9°50.534	104°17.507	live mussel community	91
30/11/2007	4373	Eastwall	4568	78395	2500	15	9°50.530	104°17.506	dead *Riftia* community	96
30/11/2007	4373	Eastwall	4570	78393	2500	10	9°50.529	104°17.505	peripheral basalt community	97
30/11/2007	4373	Eastwall	4570	78402	2500	255	9°50.534	104°17.505	dead mussel community	90

Table 4.4. Recovery of Meiofaunal Experiments: Devices are TACSs (tubeworm artificial settlement cubes = babytraps) and Sponges (meiobenthic artificical devices = plastic kitchen sponges) with piece of bucket lid with number, MB, and Austrian flag for identification

date	dive	site	x	y	z	Hdg	latitude	longitude	description	#device
26/11/2007	4371	Tica	4581	78159	2509	135	9°50.403	104°17.499	peripheral basalt community	60
22/11/2007	4369	Tica	4573	78157	2510	94	9°50.401	104°17.503	*Alvinella*/*Tevnia* community	59
26/11/2007	4371	Tica	4571	78176	2512	53	9°50.411	104°17.504	*Tevnia* community	33, 34, 35
22/11/2007	4369	Tica	4569	78167	2512	26	9°50.407	104°17.506	peripheral basalt community	61
18/11/2007	4367	Bio9	4616	77976	2508	36	9°50.303	104°17.480	peripheral basalt community	58
17/11/2007	4366	P-Vent	4629	77916	2508	76	9°50.270	104°17.472	*Tevnia* community	62, 63, 64
17/11/2007	4366	P-Vent	4631	77915	2509	57	9°50.270	104°17.471	peripheral basalt community	57
27/11/2007	4372	Sketchy	4679	77524	2506	149	9°50.058	104°17.445	*Tevnia* community	68, 69, 70
27/11/2007	4372	Sketchy	4679	77524	2506	149	9°50.058	104°17.445	peripheral basalt community	72
30/11/2007	4373	Eastwall	4566	78401	2500	114	9°50.534	104°17.507	live mussel community	65
30/11/2007	4373	Eastwall	4568	78395	2500	15	9°50.530	104°17.506	dead *Riftia* community	66
30/11/2007	4373	Eastwall	4570	78393	2500	10	9°50.529	104°17.505	peripheral basalt community	67
30/11/2007	4373	Eastwall	4570	78402	2500	255	9°50.534	104°17.505	dead mussel community	73

Table 4.5. Collections of natural communities associated with meiofaunal experiments on basalt rocks and in pelagic pumps.

Natural habitat collections

date	dive	site	x	y	z	Hdg	latitude	longitude	description
22/11/2007	4369	Tica	4573	78157	2510	94	9°50.401	104°17.503	pelagic pump from *Tevnia/Alvinella* site
22/11/2007	4369	Tica	4573	78157	2510	94	9°50.401	104°17.503	basalt from *Tevnia/Alvinella* site
26/11/2007	4371	Tica	4581	78159	2509	135	9°50.403	104°17.499	pelagic pump from periphery by *Tev/Alv* site
26/11/2007	4371	Tica	4581	78159	2509	135	9°50.403	104°17.499	basalt from periphery by *Tevnia/Alvinella* site
22/11/2007	4369	Tica	4569	78167	2512	26	9°50.407	104°17.506	pelagic pump from periphery by *Tevnia* site
22/11/2007	4369	Tica	4569	78167	2512	26	9°50.407	104°17.506	basalt from periphery by *Tevnia* site
26/11/2007	4371	Tica	4571	78176	2512	53	9°50.411	104°17.504	pelagic pump from *Tevnia* site
26/11/2007	4371	Tica	4571	78176	2512	53	9°50.411	104°17.504	basalt from *Tevnia* site
18/11/2007	4367	Bio9	4616	77976	2508	36	9°50.303	104°17.480	pelagic pump from periphery
26/11/2007	4351	Bio9	4616	77976	2508	36	9°50.303	104°17.480	basalt from periphery
17/11/2007	4366	P-Vent	4629	77916	2508	76	9°50.270	104°17.472	pelagic pump from *Tevnia* site
17/11/2007	4366	P-Vent	4629	77916	2508	76	9°50.270	104°17.472	basalt from *Tevnia* site
17/11/2007	4366	P-Vent	4631	77915	2509	57	9°50.270	104°17.471	pelagic pump from periphery
17/11/2007	4366	P-Vent	4631	77915	2509	57	9°50.270	104°17.471	basalt from periphery
27/11/2007	4372	Sketchy	4679	77524	2506	149	9°50.058	104°17.445	pelagic pump from *Tevnia* site
27/11/2007	4372	Sketchy	4679	77524	2506	149	9°50.058	104°17.445	basalt from *Tevnia* site
27/11/2007	4372	Sketchy	4679	77524	2506	149	9°50.058	104°17.445	pelagic pump from periphery
27/11/2007	4372	Sketchy	4679	77524	2506	149	9°50.058	104°17.445	basalt from periphery
30/11/2007	4373	Eastwall	4570	78402	2500	255	9°50.534	104°17.505	pelagic pump from dead mussel/*Riftia* site
30/11/2007	4373	Eastwall	4570	78402	2500	255	9°50.534	104°17.505	basalt from dead mussel/*Riftia* site
30/11/2007	4373	Eastwall	4566	78401	2500	114	9°50.534	104°17.507	pelagic pump from live mussel site
30/11/2007	4373	Eastwall	4566	78401	2500	114	9°50.534	104°17.507	basalt from live mussel site
21/11/2007	4368	V-Vent	5559	72438	2508	72	9°47.298	104°16.965	basalt from periphery (for copepod analyses)
21/11/2007	4368	V-Vent	5550	72379	2509	13	9°47.266	104°16.970	slurp from smoker (for copepod analyses)
30/11/2007	4373	Biovent	4376	79192	2503	259	9°50.963	104°17.610	basalt (for copepod analyses)
30/11/2007	4373	Persev.	4400	79189	2506	230	9°50.96	104°17.598	basalt (for copepod analyses)

Table 4.6. Recovery of Meiofaunal Experiments on Moorings: Devices are TACSs or Sponges (meiobenthic artificial devices) with number for identification

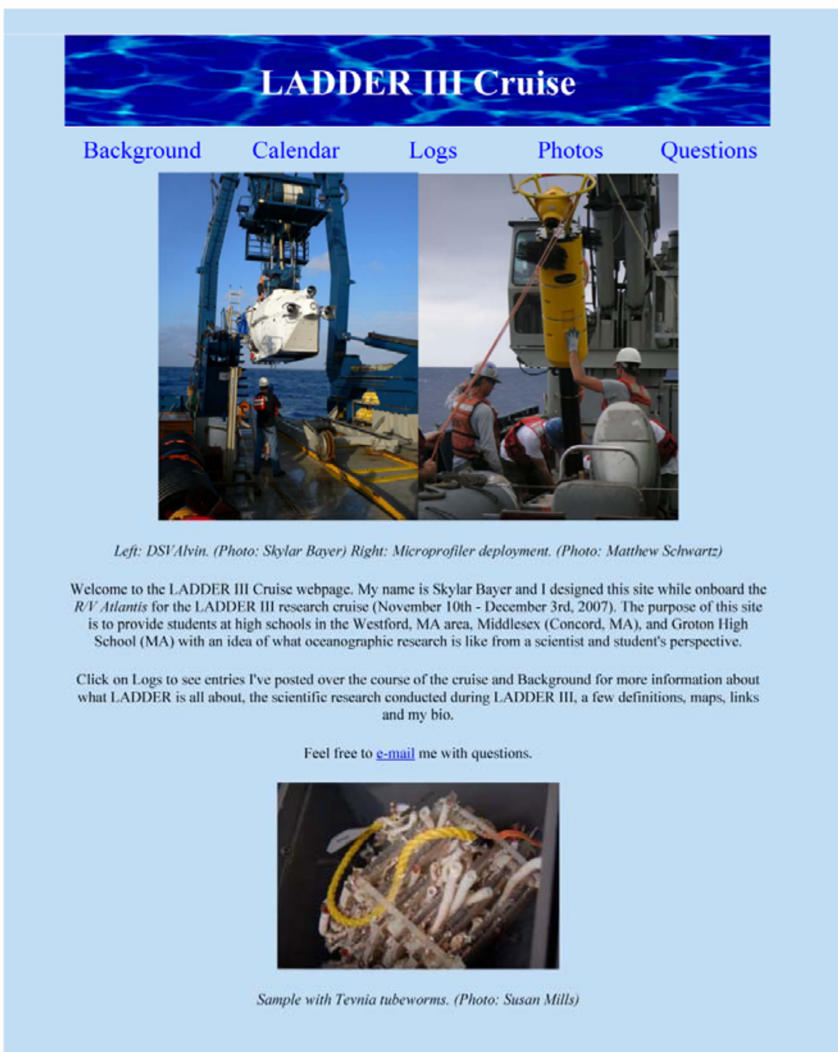
Deployment Date	Recovery Date	Site	Lon (deg)	Lat (deg)	Depth (m)	#device
30/10/2006	19/11/2007	WF	9.44	104.54	2450	M1-M3
1/11/2006	19/11/2007	EF	9.55	103.87	2450	M4-M6
3/11/2006	27/11/2007	NA	9.83	104.29	2518	M7-M9
3/11/2006	27/11/2007	NA	9.83	104.29	2450	M10-M12
8/11/2006	25/11/2007	CA	9.50	104.24	2450	M13-M15
8/11/2006	25/11/2007	CA	9.50	104.24	2573	M16-M18
12/11/2006	20/11/2007	W1	9.50	104.33	2312	M19-M21
12/11/2006	20/11/2007	W1	9.50	104.33	2812	M22-M24
12/11/2006	20/11/2007	W2	9.47	104.48		M25-M27
12/11/2006	20/11/2007	W2	9.47	104.48		M28-M30
13/11/2006	15/11/2007	SA	9.15	104.21	2450	M31-M33
13/11/2006	15/11/2007	SA	9.15	104.21	2588	M34-M36

5 Outreach Web Site

[Skylar Bayer]

Education outreach was performed on this cruise in the form of the LADDER III Cruise webpage. Skylar Bayer, an undergraduate student at Brown University, designed the site while onboard the *R/V Atlantis*. The purpose of this site was to provide students at high schools in the Westford, MA area, Middlesex (Concord, MA), and Groton High School (MA) with an idea of what oceanographic research is like from a scientist and student's perspective. Students were contacted through individual teachers who had been contacted prior to the cruise. The site included Logs, with entries posted over the course of the cruise, and Background for more information on the scientific research conducted during LADDER III (Figure 5.1). It also posted a few definitions, maps, links, photos, a calendar, questions from the students and Skylar's bio. The site got much wider distribution than we had anticipated, as it was highlighted in the weekly newsletters of the Ridge2000 InterRidge programs.

Figure 5.1. Home page for LADDER3 outreach web site.



6 Metadata, Schedules, Lists, Protocols

Metadata were compiled by Benjamin Walther from various sources including metadata files from previous cruises, information provided by individual PIs, dive logs, and Alvin navigation logs (`renav' files). They have been cross-checked and proofed, but may still contain errors. The tables presented herein are truncated versions of the full metadata files, which are posted on the Ridge2000 Data Portal.

6.1 Cruise Participant Email List

Last	First	Position	Affiliation	Email
Mullineaux	Lauren	scientist	WHOI	lmullineaux@whoi.edu
Mills	Susan	scientist	WHOI	smills@whoi.edu
Strasser	Carly	graduate student	WHOI	cstrasser@whoi.edu
Walther	Benjamin	postdoc	WHOI	benjwalther@gmail.com
Staglicic	Nika	graduate student	WHOI	nika.st@gmail.com
Bayer	Skylar	undergrad student	WHOI	skylarrb@gmail.com
Breier	Chip	postdoc	WHOI	jbreier@whoi.edu
Hogue	Brian	engineer	WHOI	bhogue@whoi.edu
Fraser	Paul	engineer	WHOI	pfraser@whoi.edu
Thurnherr	Andreas	scientist	LDEO	ant@ldeo.columbia.edu
Ruiz-Angulo	Angel	graduate student	Cal Tech	angel@caltech.edu
Liang	Xinfeng	graduate student	LDEO	xliang@ldeo.columbia.edu
St. Laurent	Lou	scientist	FSU	lous@ocean.fsu.edu
Schwartz	Matt	scientist	U W Fl	mschwartz@uwf.edu
Howarth	Eric	engineer	FSU	howarth@ocean.fsu.edu
Decoteau	Ken	engineer	FSU	
Stewart	Jonathan	graduate student	U W Fl	
Gollner	Sabine	graduate student	UVienna	sabine_gollner@gmx.at
Kolar	Ingrid	scientist	UVienna	ingrid.kolar@univie.ac.at

6.2 Cruise Letter

2 November 2007

Captain A. D. Colburn, III
R/V Atlantis, Voyage #15, Leg XXVI
Woods Hole Oceanographic Institution
Mail Stop #27
Woods Hole, MA 02543

Dear Captain Colburn:

On or about 13 November 2007, your vessel being ready for sea and weather permitting, you will depart Manzanillo, Mexico, on Leg XXVI of Voyage #15. Upon completion of the science activities the vessel shall return to Manzanillo, Mexico, on 3 December 2007.

The main scientific research objective is how larval behaviors interact with topographically-influenced flows on mid-ocean ridges, and determine how these interactions affect dispersal trajectories, maximal dispersal distances, and relative probabilities of supply to natal versus remote vents.

The planned activities are Alvin dives, CTD/LADCP surveys and mooring operations. The operations area will be the East Pacific Rise in the vicinity of 9-10N, 104:15W.

Scientific marine research within the exclusive economic zone of any foreign nation is strictly prohibited.

The scientific personnel participating on this voyage under the direction of Dr. Lauren Mullineaux, Chief Scientist, Woods Hole Oceanographic Institution, are:
R/V Atlantis
Voyage #15, Leg XXVI
13 November 2007 – 3 December 2007
Manzanillo, Mexico – Manzanillo, Mexico

Dr. Lauren Mullineaux, Chief Scientist, Woods Hole Oceanographic Institution
Ms. Susan Mills, Woods Hole Oceanographic Institution
Ms. Carly Strasser, Woods Hole Oceanographic Institution
Dr. Benjamin Walther, University of Adelalide, Australia
Ms. Nika Staglicic, Institute of Oceanography and Fisheries, Croatia
Ms. Skylar Bayer, Brown University/Woods Hole Oceanographic Institution
Dr. John Breier, Jr., Woods Hole Oceanographic Institution
Mr. Brian Hogue, Woods Hole Oceanographic Institution
Mr. Paul Fraser, Woods Hole Oceanographic Institution
Dr. Andreas Thurnherr, Lamont Doherty Earth Observatory
Mr. Angel Ruiz-Angulo, Lamont Doherty Earth Observatory
Mr. Xinfeng Liang, Lamont Doherty Earth Observatory
Dr. Louis St. Laurent, Florida State University
Dr. Matthew Schwartz, University of West Florida
Mr. Eric Howarth, Florida State University
Mr. Kenneth Decoteau, Florida State University
Mr. Jonathan Stewart, University of W. Florida
Ms. Sabine Gollner, University of Vienna
Ms. Ingrid Kolar, University of Vienna
Ms. Amy Simoneau, Woods Hole Oceanographic Institution
Mr. William Fanning, Woods Hole Oceanographic Institution

The ship's agent in Manzanillo, Mexico, will be: Vasile Tudoran Transport
819 Ohio Ave.
Long Beach, CA 90804
Contact: Vasile Tudoran
tel. (562) 882-5590, fax: (562) 434-9800, email : vtudoran@aol.com

6.3 Science Data Products (DVDs, video tapes)

The LADDER-3 science data and copies of images are stored on DVDs. The Alvin video records are also recorded on DVCam tapes. The contents of these data products are summarized below.

For the near term, the steward of the CTD/LADCP data is Andreas Thurnherr, and the steward of the Alvin data is Lauren Mullineaux. Cruise participants are asked to contact the appropriate steward if you wish to use any of these data. The images from Alvin (hand held internal, external stills, videos) may be used freely in presentations and publications. The attribution for these is 'WHOI Alvin Group/ LADDER-3 Cruise'. The hand-held images from the surface should be attributed to the individual photographer (as identified by folder name).

Alvin Data (2 disks): One directory per dive with Alvin underway data (DVLNAV, etc.) and top-lab data are on disk 1. Handheld still-camera images are found on the disk 2, also organized by dive. Data directories of instruments that were not used are empty (e.g. magnetometer). The framegrabber images were left off these disks by error. You can access those images at: http://4dgeo.whoi.edu/alvin

External Stills (3 disks): Still images from the external Alvin cameras are organized in folders by dive number in disk 1 (4366 to 4369), disk 2 (4370 to 4372), and disk 3 (4373).

Science Data (3 disks): Data from Atlantis are in directories on disk 1 (athena90, calliope, centerbeam, cruise participants, ctd, docs, scripts, seabeam) and disk 2 (adcp). These files include Atlantis underway data (date, time, depth, heading, speed, GPS, meteorology, SST/SSS, fluorometer), as well as cruise-participant photographs; SBE 911 (main CTD) raw data; documentation and scripts. Data from the LADDER-3 science party are in subdirectories of the 'science' directory on disk 1 (Alvin Dives, LADDER-3 metadata, Larval Group, Plan of Day, Shared Pictures), disk 2 (Physical Oceanography: Microstructure) and disk 3 (Physical Oceanography: 3D topography, CTD, Current Meters)

Dive Video (46 disks): Video images from 2 VCR recorders in Alvin, typically from the Port Pan&Tilt, Stbd Pan&Tilt or 3-chip cameras). Each dive has 6 disks, 3 from each recorder. Mullineaux group is missing 2 disks: 4372, 1 and 2 of 3 from VCR #1.

`Best of' Video': A disk of dive and cruise highlights compiled by Nika with help from Angel.

6.4 Mooring Standoff Protocol, TrapL3

[Lauren Mullineaux and the LADDER-3 Science Party]

On the LADDER-3 cruise, the Trap_L3 mooring was deployed at water depth 2506 m. The mooring has a sediment trap 5 m above bottom and a current meter at 11 mab. The trap will be sampling between 6 Dec. 2007 and 11 Oct. 2008. It is at:

9°50.02′ N, 104° 17.44′ W

X 4686, Y 77451

We would like to prevent the mooring from being snagged by towed instruments and minimize the possibility of resuspension of particulates by nearby submersible operations. We would like to do so without unduly restricting the work of other groups, and so intentionally placed the mooring away from active and frequently-visited vent sites. The mooring is ballasted very lightly, and a towed wire could easily move or damage it, without the operator even noticing. We request that researchers use the following stand-off guidelines:

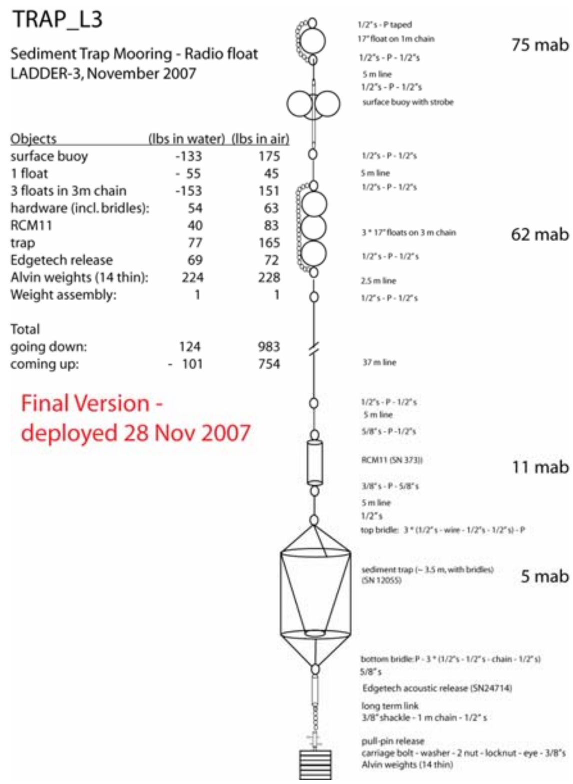


Figure 6.1. Diagram of TrapL3 mooring near Sketchy vent, for recovery in Fall 2008

1. For un-navigated instruments (i.e. no transponders on the lowered bodies) towed or lowered vertically to depths below 2400m (including CTDs): 500m horizontal standoff distance between the ship and the moorings. (500m is the maximum displacement distance for instruments lowered on the wire that we observed during our cruise while the ship was on DP.) No restrictions on instruments towed at or lowered to 2400 m or shallower.

2. For acoustically navigated instruments towed or lowered vertically to depths below 2400m:
   (a) Keep the ship and the towed body on the same side of the moorings at all times when the ship is less than 500m horizontally from any of the moorings. (I.e. Do not cross the mooring location with the towing wire, regardless how high in the water you think the towing line is.)
   (b) Keep at least 75m horizontal standoff distance between the towed platform and the mooring.

Please note that while the position of the towed body is known, the position of the towing wire is not, which is why we ask for a buffer zone, even with a navigated instrument.

3. For Alvin: Keep at least 30m standoff distance to the moorings. (for reference, Ty/Io is at X 4651 Y 77647, Sketchy at X 4683   Y 77523, and the former position of Trap L1 is X 4697 Y 77469)

6.5 CTD casts

B01: Station log: CTD

Cruise ID: AT15-26
Log sheet Completed By Benjamin Walther
Log sheet Completion date: 11/16/2007

CTD Station #	Instruments & samples	Date	Time (UTC)	Lat degrees	Lat dec min	Lon degrees	Lon dec min	Max. CTD Depth (m)
1	CTD, denitrifi	11/15/2007	21:14:16	9	9	-104	12.5	2575
2	CTD	11/16/2007	4:22:47	9	50	-104	17.5	2493
3	CTD	11/16/2007	9:43:10	9	45	-104	16.6	2526
4	CTD	11/16/2007	12:58:07	9	50	-104	17.6	2485
5	CTD	11/17/2007	3:08:00	9	31.5	-104	4.8	3010
6	CTD, denitrifi	11/17/2007	6:51:11	9	32.5	-103	58.1	2992
7	CTD	11/18/2007	1:19:58	9	35	-104	15.3	2534
8	CTD	11/18/2007	4:06:34	9	40	-104	15.9	2513
9	CTD, denitrifi	11/18/2007	8:03:56	9	53.1	-104	20.7	2829
10	CTD	11/18/2007	11:00:49	9	50.1	-104	17.5	2493
11	CTD	11/19/2007	2:33:29	10	1.5	-104	38.2	2624
12	CTD	11/19/2007	5:45:43	9	58.9	-104	36.2	1706
13	CTD	11/19/2007	8:27:36	9	55.9	-104	31.1	2477
14	CTD	11/19/2007	11:21:32	9	54.8	-104	28.6	1673
15	CTD, denitrifi	11/19/2007	14:14:37	9	53	-104	20.5	2821
16	CTD	11/20/2007	1:22:05	9	26.9	-104	32.5	2903
17	CTD	11/20/2007	4:20:49	9	27.7	-104	28	3010
18	CTD	11/20/2007	7:08:04	9	28.5	-104	24	3034
19	CTD, denitrifi	11/20/2007	10:32:08	9	29.8	-104	20.1	2763
20	CTD	11/20/2007	21:15:32	9	40.4	-104	16.1	2526
21	CTD, denitrifi	11/21/2007	8:39:11	9	54.5	-104	26.7	2501
22	CTD	11/22/2007	2:17:04	10	1.5	-104	38	2592
23	CTD	11/22/2007	4:48:53	9	58.9	-104	36.1	1706
24	CTD, denitrifi	11/22/2007	7:30:58	9	55.8	-104	31.1	2444
25	CTD	11/22/2007	10:14:18	9	54.4	-104	26.7	2198
26	CTD	11/23/2007	9:22:29	9	54.6	-104	26.7	2436
27	CTD, denitrifi	11/23/2007	12:36:46	10	2.2	-104	32.2	3090
28	CTD	11/24/2007	4:53:50	10	1.7	-104	36.2	2658
29	CTD, denitrifi	11/24/2007	7:43:32	10	0.7	-104	37.3	2634
30	CTD	11/24/2007	10:48:33	10	4	-104	41.2	1887
31	CTD	11/24/2007	13:58:19	9	59.3	-104	48.3	2444
32	CTD	11/24/2007	16:53:43	9	58	-104	41	2997
33	CTD	11/25/2007	10:47:40	9	30	-104	14.8	2552
34	CTD	11/26/2007	0:56:04	9	29.9	-104	14.5	2551
35	CTD	11/26/2007	3:59:57	9	28.5	-104	23.9	3003
36	CTD	11/26/2007	7:23:41	9	27	-104	32.6	2897
37	CTD, denitrifi	11/27/2007	8:58:23	9	49.9	-104	31.2	2732
38	CTD	11/28/2007	3:06:47	9	46.5	-104	51.2	2683
39	CTD	11/28/2007	6:22:56	9	48.6	-104	59.7	2420
40	CTD	11/28/2007	9:40:42	9	54	-104	55	3077
41	CTD	11/28/2007	19:15:41	9	50	-104	17.5	2487
42	CTD	11/29/2007	3:41:47	9	38.6	-104	38.6	2412
43	CTD, denitrifi	11/29/2007	7:12:37	9	43.1	-104	45.1	2986
44	CTD, denitrifi	11/29/2007	11:12:25	9	48.5	-104	55.7	2149
45	CTD	11/30/2007	0:37:40	9	33.4	-103	52.4	2961
46	CTD	11/30/2007	4:59:45	9	30.8	-104	10.2	2804
47	CTD	11/30/2007	9:01:48	9	44.9	-104	16.7	2528
48	CTD	12/1/2007	0:53:55	9	54	-104	24.7	1961
49	CTD, denitrifi	12/1/2007	3:59:49	9	56.5	-104	32.7	1969
50	CTD, denitrifi	12/1/2007	7:08:44	9	50	-104	24.5	2905
51	CTD	12/1/2007	10:19:19	9	58	-104	24.3	2863
52	CTD	12/1/2007	13:09:06	9	55.1	-104	18.1	2544
53	CTD	12/1/2007	15:16:12	10	0.1	-104	19.5	2552

6.6 Instrument Deployments and Recoveries

B06: Log: INSTRUMENTS   *grid origin: 9N08/104W20*

Cruise ID: AT15-26
ompleted By: Benjamin Walther
mpletion date: 11/15/2007

Instrument Type	Instrument ID #	Action	Moorin	Date	Time *UTC*	Location method	Lat *deg*	Lat *min*	Lon *deg*	Lon *min*	Grid X *(m)*	Grid Y *(m)*	Deplth (m)	Location description
							Position of instrument							
Plankton Pump	S/N 2114	Depl	L15	2007-11-16	19:31	trans	9	50.410	-104	17.506	4569.5	78173.2	bottom 2505	On axis (Tica), 9N50
Plankton Pump	S/N 9660	Depl	L15	2007-11-16	19:31	trans	9	50.410	-104	17.506	4569.5	78173.2	bottom 2505	On axis (Tica), 9N50
Plankton Pump	S/N 2114	Recv	L15	2007-11-19	18:37	trans	9	50.410	-104	17.506	4569.5	78173.2	bottom 2505	On axis (Tica), 9N50
Plankton Pump	S/N 9660	Recv	L15	2007-11-19	18:40	trans	9	50.410	-104	17.506	4569.5	78173.2	bottom 2505	On axis (Tica), 9N50
Plankton Pump	S/N 9664	Depl	L16	2007-11-16	22:57	trans	9	50.418	-104	16.955	5578.8	78187.2	bottom 2530	Off-axis, East 9N50
Plankton Pump	S/N 2116	Depl	L16	2007-11-16	22:57	trans	9	50.418	-104	16.955	5578.8	78187.2	bottom 2530	Off-axis, East 9N50
Plankton Pump	S/N 9664	Recv	L16	2007-11-18	18:01	trans	9	50.418	-104	16.955	5578.8	78187.2	bottom 2530	Off-axis, East 9N50
Plankton Pump	S/N 2116	Recv	L16	2007-11-18	17:50	trans	9	50.418	-104	16.955	5578.8	78187.2	bottom 2530	Off-axis, East 9N50
Plankton Pump	S/N 2114	Depl	L17	2007-11-20	2:53	trans	9	50.420	-104	17.516	4550.3	78191.0	bottom 2505	On axis (Tica), 9N50
Plankton Pump	S/N 9660	Depl	L17	2007-11-20	2:53	trans	9	50.420	-104	17.516	4550.3	78191.0	bottom 2505	On axis (Tica), 9N50
Plankton Pump	S/N 2114	Recv	L17	2007-11-22	10:38	trans	9	50.420	-104	17.516	4550.3	78191.0	bottom 2505	On axis (Tica), 9N50
Plankton Pump	S/N 9660	Recv	L17	2007-11-22	10:38	trans	9	50.420	-104	17.516	4550.3	78191.0	bottom 2505	On axis (Tica), 9N50
Plankton Pump	S/N 2116	Depl	L18	2007-11-20	23:57	trans	9	50.404	-104	16.971	5549.8	78162.0	bottom 2530	Off-axis, East 9N50
Plankton Pump	S/N 2115	Depl	L18	2007-11-20	23:57	trans	9	50.404	-104	16.971	5549.8	78162.0	bottom 2530	Off-axis, East 9N50
Plankton Pump	S/N 2116	Recv	L18	2007-11-22	13:08	trans	9	50.404	-104	16.971	5549.8	78162.0	bottom 2530	Off-axis, East 9N50
Plankton Pump	S/N 2115	Recv	L18	2007-11-22	13:08	trans	9	50.404	-104	16.971	5549.8	78162.0	bottom 2530	Off-axis, East 9N50
Plankton Pump	S/N 2114	Depl	L19	2007-11-22	6:03	trans	9	50.423	-104	17.507	4566.7	78197.0	bottom 2505	On axis (Tica), 9N50
Plankton Pump	S/N 9660	Depl	L19	2007-11-22	6:03	trans	9	50.423	-104	17.507	4566.7	78197.0	bottom 2505	On axis (Tica), 9N50
Plankton Pump	S/N 2114	Recv	L19	2007-11-26	17:06	trans	9	50.423	-104	17.507	4566.7	78197.0	bottom 2505	On axis (Tica), 9N50
Plankton Pump	S/N 9660	Recv	L19	2007-11-26	17:06	trans	9	50.423	-104	17.507	4566.7	78197.0	bottom 2505	On axis (Tica), 9N50
Plankton Pump	S/N 2116	Depl	L20	2007-11-22	2:00	trans	9	50.411	-104	16.969	5552.8	78174.1	bottom 2530	Off-axis, East 9N50
Plankton Pump	S/N 2115	Depl	L20	2007-11-22	2:00	trans	9	50.411	-104	16.969	5552.8	78174.1	bottom 2530	Off-axis, East 9N50
Plankton Pump	S/N 2116	Recv	L20	2007-11-26	18:22	trans	9	50.411	-104	16.969	5552.8	78174.1	bottom 2530	Off-axis, East 9N50
Plankton Pump	S/N 2115	Recv	L20	2007-11-26	18:22	trans	9	50.411	-104	16.969	5552.8	78174.1	bottom 2530	Off-axis, East 9N50
SUPR Pump	n/a	Depl	L19	2007-11-22	6:03	trans	9	50.423	-104	17.507	4566.7	78197.0	bottom 2505	On axis (Tica), 9N50
SUPR Pump	n/a	Recv	L19	2007-11-26	17:06	trans	9	50.423	-104	17.507	4566.7	78197.0	bottom 2505	On axis (Tica), 9N50
Plankton Pump	S/N 2114	Depl	L21	2007-11-26	2:35	trans	9	50.409	-104	17.503	4575.0	78170.0	bottom 2530	On axis (Tica), 9N50
Plankton Pump	S/N 9660	Depl	L21	2007-11-26	2:35	trans	9	50.409	-104	17.503	4575.0	78170.0	bottom 2530	On axis (Tica), 9N50
Plankton Pump	S/N 2114	Recv	L21	2007-11-30	19:10	trans	9	50.409	-104	17.503	4575.0	78170.0	bottom 2530	On axis (Tica), 9N50
Plankton Pump	S/N 9660	Recv	L21	2007-11-30	19:10	trans	9	50.409	-104	17.503	4575.0	78170.0	bottom 2530	On axis (Tica), 9N50
Plankton Pump	S/N 2116	Depl	L22	2007-11-26	20:09	trans	9	50.390	-104	16.950	5588.0	78135.0	2500 (5 mab)	Off-axis, East 9N50
Plankton Pump	S/N 2115	Depl	L22	2007-11-26	20:09	trans	9	50.390	-104	16.950	5588.0	78135.0	2500 (5 mab)	Off-axis, East 9N50
Plankton Pump	S/N 2116	Recv	L22	2007-11-30	17:20	trans	9	50.390	-104	16.950	5588.0	78135.0	2500 (5 mab)	Off-axis, East 9N50
Plankton Pump	S/N 2115	Recv	L22	2007-11-30	17:20	trans	9	50.390	-104	16.950	5588.0	78135.0	2500 (5 mab)	Off-axis, East 9N50
Sediment Trap L1	S/N ML11649	Recv	TrapL1	2007-11-17	17:11	Alvin	9	50.028	-104	17.436	4697.0	77469.0	2500 (5 mab)	Axial trough 9N50
Aanderaa RCM-11	S/N 367	Recv	TrapL1	2007-11-17	5:55	Alvin	9	50.028	-104	17.436	4697.0	77469.0	2500 (11 mab)	Axial trough 9N50
Sediment Trap L3	S/N 12055	Depl	TrapL3	2007-11-28	23:35	trans	9	50.018	-104	17.442	4685.7	77450.2	unknown	near Ty/Io
Aanderra RCM-11	S/N 373	Depl	TrapL3	2007-11-28	23:35	trans	9	50.018	-104	17.442	4685.7	77450.2	unknown	near Ty/Io
Aanderra RCM-11	S/N 155	Recv	CA	2007-11-25	19:40	trans	9	29.880	-104	14.489	10096.0	40330.0	2450	Axial Trough of 9N30
Aanderra RCM-11	S/N 339	Recv	CA	2007-11-25	19:56	trans	9	29.880	-104	14.489	10096.0	40330.0	2555	Axial Trough of 9N30
Aanderra RCM-11	S/N 371	Recv	CA	2007-11-25	20:00	trans	9	29.880	-104	14.489	10096.0	40330.0	2573	Axial Trough of 9N30
Sediment Trap CA	S/N ML12055	Recv	CA	2007-11-25	19:44	trans	9	29.880	-104	14.489	10096.0	40330.0	2475	Axial Trough of 9N30
Aanderra RCM-11	S/N 343	Recv	WF	2007-11-19	23:48		9	26.620	-104	32.300			2450	West flank of 9N30
Aanderra RCM-11	S/N 158	Recv	WF	2007-11-19	23:39		9	26.620	-104	32.300			2550	West flank of 9N30
Aanderra RCM-11	S/N 369	Recv	WF	2007-11-19	23:04		9	26.620	-104	32.300			2900	West flank of 9N30
Aanderra RCM-11	S/N 157	Recv	SA	2007-11-15	19:19		9	9.000	-104	12.501			2450	Axial Trough of 9N10
Aanderra RCM-11	S/N 163	Recv	SA	2007-11-15	19:15		9	9.000	-104	12.501			2570	Axial Trough of 9N10
Aanderra RCM-11	S/N 368	Recv	SA	2007-11-15	19:01		9	9.000	-104	12.501			2588	Axial Trough of 9N10
Profiler Mooring	S/N 119	Recv	W3	2007-11-20	16:25		9	28.363	-104	28.313			2259 to 3059	West flank of 9N30
Profiler Mooring	S/N 102	Recv	W1	2007-11-20	19:41		9	30.024	-104	19.816			2304 to 2804	West flank of 9N30
Aanderaa RCM-11	S/N 161	Recv	NA	2007-11-27	18:30	Alvin	9	49.982	-104	17.437	4695.0	77384.0	2450	Axial Trough of 9N50
Sediment Trap NA	S/N ML12055	Recv	NA	2007-11-27	18:35	Alvin	9	49.982	-104	17.437	4695.0	77384.0	2475	Axial Trough of 9N50
Aanderaa RCM-11	S/N 154	Recv	NA	2007-11-27	18:40	Alvin	9	49.982	-104	17.437	4695.0	77384.0	2500	Axial Trough of 9N50
Aanderaa RCM-11	S/N 366	Recv	NA	2007-11-27	18:45	Alvin	9	49.982	-104	17.437	4695.0	77384.0	2518	Axial Trough of 9N50
Sediment Trap EF	S/N ML12055	Recv	EF	2007-11-29	21:55		9	33.090	-103	52.270			2000	East flank of 9N30
Aanderaa RCM-11	S/N 370	Recv	EF	2007-11-29	22:39		9	33.090	-103	52.270			2450	East flank of 9N30
Aanderaa RCM-11	S/N 150	Recv	EF	2007-11-29	22:50		9	33.090	-103	52.270			2550	East flank of 9N30
Aanderaa RCM-11	S/N 152	Recv	EF	2007-11-29	23:25		9	33.090	-103	52.270			2900	East flank of 9N30
Sediment Trap L2	S/N ML11649	Recvo	TrapL2	2007-11-25	15:28	trans	9	29.839	-104	14.488	10097.0	40254.0	2570 (7 mab)	Axial trough, K-vent
Aanderaa RCM-11	S/N 373	Recvo	TrapL2	2007-11-25	15:28	trans	9	29.839	-104	14.488	10097.0	40254.0	2570 (11 mab)	Axial trough, K-vent

6.7 Biological Samples

B12: VEHICLE DIVE SAMPLES (from Alvin)

Cruise ID: AT15-26
Log sheet Completed By: Benjamin Walther net origin: 9N08/104W20
Log sheet Completion date: 11/18/2007

					Location, *if applicable*			Collection/Deployment of sample									Collect	
**Sample Description	Action	Dive #	Device *if applicable*	Date	Marker #	Vent name	Position on vent	Grid X (m)	Grid Y (m)	Lat *deg*	Lat *min*	Lon *deg*	Lon *min*	Depth *m*	Heading deg	Type	method	Temp. max (degC)
Basalt w/ Tevnia, limpe	Collection	4366	n/a	17-Nov-2007	L-O	P vent	tubeworm	4631	77922	9	50.274	-104	17.472	2508	78	rock&bi	grab	10.0
Basalt, bare	Collection	4366	n/a	17-Nov-2007	L-O	P vent	Bare basalt	4627	77917	9	50.271	-104	17.474	2507	73	rock	grab	10.3
Limpet slurp	Collection	4366	n/a	17-Nov-2007	L-O	P vent	4-10C	4625	77921	9	50.273	-104	17.475	2505	8	fluid&bi	pump	
Niskin	Collection	4366	n/a	17-Nov-2007	n/a	P vent	water colum	4589	77743	9	50.177	-104	17.495	2500	220	fluid	Niskin	
Pelagic pump, sponges	Collection	4366	n/a	17-Nov-2007	L-O	P vent	Tevnia basal	4630	77915	9	50.270	-104	17.473	2508	76	fluid	pump	
Pelagic pump, sponges	Collection	4366	n/a	17-Nov-2007	L-O	P vent	Bare basalt	4629	77912	9	50.269	-104	17.473	2508	58	fluid	pump	2.0
Sponge	Deployment	4366	n/a	17-Nov-2007	L-O	P vent	2-4C	4628	77921	9	50.274	-104	17.475	2509	45	biology	colonize	2.0
TASC	Deployment	4366	n/a	17-Nov-2007	L-O	P vent	tubeworm	4626	77925	9	50.276	-104	17.475	2508	47	biology	colonize	15.2
TASC	Deployment	4366	n/a	17-Nov-2007	L-O	P vent	tubeworm	4626	77925	9	50.276	-104	17.475	2508	47	biology	colonize	17.1
TASC	Deployment	4366	n/a	17-Nov-2007	L-O	P vent	tubeworm	4626	77925	9	50.276	-104	17.475	2508	47	biology	colonize	17.9
HOBO	Recovery	4366	L15	17-Nov-2007	L-O	P vent	2-4C	4631	77915	9	50.270	-104	17.472	2508	57	logger	grab	2.0
HOBO	Recovery	4366	L10	17-Nov-2007	L-O	P vent	4-10C	4626	77923	9	50.275	-104	17.475	2508	25	logger	grab	
HOBO	Recovery	4366	L11	17-Nov-2007	L-O	P vent	tubeworm	4626	77921	9	50.275	-104	17.475	2509	49	logger	grab	20.7
Sandwich	Recovery	4366	n/a	17-Nov-2007	L-O	P vent	2-4C	4628	77921	9	50.274	-104	17.475	2509	45	biology	colonize	2.1
Sandwich	Recovery	4366	n/a	17-Nov-2007	L-O	P vent	2-4C	4628	77921	9	50.274	-104	17.475	2509	45	biology	colonize	2.0
Sandwich	Recovery	4366	n/a	17-Nov-2007	L-O	P vent	2-4C	4628	77921	9	50.274	-104	17.475	2509	45	biology	colonize	2.0
Sandwich	Recovery	4366	n/a	17-Nov-2007	L-O	P vent	tubeworm	4626	77925	9	50.276	-104	17.475	2508	47	biology	colonize	16.0
Sandwich	Recovery	4366	n/a	17-Nov-2007	L-O	P vent	tubeworm	4626	77925	9	50.276	-104	17.475	2508	47	biology	colonize	10.0
Sandwich	Recovery	4366	n/a	17-Nov-2007	L-O	P vent	tubeworm	4626	77925	9	50.276	-104	17.475	2508	47	biology	colonize	14.7
Sandwich	Recovery	4366	n/a	17-Nov-2007	L-O	P vent	tubeworm	4626	77925	9	50.276	-104	17.475	2508	47	biology	colonize	11.0
Sandwich	Recovery	4366	n/a	17-Nov-2007	L-O	P vent	tubeworm	4626	77925	9	50.276	-104	17.475	2508	47	biology	colonize	17.9
Sponge	Recovery	4366	n/a	17-Nov-2007	L-O	P vent	2-4C	4628	77921	9	50.274	-104	17.475	2509	45	biology	colonize	2.0
TASC	Recovery	4366	n/a	17-Nov-2007	L-O	P vent	tubeworm	4626	77925	9	50.276	-104	17.475	2508	47	biology	colonize	13.0
TASC	Recovery	4366	n/a	17-Nov-2007	L-O	P vent	tubeworm	4626	77925	9	50.276	-104	17.475	2508	47	biology	colonize	11.3
TASC	Recovery	4366	n/a	17-Nov-2007	L-O	P vent	tubeworm	4626	77925	9	50.276	-104	17.475	2508	47	biology	colonize	11.3
Pelagic pump	Collection	4367	n/a	18-Nov-2007	n/a	Bio9	periphery	4615	77978	9	50.305	-104	17.481	2508	36	fluid	pump	2.8
HOBO	Deployment	4367	L10	18-Nov-2007	L-O	P vent	2-4C	4632	77916	9	50.271	-104	17.472	2508	23	logger	grab	2.3
HOBO	Deployment	4367	L10	18-Nov-2007	L-O	P vent	4-10C	4630	77917	9	50.271	-104	17.473	2509	43	logger	grab	16.0
HOBO	Deployment	4367	L15	18-Nov-2007	L-O	P vent	tubeworm	4628	77921	9	50.274	-104	17.474	2507	116	logger	grab	18.3
Sandwich	Deployment	4367	n/a	18-Nov-2007	L-O	P vent	2-4C	4632	77916	9	50.271	-104	17.472	2508	23	biology	colonize	2.1
Sandwich	Deployment	4367	n/a	18-Nov-2007	L-O	P vent	2-4C	4632	77916	9	50.271	-104	17.472	2508	23	biology	colonize	2.3
Sandwich	Deployment	4367	n/a	18-Nov-2007	L-O	P vent	2-4C	4632	77916	9	50.271	-104	17.472	2508	23	biology	colonize	2.2
Sandwich	Deployment	4367	n/a	18-Nov-2007	L-O	P vent	2-4C	4632	77916	9	50.271	-104	17.472	2508	23	biology	colonize	2.5
Sandwich	Deployment	4367	n/a	18-Nov-2007	L-O	P vent	2-4C	4632	77916	9	50.271	-104	17.472	2508	23	biology	colonize	2.1
Sandwich	Deployment	4367	n/a	18-Nov-2007	L-O	P vent	4-10C	4630	77917	9	50.271	-104	17.473	2509	43	biology	colonize	13.3
Sandwich	Deployment	4367	n/a	18-Nov-2007	L-O	P vent	4-10C	4630	77917	9	50.271	-104	17.473	2509	43	biology	colonize	5.1
Sandwich	Deployment	4367	n/a	18-Nov-2007	L-O	P vent	4-10C	4630	77917	9	50.271	-104	17.473	2509	43	biology	colonize	9.9
Sandwich	Deployment	4367	n/a	18-Nov-2007	L-O	P vent	4-10C	4630	77917	9	50.271	-104	17.473	2509	43	biology	colonize	8.1
Sandwich	Deployment	4367	n/a	18-Nov-2007	L-O	P vent	4-10C	4630	77917	9	50.271	-104	17.473	2509	43	biology	colonize	12.0
Sandwich	Deployment	4367	n/a	18-Nov-2007	L-O	P vent	tubeworm	4628	77921	9	50.274	-104	17.474	2507	116	biology	colonize	10.6
Sandwich	Deployment	4367	n/a	18-Nov-2007	L-O	P vent	tubeworm	4628	77921	9	50.274	-104	17.474	2507	116	biology	colonize	20.5
Sandwich	Deployment	4367	n/a	18-Nov-2007	L-O	P vent	tubeworm	4628	77921	9	50.274	-104	17.474	2507	116	biology	colonize	21.6
Sandwich	Deployment	4367	n/a	18-Nov-2007	L-O	P vent	tubeworm	4628	77921	9	50.274	-104	17.474	2507	116	biology	colonize	15.4
Sandwich	Deployment	4367	n/a	18-Nov-2007	L-O	P vent	tubeworm	4628	77921	9	50.274	-104	17.474	2507	116	biology	colonize	19.0

B12: VEHICLE DIVE SAMPLES (from Alvin)

Cruise ID: AT15-26
Log sheet Completed By: Benjamin Walther — net origin: 9N08/104W20
Log sheet Completion date: 11/18/2007

**Sample Description	Action	Dive #	Device *if applicable*	Date	Marker #	Vent name	Position on vent	Grid X (m)	Grid Y (m)	Lat *deg*	Lat *min*	Lon *deg*	Lon *min*	Depth *m*	Heading *deg*	Type	Collect method	Temp. max (degC)
					Location, *if applicable*					Collection/Deployment of sample								
Sandwich	Recovery	4367	n/a	18-Nov-2007	L-O	P vent	4-10C	4626	77923	9	50.275	-104	17.475	2508	24	biology	colonize	2.3
Sandwich	Recovery	4367	n/a	18-Nov-2007	L-O	P vent	4-10C	4626	77923	9	50.275	-104	17.475	2508	25	biology	colonize	5.8
Sandwich	Recovery	4367	n/a	18-Nov-2007	L-O	P vent	4-10C	4626	77923	9	50.275	-104	17.475	2508	54	biology	colonize	2.9
Sponge	Recovery	4367	n/a	18-Nov-2007	?	Bio9	Periphery	4616	77976	9	50.304	-104	17.480	2512	36	biology	colonize	2.8
Basalt	Collection	4368	n/a	21-Nov-2007	L-W	V vent	Tevnia	5543	72378	9	47.266	-104	16.974	2510	269	rock&bi	grab	
Basalt	Collection	4368	n/a	21-Nov-2007	L-W	V vent	Periphery	5559	72438	9	47.299	-104	16.965	2510	269	rock&bi	grab	
Limpet slurp	Collection	4368	n/a	21-Nov-2007	L-W	V vent	Tevnia	5543	72378	9	47.266	-104	16.974	2510	269	biology	slurp	
Mussels	Collection	4368	n/a	21-Nov-2007	L-W	V vent	mussel	5541	72378	9	47.266	-104	16.975	2510	266	biology	grab	
Riftia&Tevnia tubes w/	Collection	4368	n/a	21-Nov-2007	L-W	V vent	Tevnia	5543	72378	9	47.266	-104	16.974	2510	269	biology	grab	
Slurp (copepods)	Collection	4368	n/a	21-Nov-2007	L-W	V vent	Tevnia	5550	7239	9	47.267	-104	16.970	2510	269	fluid	slurp	
HOBO	Recovery	4368	L02	21-Nov-2007	L-W	V vent	mussel	5541	72378	9	47.266	-104	16.975	2510	266	logger	grab	4.9
HOBO	Recovery	4368	L07	21-Nov-2007	L-W	V vent	suspension	5553	72385	9	47.270	-104	16.969	2507	269	logger	grab	2.1
HOBO	Recovery	4368	L06	21-Nov-2007	L-W	V vent	Tevnia	5543	72378	9	47.266	-104	16.974	2510	269	logger	grab	11.1
Sandwich	Recovery	4368	n/a	21-Nov-2007	L-W	V vent	mussel	5541	72378	9	47.266	-104	16.975	2510	266	biology	colonize	2.24 - 5.25
Sandwich	Recovery	4368	n/a	21-Nov-2007	L-W	V vent	mussel	5541	72378	9	47.266	-104	16.975	2510	266	biology	colonize	2.95 - 6.51
Sandwich	Recovery	4368	n/a	21-Nov-2007	L-W	V vent	mussel	5541	72378	9	47.266	-104	16.975	2510	266	biology	colonize	5.5 - 6.1
Sandwich	Recovery	4368	n/a	21-Nov-2007	L-W	V vent	mussel	5541	72378	9	47.266	-104	16.975	2510	266	biology	colonize	4.89 - 4.9
Sandwich	Recovery	4368	n/a	21-Nov-2007	L-W	V vent	suspension	5553	72385	9	47.270	-104	16.969	2507	269	biology	colonize	2.14 - 2.15
Sandwich	Recovery	4368	n/a	21-Nov-2007	L-W	V vent	suspension	5553	72385	9	47.270	-104	16.969	2507	269	biology	colonize	2.17 - 2.32
Sandwich	Recovery	4368	n/a	21-Nov-2007	L-W	V vent	suspension	5553	72385	9	47.270	-104	16.969	2507	269	biology	colonize	2.047 - 2.14
Sandwich	Recovery	4368	n/a	21-Nov-2007	L-W	V vent	suspension	5553	72385	9	47.270	-104	16.969	2507	269	biology	colonize	2.25 - 2.3
Sandwich	Recovery	4368	n/a	21-Nov-2007	L-W	V vent	suspension	5553	72385	9	47.270	-104	16.969	2507	269	biology	colonize	2.0 - 2.05
Sandwich	Recovery	4368	n/a	21-Nov-2007	L-W	V vent	Tevnia	5543	72378	9	47.266	-104	16.974	2510	269	biology	colonize	6.3 - 28.1
Sandwich	Recovery	4368	n/a	21-Nov-2007	L-W	V vent	Tevnia	5543	72378	9	47.266	-104	16.974	2510	269	biology	colonize	18.6 - 28.1
Sandwich	Recovery	4368	n/a	21-Nov-2007	L-W	V vent	Tevnia	5543	72378	9	47.266	-104	16.974	2510	269	biology	colonize	7.42 - 16.8
Sandwich	Recovery	4368	n/a	21-Nov-2007	L-W	V vent	Tevnia	5543	72378	9	47.266	-104	16.974	2510	269	biology	colonize	6.7 - 9.3
Sandwich	Recovery	4368	n/a	21-Nov-2007	L-W	V vent	Tevnia	5543	72378	9	47.266	-104	16.974	2510	269	biology	colonize	6.5 - 8.8
Basalt	Collection	4369	n/a	22-Nov-2007	L-R	Tica	2-4C	4585	78169	9	50.408	-104	17.497	2513	48	rock	grab	5.08 - 7.96
Basalt	Collection	4369	n/a	22-Nov-2007	L-R	Tica	2-4C	4585	78169	9	50.408	-104	17.497	2513	48	rock	grab	5.39 - 8.32
Basalt	Collection	4369	n/a	22-Nov-2007	L-R	Tica	2-4C	4585	78169	9	50.408	-104	17.497	2513	48	rock	grab	5.08 - >6
Basalt	Collection	4369	n/a	22-Nov-2007	L-R	Tica	4-10C	4589	78164	9	50.405	-104	17.495	2511	44	rock	grab	2.47 - 2.54
Basalt	Collection	4369	n/a	22-Nov-2007	L-R	Tica	4-10C	4589	78164	9	50.405	-104	17.495	2511	44	rock	grab	2.46 - 2.61
Basalt	Collection	4369	n/a	22-Nov-2007	L-R	Tica	4-10C	4589	78164	9	50.405	-104	17.495	2511	44	rock	grab	4.5
Pelagic pump, sponges	Collection	4369	n/a	22-Nov-2007	L-R	Tica	Bare basalt	4576	78170	9	50.409	-104	17.502	2512	47	fluid	pump	2.0
Pelagic pump, sponges	Collection	4369	n/a	22-Nov-2007	L-R	Tica	Tevnia basal	4572	78158	9	50.402	-104	17.504	2512	47	fluid	pump	5.3
Block	Deployment	4369	n/a	22-Nov-2007	L-R	Tica	2-4C	4584	78161	9	50.404	-104	17.498	2511	59	biology	colonize	4.5
Block	Deployment	4369	n/a	22-Nov-2007	L-R	Tica	2-4C	4584	78161	9	50.404	-104	17.498	2511	59	biology	colonize	2.6
Block	Deployment	4369	n/a	22-Nov-2007	L-R	Tica	2-4C	4584	78161	9	50.404	-104	17.498	2511	59	biology	colonize	2.5
Block	Deployment	4369	n/a	22-Nov-2007	L-R	Tica	4-10C	4568	78167	9	50.407	-104	17.507	2512	25	biology	colonize	5.1
Block	Deployment	4369	n/a	22-Nov-2007	L-R	Tica	4-10C	4568	78167	9	50.407	-104	17.507	2512	25	biology	colonize	8.0
Block	Deployment	4369	n/a	22-Nov-2007	L-R	Tica	4-10C	4568	78167	9	50.407	-104	17.507	2512	25	biology	colonize	5.4
Limpet condo	Deployment	4369	LC3	22-Nov-2007	L-R	Tica	Tevnia	4591	78165	9	50.406	-104	17.494	2505	273	biology	enclosur	10.1
Limpet condo	Deployment	4369	LC2	22-Nov-2007	L-R	Tica	Tevnia	4591	78165	9	50.406	-104	17.494	2505	273	biology	enclosur	10.8
Limpet condo	Deployment	4369	LC4	22-Nov-2007	L-R	Tica	Tevnia	4591	78165	9	50.406	-104	17.494	2505	273	biology	enclosur	6.0
Limpet condo	Deployment	4369	LC6	22-Nov-2007	L-R	Tica	Periphery	4592	78165	9	50.406	-104	17.493	2505	241	biology	enclosur	3.3
Limpet condo	Deployment	4369	LC5	22-Nov-2007	L-R	Tica	Periphery	4592	78165	9	50.406	-104	17.493	2505	241	biology	enclosur	3.3
Sponge	Deployment	4369	n/a	22-Nov-2007	L-R	Tica	tubeworm	4573	78159	9	50.402	-104	17.504	2510	94	biology	colonize	2.85-4.23
Sponge	Deployment	4369	n/a	22-Nov-2007	L-R	Tica	Periphery	4569	78167	9	50.407	-104	17.506	2512	26	biology	colonize	2.23-5.14
HOBO	Recovery	4369	L01	22-Nov-2007	L-R	Tica	2-4C	4585	78169	9	50.408	-104	17.497	2513	48	logger	grab	3.0
HOBO	Recovery	4369	L03	22-Nov-2007	L-R	Tica	4-10C	4589	78164	9	50.405	-104	17.495	2511	44	logger	grab	2.5

B12: VEHICLE DIVE SAMPLES (from Alvin)

Cruise ID: AT15-26

Log sheet Completed By: Benjamin Walther   net origin: 9N08/104W20

Log sheet Completion date: 11/18/2007

**Sample Description	Action	Dive #	Device *if applicable*	Date	Marker #	Vent name	Position on vent	Grid X (m)	Grid Y (m)	Lat *deg*	Lat *min*	Lon *deg*	Lon *min*	Depth *m*	Heading *deg*	Type	Collect method	Temp. max (degC)
					Location, *if applicable*					Collection/Deployment of sample								
Sandwich	Recovery	4369	n/a	22-Nov-2007	L-R	Tica	2-4C	4585	78169	9	50.408	-104	17.497	2513	48	biology	colonize	2.65 - 7.51
Sandwich	Recovery	4369	n/a	22-Nov-2007	L-R	Tica	2-4C	4585	78169	9	50.408	-104	17.497	2513	48	biology	colonize	7.67 - 7.91
Sandwich	Recovery	4369	n/a	22-Nov-2007	L-R	Tica	2-4C	4585	78169	9	50.408	-104	17.497	2513	48	biology	colonize	2.42 - 2.65
Sandwich	Recovery	4369	n/a	22-Nov-2007	L-R	Tica	2-4C	4585	78169	9	50.408	-104	17.497	2513	48	biology	colonize	4.33 - 7.67
Sandwich	Recovery	4369	n/a	22-Nov-2007	L-R	Tica	2-4C	4585	78169	9	50.408	-104	17.497	2513	48	biology	colonize	2.92 - 3.22
Sandwich	Recovery	4369	n/a	22-Nov-2007	L-R	Tica	4-10C	4589	78164	9	50.405	-104	17.495	2511	44	biology	colonize	2.16 - 2.44
Sandwich	Recovery	4369	n/a	22-Nov-2007	L-R	Tica	4-10C	4589	78164	9	50.405	-104	17.495	2511	44	biology	colonize	3.37 - 3.93
Sandwich	Recovery	4369	n/a	22-Nov-2007	L-R	Tica	4-10C	4589	78164	9	50.405	-104	17.495	2511	44	biology	colonize	2.2 - 2.32
Sandwich	Recovery	4369	n/a	22-Nov-2007	L-R	Tica	4-10C	4589	78164	9	50.405	-104	17.495	2511	44	biology	colonize	2.3
Sandwich	Recovery	4369	n/a	22-Nov-2007	L-R	Tica	4-10C	4589	78164	9	50.405	-104	17.495	2511	44	biology	colonize	2.39 - 2.54
Sponge	Recovery	4369	n/a	22-Nov-2007	L-R	Tica	tubeworm	4573	78159	9	50.402	-104	17.504	2510	94	biology	colonize	2.85-4.23
Sponge	Recovery	4369	n/a	22-Nov-2007	L-R	Tica	Periphery	4569	78167	9	50.407	-104	17.506	2512	26	biology	colonize	2.23-5.14
HOBO	Recovery	4370	n/a	25-Nov-2007	X-6	K vent	sulfide top	10098	40055	9	29.731	-104	14.488	2563	225	logger	grab	
HOBO	Recovery	4370	n/a	25-Nov-2007	X-6	K vent	mussel patcl	10118	39991	9	29.696	-104	14.477	2563	263	logger	grab	2.2
Sandwich	Recovery	4370	n/a	25-Nov-2007	X-6	K vent	suspension	10098	40055	9	29.731	-104	14.488	2563	225	biology	colonize	2.4
Sandwich	Recovery	4370	n/a	25-Nov-2007	X-6	K vent	suspension	10098	40055	9	29.731	-104	14.488	2563	225	biology	colonize	2.4
Sandwich	Recovery	4370	n/a	25-Nov-2007	X-6	K vent	suspension	10098	40055	9	29.731	-104	14.488	2563	225	biology	colonize	2.3-10.4
Sandwich	Recovery	4370	n/a	25-Nov-2007	X-6	K vent	suspension	10098	40055	9	29.731	-104	14.488	2563	225	biology	colonize	2.3-3.0
Sandwich	Recovery	4370	n/a	25-Nov-2007	X-6	K vent	suspension	10098	40055	9	29.731	-104	14.488	2563	225	biology	colonize	2.3-5.2
Sandwich	Recovery	4370	n/a	25-Nov-2007	X-6	K vent	sulfide top	10098	40055	9	29.731	-104	14.488	2563	225	biology	colonize	
Sandwich	Recovery	4370	n/a	25-Nov-2007	X-6	K vent	sulfide top	10098	40055	9	29.731	-104	14.488	2563	225	biology	colonize	
Sandwich	Recovery	4370	n/a	25-Nov-2007	X-6	K vent	sulfide top	10098	40055	9	29.731	-104	14.488	2563	225	biology	colonize	2.8-5.8
Sandwich	Recovery	4370	n/a	25-Nov-2007	X-6	K vent	mussel patcl	10118	39991	9	29.696	-104	14.477	2563	263	biology	colonize	2.2
Sandwich	Recovery	4370	n/a	25-Nov-2007	X-6	K vent	mussel patcl	10118	39991	9	29.696	-104	14.477	2563	263	biology	colonize	2.2
Sandwich	Recovery	4370	n/a	25-Nov-2007	X-6	K vent	mussel patcl	10118	39991	9	29.696	-104	14.477	2563	263	biology	colonize	2.2
Sandwich	Recovery	4370	n/a	25-Nov-2007	X-6	K vent	mussel patcl	10118	39991	9	29.696	-104	14.477	2563	263	biology	colonize	2.3
Sandwich	Recovery	4370	n/a	25-Nov-2007	X-6	K vent	mussel patcl	10118	39991	9	29.696	-104	14.477	2563	263	biology	colonize	
Basalt	Collection	4371	n/a	26-Nov-2007	L-R	Tica	tubeworm	4581	78161	9	50.404	-104	17.499	2512	57	biology	colonize	13.2
Basalt	Collection	4371	n/a	26-Nov-2007	CAV	Tica	?	4580	78159	9	50.403	-104	17.500	2509	136	rock	grab	
Basalt	Collection	4371	n/a	26-Nov-2007	2	Bio9	Periphery	4608	77976	9	50.303	-104	17.485	2509	25	rock	grab	
Niskin	Collection	4371	n/a	26-Nov-2007	n/a	Tica	water colum	4511	78206	9	50.428	-104	17.538	2431	114	fluid	Niskin	
Pelagic pump	Collection	4371	n/a	26-Nov-2007	CAV	Tica	periphery	4580	78159	9	50.403	-104	17.500	2509	136	fluid	pump	
Pelagic pump	Collection	4371	n/a	26-Nov-2007	L-R	Tica	tubeworm	4582	78161	9	50.403	-104	17.499	2512	52	fluid	pump	
Sponge	Deployment	4371	n/a	26-Nov-2007	CAV	Tica	?	4580	78159	9	50.403	-104	17.500	2509	136	biology	colonize	
TASC	Deployment	4371	n/a	26-Nov-2007	L-R	Tica	tubeworm	4581	78161	9	50.404	-104	17.499	2512	57	biology	colonize	12.4-13.2
TASC	Deployment	4371	n/a	26-Nov-2007	L-R	Tica	tubeworm	4581	78161	9	50.404	-104	17.499	2512	57	biology	colonize	13.5
TASC	Deployment	4371	n/a	26-Nov-2007	L-R	Tica	tubeworm	4581	78161	9	50.404	-104	17.499	2512	57	biology	colonize	16.1
TASC rope (3 sponge)	Deployment	4371	n/a	26-Nov-2007	L-R	Tica	tubeworm	4581	78161	9	50.404	-104	17.499	2512	108	biology	colonize	4-28.3
Block	Recovery	4371	n/a	26-Nov-2007	L-R	Tica	tubeworm	4581	78161	9	50.404	-104	17.499	2512	57	biology	colonize	18.0-25.9
Block	Recovery	4371	n/a	26-Nov-2007	L-R	Tica	tubeworm	4581	78161	9	50.404	-104	17.499	2512	57	biology	colonize	2.7
Block	Recovery	4371	n/a	26-Nov-2007	L-R	Tica	tubeworm	4581	78161	9	50.404	-104	17.499	2512	57	biology	colonize	10.8-12.6
HOBO	Recovery	4371	L08	26-Nov-2007	L-R	Tica	tubeworm	4581	78161	9	50.404	-104	17.499	2512	57	logger	grab	28.5
Limpet condo	Recovery	4371	LC3	26-Nov-2007	L-R	Tica	Tevnia	4591	78165	9	50.406	-104	17.494	2505	273	biology	enclosur	5.2
Limpet condo	Recovery	4371	LC2	26-Nov-2007	L-R	Tica	Tevnia	4591	78165	9	50.406	-104	17.494	2505	273	biology	enclosur	15.8
Limpet condo	Recovery	4371	LC4	26-Nov-2007	L-R	Tica	Tevnia	4591	78165	9	50.406	-104	17.494	2505	273	biology	enclosur	6.3
Limpet condo	Recovery	4371	LC6	26-Nov-2007	L-R	Tica	Periphery	4592	78165	9	50.406	-104	17.493	2505	241	biology	enclosur	2.9
Limpet condo	Recovery	4371	LC5	26-Nov-2007	L-R	Tica	Periphery	4592	78165	9	50.406	-104	17.493	2505	241	biology	enclosur	2.8
Sandwich	Recovery	4371	n/a	26-Nov-2007	L-R	Tica	tubeworm	4581	78161	9	50.404	-104	17.499	2512	57	biology	colonize	9.85-19.8
Sandwich	Recovery	4371	n/a	26-Nov-2007	L-R	Tica	tubeworm	4581	78161	9	50.404	-104	17.499	2512	57	biology	colonize	7.76-28
Sandwich	Recovery	4371	n/a	26-Nov-2007	L-R	Tica	tubeworm	4581	78161	9	50.404	-104	17.499	2512	57	biology	colonize	7.76-15.3

B12: VEHICLE DIVE SAMPLES (from Alvin)

Cruise ID: AT15-26
Log sheet Completed By: Benjamin Walther   net origin: 9N08/104W20
Log sheet Completion date: 11/18/2007

**Sample Description	Action	Dive #	Device *if applicable*	Date	Location, *if applicable*: Marker #	Vent name	Position on vent	Grid X (m)	Grid Y (m)	Collection/Deployment of sample: Lat *deg*	Lat *min*	Lon *deg*	Lon *min*	Depth *m*	Heading *deg*	Type	Collect method	Temp. max (degC)
Sandwich	Recovery	4371	n/a	26-Nov-2007	L-R	Tica	tubeworm	4581	78161	9	50.404	-104	17.499	2512	57	biology	colonize	4.84-4.99
Sandwich	Recovery	4371	n/a	26-Nov-2007	L-R	Tica	tubeworm	4581	78161	9	50.404	-104	17.499	2512	57	biology	colonize	4.4-7.44
Sponge	Recovery	4371	n/a	26-Nov-2007	CAV	Tica	?	4580	78159	9	50.403	-104	17.500	2509	136	biology	colonize	
TASC	Recovery	4371	n/a	26-Nov-2007	L-R	Tica	tubeworm	4581	78161	9	50.404	-104	17.499	2512	57	biology	colonize	3.8
TASC	Recovery	4371	n/a	26-Nov-2007	L-R	Tica	tubeworm	4581	78161	9	50.404	-104	17.499	2512	57	biology	colonize	14.8
TASC	Recovery	4371	n/a	26-Nov-2007	L-R	Tica	tubeworm	4581	78161	9	50.404	-104	17.499	2512	57	biology	colonize	2.89-7.13
Basalt	Collection	4372	n/a	27-Nov-2007	L-S	Sketchy	2-4C	4681	77521	9	50.056	-104	17.445	2506	148	rock&bi	grab	2.0
Basalt	Collection	4372	n/a	27-Nov-2007	35	Sketchy	Tevnia	4777	76893	9	49.716	-104	17.392	2504	19	rock&bi	grab	13-22
Pelagic pump	Collection	4372	n/a	27-Nov-2007	L-S	Sketchy	2-4C	4681	77521	9	50.056	-104	17.445	2506	148	fluid	pump	
Pelagic pump	Collection	4372	n/a	27-Nov-2007	L-S	Sketchy	Tevnia	4681	77521	9	50.056	-104	17.445	2506	148	fluid	pump	
Sponge	Deployment	4372	n/a	27-Nov-2007	L-S	Ty/Io	2-4C	4681	77521	9	50.056	-104	17.445	2506	148	biology	colonize	2.1
TASC	Deployment	4372	n/a	27-Nov-2007	L-S	Ty/Io	2-4C	4681	77521	9	50.056	-104	17.445	2506	148	biology	colonize	2.51-2.61
TASC	Deployment	4372	n/a	27-Nov-2007	L-S	Ty/Io	2-4C	4681	77521	9	50.056	-104	17.445	2506	148	biology	colonize	2.5-2.73
TASC	Deployment	4372	n/a	27-Nov-2007	L-S	Ty/Io	2-4C	4681	77521	9	50.056	-104	17.445	2506	148	biology	colonize	2.5
HOBO	Recovery	4372	n/a	27-Nov-2007	L-S	Ty/Io	2-4C	4681	77521	9	50.056	-104	17.445	2506	148	logger	grab	2.0
HOBO	Recovery	4372	n/a	27-Nov-2007	L-S	Ty/Io	2-4C	4681	77521	9	50.056	-104	17.445	2506	148	logger	grab	2.2
Sandwich	Recovery	4372	n/a	27-Nov-2007	L-S	Ty/Io	2-4C	4681	77521	9	50.056	-104	17.445	2506	148	biology	colonize	1.9-2.0
Sandwich	Recovery	4372	n/a	27-Nov-2007	L-S	Ty/Io	2-4C	4681	77521	9	50.056	-104	17.445	2506	148	biology	colonize	2.06-2.61
Sandwich	Recovery	4372	n/a	27-Nov-2007	L-S	Ty/Io	2-4C	4681	77521	9	50.056	-104	17.445	2506	148	biology	colonize	2.06-2.33
Sandwich	Recovery	4372	n/a	27-Nov-2007	L-S	Ty/Io	2-4C	4681	77521	9	50.056	-104	17.445	2506	148	biology	colonize	2.14-2.57
Sandwich	Recovery	4372	n/a	27-Nov-2007	L-S	Ty/Io	2-4C	4681	77521	9	50.056	-104	17.445	2506	148	biology	colonize	2.40-2.58
Sandwich	Recovery	4372	n/a	27-Nov-2007	L-S	Ty/Io	2-4C	4681	77521	9	50.056	-104	17.445	2506	148	biology	colonize	2.38-2.77
Sponge	Recovery	4372	n/a	27-Nov-2007	L-S	Sketchy	2-4C	4681	77521	9	50.056	-104	17.445	2506	148	biology	colonize	2.1
TASC	Recovery	4372	n/a	27-Nov-2007	L-S	Sketchy	2-4C	4681	77521	9	50.056	-104	17.445	2506	148	biology	colonize	2.51-2.61
TASC	Recovery	4372	n/a	27-Nov-2007	L-S	Sketchy	2-4C	4681	77521	9	50.056	-104	17.445	2506	148	biology	colonize	2.5-2.73
TASC	Recovery	4372	n/a	27-Nov-2007	L-S	Sketchy	2-4C	4681	77521	9	50.056	-104	17.445	2506	148	biology	colonize	2.5
Tide gauge	Recovery	4372	n/a	27-Nov-2007	119	Sketchy	n/a	4768	77106	9	49.831	-104	17.397	2501	228	logger	grab	
Basalt	Collection	4373	n/a	30-Nov-2007	n/a	Eastwall	tubeworm	4570	78402	9	50.535	-104	17.505	2500	255	rock	grab	
Basalt	Collection	4373	n/a	30-Nov-2007	n/a	Eastwall	mussel patcl	4566	78401	9	50.534	-104	17.507	2500	114	rock	grab	
Basalt	Collection	4373	n/a	30-Nov-2007	n/a	Biovent	n/a	4376	79192	9	50.963	-104	17.611	2503	259	rock	grab	
Basalt	Collection	4373	n/a	30-Nov-2007	n/a	Perseverance	n/a	4400	79189	9	50.962	-104	17.598	2506	230	rock	grab	
Niskin	Collection	4373	n/a	30-Nov-2007	n/a	Ty/Io	water colum	4414	77431	9	50.008	-104	17.591	1525	81	fluid	Niskin	
Niskin	Collection	4373	n/a	30-Nov-2007	n/a	Ty/Io	water colum	4634	77454	9	50.020	-104	17.470	2423	88	fluid	Niskin	
Pelagic pump	Collection	4373	n/a	30-Nov-2007	n/a	Eastwall	tubeworm	4570	78402	9	50.535	-104	17.505	2500	255	fluid	pump	
Pelagic pump	Collection	4373	n/a	30-Nov-2007	n/a	Eastwall	mussel patcl	4566	78401	9	50.534	-104	17.507	2500	114	fluid	pump	
Sponge	Deployment	4373	n/a	30-Nov-2007	n/a	Eastwall	mussel patcl	4566	78401	9	50.534	-104	17.507	2500	114	biology	colonize	1.9
Sponge	Deployment	4373	n/a	30-Nov-2007	n/a	Eastwall	dead Riftia	4568	78395	9	50.531	-104	17.506	2500	15	biology	colonize	1.86-2.15
Sponge	Deployment	4373	n/a	30-Nov-2007	n/a	Eastwall	Periphery	4570	78393	9	50.530	-104	17.505	2500	10	biology	colonize	1.9
Sponge	Deployment	4373	n/a	30-Nov-2007	n/a	Eastwall	dead mussel	4570	78402	9	50.535	-104	17.505	2500	255	biology	colonize	2.8
Sponge	Recovery	4373	n/a	30-Nov-2007	n/a	Eastwall	mussel patcl	4566	78401	9	50.534	-104	17.507	2500	114	biology	colonize	1.9
Sponge	Recovery	4373	n/a	30-Nov-2007	n/a	Eastwall	dead Riftia	4568	78395	9	50.531	-104	17.506	2500	15	biology	colonize	1.86-2.15
Sponge	Recovery	4373	n/a	30-Nov-2007	n/a	Eastwall	Periphery	4570	78393	9	50.530	-104	17.505	2500	10	biology	colonize	1.9
Sponge	Recovery	4373	n/a	30-Nov-2007	n/a	Eastwall	dead mussel	4570	78402	9	50.535	-104	17.505	2500	255	biology	colonize	2.8