Exploring New Patterns of Biological Succession at the Rosebud Hydrothermal Vents - Galápagos Rift

R/V Atlantis 11-27
May – June 2005

Cruise Report

EXPLORE


Return to the Galápagos Rift
MAY 20 - JUNE 3, 2005
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Executive Summary

In May-June, 2005, a multidisciplinary expedition was conducted on the Galápagos Rift, from the Rosebud hydrothermal field at 86.5°W to the Inca Transform at 85ºW, in order to 1) investigate the role fluid chemistry and microbial assemblages in the development of nascent hydrothermal communities, 2) conduct in-situ colonization experiments, 3) map the biology and geology of the Rosebud vent field through mosaic imaging, and 4) explore the eastern Rift for undiscovered low- and high-temperature hydrothermal systems. Through support from NOAA's Ocean Exploration Program, and supplemental support from the National Science Foundation, the Deep-Ocean Exploration Institute, and the Woods Hole Oceanographic Institution; a synergistic array of deep-ocean vehicle, including Alvin and TowCam (a digital towed camera system), was used to deploy experiments, collect samples, make seafloor observations, and acquire digital imagery. An Education and Outreach program, that included Dive and Discover and NOAA Oceanexplorer web portals, was successfully implemented.

The Alvin dive program began at the Rosebud hydrothermal vent site to assess the changes in the biological community structure and the nature of venting since 2002. We confirmed that every vent area that was active in 2002 was still active during this 2005 program. Faunal communities were dominated by tubeworms (mostly *Riftia pachyptila*) and bathymodiolid mussels. Both *Riftia* and mussel communities had increased in both lateral and vertical extent. Maximum hydrogen sulfide concentrations and temperature within these communities were as high as levels observed in 2002. During the cruise, the historic Musselbed (discovered in 1979) community was located during night operations, which was determined to be inactive during subsequent Alvin dives. The Clambake II site (discovered in 1977) was found to be greater than 100 m x 130 m in extent and hydrothermally inactive. Two dives to the Garden of Eden vent field (also discovered in 1977) revealed an extremely large centrally-located *Riftia* community surrounded by mussel clumps, small tufts of *Riftia*, and dense serpulids. Additional exploration to the east via multibeam mapping and using TowCam did not reveal any other new sites of hydrothermal activity near these known vent fields. Integrated experiments, which combined the deployment of multiple autonomous time-series chemical loggers, colonization panels, temperature loggers, and time-lapse imaging systems, were successfully conducted within both a *Rifta*-dominated assemblage and a mussel-dominated assemblage at Rosebud over a ten-day period. To simultaneously correlate species-specific larval presence, two time-series larval collectors (sediment traps) were deployed 10 m from these experiments. Additional discrete water samples for chemical analyses of hydrothermal fluids and collections of macrofaunal and microbial communities were also made to assess the heterogeneity and diversity of environments hosting these communities. As evident in the following pages, we accomplished all of our objectives. Through shipboard multi-disciplinary collaboration and discoveries via exploration, we collected additional integrated data to address rapidly developing hypotheses born out of the course of our expedition.

1. Introduction

1.1 Background

In May 2002, the exploration of the Galápagos Rift using DSV *Alvin* on a NOAA-Ocean Exploration Program cruise (R/V Atlantis, Cruise AT7-13) led to the discovery of a nascent low-temperature hydrothermal vent field (Rosebud) at 86° 13'W (Shank et al., 2003). The importance of this finding is two-fold. First, there was no previous evidence for low-temperature venting or robust faunal communities in the area surrounding the Rose Garden vent (initially discovered in 1979; Hessler et al., 1988). In 2002, we observed 24°C vent fluids (the highest recorded for Galápagos vents) supporting nascent communities of vent animals growing from cracks in what appeared to be a very recent lava flow with sheet and curtain-folded surface textures. The lava has a different geochemical signature from basalt previously sampled from the area around Rose Garden in 1985 (M. Perfit, pers. commun., 2002). The observational and geochemical data suggest a recent magmatic event resulting in a seafloor eruption of lava, probably within 2-3 years of May 2002, had paved over the old Rose Garden vent community (as well as the abundant seafloor markers and *Alvin* weights previously observed in this area). The second important observation of the new Rosebud vents is the nature of the faunal communities. The current distribution, size and type of fauna at Rosebud represent assemblages previously unseen at Pacific vents. Rosebud vents simultaneously host youthful assemblages of juvenile *Riftia*, mussels and clams (millimeters to a few centimeters in length). Previously observed community structures have never witnessed the temporal coexistence of these species at such juvenile stages. Also important is that our in-situ measurements of fluid chemistry (Ding et al., 2002) revealed that extensive suitable habitat space was available yet currently not colonized as of 2002.

The current expedition provided an important opportunity to study unique faunal assemblages at Rosebud vents within what is estimated to be <~6 years from the eruption event that led to Rosebud's formation, and to explore other nearby (<10 km) and well-known (historically significant) vent sites to determine the extent of the volcanic eruption that paved over Rose Garden (*e.g.,* Musselbed was a thriving low-T vent site when last visited in 1990). The Return to Galápagos Expedition took maximal advantage of the 2002 findings and explored the time and space domain via integrated co-located investigations of the temporal development of microbial and macrobiological community structure and the role that variations in diffuse fluid chemistry play in regulating the community structure. Conducting these time-series studies was time critical because of the known short time span (following volcanic disturbance) over which many key ecological processes occur through species interactions and vent community colonization and development.

The Galápagos Rift hosts a biologically unique system in that its constituent vent fauna differs from East Pacific Rise (EPR) fauna by 58%. Several key ecological species (*e.g.*, *Tevnia jerichonana* tubeworm) thought to facilitate and direct the sequential colonization of other fauna (*e.g., Riftia*) (Mullineaux et al. 2000) at EPR vents are notably absent at Rosebud. Thus, the ecological mechanisms (*e.g.*, larval input, species interaction, vent fluid chemistry, etc.) controlling the colonization and development of vent communities at the Galápagos Rift are expected to be markedly different from any

previously documented at mid-ocean ridges (*e.g.,* Shank et al 1998; Van Dover 2000). Similarly, the presumed absence of long-lived high-temperature black smokers at 86°W places temporal constraints on the chemical composition of vent fluids. While the influence of high-temperature fluid chemistry is considered strong on EPR vent communities (Shank et al. 1998; Fornari et al. 1998), this component appears to be absent at the Galápagos Rift at 86°W where our recently collected near-bottom magnetic data show convincingly that no high-temperature venting has ever occurred here. Hence the impact of the lack of high-temperature chemical constituents on the development of faunal assemblages and their habitats on the Galápagos Rift is unknown.

2. Cruise Objectives

The specific goals of the expedition were to:

(1) "map" the biological and chemical features of various microhabitats within the Rosebud site through the in-situ characterization of temperature, pH, and other physiochemical parameters that link with microbial biofilms and the colonization of different invertebrate species;

(2) conduct comparative quantitative digital image surveys of the vent field to assess the changes in community structure that have occurred since May 2002. Image results extracted from the photomosaics and detailed imaging surveys of the Rosebud vent field in 2002 revealed that this site consists of 4 major venting areas containing vestimentiferan tubeworms, and linear rows of bathymodiolid mussels (average ~1 cm in length) growing along cracks in the sheet lava surface, and adjacent carpets of amphianthid anemones;

(3) install time-series instruments to assess correlations in the structure of the various vent communities with the presence of specific larval species (through time-series larval collectors), larval settlement (through basalt-panel, time-lapse camera and temperature probe array deployments), and vent fluid temperature and chemistry (through autonomous in-situ measurements);

(4) obtain adults and juveniles (and larvae in traps) of vent species (e.g., tubeworms and mussels) to examine their genetic composition. By sampling discrete populations, we can compare their genetic composition and infer how related each individual is to its community on the Galápagos Rift, as well as to other communities inhabiting vent sites in the Eastern Pacific. By sampling the various life stages, we can use fine-scale genetic markers and analyses to infer the mechanisms the larvae use to get from one site to another and where they may have originated;

(5) conduct a night exploration program that employed a digital towed camera with a Conductivity/Temperature/Depth (CTD) system to explore for additional hydrothermal vents and conduct reconnaissance at the previously studied vents sites (e.g., Musselbed vent site 8 km from Rosebud and last observed in 1990) to determine if and how these sites might have been affected by the volcanic activity that covered the Rose Garden site;

to genetically assess inhabitants of these more eastern sites (as in #4 above; and to locate the first active high-temperature vents and the fauna they host on the Galápagos Rift, and;

(6) develop a well-documented and easy-to-use software package for PC-based computers that is tailored to convert video imagery acquired from Alvin, operated within both absolute (e.g. LBL) and relative (DVL) navigation networks, and quickly produce a set of geo-referenced photomosaics, which can then be directly layered within a Geographic Information System (GIS).

3. Operations Summary

The cruise departed Puntarenas, Costa Rica at 0630 hours (Local, -6) on May 19, 2005 and steamed directly to the primary dive site at 86° 13.5'W, 0° 48.5'N - the Rosebud vent site (see **Table 1** for full operations summary and **Figure 1** for a map of the area). Early on May 21, we arrived on station and deployed two LBL transponders (see **Figure 1** and **Table 3** for location information), surveyed them, and commenced diving with Alvin Dive 4114 on the same day. Eleven dives were successfully completed. Dive statistics are shown in **Table 2**. Night operations during the cruise consisted of using the WHOI TowCam (Fornari, 2003) for digital camera surveys within the rift valley and along the axial volcanic ridge to search for additional sites of hydrothermal venting and to conduct reconnaissance of the geology of the rift valley and distribution of lava flows. Two larval collectors and a time-lapse digital camera system were also deployed and recovered during this expedition. A single night Multibeam survey of the Galápagos spreading center was also completed on May 28.

Date	Area	Alvin Dive	TowCam	Other Operations
19 May	Depart Puntarenas 0600			
20 May	Transit			
21 May	Rosebud	4114	1 - *Musselbed*	Deploy transponders (2) Deploy larval collectors (2)
22 May	Rosebud	4115	2 –Musselbed	Deploy time-lapse camera
23 May	Rosebud	4116	3 – Musselbed	
24 May	Rosebud	4117	4 – Garden of Eden	
25 May	Musselbed	4118	5 – East of Eden	
26 May	Rosebud	4119	6 – East of East of Eden	
28 May	Garden of Eden	4121		Multibeam GSC
29 May	Rosebud	4122	8 – North of Rosebud	
30 May	Rosebud	4123	9 – Across axis	Recover larval collectors (2) Recover time-laps camera
31 May	Rosebud Rose Bowl	4124		Recover transponders Transit to Pt Caldera 1800
1 June	Transit			
2 June	Transit			
3 June	Arrive Pt Caldera 0800			

Table 1. Operations summary for AT11-27

3.1 Alvin Operations

					Time			
Date (May)	**Dive**	**Area**	**Pilot**	**Observers**	**Start**	**Stop**	**Total**	**Max Depth**
21	4114	00°48.350'N 86°13.659'W	Eppard	Shank Ding	15:39:00	23:06:00	7:27:00	2451
22	4115	00°48.350'N 86°13.659'W	Tarantino	Humphris Seyfried	14:10:00	23:00:00	8:50:00	2451
23	4116	00°48.350'N 86°13.659'W	Strickrott	Shank Khosla	14:00:00	21:26:00	7:26:00	2452
24	4117	00°48.350'N 86°13.659'W	Hickey	Fornari Dubno	13:59:00	22:55:00	8:56:00	2451
25	4118	00°47.894'N 86°09.210'W	Berry	Humphis Eppard	14:28:00	22:46:00	8:18:00	2493
26	4119	00°48.350'N 86°13.659'W	Tarantino	Fornari Nomikos	14:01:00	22:48:00	8:47:00	2453
27	4120	00°47.500'N 86°07.58'W	Strickrott	Beaulieu Soule	14:13:00	22:57:00	8:44:00	2489
28	4121	00°47.664'N 86°08.51'W	Hickey	Shank Govenar	14:01:00	22:32:00	8:31:00	2525
29	4122	00°48.350'N 86°13.659'W	Eppard	Knee Ward	13:58:00	21:57:00	7:59:00	2450
30	4123	00°48.375N 086°13.833W	Tarantino	Buckman Spear	14:23:00	23:05:00	8:42:00	2451
31	4124	00°48.350'N 86°13.659'W	Strickrott	Soule Ward	14:07:00	22:15:00	8:08:00	2452

Table 2. Alvin Dive statistics for AT11-27 cruise.

3.2 Multibeam Mapping

A multibeam survey was conducted along the Galápagos Spreading Center (GSC) east of the Inca Transform at 85° 24'W, comprising two lines. The east heading line traversed within the axis of the rift valley, while the west heading line traversed ~4 km north of the rift valley.

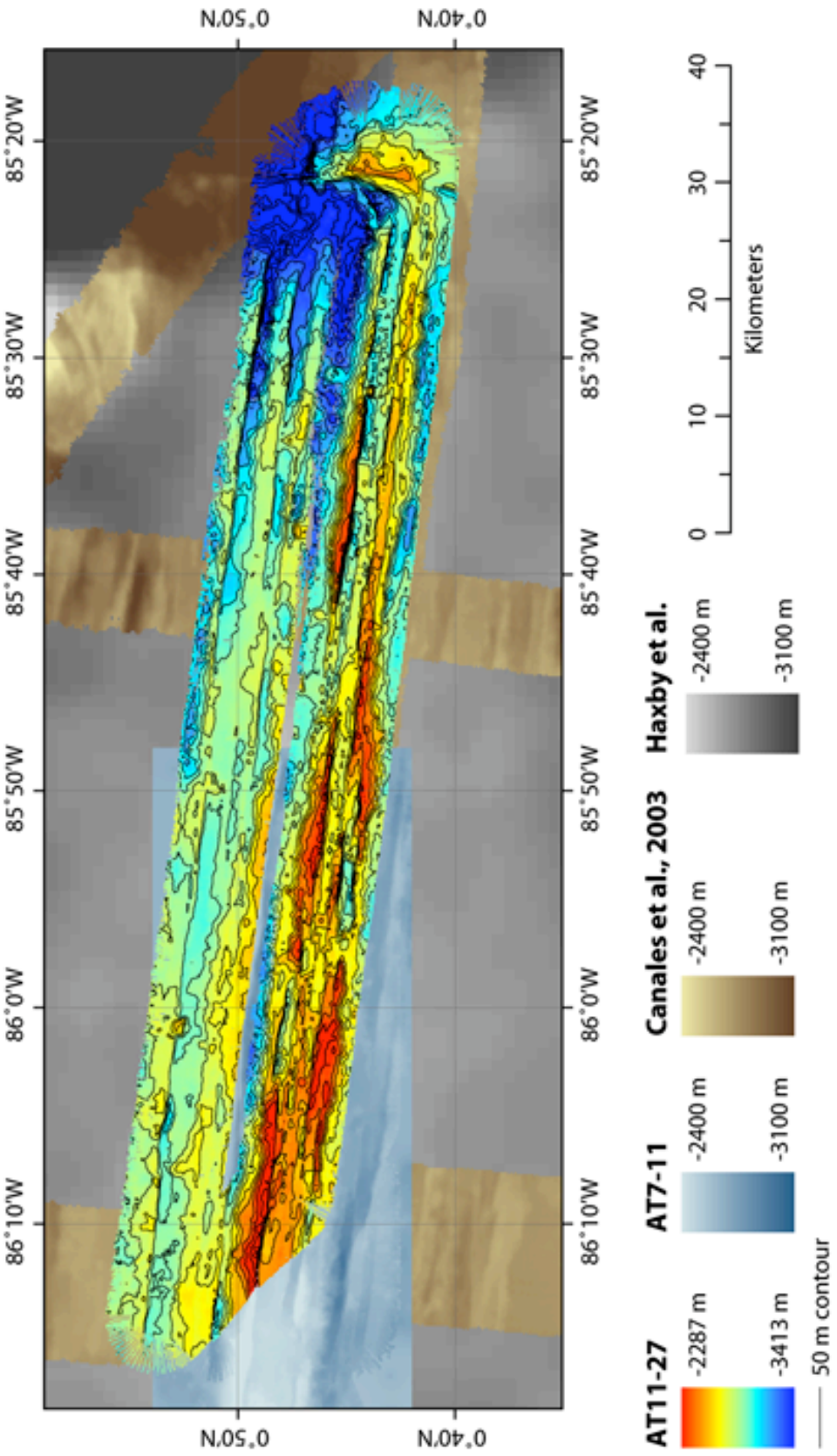


Fig. 1. Composite multibeam map.

Fig. 2, WHOI TowCam (left) and time-lapse camera system (right) as configured during AT11-27 cruise. Images are taken at ~ 2 m elevation with strobe illumination. Camera settings were 1/60 sec exposure at f-5.3.

3.3 Seafloor Imaging

Several types of digital still seafloor imaging were conducted during the cruise. A towed digital camera (TowCam) was used for night time surveying, a downlooking camera and strobes were mounted on Alvin was used for vertical incidence imaging, and a time-lapse system was deployed to take photographs of a colonization experiment that combined macro- and microbiology and in-situ chemical sensing. The digital camera is the same for all systems (DeepSea Power & Light DigiSeacam model) and consists of a Nikon 995 camera mounted in a pressure housing with water corrected optics. Strobe illumination for all systems was provided by a Benthos 383 strobe powering two 300 watt/sec flash heads.

3.3.1 TowCam, RatCam and Alvin DSPL

The WHOI TowCam is an internally recording digital deep-sea camera system that also permits acquisition of volcanic glass samples using up to eight (8) rock core winches, and triggering of four (4) 1.2 liter or 5.0 liter Niskin bottles, in conjunction with CTD water properties data (Fornari, 2003). The TowCam is towed on a standard UNOLS 0.322" coaxial CTD sea cable, thereby permitting real-time acquisition of digital depth and altitude data that can be used to help quantify objects in the digital images. The use of the conducting sea cable and CTD system permits real-time, manual triggering of any of eight rock core units or four Niskin bottles on the sled so that discrete samples of volcanic glass or seawater can be collected during a lowering from specific areas. By operating either at night in between Alvin dives, or during other seagoing programs, photographic information of the seafloor can be recorded for near real-time analysis and for planning subsequent Alvin dives or other sampling/surveying programs using other vehicle systems. The TowCam was used during AT11-27 to survey for additional hydrothermal vent sites and to conduct reconnaissance imaging to help compile the geologic map of the dive site. Details of the system are provided in a user manual posted on a web site at: http://www.whoi.edu/marops/support_services/list_equip_towed_camera.html

Surveys were done using layback navigation (difference between camera depth and wire out) assuming that the camera was directly behind the ship (found to be reasonable based on LBL navigated camera tows at other locations). Average layback position of the camera behind the ship was ~300-350 m while towing at ~1/3 knot. Nine camera tows were carried out. One tow was not successful due to problems with the CTD cable termination and altimeter settings. A pinger was used as a backup altimeter for all tows, but once the CTD cable termination issue was resolved, the altimeters worked very well. The system collects ~1800 digital images per lowering. They are 2048 x 1536 pixels, color, high-resolution JPEG format files, each ~900 kbytes in size. Each image is date/time stamped when acquired, but the image filenames are in standard Nikon format and must be converted in order for the files to be tagged with date and time as the file name. DOS and Apple Mac OSX Perl scripts are used for converting the raw Nikon formatted files to date/time named files having the format: "yyyy_mm_dd_hh_mm_ss.jpg". In addition, a Perl script has been written to correct image file name times based on correlation to photographs of GMT clock time at the beginning and end of each tow in order to correct for any clock drift over the course of a cruise. **Table 3** provides the calibrated field of view at normal towing altitudes.

Altitude above Bottom	3 meters	5 meters	7 meters
Field of View in Seawater	3.49mx2.62m	6.06x4.54m	8.03x6.02
Pixels/Meter	586	338	255

Table 3. Field of view in seawater for DSPL DigiSeaCam.

3.3.2 Mosaic Imaging

Imagery on this cruise was collected from three main sources: video cameras mounted on the top and manipulator arm of DSV Alvin (two single chip cameras and one 3-chip, respectively), DSL downlooking camera with 3.3 megapixel resolution, and TowCam. All the cameras were calibrated using checkerboard calibration target and Matlab Calibration toolbox from Caltech. The calibration data obtained is as follows:

Camera 1 (1-chip); Frame: 720*480; Horz FoV=70.5 degrees; Vert FoV=54 degrees

Focal Length: fc = [509.57783 464.21431] ± [3.85782 3.96879]
Principal point: cc = [348.57449 270.14089] ± [4.67584 3.54322]
Distortion: kc = [-0.24602 0.11213 0.00085 -0.00157 0.00000] ± [0.01252 0.01599 0.00123 0.00171 0.00000]
Pixel error: err = [0.24652 0.47076]

Camera 2 (1-chip); Frame: 720*480; Horz FoV=70.5 degrees; Vert FoV=54 degrees

Focal Length: fc = [509.84562 463.98912] ± [7.83021 7.35175]
Principal point: cc = [347.97465 274.59358] ± [5.61440 5.05080]
Distortion: kc = [-0.26799 0.17889 0.00221 0.00045 0.00000] ± [0.02048 0.04314 0.00272 0.00128 0.00000]
Pixel error: err = [0.52742 0.58354]

Camera 3 (3-chip); Frame: 720*480; Horz FoV=49.3 degrees; Vert FoV=37 degrees

Focal Length: fc = [784.21867 714.70979] ± [13.63366 12.74924]
Principal point: cc = [344.53577 224.02027] ± [11.24166 8.94783]
Distortion: kc = [-0.26093 0.08781 0.00040 0.00011 0.00000] ± [0.03393 0.15719 0.00242 0.00240 0.00000]
Pixel error: err = [0.21379 0.42367]

TowCam camera; Frame: 2048*1536; Horz Fov=48.88 degrees; Vert FoV=37.62 degrees

Focal Length: fc = [2253.16399 2254.87566] ± [89.02881 89.35861]
Principal point: cc = [1037.36487 811.15759] ± [9.03623 13.47364]
Distortion: kc = [-0.21183 0.19658 -0.00022 0.00210 0.00000] ± [0.02214 0.10705 0.00121 0.00094 0.00000]
Pixel error: err = [0.35527 0.32110]

Downlooking camera; Frame: 2048*1536; Horz Fov=49.31 degrees; Vert FoV=37.90 degrees

Focal Length: fc = [2230.90400 2236.51232] ± [31.27563 31.34162]
Principal point: cc = [1037.60103 751.93368] ± [15.56772 19.77844]
Distortion: kc = [-0.18069 0.40447 -0.01011 0.00372 0.00000] ± [0.02862 0.18486 0.00207 0.00145 0.00000]
Pixel error: err = [0.59522 0.84065]

Prior to dives observers and pilots were asked to:
1. Keep video cameras down (as normal with respect to the seafloor as possible) during the transects (relatively long, steady-motion runs of the vehicle), and
2. When the vehicle is not moving, pan one of the video cameras, trying to catch as wide as possible view of the interesting site.
The intention was to process video sequences of transects and panoramas, produce planar and panoramic mosaics, and eventually include mosaic images in GIS database associating them with linear paths or single locations. However this effort has been seriously hindered by lack of illumination, as this time Alvin did not have 1200 Watt DSL lights, which were present on the AT11-7 leg in February, 2004, when this processing was first attempted. As part of the NSF-funded project, we have attempted the automatic processing of video imagery collected during a dive. Only the first stage of automatic processing has been achieved.

3.4 Navigation

3.4.1 Alvin Long Baseline (LBL) Acoustic Navigation

Long baseline (LBL) navigation was used primarily in the Rosebud area. We utilized the ABE 2002 microbathymetry to plan the dives. Details of the transponder network, including surveyed positions and local x/y origin used are shown in **Table 4**.

3.4.2 Alvin Navigation Processing

During all dives, Alvin navigation data were acquired using the bottom-lock Doppler navigation DVLNAV software (Whitcomb et al., 2003). When within the network of transponders deployed Rosebud, the Doppler navigation was supplemented with long baseline (LBL) acoustic navigation. When LBL was available, it was used to

"renavigate" the Doppler navigation by matching the mean of the Doppler track to the mean of the LBL track. 'Navplot', a suite of MATLAB programs developed by D. Yoerger, L. Whitcomb, and J. Howland, allowed the user to manually remove bad LBL data points and apply the renav horizontal shift to the Doppler navigation data, which in turn was used in combination with software developed by V. Ferrini to 'renavigate' LBL and DVL navigation for our dives.

ALVIN Transponder Log			**Cruise**	AT11-27	**Chief Sci**	Shank	**Date**	May 05
Location	Galapagos Rift/ Rose Bud		**Origin**	00N15 86W15				
Purpose	Biology		**UTM Zone**	16	**Time Zone**	6	**Mag Var**	4°E

Xpdr Freq	Owner	S/N	Net ID	Rel Code	Surveyed Pos	Surveyed Pos	Survey Dpth	Recovered
11.0	ALVIN Burn Volts 13.7	48500	A	E	00N48.071 Y=60947	86W13.979 X=1894	2265M RMS 0.77 Pts=169	YES
10.5	ALVIN Burn Volts 12.0	35003	B	D	00N48.100 Y=61001	86W13.214 X=3314	2283M RMS 0.59 Pts=94	YES

Table 4. Copy of the Alvin LBL transponder positions based on surveys conducted using ship's P-code GPS system. RMS error of position is < 1 m.

This shift, usually on the order of 10s of meters, improves navigational accuracy by including LBL navigation, and compensates for drift within the Doppler navigation that occurs over the course of the dive. If LBL was not used, the raw Doppler navigation data ('*.csv' files saved by DVLNAV) were used as Alvin navigation. These have less absolute accuracy than LBL or LBL-Doppler 'renavigated' navigation. However, it was found that if Alvin was surveyed in at the start of the dive, the navigation agreed very well with the expected terrain features imaged by the side scan sonar or previously run camera tows. All Alvin navigation data were binned at 1Hz to create text files and MATLAB ('*.mat') files containing time, position in local XY, UTM, Lat/Lon, water depth, altitude, pitch, heading, roll and altitude. Individual, time annotated maps for each Alvin dive are shown in section 5.

3.4.3 Imagenex Scanning Altimeter Data Processing

Section 5 contains detailed navigation and bathymetry maps for each dive track. After processing navigation data, Imagenex (675 kHz scanning altimetry) data were processed using a set of MATLAB scripts to calculate the position and corrected depth soundings for each ping ('go_vlf.m'). These soundings ignore the effects of tidal fluctuation. The depth data were filtered using offsets declared in a filter file called 'imagenex filter.dat'. This file dictates the maximum allowable horizontal range (10 m) and the maximum depth range (25 m) as well as the number of standard deviations (7) about the mean outside of which data are considered unacceptable. Since this method

does not remove all 'bad' depth data (i.e. when incorrect depth values are reported over time periods of many seconds), an additional step was included to allow the user to remove bad depth data. This was done by plotting depth as a time series of points that can be edited by drawing rectangles around bad depth points. The final xyz data were saved into two text files in the directory with the raw Imagenex data: one in Lat/Long ('*.llz') and the other in local XY ('*.xyz'). These data provide substantial improvement over the ABE data acquired in 2002 where the AUV was flying at ~40 m altitude and with 60 m line spacing. A preliminary Imagenex composite map of Rosebud is shown in **Figure 3** and a comparison map showing differences between it and the Alvin Imagenex map made in 2002 is shown in **Figure 4**.

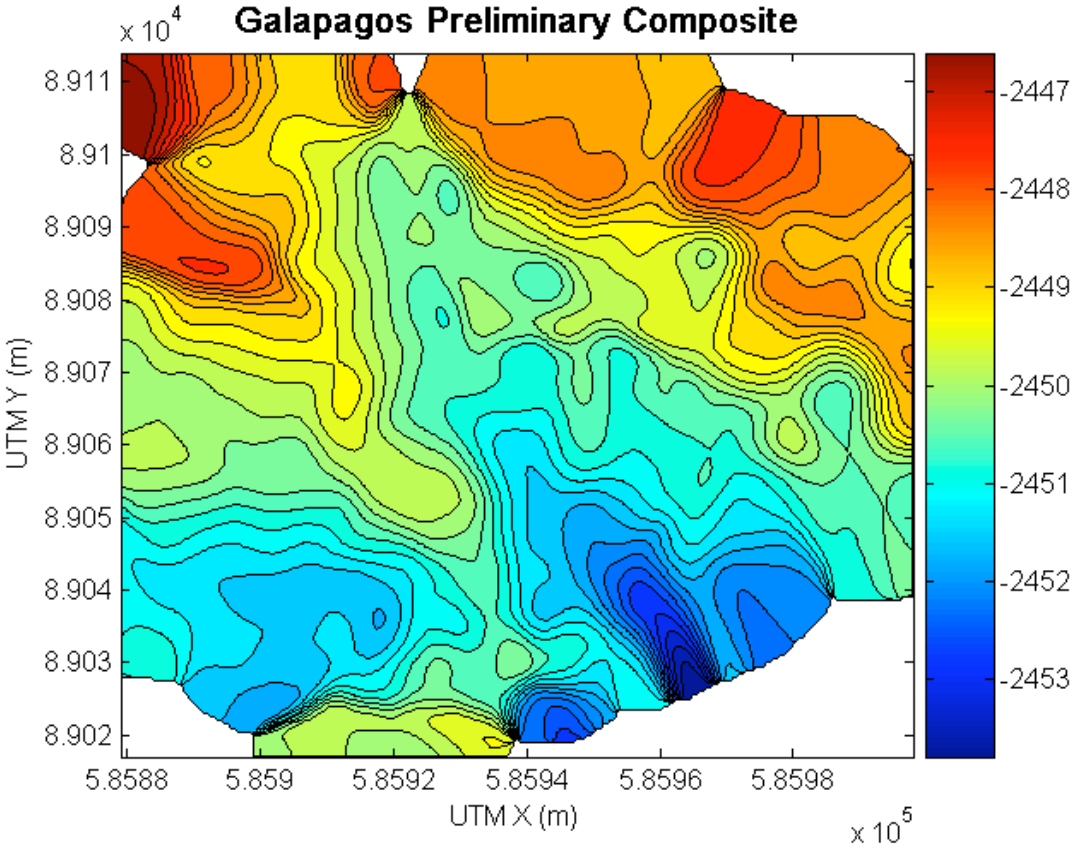


Fig. 3. Imagaenex composite map of the Rosebud area.

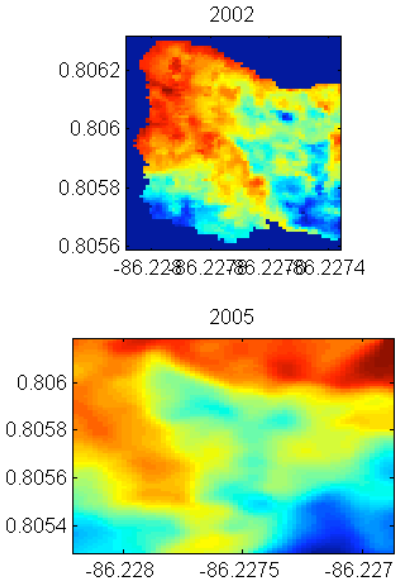


Fig. 4. Comparison of Imagenex data between 2002 (top) and 2005 (bottom).

3.4.4 Layback Navigation for Camera Tows

Towed camera surveys were conducted with the ship using Dynamic Positioning (DP) at speeds ranging from 0.3 to 0.5 knots. Most of the survey lines ran from west to east across the rift valley axis. **Figure 5** shows the locations of all the TowCam surveys. Detailed maps for each tow plotted over multibeam, ABE microbathymetry (when available) and side scan sonar are shown in Appendix 8.6.

The ship's navigation for the duration of the camera tows was extracted from the daily ship's '.dat' files. After shipboard analysis of wire out and TowCam depth during initial tows, the mean layback of the TowCam was determined to be ~350 m and the position of the system behind the ship was calculated using a Matlab script, 'Layback.m', written by Adam Soule**.** The script utilizes the ship location to determine a course over ground. The layback is then applied to that position and course and sampled at the frequency of the CTD (~1 Hz) and flash data (~0.067 Hz) records collected by the camera system.

3.4.5 Near Bottom Magnetics - TowCam

A small, self-contained magnetometer system was built to record magnetic data during the deep-tow camera operations. The magnetic sensor is a Honeywell model HMR2300 digital 3-axis magnetoresistor that produces a digital RS232 output. This is the same type of sensor as used on ROV Jason. A separate pressure housing containing a datalogger and battery pack was built using a "Persistor" brand datalogger and compact flashcard memory storage (64 Mb). Data is collected at a 1 Hz rate and the hourly files log elapsed time, battery voltage and the three vector components of the magnetic field. A simple Perl script reads the ascii files and converts the elapsed time to GMT time and the raw millivolt readings to magnetic field units (6.667 nanoTesla per millivolt). The magnetic data were merged with ship navigation data as described earlier to produce a composite of camera tow depth, altitude, position and magnetic value. The three-component magnetic data can also be used to calculate a magnetic heading. A calibration circle of the magnetometer on the camera tow system was completed during work at the EPR in 2004. The result confirmed that the magnetic effect of the camera tow frame is negligible recording less than 82 nT for a magnetic effect, which is substantially less than the observed magnetic anomalies of several thousand nanoTesla.

3.5 Larval Collector (Sediment Trap) Operations

Two time-series sediment traps (McLane PARFLUX Mark78G-21) were deployed "anchor-first" with an acoustic release on the hydrowire during night operations on 21 May 2005 (**Table 5**) to collect larvae. Seafloor positions of the traps, just prior to dropping the moorings, were determined within the LBL net via a relay transponder clamped to the wire just above the wire acoustic release (**Figure 6**). The two sediment traps were deployed within 200m from Marker B for 2.25days and moved by Alvin to within 20m of Marker B for 6 days over the same time period as the colonization experiments (**Table 5**). Sediment trap moorings were recovered individually via acoustic release on 30 May 2005.

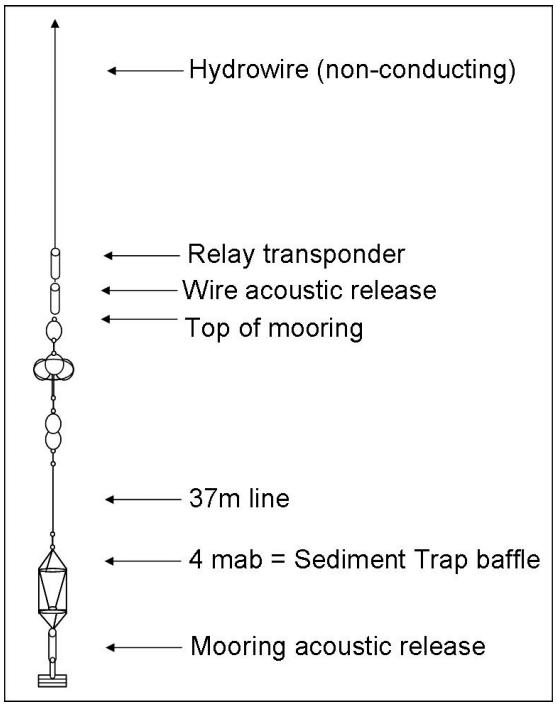


Fig. 5. Mooring deployment configuration.

Sediment trap schedule (GMT = local + 6hr)

		LOCAL DATE/TIME			During	Dive Location	Chemical
Prior to positioning at Rosebud	CUP 1*:	22 May	04:00	6-hr			RNALater
	CUP 2*:		10:00	6-hr	D4115	Rosebud	RNALater
	CUP 3:		16:00	6-hr			DMSO
	CUP 4:		22:00	6-hr			DMSO
	CUP 5:	23 May	04:00	6-hr			DMSO
	CUP 6*:		10:00	6-hr	D4116	Rosebud	DMSO
	CUP 7:		16:00	6-hr			DMSO
	CUP 8:		22:00	6-hr			DMSO
	CUP 9:	24 May	04:00	6-hr			DMSO
	CUP 10*:		10:00	6-hr	D4117	Rosebud	DMSO
At Rosebud between Markers B and K	CUP 11:		16:00	1-day	D4118	MusselBed	DMSO
	CUP 12*:	25 May	16:00	1-day	D4119	Rosebud	DMSO
	CUP 13:	26 May	16:00	1-day	D4120	E of MusselBed	DMSO
	CUP 14:	27 May	16:00	1-day	D4121	E of MusselBed	DMSO
	CUP 15:	28 May	16:00	6-hr			DMSO
	CUP 16:		22:00	6-hr			DMSO
	CUP 17:	29 May	04:00	6-hr			DMSO
	CUP 18*:		10:00	6-hr	D4122	Rosebud	DMSO
	CUP 19:		16:00	6-hr			DMSO
	CUP 20:		22:00	6-hr			DMSO
	CUP 21:	30 May	04:00	6-hr			DMSO
	END	30 May	10:00				

* = corrupted due to resuspension by Alvin

Table 5. Temporal periods of collection by sediment trap cups, location, and preservative.

4. Preliminary Results

At Rosebud, three in-situ autonomous chemical loggers, ten temperature loggers, and twelve basaltic panels were deployed in *Riftia* and mussel assemblages to assess: 1) the relative differences in H_2, H_2S and pH in low temperature hydrothermal fluids issuing from vents characterized by different faunal assemblages; 2) the temporal variability of vent emissions and the delivery of nutrients to the constituent fauna; 3) identify the initial microbial colonizers at low temperature vents (on native and non-native basalt panels); 4) assess the role these colonizers play in influencing colonization by invertebrate species. A WHOI time-lapse digital camera system was successfully deployed for 6 days (acquiring an image every 6 minutes; total of 1650 images) with the colonization panels and data logger in the field of view.

4.1 Mulitbeam Mapping

Several discontinuities in the rift valley walls were observed at 86° 00'W and 86° 36'W. East of 86°W, the rift valley narrows to nearly 2 km in width, compared to the ~4 km width near Rosebud at 86° 14'W. The axial volcanic ridge that is prominent within the central portion of the rift valley from Rosebud east to the 86°W discontinuity, also appears to end at the discontinuity. The rift axis contains several small cones and lines of cones but their crests are 20-60 m deeper than those near Rosebud. There are several breaks in the rift valley walls and at times there is an inner rift wall usually along the

southern margin of the rift valley. Abyssal hills are prominent on the Cocos plate north of the GSC rift and have a spacing of ~4-6 km between major scarps. The abyssal hills terminate about 2-6 km from the transform. The intersection area is marked by a prominent high with a 'cockscomb' plan-view appearance suggesting that there has been overshooting of dikes across the ridge-transform intersection (RTI) terrain over time. There is no prominent inside corner high at the RTI and the intersection deep has relief of only ~ 150 m.

4.2 Macrobiology

4.2.1 Area Summary

Comparative quantitative digital image surveys of the Rosebud field were conducted to assess the changes in community structure that have occurred since May 2002. Downlooking and panoramic video imagery from the 3-chip video camera and the DSPL downlooking camera with 3.3 megapixel resolution revealed the rapid colonization and expansive growth of the Rosebud tubeworm and mussel communities over the past 3 years. The clam population also increased in abundance within cracks in the sheet flow. Several *Riftia* communities in elevated flux (up to 20°C) within Rosebud were appeared to be devoid of mussels, indicating that mussels had not yet settled among these tubeworms. Sampling of these communities indicates that the number of species has more than tripled since 2002. Correlations of fluid chemistry in each community sampled and species composition will be undertaken. All sites that were active in 2002 were still active, and the extent of the communities has increased to the northeast and southeast.

Vents on the Galápagos Rift differ in faunal composition from all other hydrothermally active ridges by over 40%. This is largely due to the absence of black smoker habitats. High-temperature black smokers hosts host different species than low-temperature diffuse flow habitats of *Riftia* and mussels. While considered a key species in the development of vent communities on the EPR, *Tevnia jerichonana*, a vestimentiferan tubeworm that coexists with *Riftia*, has never been observed on the Galápagos Rift. We discovered and collected a *Tevnia*-like morph within the central Rosebud field (and at Rose Bowl) that will be examined genetically to identify this species. This same approach will be utilized to investigate a (large) putative new species of terrebellid polychaete.

To examine larval availability to the Rosebud site (as well as for genetic comparisons to adults), we deployed two larval collectors inside and outside of the Rosebud vent field for 9 days (separated by 100 m for three days and 20 m for 6 days). Particulates and pelagic fauna in the upper water column suggested high rates of productivity above the vent field. Despite the short duration (6 hours or 1 day) in which each cup collected falling particulates, an eighth to a quarter inch of material was collected in each of the 21 sampling cups of both traps. Numerous bythrograeid crab megalopes (juveniles) were observed in several cups of both traps.

Little is known about the cellular adaptations of vent-endemic foraminiferal species for living in vent environments due to the cellular degradation during transport to the surface- warming and pressure changes upon ascent significantly affected their cellular structure, causing ultrastructural investigations to be equivocal. To investigate the

cellular ultrastructure of benthic foraminifers such *as Abyssotherma pacifica*, we fixed colonization panels (in sodium cacodylate and TEM-grade gluteraldehyde) on the seafloor using the Enzymatic Sampler-1, constructed for this purpose. This first collection of over 30 forams will allow us to determine the presence/absence of (1) prokaryotic endobionts, (2) sequestered chloroplasts, (3) peroxisome-endoplasmic reticulum complexes, and (4) ectobionts,

4.2.2 Colonization blocks and time-lapse camera deployment

As shown in **Figures 6 and 7**, during Cruise AT11-27 we deployed two time-series experiments at Marker B at the Rosebud vent field on the Galápagos Rift (depth 2452m). Both experiments included a total of 6 colonization panels and blocks, consisting of 3 native EPR basalt panels and 3 non-native river basalt blocks. Both experiments also included a Seyfried chemical sensor and data logger (replaced once per site during each of the experiments) and 5 VEMCO temperature sensors. Experiment 1 (Expt1) was deployed within and right next to a thriving patch of *Riftia pachyptila* tubeworms, and Experiment 2 (Expt2) was deployed 1.5 m away in a thriving patch of *Bathymodiolus thermophilus* mussels. As detailed in **Table 1**, the deployment period for Expt2 (7days) was contained within the deployment period for Expt1 (9 days for the panels/block collected in seawater and 10 days for the blocks collected into glutaraldehyde and sodium cacodylate). Results for the basalt panels from Expt1 can be compared directly with an analogous experiment deployed in Feb. 2004 at Tica Vent at the EPR. A time-lapse camera system, nicknamed RatCam, was deployed to monitor Expt2 for 6 days. In addition, two time-series sediment traps were deployed within 200 m from Marker B for 2.25 days and moved within 20 m of Marker B for 6 days over the same time period as the colonization experiments (see Sediment Trap Schedule in **Table 5**).

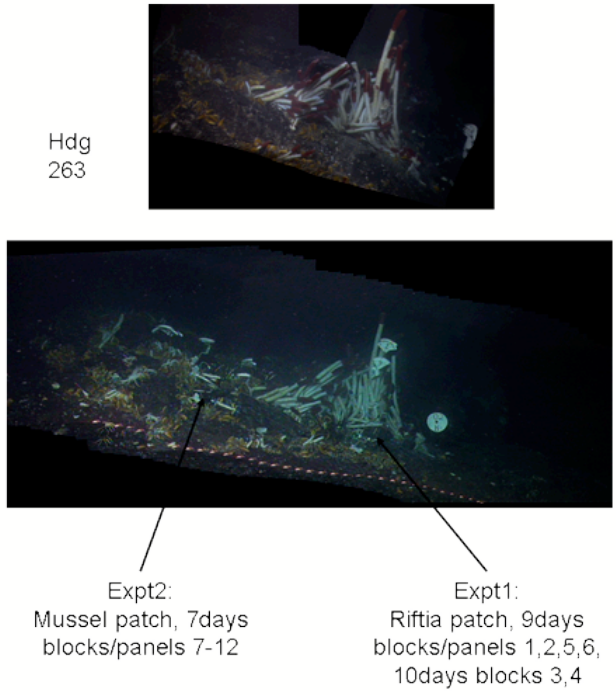


Fig. 6. Photomosaics of Marker B area and colonization block experiments.

Although not checked yet against the original hand-written sample grids, the following are totals for macrofauna sampled from the blocks/panels (including sample chamber "washings"). These totals do not include foraminifera saved for Joan Bernhard. Note the majority of these macrofauna are foraminifera (72 of total 136). Notably, we had on the order of 10 mussel recruits and several limpet recruits (based on size). Panel1: 3, Block2: 14, Block3: 6 (plus forams for J. Bernhard), Block4: 2 (plus forams for J. Bernhard), Panel5: 39, Panel6: 24, Block7: 9, Block8: 2, Block9: 5, Panel10: 15, Panel11: 7, Panel12: 10.

In addition, the TIGR group (N. Ward and K. Penn) scraped the panels and blocks (and froze them for whole panel extractions) for microbial analysis (see Microbiology, section 4.3). All panels and blocks were photographed whole in the cold room prior to sorting under the dissecting scope using sterile tools. Many of the recruits and microbial biofilms were digitally photographed under the dissecting scope.

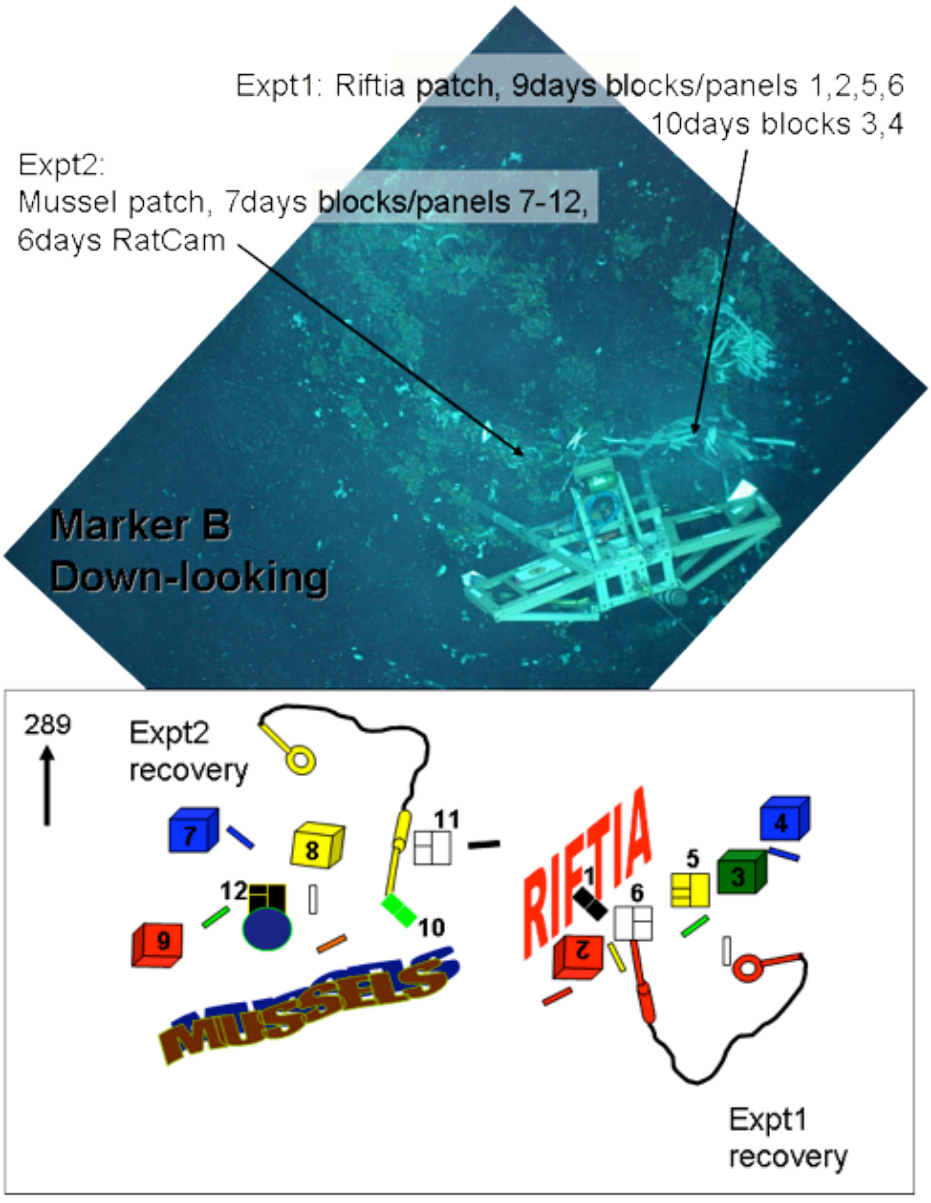


Fig 7. Upper - Downlooking photograph of experiment site. RatCam can be seen in lower. Lower, diagram of layout of blocks, and dataloggers for experiments 1 and 2.

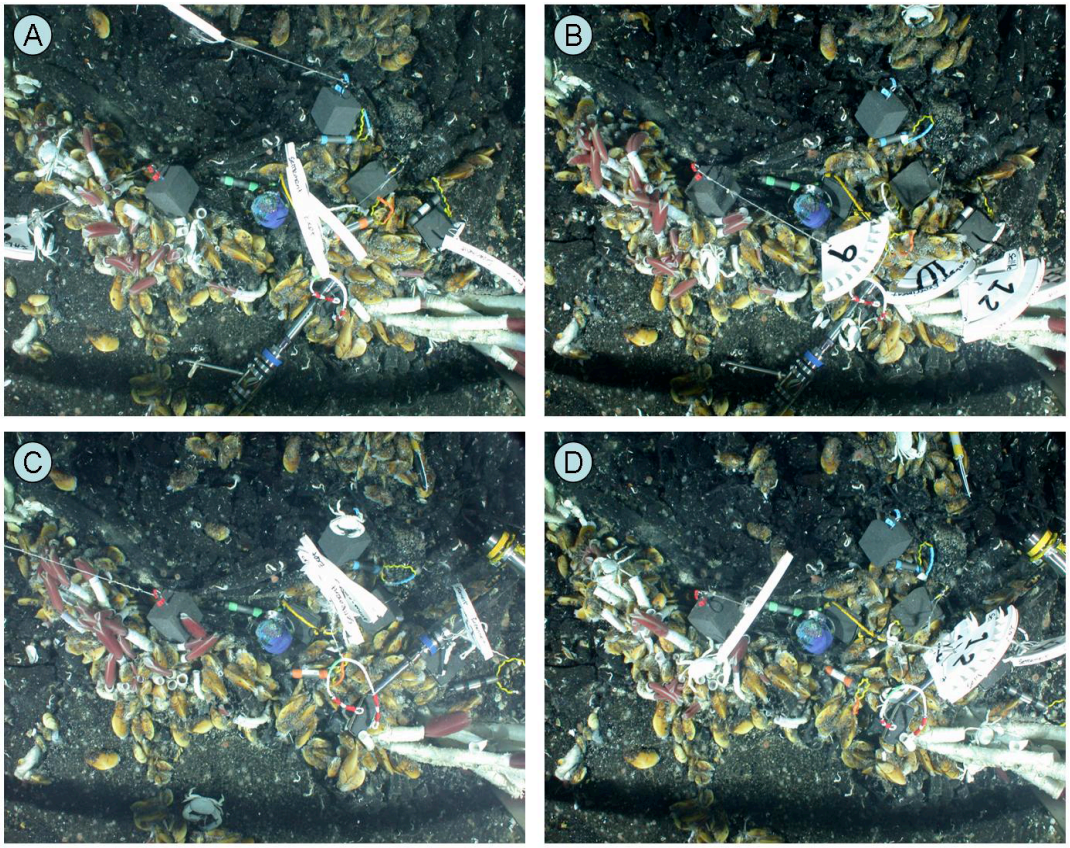


Fig. 8. Time-lapse camera images from RatCam. A. 2005_05_23_21_22_54 (first photo with globe in field of view); B. 2005_05-25_17_53_01 (2 days later); C. 2005_05_27_17_53_08 (4 days later); D. 2005_05_29_17_53_15 (6 days later, last photo prior to Ratcam recovery).

4.2.3 Larval Collectors

Both larval collectors (sediment traps) successfully completed the sampling schedule (**Table 5**) over the total of 8.25 days. Despite the short 6-hour (or 1-day) duration in which each cup collected falling particulates, an eighth to a quarter inch of material was collected in each of the 21 sampling cups on each of the traps (**Figure 9**). Particulates and pelagic fauna in the upper water column suggested high rates of productivity above the vent field. Several bythograeid crab megalopes were collected into the trap cups.

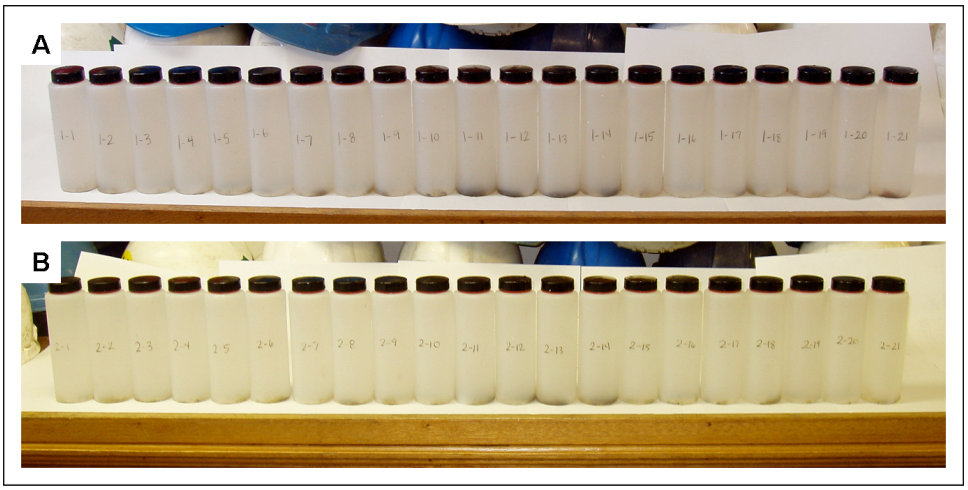


Fig. 9. Sediment trap cup samples from Mooring 1 (A) and Mooring 2 (B) deployed at Rosebud from 22-30 May 2005. Cups numbered 11-14 were open for 1-day while the rest were open for 6-hr intervals.

4.2.4 Mosaic Imaging

All paths of the submarine on the seafloor (with good Doppler bottom lock) was divided into 15-m segments. Depending on the speed of the submarine, the duration of single segments were ~ 1- 10 min. Obviously, all 30 frames per sec in video are not required for successful creation of the mosaic. For efficiency, frames have to be decimated, and the rate of decimation should depend on the speed and camera altitude, because the altitude determines size of the camera footprint. We have assumed that robust co-registration of video frames by the featureless frequency domain-based automatic technique requires 90 % overlap between sequential frames. As an input we have used the data obtained from the process of re-navigation – blending measurements from Doppler velocimeter with LBL fixes from the transponders with known position. This data also contains measurements of vehicle altitude (from the Doppler altimeter), vehicle heading and attitude. Given the starting frame (and its footprint) at the beginning of a segment, the algorithm was searching for the next frame, with the footprint overlapping with the previous one by 90 %t. Number of skipped frames was recorded for the next processing stage. A typical record for a segment looks like the following:

```
 18  34    35.0000   2450.0600    5.2825   259.6470   -8.8886    0.8217 586027.2660  89086.3681
 18  36     4.0000   2449.1700    6.0600   258.8220   -8.6046    0.6221 586012.2151  89085.5318
25,122,102,88,83,86,121,102,113,139,148,163,138,146,159,77,98,106,63,72,107,97,95,113,107,23
```

First two lines show the navigation and attitude data for the beginning and end of the segment respectively (hour/minute/second/depth/altitude/heading/pitch/roll/UTM X/UTM Y). The third line starts with the number of frames required for the mosaic of this segment, 25, followed by numbers of skipped frames between the frames that are going to be used for mosaicing. The sum of these numbers, 2668, corresponds to the number of frames in a period of time from the beginning to the end of the segment, 1 min 29 sec.

The following stages of processing will consist of automatic acquisition of frames, specified in segment descriptions, their pre-processing (correction for lens distortion, cropping, contrast enhancement), pairwise co-registration, and combination in mosaics that can be geo-referenced by using results of re-navigation.

On three dives (4115, 4117 and 4124), imagery from the downlooking still digital camera was collected for the purpose of creation of a map of the Rosebud site, to be compared to the analogous map of this site created from the data collected in 2002 on dive 3790. On the first two dives data from the LBL transponders were available, and so the data collected by DVLNAV underwent the process of re-navigation. Positioning and attitude information associated with the moments when the images were taken (images have creation timestamp encoded in EXIF information and after downloading from the camera are renamed accordingly to this timestamp) are used by the program PatchMap to display georeferenced locations of image footprints. Color on the produced map indicate density of coverage.

The least robust measurement in this processing is the camera altitude that defines size of the image footprint. DSV Alvin usually has two altimeters, but one of them was flooded in the beginning of the cruise, so only the data from the Doppler altimeter have been used. It is mounted 6.553 meters aft of the bow, which is the furthest point forward on the hull (just behind the pilot's viewport). The altimeter is measured to be -1.124

meters from the metal bottom skids. The raw data reported by the altimeter is corrected for this vertical offset before logging. Nevertheless horizontal offset between the altimeter and the camera makes an assumption that size of the image footprint is known unreliable. This was confirmed by comparison of overlap between two consecutive images based on navigational data and from imagery. Often images that have to have significant overlap according to the navigational data, do not have it in reality at all. Although this may be explained by inaccuracies in positioning, the most likely reason is the altitude errors.

Figure 10 shows the output of PatchMap – combined coverage from three dives. The density of coverage and absence of significant gaps suggest that the post-processing would allow for construction of the map for comparison with the Rosebud map from 2002.

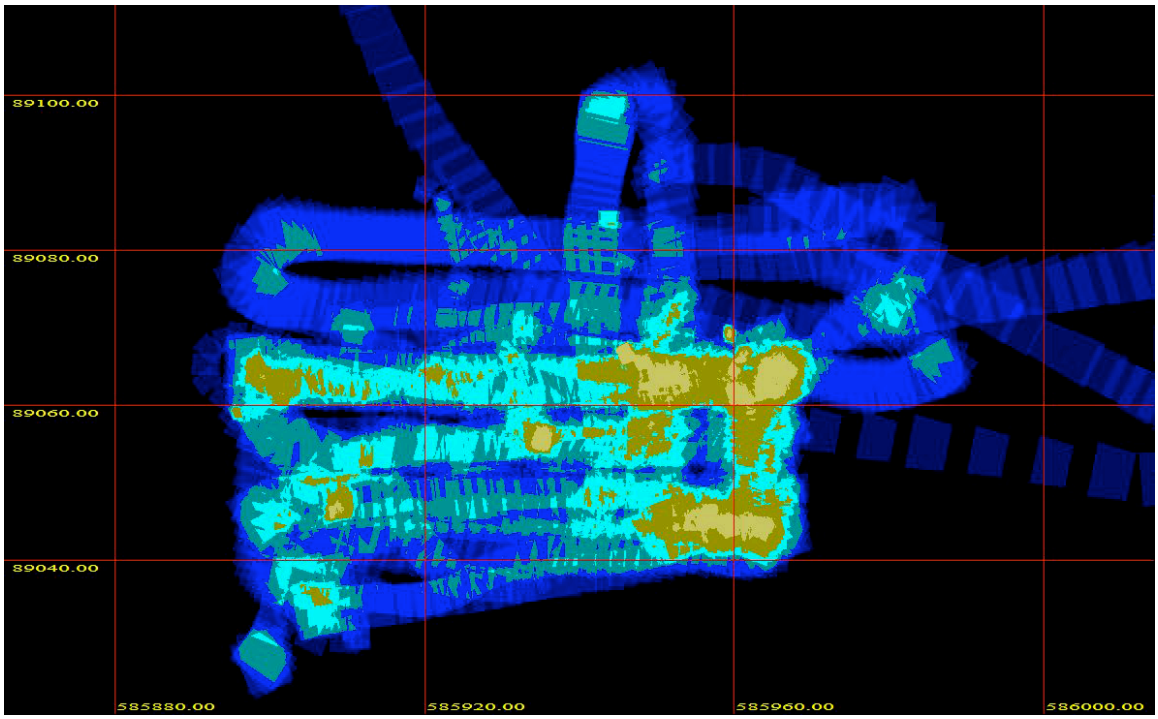


Fig. 10. Coverage of downlooking Alvin digital images over the Rosebud vent field. Dark blue is light blue is %, brown is % and tan is & overlap.

4.3 Microbiology

Filaments of sulfur bacteria attached to the colonization blocks consisted of extremely large cells (estimated diameter 50 μm) packed inside a rigid sheath and containing phase-bright globules that we assume to be sulfur. Filamentous sulfur bacteria from deep hydrothermal vents have been previously reported, but the large size of these cells is unusual and to our knowledge there are no published accounts of similar morphologies from deep vents.

More than 200 microbiological samples were collected, from multiple individuals

of *Riftia pachyptila*, *Bathymodiolus thermophilus*, and *Calyptogena magnifica*, as well as a smaller number of other vent fauna. To our knowledge this is the most comprehensive collection of surface biofilms from deep hydrothermal vents yet performed, and will allow us to gain a better understanding of the role of these biofilms, together with diffuse fluid chemistry, as settlement cues for vent fauna.

The primary objective of the microbiological work conducted on this cruise was to determine the structure of prokaryotic communities that form biofilms on the surfaces of vent fauna and other solid substrates. This information will be used to gain a better understanding of the role of these biofilms, together with diffuse fluid chemistry, as settlement cues for vent fauna. Preliminary data collected from a limited number of *Riftia pachyptila* individuals from the East Pacific Rise suggested the presence on the tube exterior of a diverse bacterial population that differed in composition from that found in the water column and on inanimate (rock) surfaces. In returning to the Rosebud and MusselBed vent sites, we intended to sample multiple *Riftia* individuals, to determine (a) whether the apparently characteristic tube biofilm population was supported by more intensive sampling, (b) whether different parts of the tube were inhabited by different bacterial species, and (c) whether bacterial populations found at Rosebud would resemble those found at EPR. Collection of biofilms associated with other vent fauna, and with inanimate surfaces, was planned. We also aimed to perform colonization experiments in which the settlement and colonization of both microbes and macrofauna would be investigated after a short (approximately 10 day) deployment. We expected these experiments to help us identify the primary microbial colonizers, which provide the foundation for development of a complex biofilm.

During 11 Alvin dives between May 21 and May 31 2005, we collected biofilm samples from 38 *Riftia* individuals, of which 17 were sampled in triplicate and the remainder once only, giving a total of 72 biofilm samples. Three *Riftia* trophosome samples were preserved for investigation of microbial symbionts. A total of 33 *Bathymodiolus thermophilus* individuals were sampled (11 in triplicate), resulting in 55 separate biofilm samples. Biofilms were also harvested from 5 dead mussel shells (total 7 biofilm samples) collected at MusselBed, and 3 *B. thermophilus* gill samples were preserved for future symbiont studies. Seven *Calyptogena magnifica* individuals were sampled (total 9 biofilm samples), and 3 gill samples also retained for analysis of symbionts. Other animal biofilms sampled included those from 5 *Tevnia*-like tubeworms (total 11 samples), one shrimp, and one galatheid crab. Fourteen biofilm samples were obtained from the surfaces of ten different rocks, and background water column samples were taken once using major pairs, and twice with Niskin bottles (10 liter volume) mounted on the TowCam. Biofilms were also harvested from multiple surfaces of colonization panels, with sampling being guided by the location of macrofauna. Where possible, biofilm samples were taken from areas colonized by fauna and control areas lacking faunal settlement. A total of 43 samples were harvested from the colonization experiments. The final number of samples taken during the cruise exceeded 200, providing us with an excellent opportunity to examine the composition of microbial communities associated with vent surfaces, in the context of the chemical data.

Phase-contrast microscopy of the samples suggested the presence of active bacterial communities on nearly all surfaces examined. The *Riftia* tube surface was particularly heavily colonized, and similar cell morphologies were observed in multiple

individuals, from Rosebud, Garden of Eden, and the new vent site discovered on Dive 4124. Dominant members of the flora included phase-bright rods, probably indicating intracellular deposition of sulfur, and filamentous cells of several different morphologies. As the bulk of sample processing (DNA extraction, PCR, cloning and sequencing) and analysis will be conducted at TIGR post-cruise, information regarding the exact composition of the bacterial communities is not yet available. We recovered several pieces of rock and a galatheid crab that were heavily colonized by extremely large filamentous bacteria, visible to the naked eye. These filaments also dominated the biofilm formed on the colonization panels. Phase-contrast microscopy showed these filaments to consist of very large cells (estimated diameter 50 μm) packed inside a rigid sheath and containing phase-bright globules that we assume to be sulfur. Filamentous sulfur bacteria from deep hydrothermal vents have been previously reported, but the large size of these cells is unusual and to our knowledge there are no published accounts of similar morphologies from deep vents. Samples were preserved for future light and electron microscopy, and for the phylogenetic analysis that will allow us to place these bacteria in relationship to other large sulfur bacteria.

4.4. Chemistry

We have obtained the first simultaneous *in-situ* chemical and temperature data for the Galápagos Rift hydrothermal system. Real-time ("Ghostbuster") and time-series (data-logger) data reveal close correspondence between chemical species concentrations and temperature- the higher the temperature the greater the dissolved concentration of H_2S and H_2, while pH lowers. Preliminary data suggest that at the highest temperatures encountered at Rosebud (Marker B) (approximately 17-18°C), pH (in-situ) is nearly two log units lower than ambient seawater.

The relatively high temperatures observed for mussels at Rosebud (Marker B) suggest dissolved redox chemistry and pH similar to that of the nearby *Riftia*-sourced fluids, although this point needs to be confirmed by more complete examination of the data from this and other sites.

The maximum dissolved H_2S measured and/or monitored (in-situ) or directly sampled from vent fluids during the cruise is more than a factor of 20 lower than reported in 2002. It is likely that this will have a very significant effect on the bio-geochemical evolution of the system with concomitant effects on faunal communities at Galápagos.

The primary objective of the geochemistry group from the University of Minnesota was to acquire time series data on the chemistry of diffuse flow vent fluids issuing from bio-geochemical environments on the Galápagos Rift. Three different approaches were used to accomplish cruise objectives. The first and second entailed the use of in-situ chemical sensors, while the third made use of conventional "majors" samplers that were used to obtain discrete samples from approximately 25 vents (**Table 6**). These samples revealed a vent fluid chemistry dominated by mixing with seawater as indicated by the moderately low temperatures and moderate values of pH and alkalinity. In general, the highest temperatures (~17°C) and lowest pH values were observed for fluids issuing from the base of Riftia at Marker B, Rosebud vent complex. Full fluid chemistry for major and minor dissolved species will be determined in the geochemistry labs at the University of Minnesota.

In addition to the discrete samples, a major activity of the group involved deployment of real-time and time series in-situ chemical sensors throughout the Galápagos vent field. Real-time measurements of temperature, pH and redox species was provided using the chemical sensor array- or "Ghostbuster", as it is more endearingly referred to by the Alvin group.

4.4.1 Real-time in-situ temperature and chemistry

This Ghostbuster array of temperature and electrochemical sensors is used an ICL/RS232 communication package to provide continuous information on vent fluid temperature and chemistry (**Figure 11**). As with all devices of this sort, however, steady state temperature is an essential prerequisite for acquisition of quantitatively meaningful chemical data.

Fig 11. "Ghostbuster" chemical and thermal sensor on the DSV Alvin prior to a dive.

Preliminary assessment of real-time sensor measurements by the UM group and other cruise participants indicates moderate success in fulfilling this requirement (**Figure 12**). For example, data indicate that approximately 50% of the real-time measurements failed to satisfy the steady state condition. One reason for this likely involves the relatively low vent temperatures, which is an indication of dynamic mixing processes near vents, shrinking the region of maximum temperature stability. Even so, the data that were obtained indicate relatively low H_2S concentrations for the 2005 Galápagos vent fluids, perhaps less than approximately 50um/kg. These preliminary estimates contrast greatly with H_2S data obtained from similar vents in 2002 where values as greater than 550 um/kg were reported.

In-situ pH and H_2 data have not yet been assessed. Thus, Ghostbuster measurements indicate the following:

- The highest measured in-situ temperature is 20.4°C during dive 4120, Garden of Eden
- The highest measured temperature in the Rosebud field is 17.1°C, obtained during dive 4114 at Site, Marker B.
- The Ghostbuster sensor package was used effectively on 10 dives. The lone exception (dives 4119) was caused by Alvin communication difficulties.

Following unambiguous interpretation of temperature measurements during all dives, chemical variability of redox species and pH will be assessed with good accuracy in order to constrain better the feedback between geochemical and biological processes.

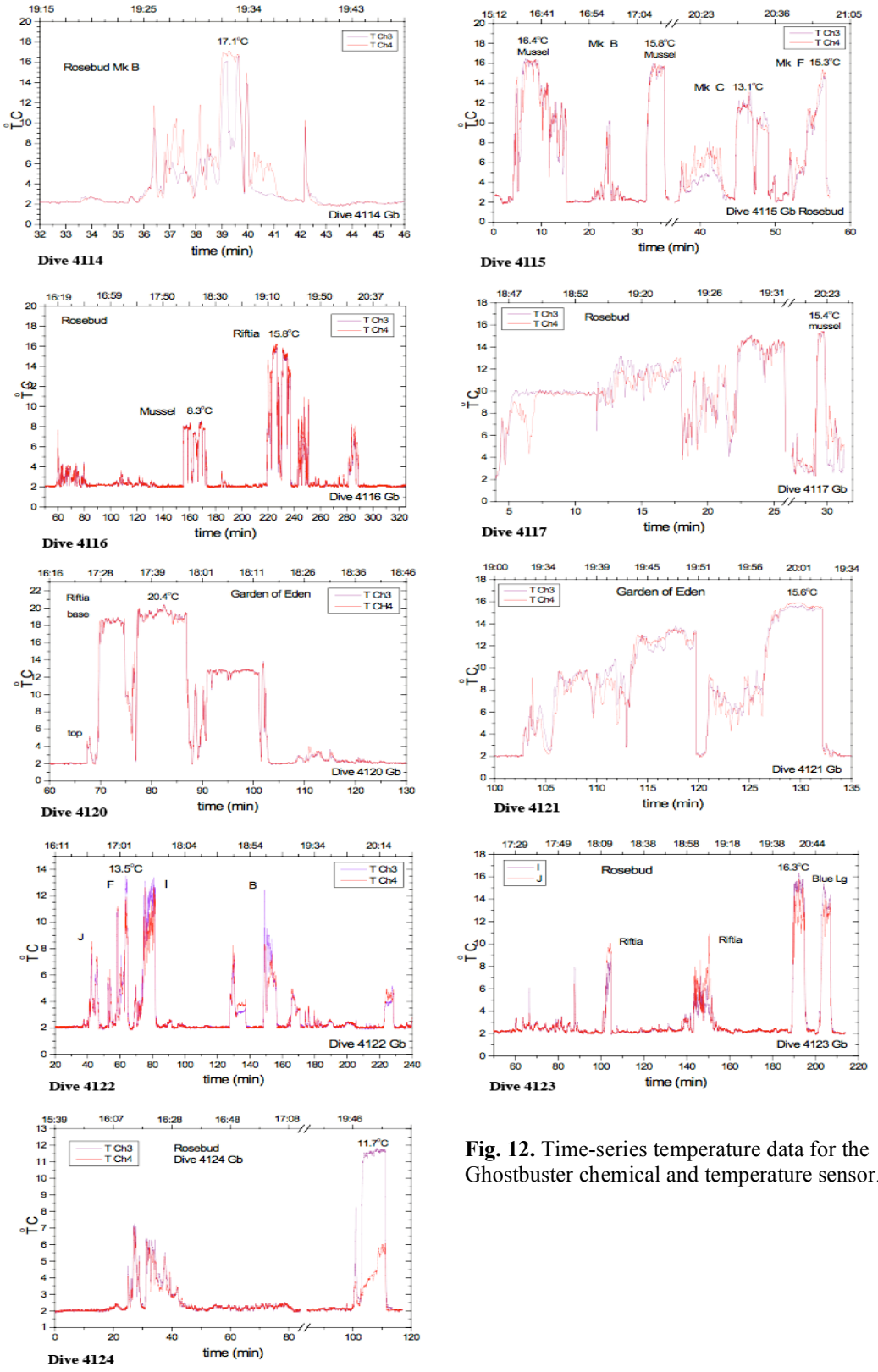


Fig. 12. Time-series temperature data for the Ghostbuster chemical and temperature sensor.

4.4.2 Data-logger deployment/results

During the first series of dives to the Galápagos vents in 2005, chemical and temperature data-loggers were deployed at Rosebud in direct association with

colonization panels. In-situ communication data for the deployed loggers revealed inconsistencies attributable to unusual power consumption. Accordingly, the deployment periods were shortened to 3-4 days, rather than the initially anticipated 8-10 day deployments. Results from 1 data-logger indicate small scale and recurrent temperature variability- on the order of 10-20%, together with moderately low H_2S (analogous to data obtained from real-time measurements), which fluctuate too, but precisely in phase with temperature variability. Preliminary pH data suggest acidification relative to seawater by as much as 2 orders of magnitude, with the lower pH corresponding to the higher temperature fluids. Similar results exist for dissolved H_2, although these data may be close to our analytical limits of detection. Additional efforts will be needed to quantitatively establish the monitored geochemical signals in terms of the high-resolution time series trends. This will be accomplished during subsequent analysis at the University of Minnesota.

Water Samples – U. of Minnesota				
Dive	**Sample**	**Location**	**T (°C)**	**pH**
4114	M-4114-23	Rosebud / Marker B	17	7.6
	M-4114-24	Rosebud / Marker B	17	7.8
	M-4114-25	Rosebud / Marker B	17	6.9
	M-4114-26	Rosebud / Marker B	17	7.4
4115	M-4115-23	Rosebud / Marker B	15	7.0
	M-4115-24	Rosebud / Marker B	15	7.6
	M-4115-25	Rosebud / Marker B	15	7.1
	M-4115-26	Rosebud / Marker B	15	7.2
4116	M-4116-23	Rosebud / Marker N	17	7.0
	M-4116-24	Rosebud / Marker N	17	7.1
	M-4116-25	Rosebud / Marker N	16	7.1
	M-4116-26	Rosebud / Marker N	16	7.0
4117	M-4117-23	Rosebud / Marker I	14	6.8
	M-4117-24	Rosebud / Marker I	14	6.6
	M-4117-25	Rosebud / Marker I	15	6.6
	M-4117-26	Rosebud / Marker I	15	7.0
4120	M-4120-23	Garden of Eden	seawater	
	M-4120-24	Garden of Eden	seawater	
	M-4120-25	Garden of Eden /Marker Q/Riftia	18	7.2
	M-4120-26	Garden of Eden /Marker Q/Riftia	18	7.3
4121	M-4121-23	Garden of Eden /Marker Q/Riftia	16	7.0
	M-4121-24	Garden of Eden /Marker Q/Riftia	16	7.2
	M-4121-25	Garden of Eden /Marker Q/Riftia	16	7.0
	M-4121-26	Garden of Eden /Marker Q/Riftia	16	7.3
4122	M-4122-23	Rosebud / Marker I	12	7.3
	M-4122-24	Rosebud / Marker I	12	7.2
4124	M-4124-23	New Site / XY: 2342_61532	8	7.6
	M-4124-24	New Site / XY: 2342_61533	8	7.5
	M-4124-25	Rosebud / Marker B	17	6.9
	M-4124-26	Rosebud / Marker B	17	7.6

Table 6. Fluid samples ("majors") obtained from vents in 2005 during Galápagos Rift Expedition (11-27).

4.5. Geology

Based on Multibeam sonar and detailed ABE near-bottom altimetric mapping, the 4 km wide rift valley of the GSC in the Rosebud area is characterized by steep north and south walls with 100-150 m of relief. The rift floor slopes gently to the north and south from the apex of the axial volcanic ridge (AVR) at ~2420 m to the base of the rift-bounding walls at ~2460 m depth. The AVR is composed of several volcanic cones spaced ~200-400 m apart with ~20-50 m total relief and basal diameters of ~100-300 m. The AVR trends ~280° and lies ~200 m north of a small fissure system mapped by ABE in 2002 that cuts the Rosebud vent field and is the presumed location of the dike heat source driving the hydrothermal system at the site.

Over ~25 km of the AVR was investigated using the TowCam, from 86° 15'W to 86° 0'W. The dominant flow morphologies include variably sedimented pillow lava found mainly on the volcanic cones, interspersed areas of lobate flows, some exhibiting collapse features, and zones of channelized sheet flows having a range of surface textures that suggest high effusion rates. Fissures, 1-20 m wide are nearly continuous on the crest of the AVR and are, in places, the sites of active hydrothermal diffuse flow.

TowCam #9 traversed the rift valley at the longitude of Rosebud and provides a good characterization of the relative ages of lava flows within the rift based on sediment cover and extent of faulting and fissuring across the rift floor. Small faults are observed on either side of the main rift walls within a few hundred meters of the principal scarp. Extensive talus is present at the base of the wall and overlies sedimented pillow and lobate flows. Most of the rift floor is variably sedimented pillow flows at times tending to lobate morphology. The sediment cover decreases markedly within the rift valley, compared to flows north and south of the rift walls; flows within the rift show glassy reflections in the photographs despite the sediment cover.

A glassy, curtain-folded sheet flow is present ~300-500 m south of Rosebud and has similar morphology to the flow that hosts the hydrothermal communities. Detailed mapping using Alvin and TowCam data from 2002 and 2005 cruises will be carried out in the next few months, but based on the dive and photographic observations it is clear that an eruptive fissure that sourced the flow at Rosebud is present ~100-150 m north of the hydrothermal vent field. The eruptive fissure was identified on dive 4124 and followed for ~400 m to the west. The fissure is ~1-5 m wide and 2->8 m deep, occasionally forming 5-10 m wide collapse areas along the fissure strike. The inner walls of the fissure are lined with bathtub rings indicating it was filled with lava that drained back down into the fissure within the recent past. Divers observed fresh sheet flows emanating from the fissure and flowing south. There are areas where the sheet flows shows clear channels with lineated-sheet morphologies indicating the direction of flow. The small volcanic cone north of Rosebud was also investigated and found to consist of older, sedimented pillow flows. The Rose Bowl vent community was found in one of the collapse features along the fissure ~200-300 m WNW of Rosebud.

One of the key results of the geological mapping conducted during this cruise was to unequivocally identify the source of the Rosebud flow and to confirm that it is a recent eruption sourced from an E-W trending fissure along the southern margin of the AVR in this area of the rift valley.

4.6 Geographic Information Systems

We constructed a GIS database for Rosebud and the surrounding area using ESRI's ArcMap software. We began from a base of gridded multibeam bathymetry data for the Galápagos Spreading Center. Data collected during 2002 was added to the database including vent locations, sample locations, Alvin tracks, high-resolution near bottom bathymetry, and towed-camera tracks. We added data from the 2005 cruise as it was collected including multibeam bathymetry, near-bottom Imagenex bathymetry from Alvin, sample locations, and transponder locations. Alvin tracks have metadata including vehicle attitude and downlooking photographs. TowCam tracks have metadata including CTD data and images. A total of 33,000 images of the seafloor are contained in the database.

4.7 Education and Outreach

Dive and Discover, Expedition 9: Return to the Galápagos Rift

Dive and Discover was designed in 2000 by Susan Humphris and Dan Fornari (WHOI Geology and Geophysics Department) with the goal of immersing students in the excitement of exploring the oceans. The ninth expedition took place May 20 to June 3, 2005. This expedition returned to the Galápagos Rift, located on a mid-ocean ridge about 250 miles from the Galápagos Islands where hydrothermal vents and exotic organisms were first found in 1977. Before the expedition Katherine Joyce (WHOI Graphic Services) redesigned the site; she also posted all materials to the site from shore throughout the cruise. It was the first redesign in five years. During Expedition 9, science writer Amy Nevala (WHOI Communications Department) wrote 16 daily stories, which were edited by Dan and Susan; took 7 to 12 photos daily, each with captions and photo credits; produced 9 videos, and wrote 5 interviews with scientists and crew. Also provided were the daily meals and weather. On shore, Jim Kent (WHOI Communications Department) provided daily editing for all text produced. Susan responded to more than 100 emails sent to the ship from students and the public, with the input of scientists, Atlantis crew and Alvin pilots. Danielle Fino (WHOI Web Group) provided the following statistics for the expedition:

Dive and Discover stats From May 20 to June 1

Visits
Total: 20,592
Avg per day: 1,584
Visit duration: ~14 minutes
International visits: ~11%
WHOI visits: 2.5%
Search Engine Bots - 21%
- *Note: This is much higher than usual. May be because it is a new site.

% Visits by Domain
..com - 53%
..net - 19%
..edu - 5%
..org - 1%

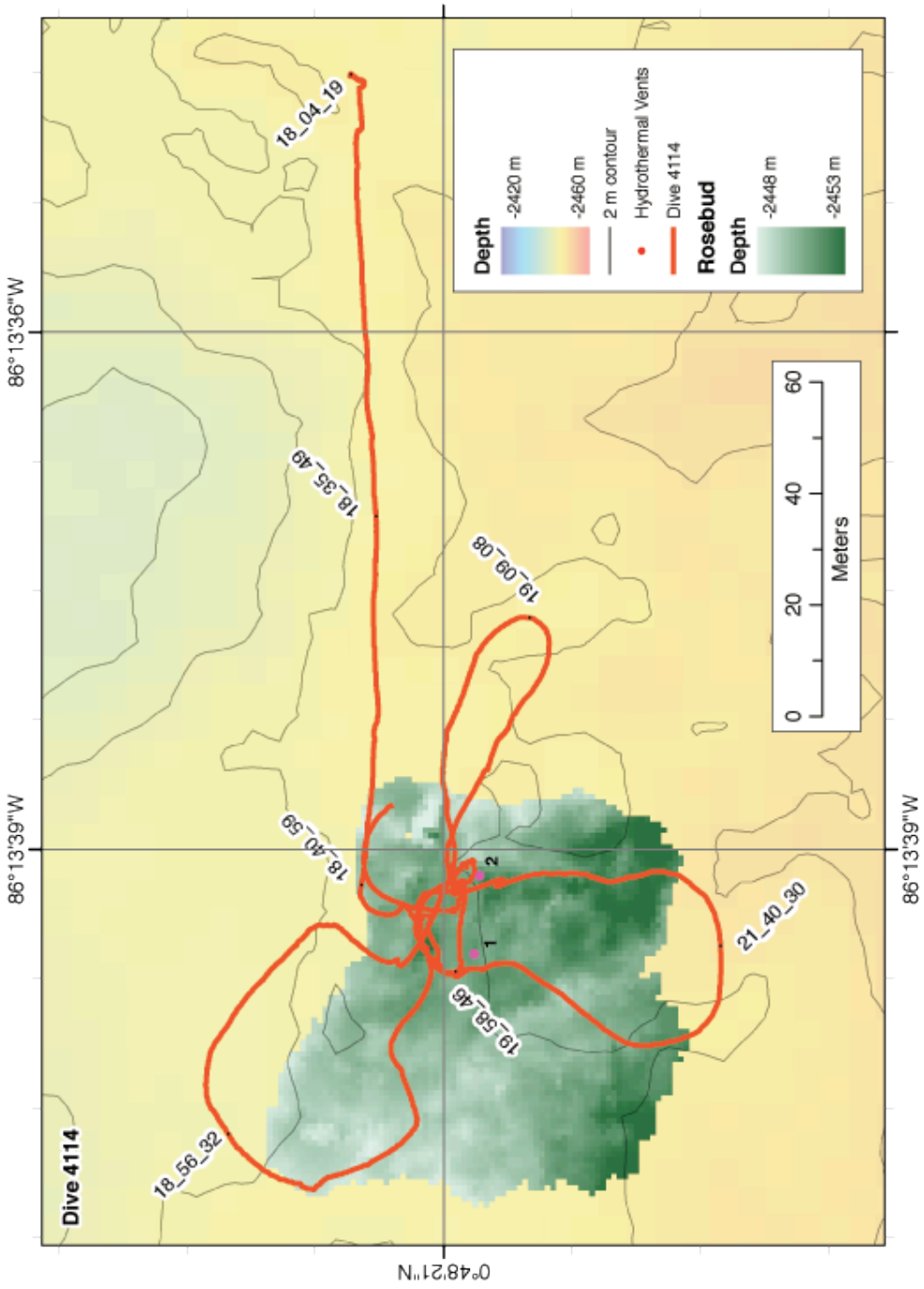
% Visits by Top Countries
United States - 89%
United Kingdom - 2%
Canada - 1%
Netherlands - 1%
Australia - 1%

% Visits by Top States
California - 43%
Mass - 10%
Virginia - 8%
Penn - 3%
New York - 3%

Images and text were also sent for use on the NOAA Oceanexplorer web portal, which also featured this expedition. A summary of the cruise can be seen on this web site: www.oceanexplorer.noaa.gov.

5. Alvin Operations

Dive 4114 – Dive Track



Galápagos Rift 2005
AT11-27

Dive 4114 May 21, 2005

Bottom Target: Rosebud- 00°48.350'N 86°13.659'W
Pilot: Gavin Eppard
Port: Tim Shank
Stbd: Kang Ding

Basket Load [water weight]

Kang Probe [12]	hi-T probe
Double biobox [8]	2 seafloor markers [2]
4-barrel enzymatic sampler [11]	Seyfried Deployable Probe [15]
hydraulic slurp gun [15]	6 basalt plates (3 native/3 block)[18]
2 major pairs (ICLs) [66]	5 vemcos [5]

Dive Objectives

The major objectives of this dive are to conduct a reconnaissance survey of the Rosebud Field; characterize the fauna and habitats through detailed imaging and chemical surveys; and deploy autonomous chemical logger with colonization panels and time-lapse temperature probes.

Datasonics altimeter had a ground. Framegrabber did not work until late in the dive. In sub navigation was very good. Downlooking images likely not good until short survey at end of dive.

15:30		Commenced dive.
15:58	1000m	Turned Maggie on. Completed two spins at 1000 meters in both right and left directions- took place over the span of 5 minutes. Downlooking camera had a ground so secured it until checked again on bottom.
16:30	1400m	tested Ghostbuster/Kang Probe and works well. The ICL connection to the Logger intermittent at best. Think the problem is in the cable from the boot.
17:18	2447m	On bottom and trouble shooting grounds for the last 500m. The datasonics altimeter has an 9 ground (flooded). Secured for dive.
18:00	2447m	Setting up. Rebooting computers and all sensors.
18:12		All systems appear to be back up except for the framegrabber. Then set up camera systems for transiting to site.
18:15		Our landing position is 150m at 272 away from Marker A at Rosebud.
18:24		Noted spaghetti worms at landing site. Much smaller than seen before, brachyuran crabs, nematocarcinid shrimp. On lobates with shallow collapse wall. Water is particularly murky here.
18:30		Traversing to site seeing contact between lobates and very fine curtain folded flow trending SW and NE. Some sediment- mostly a dusting with red holothurians. Water still murky.
18:32		Contact with sheet flow and hackley folded flow; collapse here. Rat tails and red shrimp here. We're 130 meters away from the site.
18:35		x2449 y61468 Broad lobates with little fingers once in a while. Red holothurians.
18:37		x2541 y61467 Sheet flow over lobates- 56 meters away. Starting to see actinostolid anemones.

18:40		Now seeing a dandelion or two. Water still murkey. Galathieds and bythitid fish more abundant. Okay, now seeing tubeworms off in the distance, and slowing down to take a panoramic view on the port pan and tilt. We then moved forward to get a closer look. Seeing Marker A and B as well as tubeworms north and south along the crack leading through A and B sites. We moved to go by and to the south of the communities in order to circumnavigate the field. There is a large (sub length) collapse trough ringing the northern end of the field. Anemones and serpulids around the outskirts as well. Coming back to the A and B marker areas. The main line of communities here are on a 160°trend.
18:58		Noticing a collapse ring around the northern end of the field.
19:16	2451m	At maker B. community.
19:18		Imaging panorama of Marker B Community.
19:27	2452m	2502 61448. Ghostbusting at the base of the tubeworms – 17.1°C.
19:40		Trying the alving hi T probe in same spot- 14°C. hdg- 286.
20:07		Taking MP yellow, but ram is too short.
20:14		Trying MP Blue- right side fired. No ICL temperatures (Hi-T probe 14.3°C). Okay, now they are both firing.
20:19		Trying Yellow MP again. Yes, it is firing- 14.3°C hi T probe.
20:30		Deploying blue (sensor head) logger at the bast of the Riftia. Logger is actually yellow. Deploying basalt panel on top of logger. Now the blocks are being deployed. White panel (#6) is on top of the logger at 20:40. Yellow vemco is north of white panel. Panel #5 is south of logger on basalt. Panel #1 is placed amongst the worms. The green vemco was placed at the base of the worms.
21:24	2451m	We're moving north a bit to grab some animals (just north of marker A) to start our processing. x2487 y61448. We're on the side of a collapse where leaky flow is coming out. *Riftia* and mussel clumps. Grabbing 3 mussels and placing them into Chamber #2.
21:28		Now grabbing Riftia at the same location- x2487 y61448. Placing them in Chamber#3. Depth is 2451m.
21:40		Starting slow very short downlooking survey over Marker F, A, and B. Good coverage.
21:46		Weights away.

Dive Report – Stbd Observer

Dive 4114 May 21, 2005

Pilot: Gavin Eppard, Port: Tim Shank, Stbd: Kang Ding
Target area: Rosebud (00º 48.350'N, 86º13.659'W)

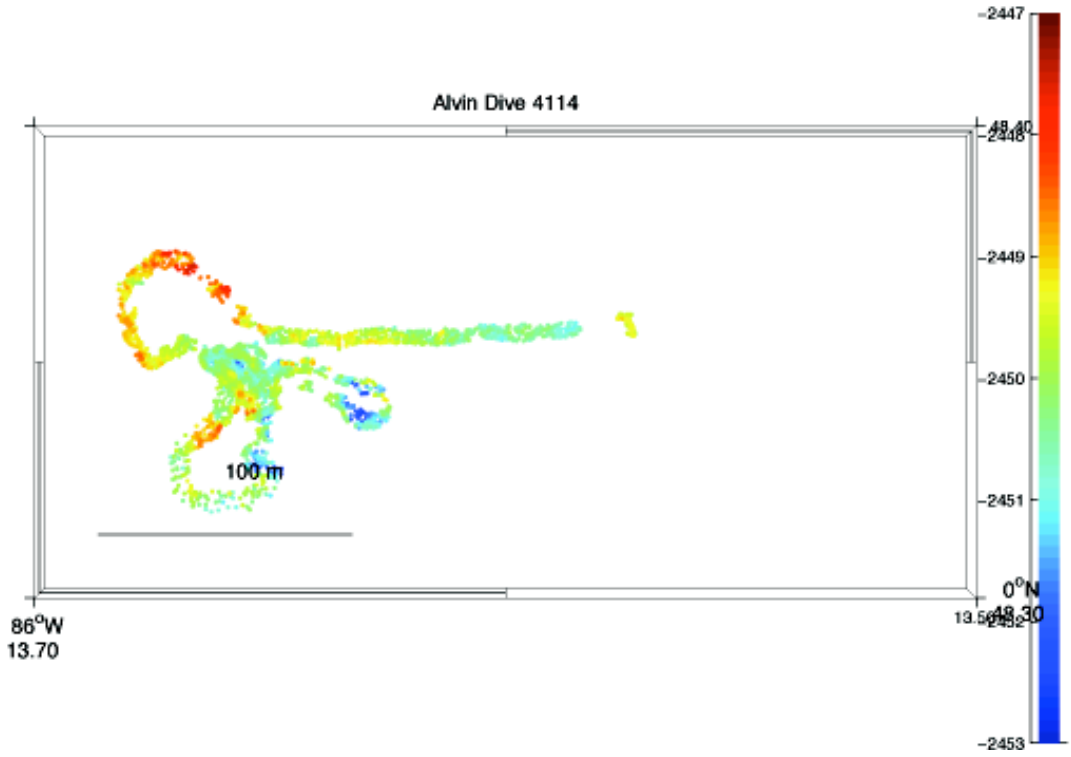
Recorded by K. Ding

15:30 Hatch sealed, bridge and A-f ready for launch
15:33 in the water, UQC check, detecting Ground
15:36 Ground seen (Dan's cameral?), Dan's cameral is off, then Grnd is gone.
15:40 Diving
16:00 Magie is on, depth 500m
16:11 800 m, Magie 2 spins in ach direction
16:19 1000 m
16:40 1400 m, checking Ghostbuster fine, Yellow Datalogger is not
16:41 1499 m, Yellow Datalogger communication come back and is fine
16:54 4~5 Ground is detected, can not be isolated, then the level is approaching 6~8
17:01 1953 m, Grnd 5.5
17:02 1923 m, Grnd up to solid 9!
17:04 begin to shut sub Sub' computers down, Grnd still 9 steady, appears from NAV box,
17:07 2094 m, talking to the top lab, secure NAV box with the depth on, Grnd ~ 7
2225 m, both Dan's cameral are removed from the line.
17:16 2329 m, preparing for landing Grnd=9
17:24 2448 m, landed
17:26 working to resolve Grnd, which is still at 9; Magie db9 is unplugged, acoustic
17:34 turn NAV box off, still 9, checking Alt-meter, grnd cleared, re-plug it back, only see thegrnd is back. We determined, it is coming from Alt-meter.
17:39 2448 m, 4 video connected, so as magie, all db9s were pluged in, no Grnd is seen, turning computers on.
17:49 Computer is on with screen
17:58 Hdg +183, 2448 m,
18:07 Checking Ghostbust(Gb) in using file D4114B, T read out 2°C, Yellow Datalogger is also checked with 2°C read-out, using file D4114Bd
18:32 heading +259, X 2593, Y 61468, depth 2450 meter. Gb is kept on. Sub is moving, seen fresh basalt, vent animals
18:40 Gb: 2.1°C, see Galazhil crab (?) Hdg +271, X 2510, Y 61468, Alvin Amb Tmp: 2.09ºC
18:41 see Mark A, big and tall tubeworm, fish, red shrimp, mussel, Gb: 2.1°C,
Hdg +270, X 2496, Y 61469, Alvin Amb T: 2.115ºC
19:05 back towards the B vent area , from the distance see smoke-like grayish flow out of of Mk B riftia pacth. Gb T up to 2.3°C from 2.1°C. The tubeworm is big with large fat plum. Hdg: 76, X 2514, Y 61448

19:20 Gb 2.6~2.7°C, see 02 B marker, Hdg 263, X 2502, Y 61448
19:23 using Gb into worm patch, on up portion of the tubs, see T as 10.4°C
19:26 at the base of tubes, Gb reads a 17.1°C
19:40 Gb is taken out from the base of Riftia. Alvin HT probe is getting ~14°C. Heading +286, X 2501, Y 61447.
20:08 Taking MP Yellow, it is not fired, ram too short
20:10 trying MP Blue
20:12 right side of MP Blue is fired. MP ICL is not working. But left side is not fired. (B marker site)
20:22 Ht probe reads 14.3°C
20:24 deploying the logger DL (sensor head is Blue, logger is yellow). Pin is pulled out. Arm is on the sensor' handle. The senor tip is moved into the tube base. Deploying marker 6 (?). The marker string flowed away. ICL for DL is nor working, only with occasional communication, reads out 11.6°C-12.6°C. Placed yellow and blue VAMCO (small T logger). Panel #1, Green Vamco
20:54 2451 m, hding +286, y 61447, x 2502. still deploying, the 4th is empty
21:00 bio-box opened. Block #2 moved out, and red Vamco, #4 is on right off the sensor. Lost Blue Vamco, found latter.
21:19 Hdg +336, 2503, 61447, 2451 m, picking bio-samples. 2 Mussel samples are placed in chamber of the first left. Tubeworm is in the first right.
21:29 Lid is closed. MP are all fired.
21:34 2449 m, + 249, 2487, 61406
21:39 +227, 2477, 61418, sub is moving.
21:45 +333, 2445 m, 2499, 61447, using magie at F, B, A marker sites. All the weights are away.

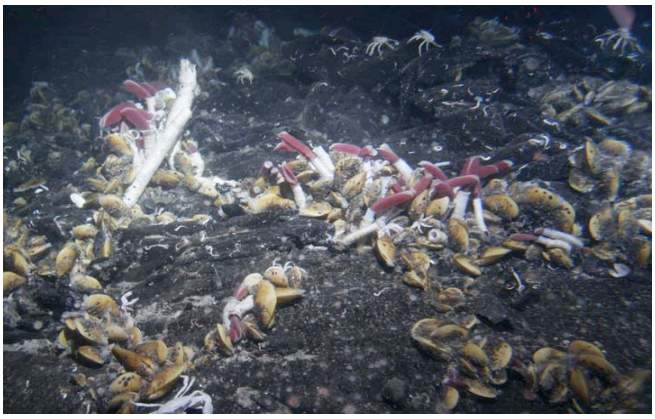
Bottom time: 4 hours 21 min.

Dive 4114 Imagenex



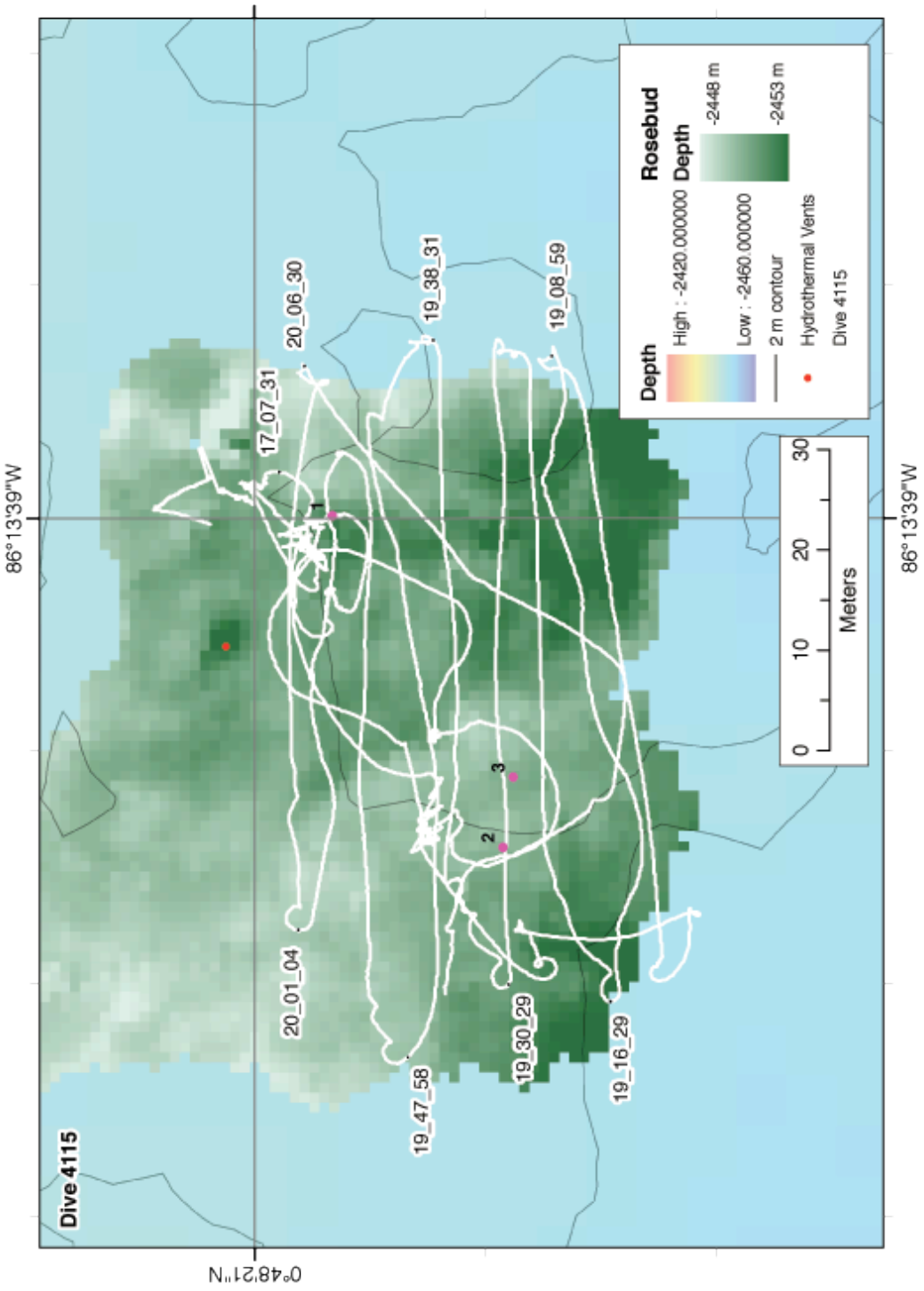
Dive 4114 – Pictures

Rosebud Marker B Site



Rosebud mussels and Riftia tubeworms

Dive 4115 – Dive Track



Galápagos Rift 2005
ATL-27

Dive 4115 **May 22, 2005**

Bottom Target: Rosebud – 00°48.35'N 86°13.659'W
Pilot: Tony Tarantino
Port: **Susan Humphris (tape transcript)**
Stbd: Bill Seyfried

Basket Load [water weight]

Kang Probe [12]	hi-T probe
Double biobox [8]	2 seafloor markers [2]
4-barrel enzymatic sampler [11]	Seyfried Deployable Probe [15]
hydraulic slurp gun [15]	6 basalt plates (3 native/3 block) [18]
2 major pairs (ICLs) [66]	5 vemcos [5]

Dive Objectives

The major objectives of this dive are to deploy autonomous chemical logger with colonization panels and time-lapse temperature probes; conduct a downlooking mapping survey of the Rosebud Field; characterize the fauna and habitats through detailed imaging and chemical surveys; sample biological communities for genetic studies; and deploy larval traps.

Ground at the surface; became more intermittent on the way down. Isolated to the Maggie during descent. At bottom, had a major ground (8); all systems shut down, and ground isolated to the down-looking camera, which was shut down until the survey. Navigation good throughout the dive.

Time	Depth	
1435	950	Turning on the Maggie.
1100		Commence Maggie spins – about 2.5 minutes per rotation; clockwise first
1330		Just finished two clockwise spins, and starting two anti-clockwise spins
1530		Just finished anti-clockwise spins. Will leave the Maggie on, but unplugging it from computer to check the grounds.
1515		Ghostbuster tested – seems to be working fine.
1520		Blue logger tested – some error messages, but working. Isolated the ground to the Maggie, so turning it off for the dive.
1540	2440	Bottom in sight – fresh sheet flow with a lot of serpulid worms; lava has glassy surfaces. Galatheid crabs, some anemones. Lot of mussels in the area. Marker B in sight to port.
		On the bottom; have an 8 ground. Securing electrical systems and computers to try to determine the cause.

1624 Sitting on bottom at Marker B. The down-looking camera is causing the ground so it has been secured and booms are in.

1629 Everything on – Imagenex, video, framegrabber, and Insite camera. Maggie and down-looking camera are secured. Heading towards the mussels and will look for a place to deploy the logger.

1647 2452 Just completed some measurements in a clump of mussels with the ghostbuster as a possible place to deploy the logger:

x: 2498 y: 61446

Base of clump: 16.1°C

Middle of clump: 13-13.5°C

Top of clump: 5-10°C

Now moving to a second mussel clump location nearby to see if the temperatures are higher or more stable.

1708 Maximum temperatures reached in second clump was no more than 9°C, so moving back to first location to deploy the blue logger. Will repeat the ghostbuster base measurement, and then will do the major pairs.

1714 Just remeasured the base T at the first location: 15.3-16°C, so will take both major pairs here and then will deploy the blue logger.

x: 2501 y: 61445

1721 2452 Taking the blue major pair – ICL T measurement: 15.3°C; both springs back.

1728 Filling the yellow major pair – T measurement: 15°C; both springs back.

1729 Water sampling completed; getting ready to deploy the blue logger.

1732 2452 Deploying the blue logger – it is communicating and is reading T=8.5°C

1743 Still working on blue logger – temperatures from 8.5-9.1°C. Trying to get it into the hotter part of the flow

1746 Logger is in place, and will deploy one of the EPR basalts on top of the probe. Now getting 10.8°C on logger.

1747 Native basalt Piece 10 on top of the logger. ICL loop released.

1752 *Panorama with 3-chip* camera showing the B Marker, all the tubeworms, and then across to the blue logger and Basalt Lava 10.

1755 Getting set up to put other basalt panels around the blue logger.

1758 In position to deploy the basalt panels.

1800 Deploying blocks:

Basalt Lava 11	Black Vemco
Basalt Lava 12	White Vemco
Basalt Cube 8	Orange Vemco
Basalt Cube 7	Blue Vemco
Basalt Cube 9	Green Vemco

1814 All blocks in position. Repositioning sub to do a 3-chip panorama.

1821 Completed *panorama with 3-chip camera*; all block markers shown up well. Going to move around to the yellow logger to try to communicate.

1833 Completed *panorama with 3-chip camera* from the side of the B site where the yellow logger is located.

DOP: x: 2493 y: 61440

LBL: x: 2499 y: 61447

1835 Yellow logger is communicating through ICL: T=15.7°C

1844 Will attempt the survey. Will drive over to find Marker C that will put us on the west side of the box, and then will design survey. The underlay base map is shifted to the north by ~20-30 m.

1845 Yellow logger seems to be communicating fine and read temperatures of 14.2-15.7°C.

1846 Leaving Marker B and heading towards Marker C. Should be ~20-25 m to the SW. Passing over Marker A – heading SW. Lot of anemones, and along the cracks there looks to be some bacterial mat.

1856 On the W. side of the field and will turn to do the first survey line to the E. Turning the down-looking camera on just for this survey – still has ground.

2013 Just completed the down-looking survey; securing the camera because of the ground. Light booms are in. Ended the survey at Marker C; getting ready to sample mussels.

2019 Settling down in a patch of abundant mussels to do some ghostbuster measurements and collect some samples.

2036 2451 Marker C mussel community: **x: 2468 y: 61429**
Taking temperatures at the mussel community:
Base of mussels: 10.6°C
Middle of mussels: 11.6-12.0°C
Top of mussels: 5-7°C
Now going to slurp at base of mussels.

2044 Completed slurp at the base of the mussels into Black Chamber. Now sampling mussels and placing them in Chamber 3.

2052 2450 Finished at Marker C collecting mussels and have put out Marker I at the site of collection. *Panorama of site and stills of site completed*. Heading to Marker F.

2057 2451 At Marker F and will repeat same measurement and sample sequence:
x: 2475 y: 61428 (target 15 on screen)
Taking temperatures in the Riftia community:
Base of tubeworms: 15°C
Middle of tubeworms: 8.8-9.4°C
Top of tubeworms: 2.5°C.

2111 Completed slurp at base of tubeworms into Pink Chamber.

2119 Sampled worms and placed in biobox. Have put Marker J at the site of collection.

2121 Collected a rock sample with biology on it from Marker J site – in biobox.

2123 Finished working at Marker F and going fish or bacterial mat hunting -- unsuccessful.

2135 Dropped weights and ascending.

Dive Report – Stbd Observer

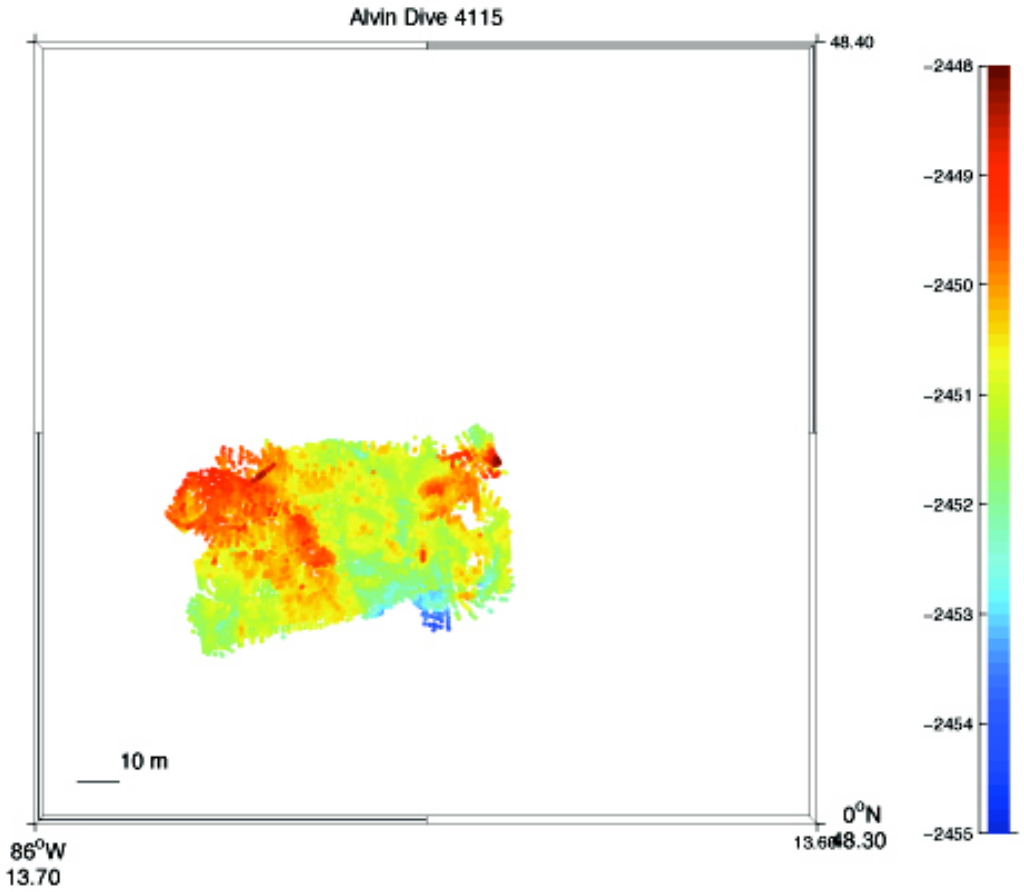
Dive: 4115:
Pilot: Tony Tarantino
Port: Susan Humphris
Stb: W. Seyfried

Date: May 22, 2005

Time	Event
~15:07 GMT	Maggie first rotation completed in a bit longer than three minutes. Second spin completed in 2. 5 minutes. Maggie likely source of ground (3 gnd)/ maggie isolated.
15:15	Ghostbuster tested no problem with communications
15:20	Datalogger tested-communication continuous-temperature external to the sub is 2.3 degrees C- no errors
15:25	Data logger (blue) tested again several error messages, but 90% successful communication.
15:27	Ghostbuster again tested- OK
15:40	Near bottom
15:41	Sheet flows observed with abundant glassy surfaces- approaching Marker B
	Eight ground on 26 plus the hull- shutting down electrical systems all computers and systems support
16:24 17:05	Ghostbuster control panel turned on- sensor data taken at mussels in the vicinity of Marker B – base T=16.1C, middle=13.5C, top=5-10C (top ~6-7 inches above the base). Ghostbuster repositioned in the attempt to locate higher temperature fluids
17:08-17:14	Ghostbuster re-deployed as at earlier test (mussel) site. Temperatures again at base about 15.3-16C (base)
17:16-17:21	Majors pair sample (Blue) ICL Temp.= 15.3 at mussels (base) at Marker B
17:25-17:29	Majors pair sample (Yellow) ICL Temp=15C
17:30-17:50	Blue Datalogger activated- no communications problems and off-loading of logger at mussels at Marker B. Communications error messages begin to appear into the deployment, but the data stream still very good. Temperature = 10.8C and basalt panel laid over the sensor tip. ICL turned off and loop released.
17:54	Basalt cubes and associated vemco (temp. probes) deployed and dispersed near the mussels and blue data-logger near Marker B.
18:14	Basalt blocks all deployed
~18:20	3-chip panorama of Marker B area carried out
18:21-18:37	Sub-repositioned to acquire ICL communication with Yellow data-logger. Very good communication link. Temp. 14.2C-15.7C
18:45	Cease communication with Yellow data-logger
20:13	Down-locking Imagenex survey completed
20:20	Site C Ghostbuster vertical profiling carried out base of mussel patch T=2.1C

20:21	3.1-3.5C (Ghostbuster) at site C mussel patch (top),
20:36	Base: 10.6C, middle, 12-11C and top ~5-7C for mussel patch temperatures
20:39	Slurping at base of community carried out
20:45	Mussel samples retrieved (Marker C) and placed in bio-box
20:49	Marker H/I placed at the tube worm mussel area
20:51	Camera stills taken at Marker H/I
20:59	Marker F
Time	Event
20:60	Ghostbuster measurements- top, middle and base of Riftia patch
	Top=2.5C, middle=3.8-5.4, base= approximately 15C
21:02	Ghostbuster measurement in the middle of the Riftia patch (F) 8.8-9.4C
21:03	GB base max measurement approximately 15C.
21:05-21:11	Slurping of the top area of the Riftia patch (marker F)
21:18	Marker J off-loaded, site of tubeworm samples
21:23	Riftia samples and lava sample taken at J-Marker and stowed in bio-box-starboard rear (riftia). Basalt (port)
21:35	Weights dropped after approximately 5 minute unsuccessful effort to catch bithidid fish.

Dive 4115 – Imagenex

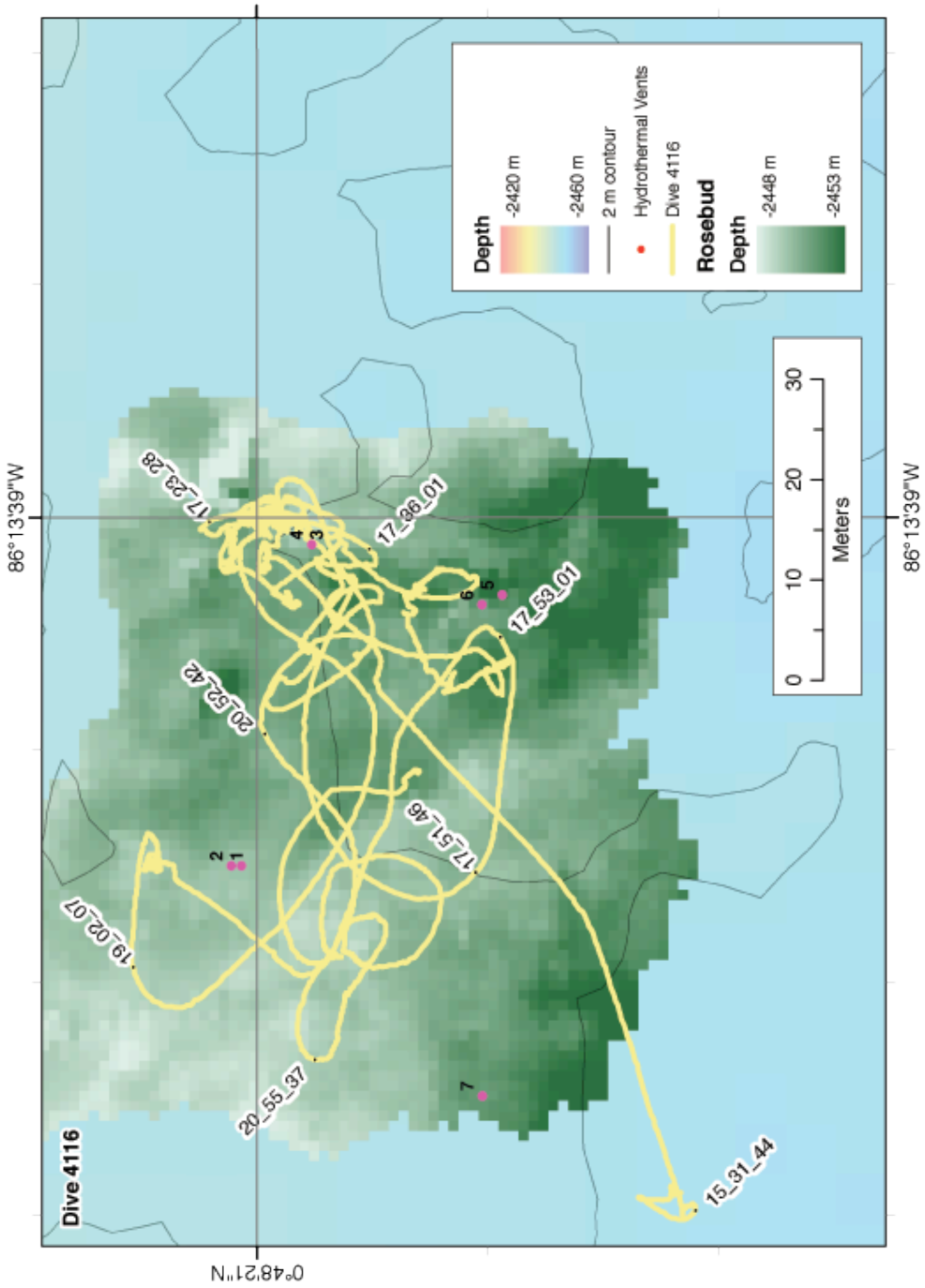


Dive 4115 – Pictures

Basalt panel experiment at Marker B, Rosebud

Brachyuran crabs climbing over mussels at Rosebud

Dive 4116 – Dive Track



Galápagos Rift 2005
AT11-27

Dive 4116 May 23, 2005

Bottom Target: Rosebud- 00°48.350'N 86°13.659'W
Pilot: Bruce Strickrott
Port: Tim Shank
Stbd: Vinod Kohsla

Basket Load [water weight]

Kang Probe [12]
Double biobox [8]
4-barrel enzymatic sampler/reservoir[13]
2 major pairs (ICLs) [66]
Glass Planet [8]
hi-T probe
4 seafloor markers [2]
hydraulic slurp gun [15]
CBS News Hi Def Camera in ball (8)

Dive Objectives

The major objectives of this dive are to deploy the RatCam at the Marker B mussel site; characterize the fauna and habitats through detailed imaging and chemical surveys; sample biological communities for genetic studies; and deploy larval traps.

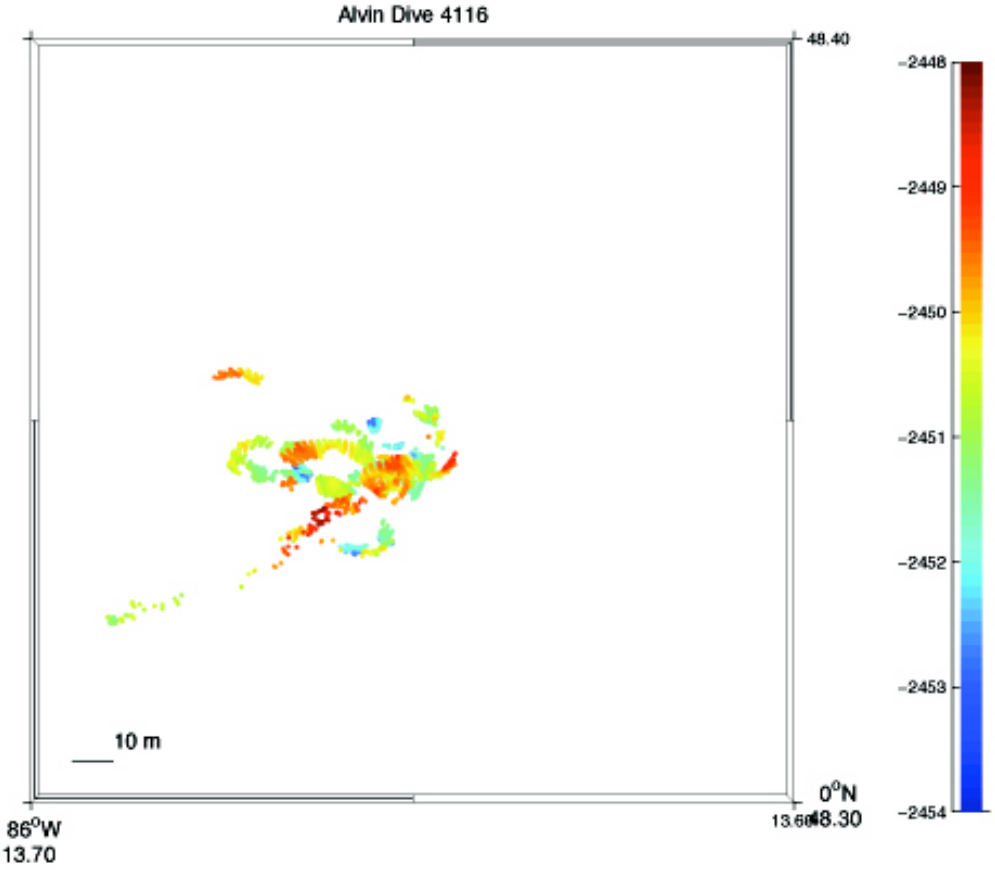
Reminder: turn on Maggie once in the water; near bottom, turn on Imagenex, Video, Framegrabber, Downlooking Camera (boom strobes out), Insite Camera

"02 A" Riftia Community (x2498 y61430)(D4114)
"02 B" Riftia Community (x2501 y61445)(D4115)
"02 C" Mussel Community (2468 y61429)(D4115)
"02 F" Mussel Community (2475 y61431)(D4115)

14:00		In water
14:03	100m	Turned Maggie on.
14:38	1000m	Started two spins at 1000 meters in both right and left directions- took place over the span of 5 minutes. Fired up Kang probe- works well.
14:45		Stopped Maggie spins.
14:56	1711m	Moving away from the Ratcam- don't want to land on it.
15:05	2100m	Imagenex on.
15:17	2375m	CTFM sonar on and noticed RatCam
15:32		Leaving landing site.
15:39		At Marker B (2520 61327) Hdg 296
15:45-15:53		Talking to the blue logger. 10° to 8°C.
15:51		Reset Doppler to marker B. Current pushing us due east.
16:16		Panorama with the 3chip camera at Marker B.
16:20		Setting up to move Ratcam over Marker B mussels. Put RatCam in place. Moved to western part of field. Found mussels with low flux and no *Riftia* present. Only one anemone.
18:06	2450m	2471 61456; 8°C, Ghostbusting down on the basalt beneath and around mussels.
18:08		7.9°C; 18:10 to 18:11:25
18:18-18:18:44		Ghostbusting in mussls- seeing 8.5C and stable.

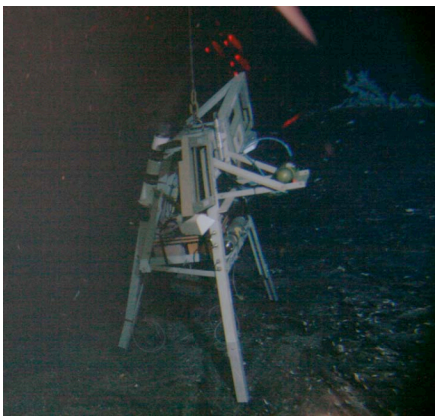
18:32		Slurp sample within the mussels (green chamber). Not a lot of power in the slurp. Depth 2451m. Took digital pictures of this mussel clump which is aligned on a 269 bearing.
18:42		Grab sampling of mussels where chemistry was taking. This will be Marker M at x2471 61455.
18:51	2453m	x2471 y61456 at marker M taking basalt sample coming up with the mussels. Hdg 278. Placed in Chamber 1. It's a sheet flow from under the mussels. Now we're going to leave here and find a healthy *Riftia* community without mussels in contact. I saw some just a sub length away from Marker B.
19:37		Okay, now we're in front of the *Riftia* patch. Ghostbusting with temps of 14°C-looks hotter. 2452m. Slurping into red chamber. 2503 61448. Hdg. 146.
19:46		Bruce is grabbing a tubeworm and half the clump came up. Going to place the whole *Riftia* basket in the biobox.
20:07		Deploying Marker N here. x2503 y61448. Then moving to look for a mussel area without tubeworms. We moved a little to the west and see an isolated clump nestled between lobates. Low fluid flow. I think I see one Riftia at the base of the clump. We are setting up to use the Ghostbuster. These will be stations 11-13. Temperature is stable around 7.2°C. 2498 61429.
20:28		Slurping into black chamber
20:33		Taking a mussel grab and placing it in Chamber #2. x2497 y61431. Hdg. 072.
20:34	2453m	x2498 y61429. Taking a small piece of basalt (Rock sample #2) and placing it in bottle basket. Hackely flow, and taking video of it. Deploying marker K here.
21:05	2453m	Moving toward the center of the field to find Marker F. Whoa. Just saw a crack in the sheet flow with what looks like Tevnia. Turning the sub around. We're almost out of power. Taking video of it. Bruce thinks he can grab them, and he thinks they are Tevnia as well.
21:10	2451	Hdg. 250. x2498 y61431. Grabbing Tevnia in this small crack- there may be about 5 of them. Placing in Chamber #3. Placing Marker L right on the crack so that tomorrow's dive can do chemistry here. L is southeast of Marker M.
21:17		Weights away.

Dive 4116 – Imagenex



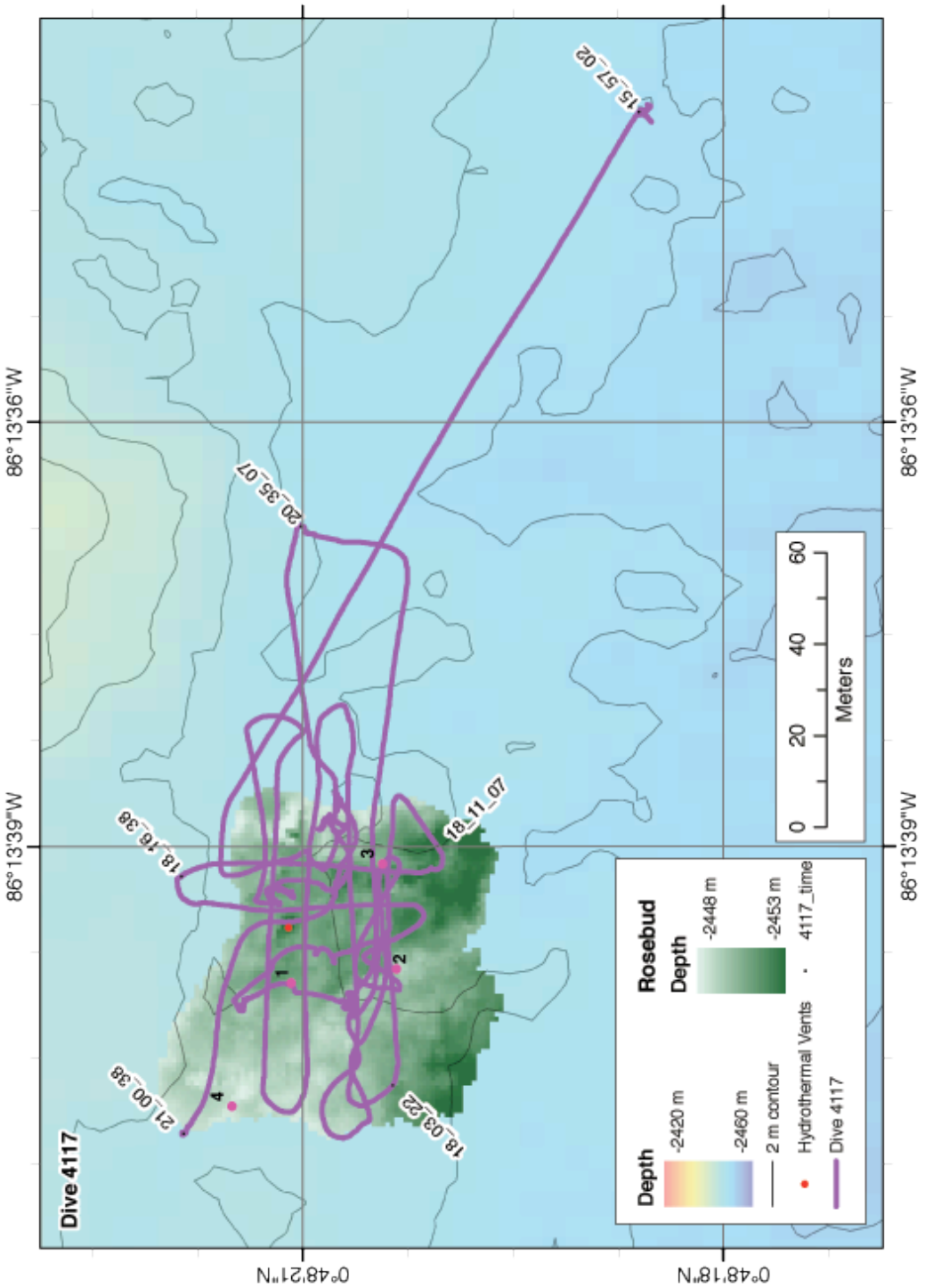
Dive 4116 – Pictures

Calyptogena clams at Rosebud



RatCam deployed at Marker B, Rosebud

Dive 4117 – Dive Track



Dive Report – Port Observer

Pilot – Pat Hickey
Port Observer – Dan Fornari
Stbd. Observer – Dan Dubno

Objectives of the dive were to: reposition sediment traps, conduct fill-in down-looking imaging lines over the Rosebud field to help build the overall mosaic: replace yellow chemical logger with red logger at the B marker/Rat Cam experiment site, investigate L-marker area, sample and do Ghostbuster chemical scanning, collect major fluid samples at hottest flow areas, slurp for bacteria and collect a pair of samples from high-flow and low flow areas with, and without limpets, and to collect lava samples from within and outside the Rosebud field.

Time (Z)	**Comments**
1411	testing Ghostbuster probe on descent-it's communicating
1417	red chem. logger tested - comms problem, talked with kong - 7.1°C, all OK
1434	1071m depth, x- 2767 y-62309, heading to bottom
1440	doing maggie turns to port
1446	finished 2nd Maggie turns to starboard 1350 m depth,
1504	1829m, about 70m away from Rosebud, descending
1512	2070 m depth, about 400 m to bottom
1515	at 2180 m depth
1522	2378 m depth, about 100 m from bottom
1530	2451 m landed on sheet flow x-2643y- 61243
1548	36 m altitude, looking for floatation balls of sed trap #1 with CTFM sonar
1559	transiting up to Marker B site with sed. Trap #1
1602	going over lobates now, about 100 m from Marker B site
1605	2446m depth, heading 296°, x-2539 y-61444
1610	deployed Sed Trap #1 on periphery of Rosebud east of Rat Cam at x-2493, y-61447, 2449 m depth, about 10-15 m east of RatCam and ~ 10 m north of K marker, K marker is East of Marker B and RatCam and ~ 5-10 m south. N marker is just north of RatCam.
1618	taking photos of the sed. Trap #1 mooring, now going to test yellow chem. logger.
1636	replacing yellow chem. logger with the red chem. logger, we're putting it back in the same place as where the yellow logger probe was.
1642	finishing deploying red chem. probe, temp 16.5°C, confirmed that colonization block is on top of probe. Some comms. problem with red logger after a bit but it was determined that it was recording OK so we left it.
1652	reset DVL Doppler nav at marker B using x-2501, y-61445
1702	in front of RatCam testing to see if we can get higher temps with hiT probe max temp ~ 15°C.
1714	doing slow pan across the animals below the RatCam looking north. By A and B markers
1718	changing video tapes
1723	observed strobe flash from RatCam, so it is working OK, now setting up

for doing downlooking survey at ~4-6m altitude

Time (Z)	Comments
1733	heading west on line 1 for downlooking survey along 61450 Y
1738	C marker is just off port side about 8m off to port, south pressure ridge with smooth surface in the center of Rosebud field is flanked by curtain folded sheet flow to either side.

Downlooking survey using DSPL camera was done on 4 E-W lines and 2 N-S lines, along with the general wandering around.
The dspl camera was ON all dive.
The 4 E-W lines proceeded from N to south, we started the first one east of marker B - RatCam position.
The times of start and end of each of the E-W lines is shown below (S=Start, E=End)

1741E----------1733S - **Line 1**
|
|
1743|S----------1749E - **Line 2**
|
|
1801E ----------|1751S - **Line 3**
|
|
1804|S----------1809E - **Line 4**

The two N-S lines were done about 10 m from each other the eastern line was done over the long of RatCam from 1809S to 1815E
The 2nd line went from south to north, 1819S to 1824E

1741	off on lobates to west of Rosebude field, turning south end of Line 1	x-2456 y-61450
1743	start of Line 2	
1749	end of Line 2	
1751	Start of Line 3 to the west	
1801	End of Line 3, turning to south to get 10m south to start Line 4	
1804	Start of Line 4, just passed I marker on port side	
1809	End of Line 4, setting up to make 2 N-S lines over RatCam site	
1809-1815	south to north line over RatCam site	
1816	2504 61470, heading south for next N-S tie line	
1828	heading now to go check out crab trap deployed on 2002 cruise? crab trap, it's all rusty broke it up and left it, then will go to marker L to look do chemistry and sample	
1848-1854	Ghost-bustered small riftia community in crack near marker L at 2451 m depth x-2476 y-61456, ~10°C, then sampled	

1900 sampling at Station #1

Time (Z) Comments

SAMPLE STATION #1 NEAR MARKER L- 2451M DEPTH, X-2476 Y-61456
tubeworms and mussels from near Marker L crack in Biobox
This is a sample from 'less' flow area without limpets visible on worms.

1900-1915 maneuvering to Marker I (02-C marker) community along margin of collapse towards northern edge of Rosebud field.

SAMPLE STATION #2- NEAR MARKER I- 2451 M DEPTH, X-2479, Y-61433

1915-1933 GhostBustered in tubeworm patch, first did BASE of worms, then did TIPS of worms, by plumes, then did mid-way inbetween

1943 took video near Marker I where we just did chemical probing

1948-1955 Took both major pairs at this site, Blue and Yellow pair, from heading of 266° 13.8°C to 14.7°C were temperatures during sampling

1959-2004 Taking slurp sample by Marker I community - putting it into the WHITE slurp chamber 14.5°C water- this sample is correlative to the GhostBuster samples and the 2 major pairs taken at this site.

2008 Taking fuzzy rock and mussel sample from near Marker I site
PUTTING IN CHAMBER #1

2013 Sampling mussels WITH LIMPETS near marker I, about 10 mussels in CHAMBER #4
(NB I AND J MARKERS ARE NEAR EACH OTHER, HAVE SEEN BOTH DURING SAMPLING OPERATIONS)

2019-2028 GhostBustering at mussel w/limpet sampling site, near Markers I and J
2019- logging in ambient water, at rock surface it is about 2.8°C
Did a sequence of scans, close to rock surface, far from it, and midway inbetween the closest sampling to the rock surface yielded the coldest temperatures, the far distance scans were the hottest and the mid-way ones were in between

2039-2042 Moving Sediment Trap #2 to near RatCam and Marker B community. The sediment trap is right by the K Marker at x-2519 y-61436,

2043 now moving to head west to sample flow within Rosebud field

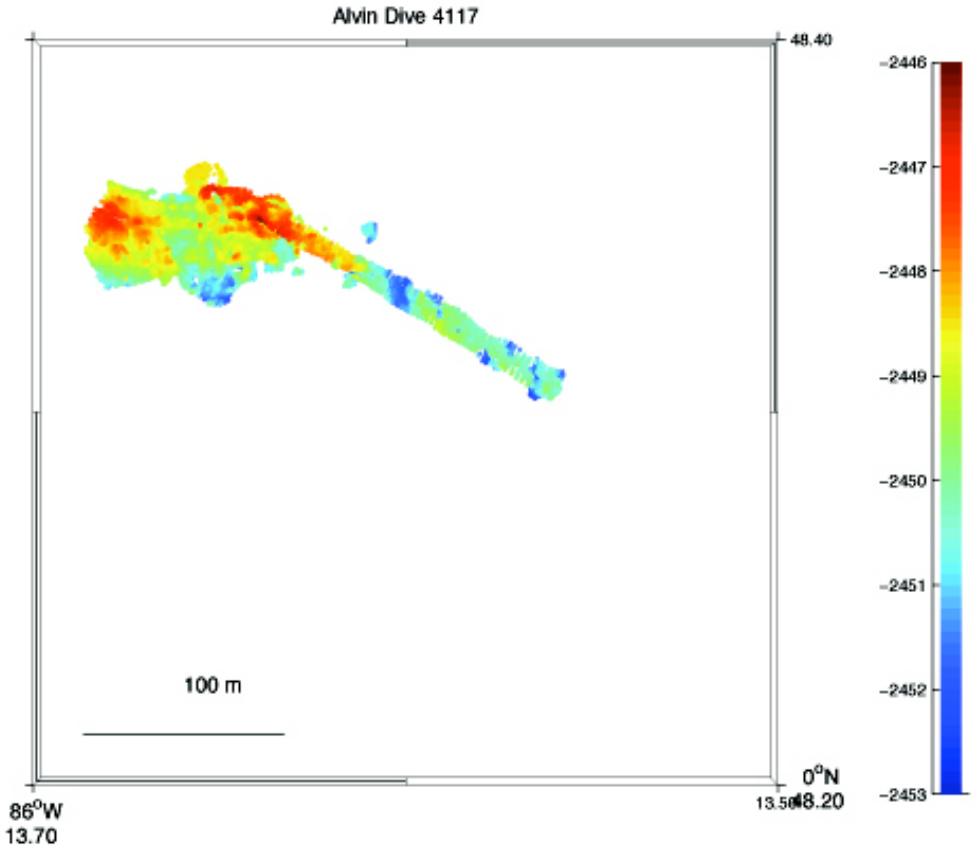
2047-2053 **SAMPLING STATION #3**
sampling curtain folded lava in middle of Rosebud field at 2452m depth
x- 2502 y-61436 (placed in back of wire bottle basket).

2054 heading west out of Rosebud over to lobates at edge of the field to sample lobates at margin

2106 SAMPLING STATION #4
sampling lobate crust plate at the west margin of the Rosebud field at 2450 m depth, x-2449, y-61469. VERY LARGE PIECE

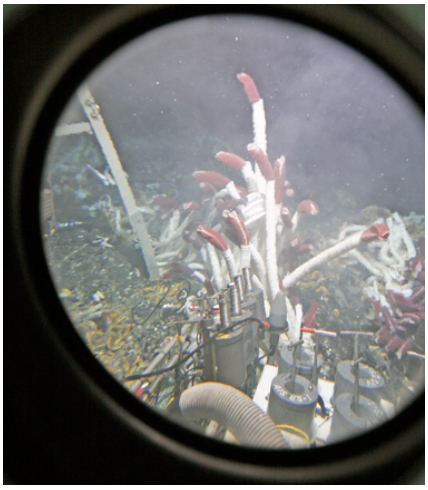
2115 End of Dive.

Dive 4117 – Imagenex



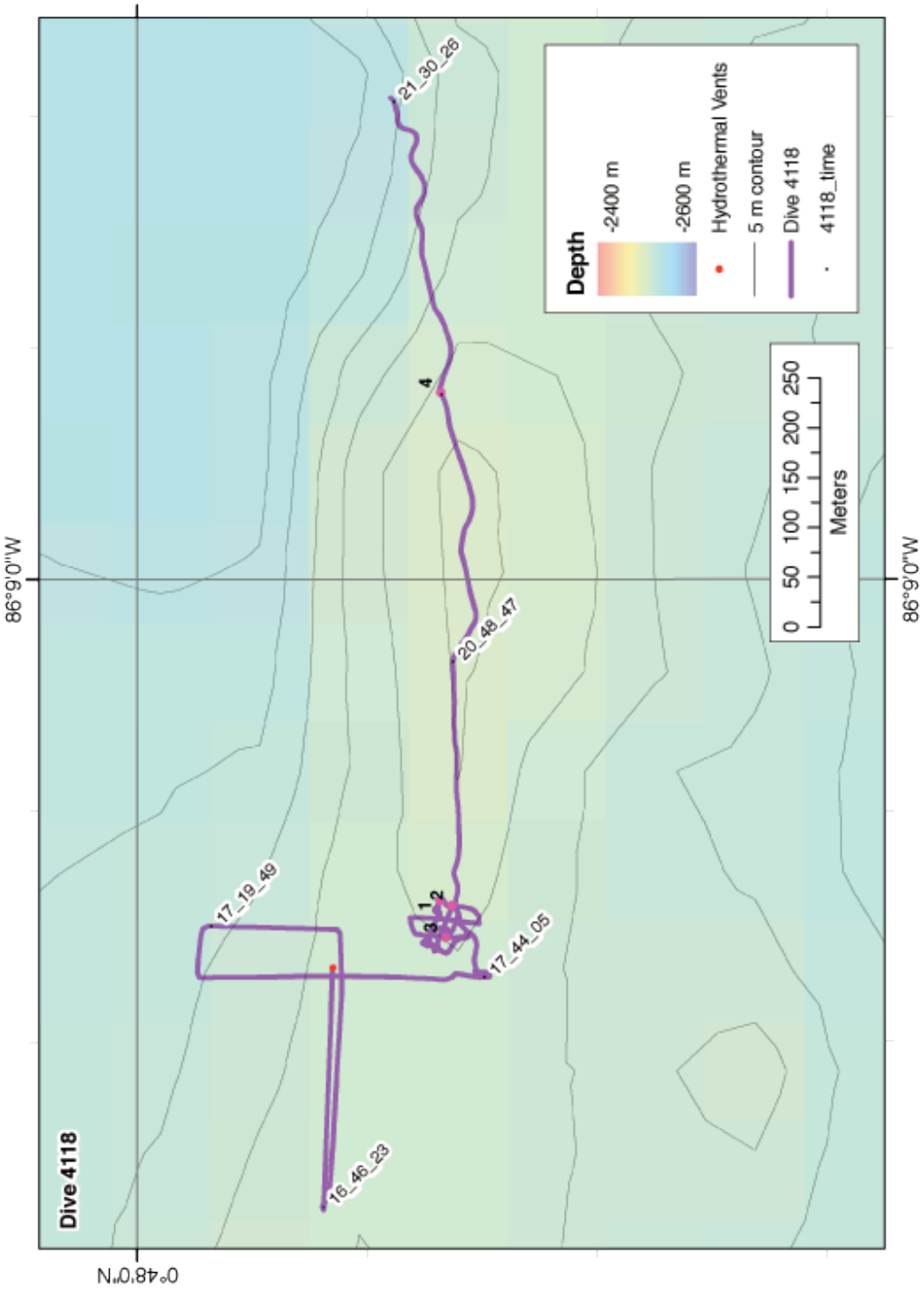
Dive 4117 – Pictures

Curtain folded lava at Rosebud



Marker B Riftia and the RatCam

Dive 4118 – Dive Track



Dive 4118 May 25, 2005

Bottom Target: Mussel Bed – 00°47.894'N 86°09.210'W (x: 10742 y: 60616)

PIT: Anthony Berry
Port: **Susan Humphris (tape transcript)**
Stbd: Gavin Eppard

Basket Load [water weight]

Kang Probe [12]	hi-T probe
Double biobox [8]	4 seafloor markers [2]
4-barrel enzymatic sampler [13]	Seyfried Deployable Probe [15]
Hydraulic slurp gun [15]	2 major pairs (ICLs) [66]
Fishing net [2]	

Dive Objectives

The major objective of this dive is to locate, conduct reconnaissance, and sample the Mussel Bed vent site, last observed in May 1990.

Doppler navigation only – no transponders. Grounds fixed by recycling power – no serious problems on dive.

Time	Depth (m)	
1506	972	Turning on the Maggie. Commence Maggie spins – about 2 minutes per rotation; clockwise first.
1512	1097	Just finished two clockwise spins, and starting two anti-clockwise spins
1517		Just finished anti-clockwise spins. Will leave the Maggie on for the dive.
1527	1465	Tested the logger and the ghostbuster – the logger is not recording; the ghostbuster is working fine, reading T of 3.3°C. Will test the logger again when we reach the bottom.
1602		About 200 m off bottom – turning on the Imagenex, video, etc.
1610	2476	The bottom is in sight. Lightly sedimented, very large lobate pillows.
1616	2488	Sitting on the bottom while the ship surveys in our position so we can set the Doppler.
1624		Problems with the down-looking camera – not getting any signal. Checked the logger again, but still not working.
1638	2488	Still sitting on the bottom waiting for the survey.

1646 We have our Doppler fix: **x: 10502 y: 60625.** This puts us 240 m, bearing 092° to the 1990 position of Mussel Bed. Now getting neutrally buoyant before getting underway.

1659 2487 Just passed a stack of Alvin weights (ours??). Coming up over glassy, lobate flows that are lightly sedimented. Heading 098°.

1701 2487 Heading 096°. Still over the lobates and pillows – they are extremely large: 2 m long and diameters of 1+m. No sign of any shells, etc. The sediment cover is a light dusting and can see the glassy surfaces of the lava reflecting Alvin's lights.

1705 2485 Heading 097°. Continuing to head over large lobate pillows towards the given location of Mussel Bed. Still not sign of any dead shells, etc.

1710 2490 Heading 092°. We are ~18 m past the 1990 location of Mussel Bed – still no evidence of Mussel Bed. Now planning a search pattern.

1714 2491 Heading 0°. Decided to head north on a first leg of a search pattern to see if we cross the axial rift. We will then move 50 m W and head south if we have not found the rift or Mussel Bed.

1716 2493 Heading 0°. Still over large lobates with some brittle stars on rocks. Still a light dusting of sediments. Will continue north until we see older terrain.

1719 2494 ~110 m north of the 1990 location. The sediment thickness suggests a similar age and there are accumulations of sediments in the pockets between them. Going to turn w and move 50 m before heading south.

1723 2495 Completed 50 m W, and now turning to head S. and will run past the 1990 location. So far, only seen large lobates with light dusting of sediment; no indication of any seafloor age difference so far.

1725 2494 Heading 180°.

1728 2492 Heading 180°. Gone about 50 m from our most northerly extent of the survey. Have not seen anything that looks young, nor have we seen any large fissures, so suspect we are north of the main rift zone.

1732 2487 ~5-10 m from the original target. Continuing to head south.

1735 2485 ~40-50 m south of original target. Lot more sediment suggesting it is older, but moving upslope. Crossing an E-W fissure that has a lot of sediment in it – first fissure we have seen.

1739 2483 A big collapse feature, about 3-5 m deep.

1741 2482 Heading 184°. Just past over a large collapse feature that could be part of the axial rift. We are going across to the other side. Feature about 15-20 m – cannot see anything in the bottom of it.

1744 2481 S. of the collapse feature, and we are going back to it as we think it is probably part of the rift.

1747 2482 Heading back north to the rift/ large fissure.

1748 2476 Above the fissure and going to turn E. and work our way along for a few hundred meters, and will then turn to the W. and work our way along the other wall.

1753 2482 Working our way to E. along the edge of the wall (to starboard). Out of port, looking into fissure. A lot of broken up rock, although still a lot of sediment.

1757 2482 In field of clams that appear to be dead, a lot are broken up, and they are in the cracks between lobates. There are also mussels, not clear if they are alive. Float with a 9 that is preceded by a number or letter buried in the clam shells. Not convinced we have seen anything alive.

1801 2481 Continuing to head east.

1802 2478 Two more Alvin dive weights. Position: **x: 10800 y: 60492**. Galatheids in the area, and we are down in a hole with serpulids covering the rock walls. Going up the side of the wall to the top.

1804 2479 Exploring this area – have the signpost from 1990 in sight.

1810 2475 Resetting the navigation. Up on the top of the wall. Interesting sea star, and a lot of serpulids on the rocks. Also lots of dead clams.

1813 2476 White star fish – going to try to slurp it into the green chamber. **x: 10810 y: 60509.** The challenge is going to be to find something alive.

1828 2476 Just finished sampling the sea star – it is stuck in the first part of the slurp tube. Also changing the video tapes. Will take pictures of the signpost, and will then do a reconnaissance survey of the site to see if there are any live areas.

1839 2477 Heading 149°. Just found Alvin weights with Dive 2019 on them. *Doing a panorama of the signpost.*

1846 2477 Continue west to find westerly extent of the field, and then will head back around and try to define size of the field and active areas.

1848 2477 Heading 270°. Still finding large number of dead clams.

1849 2478 Found some more Alvin weights. There are also hydroids. All shells are dead and many are dissolving away.

Reached the western edge of Mussel Bed; going to turn to port and try to do a series of lines over the site to define its extent. Over lightly sedimented pillows and out of the vent field.

1859 2485 Stopped on the SW side of the field at a small patch of mussels to see if they are alive. We are going to poke them with the T-probe.

1908 2486 The mussels are dead. We are going to do a series of N-S runs to image the field. More dive weights.

1909 2483 Turning to head N. across the field. Still up above the fissure.

1912 2478 Moving north – seeing more deal clams. A lot have sediment accumulating on them – doesn't look like this part has been active for a number of years.

1914 2480 Moving 10 m E. to do a southerly transect.

1916 2478 Heading S. Into dead clams as far north as – **x: 10793 y: 60535.**

1917 2476 More dive weights. Also a plankton net – 1 m diameter at **x: 10799 y: 60474**.

1930 2483 **x: 10805 y: 60497.** In an area where we think there may be diffuse flow. The reason is that there is a concentration of galatheid crabs in this small embayment in the rift wall.

1932 A lot of mussel shells, all covered in a black (Mn?) stain, and they have completely white interiors – definitely dead. Putting ghostbuster in to see if there is diffuse flow – we think we may see signs of shimmering water.

1941 2483 Run the ghostbuster and there is no sign of warm water. We did see a couple of brachyuran crabs, but there is no temperature signal. Going to collect some mussel shells here and put them in the biobox.

1944 2483 Collecting two rocks from the same place, and put them in biobox. One has some biology on it.

2006 2477 **x: 10771 y: 60522.** We are stopping to collect some clam shells.

2015 2477 Were not able to pick up clams at that site because they in the pockets between rocks and were hard to reach.

2032 2481 **X: 10773 y: 60502.** Picked up some clam shells and they are in Chamber 3. They seem very delicate and appear to have dissolved considerably. Going to head East along the rift.

2034 Heading SE to get back in the rift that we have followed, and then we will follow it E. towards the T anomaly detected last night ~800 m away.

2037 2480 Heading E. with the wall on the starboard side, so on S. side of the rift. Still over lightly sedimented, very large lobates. Some white staining on the broken edges.

2039 2478 **x: 10898 y: 60490.** Come into another area of dead clams about 100 m E of Mussel Bed.

2479 Coming out of clam area at **x: 10911 y: 60491.** Looked like another Mussel Bed-type area with dead clams in the crevices in the rock.

2043 2481 Area of lobate flows; a lot of rocks have white-colored staining or precipitation along their cracked edges.

2045 2479 Out of the clam area and now in a more sedimented, lobate pillows. Sediment thickness is several mm. Looks very much more sedimented than anything seen in the rift on the dive.

200 m E. of Mussel Bed – still in an area of sedimented pillows. Quite a thick sediment cover in the rift apart from the talus at the base of the S. wall.

2048 2492 Continuing to follow the rift; this area is more highly sedimented. Lost sight of S. wall, so turning to south a little to reacquire the wall.

2051 2478 About 300 m E. of Mussel Bed: **x: 11104 y: 60474.** Reacquired the S. wall so continuing E. over sediment-covered lobates. Looks pretty dead and it seems unlikely there has been any recent activity.

2054 Going over a very deep fissure, trending generally E.

2056 2482 About 400 m E. of Mussel Bed. The fissure has now broadened and can see the bottom of it – the fissure seems to be petering out. Rocks are still heavily sedimented – lot of hydroid-like organisms, also a sea whip on tops of rocks.

2057 2489 About 500 m E. of Mussel Bed. Just come to a flow front between the older lavas and a flow that looks relatively fresher. Very lobate, less sediment, and the glassy surface is visible. Looks like a younger area. Collapse pit out the stbd. side. Stopping to take a sample of this younger flow – **x: 11320 y: 60508**.

2118 Finished sampling the lava flow, and going Warp 10 towards the temp. anomaly location.

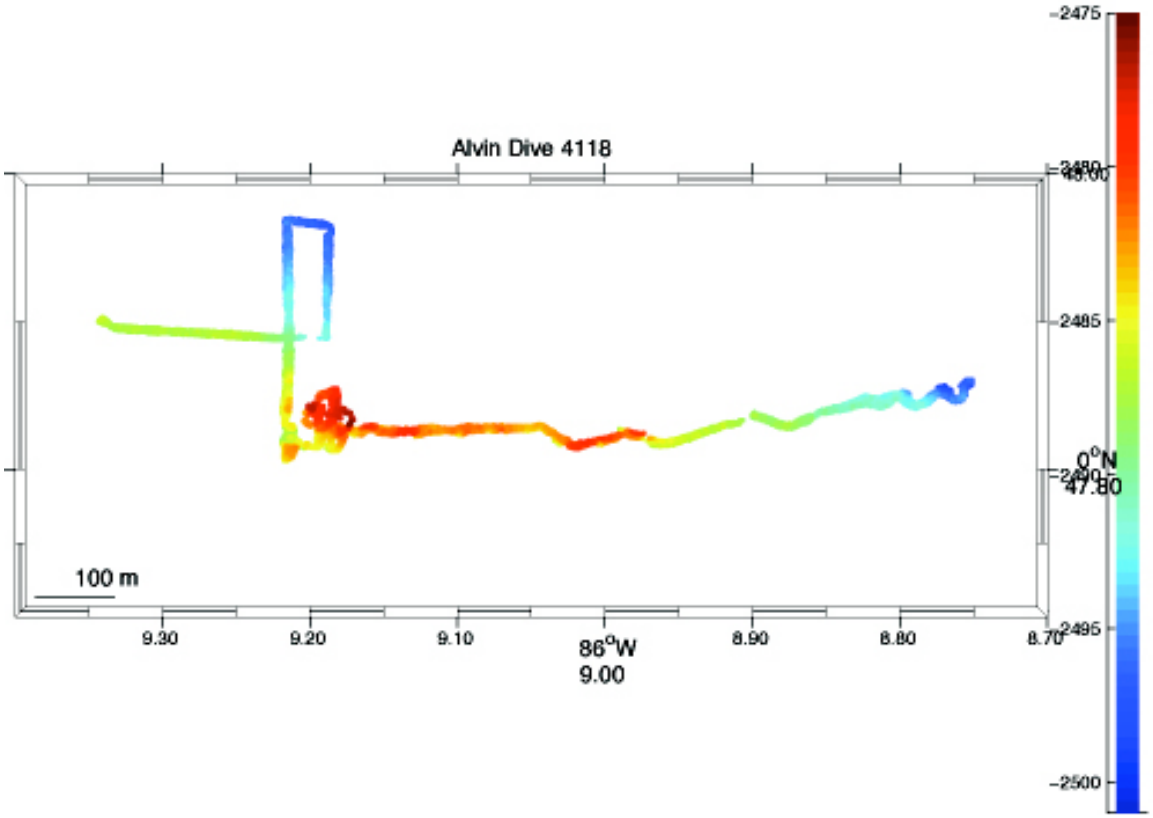
2123 2488 About 600 m. E. of Mussel Bed. Back over more heavily sedimented pillows; no signs of any cloudy water. This area looks old.

2126 About 700 m E. of Mussel Bed. Pretty sure we are still in the rift, but the rocks here have several mm. of sediment.
W-E fissure – cannot see the bottom.

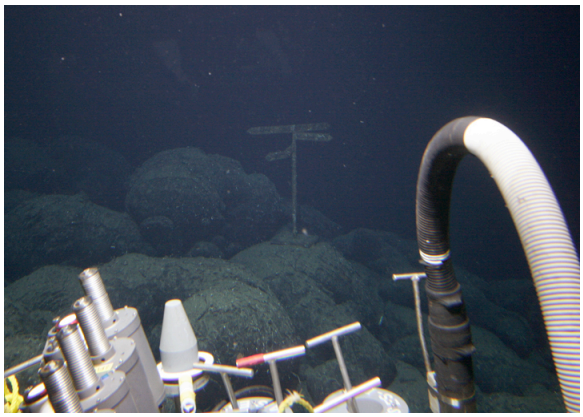
2130 2495 Still over the fissure, but the lavas are still heavily sediments. Close to 800 m from Mussel Bed. Does not look like the type of terrain to find a black smoker! More heavily sedimented than anything we have seen.

2131 All weights away.

Dive 4118 – Imagenex



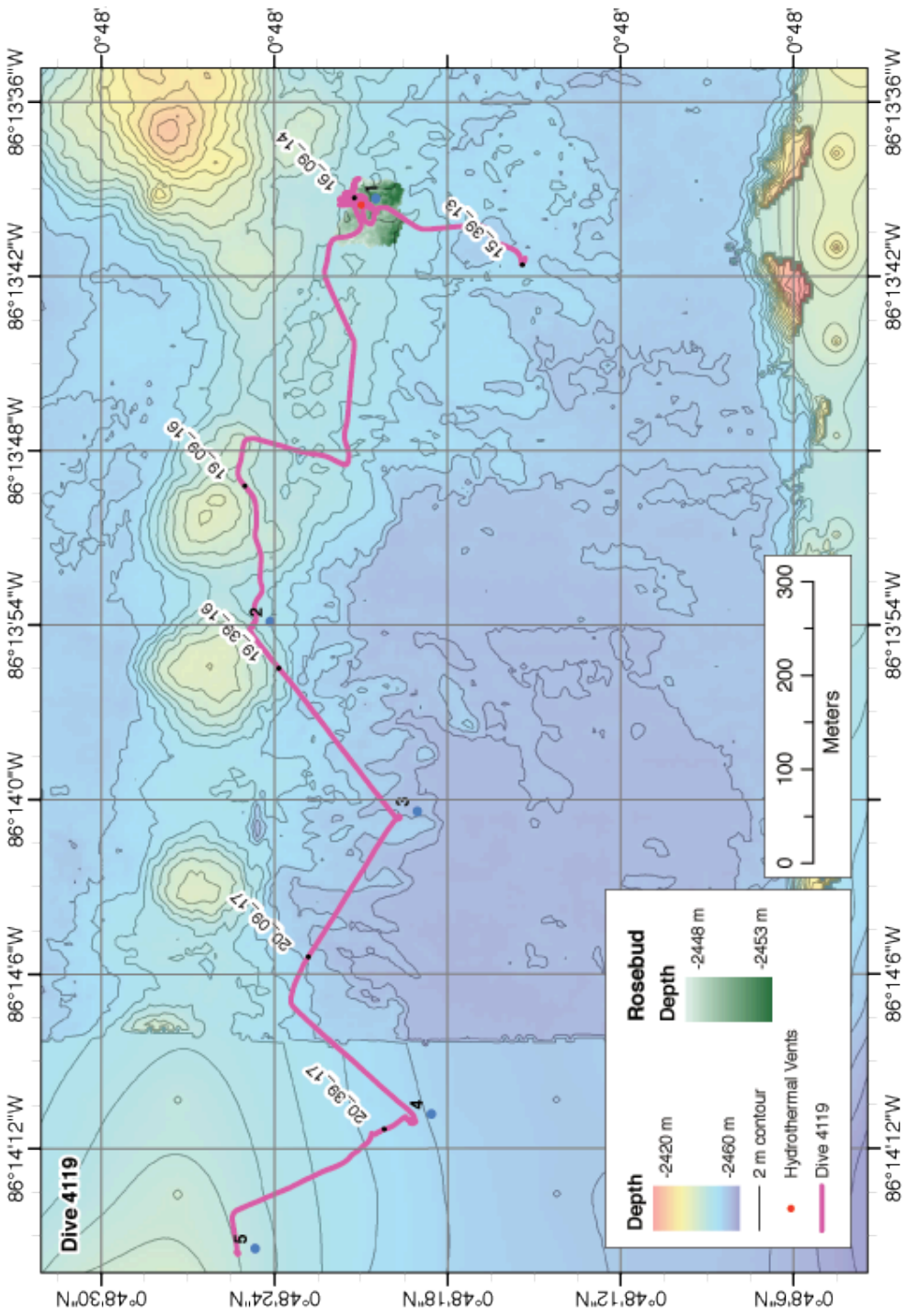
Dive 4118 – Pictures



Signpost at ClamBake

Dead Clams and galetheid crabs at ClamBake

Dive 4119 – Dive Track



Dive Report – Port Observer

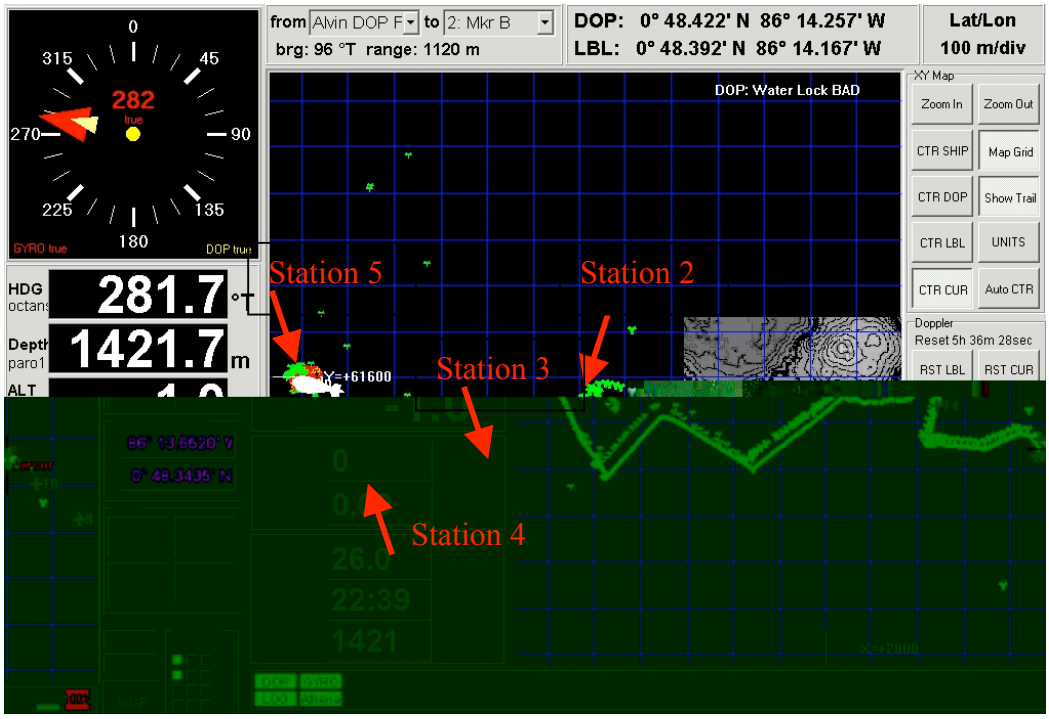
Pilot – Anthony Tarantino
Port Observer – Dan Fornari
Stbd. Observer – Peter Nomikos

Objectives of the dive were to: test and replace one of the chemical loggers at the Marker B, RatCam experiment site, conduct fill-in down-looking imaging lines over the Rosebud field to help build the overall mosaic, do panoramic video imaging of the Marker B/RatCam community and downlooking imaging of the community, sample clams nearby the B Marker, catch fish, collect background water samples with the major pairs, and explore west of Rosebud for other evidence of ventding and to collect lava samples from flows adjacent to the Rosebud field.

Time (Z)	**Comments**
1400	Descending
1409	Magnetometer on at 200 m depth
1544	Approaching bottom, downlooking strobes ON
1610	On bottom, getting trimmed, then will go do downlooking survey of Marker B RatCam experiment area
1620-1635	Downlooking survey of Marker B/RatCam area
1637	**Very good downlooking photos in digital camera of RatCam experiment**
1642-1644	taking panoramic view of RatCam area with 3-chip video fromk heading of 018°
1645-1655	more imaging of RatCam experiment, now will move off to collect clams
1707-1718	**STATION #1 - 2450 m depth, x-2495, y-61441** collecting clams, mussels and crab just west of RatCam, 5.24°C water with Alvin probe
1722-1733	Went over to replace blue chem. Logger with yellow logger at RatCam site
1745-1816	Deployed yellow logger beneath RatCam next to original position just west of the Planet, also moved the black Vemco temp. logger to near the black collection block
1825-1845	Trying to catch fish for Kate using suction sampler and the net- NO LUCK
1850	Start traverse to the west to explore for other vents and follow fissure that cuts through RoseBud and east of Rosebud (see map below for dive track)
1850 to 1923	Traversed generally to the west at latitude of RoseBud, Marker B site and then did a track to the north. Now stopped to sample at Station #2
STATION #2	- ~ 500 m west of Rosebud, Marker B 2450 m depth, x- 2045 y- 61554
1923-1931	Sampled curtain folded flow and put in BioBox, 2 pieces
1935	Continued traversing to the SW over lobates with some sheet flow contacts and a few fissures or linear collapse features.
STATION #3	- ~ 700 m west of Rosebud, Marker B 2453 m depth, x- 1843 y- 61397
1953	Station #3, sampling lobate crust, put in Fwd port chamber
2005	Continuing traverse up to NW then to SW to cut across fissure system if seen
2010	Stopped to take sample of older lobate flow we just crossed into
2010-2025	Sampling at Station #4
STATION #4	- ~ 900 m west of Rosebud, Marker B 2454 m depth, x- 1521 y- 61382

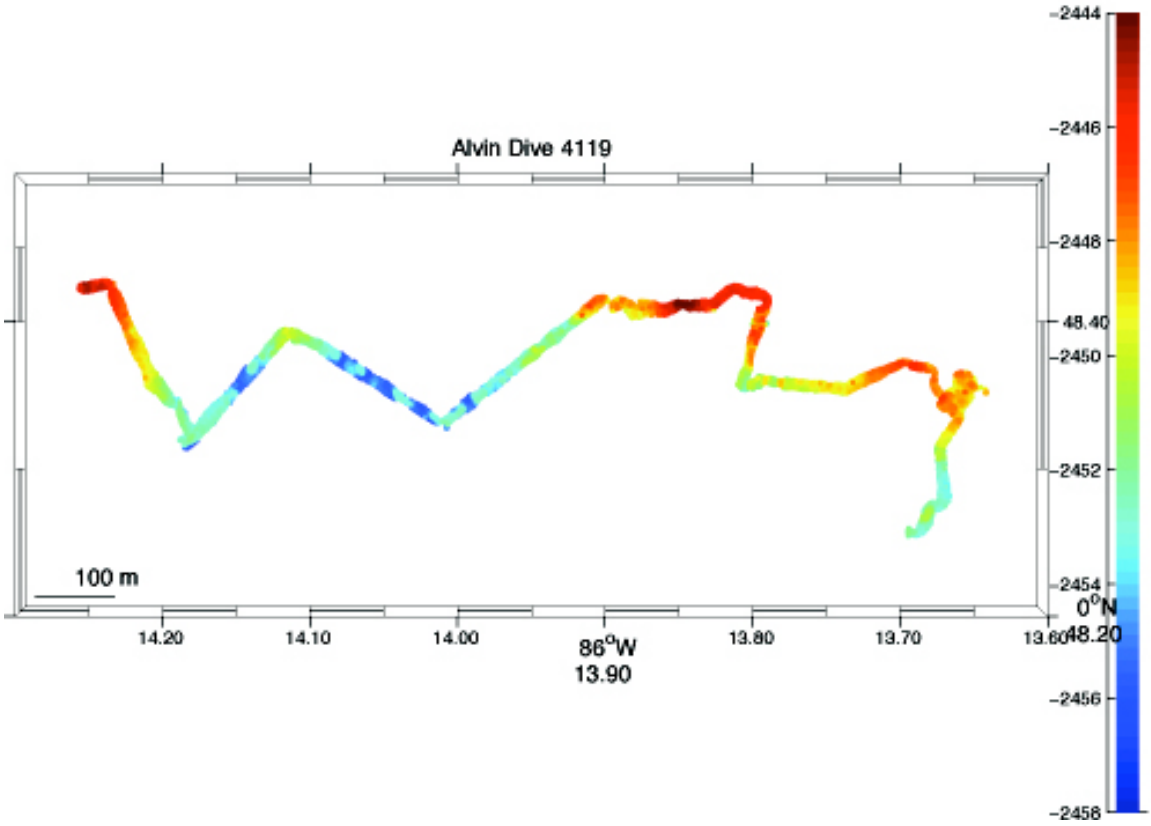
2020 Sampled pink and white holothurians and put in GREEN slurp chamber
2025 Sampled lobate flow crust, older looking, put in STBD FWD chamber
2030 Continued traverse up to NW to finish dive, crossed into a curtain folded flow stopping to take final sample and fire Majors for background water

STATION #5 - ~1100 m west of Rosebud Marker B site, 2447 m depth, x- 1378 y- 61570
2054 Firing yellow and blue major pairs for background water.
2101 Sampled pink holothurian into slurp chamber
2104 Sampled curtain folded lava and put in STBD AFT chamber.
2115 End of Dive

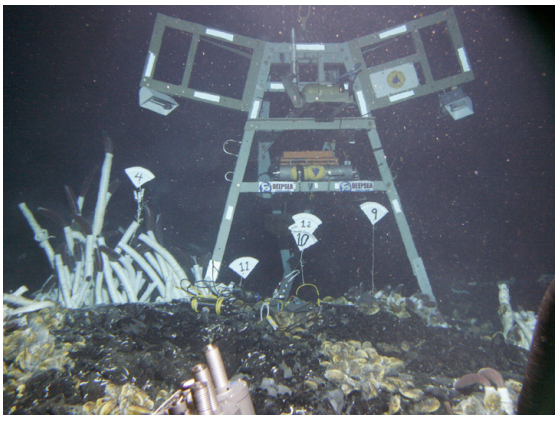


Map shown above indicates DVL track (solid green line) and LBL track (dotted line) for dive navigation to show dive track for exploration done during the rest of Dive 4119.

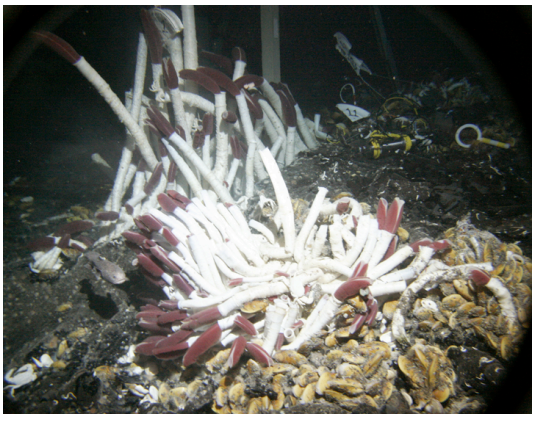
Dive 4119 – Imagenex



Dive 4119 – Pictures

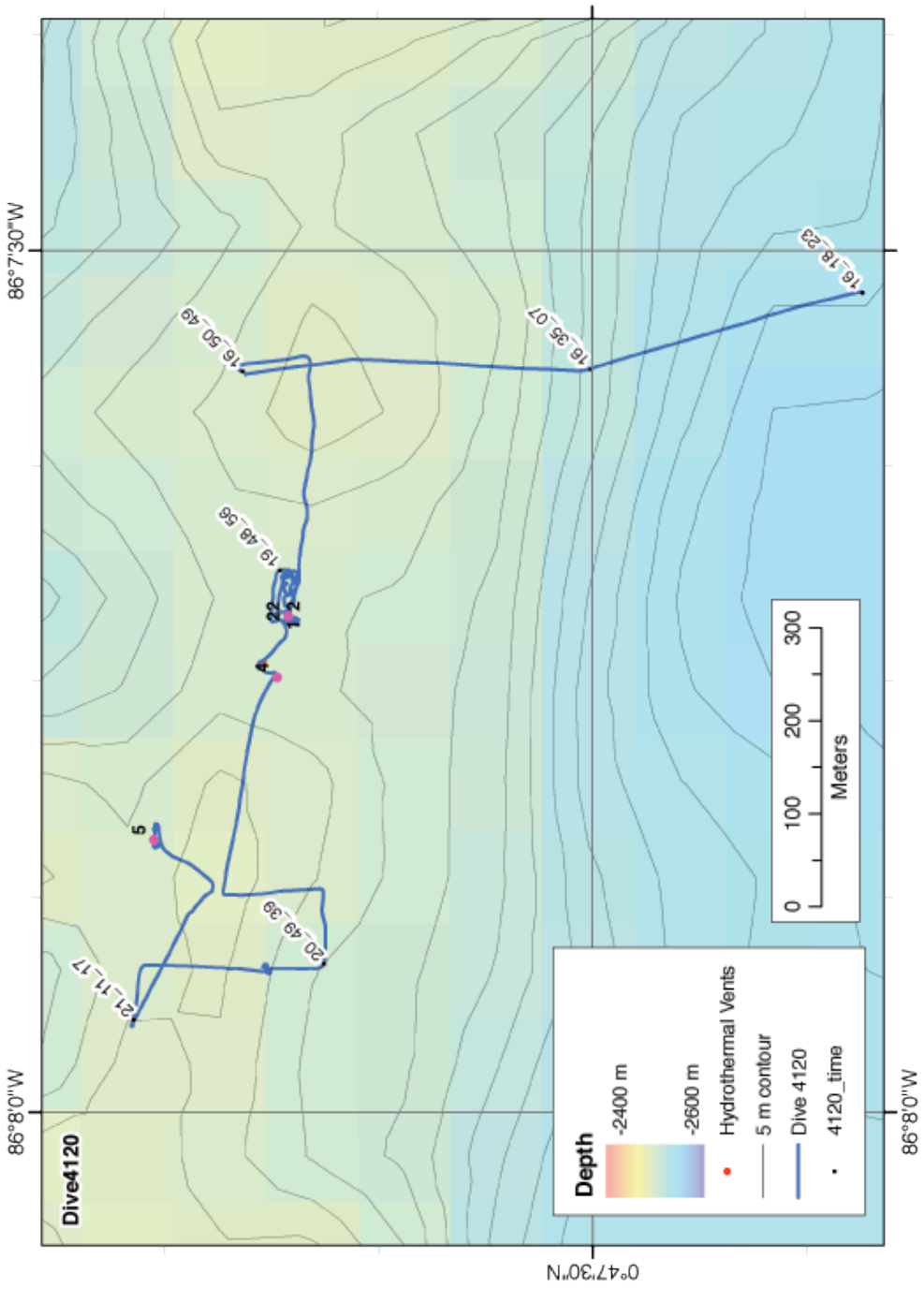


RatCam above settlement panels at Marker B, RoseBud



Marker B, RoseBud

Dive 4120 – Dive Track



Dive Report – Port Observer

Dive 4120 Report
27 May 2005
Stace Beaulieu (Port Observer)

Summary of Samples:
Biobox: ~9 Riftia
Chambers: Port fwd: ~7 mussels; Port aft: rock sample 2
Slurp: red: Riftia patch; green: funky worm; black (originally thought white): microbes and basalt chips near mussel patch
Major pairs: yellow: Riftia patch; blue: ambient water.
GB: 1) 7min, 18.7C; 2) 10min, 19+C; 3) 10min, 13C
Basket: aft: rock sample 3; fwd: rock sample 1
Downlooking still camera and 3-chip video survey of Q-P study site (Garden of Eden)
Deployed MKR Q at Riftia patch (W side) and MKR P at mussel patch (E side) at Garden of Eden

Chronology:
Time (GMT)
14:13 Alvin cleared to dive
14:30 500m, lots of bioluminescence
14:39 765m, start Maggie spins
14:53 1000m, checked Ghostbuster
14:54 1184m, completed two Maggie turns; tested downlooking camera in water column
15:01 checked bearing from ship; noted underlay not available for DVLNAV
15:14 ship still transferring people to sailboat and not in range for surveying Alvin position
15:31 2000m, checked Ghostbuster
15:47 started videotapes
15:51 see bottom; Doppler altitude reads 8m
15:52 jumbled hackly basalt; Bruce notes 2 small galatheids
15:56 2533m (TWD = total water depth), sitting on bottom waiting for ship survey; checked Framegrabber on; 3-chip video rattail
16:02 3-chip panorama test for Adam
16:05 video crinoid
16:09 video shrimp
16:12 noted Ghostbuster 10sec ahead of DVL GMT clock
16:15 video crinoid
16:16 video shrimp; still waiting for ship survey
16:18 X13870, Y59600 (waited total of 22min for ship survey of Alvin position)
16:20 lifted off bottom to start traverse up slope; made sure booms out for strobe for downlooking camera; Imagenex on
16:23 started recording depth profile every couple minutes in my notes to help in deciding when we reach the ridge crest (see hand-written notes)
16:25 sediment-covered pillow basalt

16:26 hdg 345 (W of N)
16:27 climbing up slope, trying to adjust altitude for camera transect
16:28 ditto
16:29 hdg 342
16:30 collapsed area with less sediment cover; note 3-chip zoomed all the way out and pointed down to side to avoid slurp hose shadow
16:31 sediment-covered pillow basalt
16:34 drove on the order of 200m, now near the target launch location for Alvin
16:35 changed hdg to N, hdg to dive plan target 2 over the ridge line
16:36 ditto, with some lobate
16:38 steeper upslope
16:40 2487m, starting to flatten out (note afterward: this was not the top of the ridge, but rather an area with cracks and shallow fissures)
16:41 sediment-covered pillow basalt; note crack at 2481m
16:42 another crack at 2479m
16:43 V TGT 22 (virtual target) significant fissure, depth 2482m, Adam notes cutoff pillow basalt
16:45 depth 2476m; crack at 2472m
16:46 V TGT 23 = fissure near ridge crest with sliced basalt pillows; sliced wall with staining
16:48 2464m
16:49 2464m; turned at 2466m b/c Bruce sees downslope ahead
16:50 turned back S to fissure TGT 23
16:51 2468m, dead mussels; did not sample, did not leave science marker
16:54 hdg 174
16:56 turning W into fissure
16:57 wall of fissure, hdg 264, 2 sub lengths wide
16:58 2469m, note brachyuran; see walls of fissure in starboard pan/tilt
16:59 following fissure at hdg 274
17:02 3 brachyurans
17:04 5 brachyurans
17:06 2488m, encountered serpulid worms on wall, entering Garden of Eden site
17:07 Riftia plus smoke in the water, mussels, bacteria mat, anemones not as dense as Rosebud, shimmering water
17:10 Adam sees crab trap to starboard; we are wondering if this is Garden of Eden #3 site?; large robust Riftia
17:11 video of “pagoda” of floats (looks like Ruth Turner / Cindy van Dover settlement panel experiment)
17:12 W extent of vent field
17:13 encounter large Riftia mound
17:14 pan starboard camera (VCR1) Riftia mound
17:19 lots more shimmering water than noticed at Rosebud, again Riftia without many associates
17:20 V TGT 25 = entering vent field; V TGT 26 = old settlement panels; V TGT 27 = Tica-like tubeworm mound; lots more tubeworms than Rosebud; Bruce notices some at 5-6ft

17:26 GB = Ghostbuster above Riftia patch reading 5C; video starboard pan/tilt; GB still 10sec ahead of GMT clock
17:28 start GB Sample 1; reading 18.7C
17:29 using hiT probe to validate GB temp rdg; GB holding at 18.5C
17:30 video hiT probe
17:32 hiT probe 13.3C; Bruce put hiT probe away b/c trusting GB working fine
17:33 end GB Sample 1 (should be ~7min); moved GB to top of Riftia tube 9.7-9.9C; top of tube steady at slightly <10C
17:36 start GB Sample 2 rdg 19+C; note white shrimp on Riftia tube
17:38 GB dropped to 18.6C, then hovered at 19C; hidef video thru pilot viewport
17:40 switched videotapes; GB holding at 19C, got a 20C
17:42 GB video VCR1
17:44 closeup Riftia patch VCR1
17:45 GB 19C; note hdg 330 while doing GB Sample 2
17:46 end GB Sample 2 (should be 10min)
17:49 moving to other side of Riftia clump; mussels strewn on outskirts but not within Riftia patch; see some larger amphipods but no swarms
17:53 reset DVLNAV V TGT 28 = X13522, Y60218, 2488m, at Riftia patch
17:57 pan Riftia on VCR1
17:59 V TGT 29 W edge of Riftia patch
18:00 probing with GB, only getting to 10C
18:02 start GB Sample 3, holding at 12-13C, hdg 70 (looking at patch to E); notice that Riftia patch is oriented E-W similar to fissure
18:04 pan Riftia clump starboard pan/tilt VCR1; GB holding at 12.8C
18:09 pan starboard camera VCR1
18:12 end GB Sample 3, holding at 12.8C; again note EW orientation of Riftia patch, note few mussels, very hard to reach the base of the tubeworms b/c down in basalt cracks, rough topography, note fuzzy galatheid
18:16 hdg 238; note drawing of Riftia clump and GB samples in hand-written notes
18:19 did not complete GB Sample 4 b/c only getting to 10C
18:22 moved away from Riftia patch to come back at better approach angle for water sample
18:25 grabbed yellow major pair; major pair temp rdg 16.2, 16.5, 17.2, 17.0, 17.4, 17.8, 18.0, 17.5 at tip
18:30 completed yellow water sample
18:32 lost 1 Riftia attempted to sample
18:34 Bio Sample 1 Riftia; most are too big for biobox
18:38 slightly moved Alvin to access Riftia better for sampling
18:40 note baby bythitid!; Bruce mentions current tending to push us N
18:42 sampling Riftia again at hdg 95 (looking W into Riftia clump), depth 2488m
18:44 Bruce sees some limpets on Riftia tubes while sampling
18:47 sampled Riftia #6; Bruce says tubes very well anchored; final total ~9 Riftia into biobox; note to self: did not notice sea cucs on westward traverse thru fissure to this GofE site
18:49 closed biobox
18:51 needed to move Alvin for slurp sample

18:53 noted 26V ground in Alvin main ballast
18:55 Bio Sample 2 red slurp into base of Riftia patch (where sampled yellow major pair); note GB was also taken near yellow major pair (not exact, but quite close); slurp sample sucked up crab, shrimp; zoomed in starboard pan/tilt
18:59 completed red slurp
19:04 entire Riftia mound on VCR1, followed by pan on starboard (but not good enough for mosaic)
19:05 deployed MARKER Q at Riftia patch Garden of Eden
19:08 photo MKR Q thru pilot viewport, also VCR1; note barely any mussels among Riftia here
19:11 Bio Sample 3 green slurp weird swimming polychaete worm (Bruce hadn't seen one before)
19:12 flying over anemones
19:18 stopped at mussel clump and fuzzy biofilm on rocks
19:20 VCR1 pan of mussel sample area, biofilm "blows" in our "breeze"
19:21 hiT probe 4.2, 4.4C, max 5C in mussel clump, among fuzzy galatheids (looks like the thick filament biofilm)
19:24 Bio Sample 4 mussel collection on VCR1, port forward chamber about 6-7 mussels; V TGT 30
19:29 V TGT 30 marked mussel collection with MKR P, depth 2489m; approx 40m E of MKR Q; rocks too big here not able to sample fuzzy rock
19:32 moved 3-chip to downward position for mow-the-lawn survey of field
19:33 area around P has the most microbial-mat covered rock; serpulids seem dispersed but not synoptic with microbial mats; large area of diffuse venting and shimmering fluid
19:38 zoomed VCR1 b/c thick microbial covered basalt
19:39 Bio Sample 5 slurp into black chamber (originally thought was in to white chamber)
19:40 note basalt chips getting sucked up into slurp; sample within 10m of MKR P
19:44 switched videotapes
19:47 returned to fissure "mouth"; diffuse vent "spills" out of fissure
19:49 starting an E to W line at N edge of field in saddle; video downlooking; V TGT 31 at start of survey; see galatheids to port and nada to starboard
19:52 serpulids to port, Adam sees Van Dover panels to starboard; assume Van Dover panels at N extent of field, maybe even too far N and actually outside of field
19:53 changed hdg to S, see tubeworm clump to port
19:55 turned to E to mow the lawn; Riftia patch seems constrained EW b/c on this second EW line I don't see much fauna
20:00 approach wall of fissure
20:02 wall of fissure and head W again; I saw nada to port; Adam saw serpulids to starboard
20:04 Dive Weights Dive 993 to port! Note diagram of vent field in hand-written notes; overall conclusion two separate patches within the field with Riftia at W and mussels at E; we didn't see any clams; overall conservative estimate size 40 x 15 m; less conservative 50m x 20m
20:09 driving W dead shells 15m past Riftia clump; still see crabs

20:13 tried slurping fish
20:14 2489m, tried to get rock sample (not possible) in lightly sedimented lobate area, maybe 50m NW of Riftia patch
20:17 grabbed again at glass; notice 2 sea cucs to port (similar spp to sample from yesterday's dive), still about 50m from Riftia patch
20:19 still trying for rock sample; obvious sea cucs deposit feeding on sedimented lobates; did not get rock sample
20:20 hdg to W to top of next ridge crest; see time-depth profile in hand-written notes
20:21 Rock Sample 1 with starboard manipulator (see VCR2) plus photo thru starboard viewport
20:22 2489m, V TGT 32 for Rock Sample 1
20:24 asked to point 3-chip downlooking
20:26 adjusting ballast
20:34 brachyuran to starboard
20:38 brachyuran to starboard
20:39 turn S in search of T anomaly target ridge top
20:42 2486m, nada
20:44 located large fissure? With lava pillars; looks like EPR rift features; completed 100m transect S and turned W
20:49 2492m, huge pycnogonid; completed transect <100m W and turned N
20:53 stopped for large dumbo octopus, great VCR1 and VCR2; tentacles extend to size of Alvin basket; largest that Bruce has ever seen; curls its tentacles backwards into shape of rattail for mimicry? Or streamlining; Bruce says covered with bacteria-like
20:59 asked to point 3-chip downlooking
21:00 continued N transect
21:02 stopped to focus on anemone; no need to sample
21:05 Bruce notes glassier rock
21:08 slight move to W
21:12 2469m, turned to SE, note sedimented pillows
21:14 2472m
21:16 2471m, many sea cucs of different spp
21:19 brachyuran crab
21:20 brachyuran crab; upslope
21:22 2468m; mound of lobates, sea cucs, at 2464m seems to flatten out top; think we crossed over peak
21:24 stopped to take rock samples for Adam; 2470m very near top of summit where we had expected T anomaly (found out later after dive that this would not be expected here); Bruce was trying for rock nub with soft coral attached
21:27 see VCR1 for attempt at rock sample; very fragile and broke off; note we did not do a ship survey for position at end of dive
21:31 trying again for rock sample
21:32 Rock Sample 2 into port aft chamber; V TGT 33
21:35 searching to slurp sea cuc (did not get it b/c I moved too fast and changed Alvin buoyancy!)

21:36 Rock Sample 3 into aft basket; this was part of the rock that he had been trying to collect before that had broken off
21:39 reported XY to TopLab X13274, Y60357
21:41 tripped major pair blue water sample for background water sample
21:44 weights away and left the bottom; took several DVLNAV snapshots
22:18 start Maggie spins on way up
22:30 end Maggie spins
END

Dive Report – Port Observer

May 26, 2005

Pilot: Strickrott

Port: Beaulieu

Stbd: Soule

Dive Summary

The primary objective of this dive was to locate, conduct reconnaissance, and sample the Camera Tow #4 temperature anomalies. Both anomalies were located along the ridge crest and showed ~0.2˚C increase in temperature over the ambient signal at ~5 alt. above the seafloor. The plan for the dive was to begin south of the ridge crest. Transit north to a small constructional mound on the seafloor and travel west until we encountered the anomalies.

The dive was aided by landing quite near (within 500 m) the launch target. The transit upslope did not prove difficult. We travelled through pillow and lobate flows and at the ridge crest encountered a series of E-W trending fissures. We followed the largest of these fissures to the west along and down the constructional mound nearest the launch target. Within a short distance we began to see vent animals, primarily serpulid worms, coating the walls of the 'master' fissure. At the base of the constructional mound, the fissure disappeared underneath a slightly fresher looking lobate flow in a saddle between two constructional mounds. Within this flow we found smoke in the water and soon came upon a thriving vent community containing mussels, riftia, crabs, worms, and other vent animals (no clams). Upon our arrival we found evidence of previous visits by Alvin including an old crab trap, a sediment panel experiment by Cindy VanDover or Ruth Turner, and a set of Alvin weights marked 993 that corresponded to a dive from 1979. After some deliberation we concluded that this site was Garden of Eden #3. We collected mussels, riftia, rocks, and water at the vent site. The animal communities were located within an E-W elongate blob hosted within the lobate flow. The orientation of the animals corresponded to the orientation of the fissure. After sampling we continued W along the fissure looking for the second temperature anomaly. Our investigation focused primarily on the top of the next constructional mound. We didn't find any evidence of vent life, but later learned that the temperature anomaly was probably located within the saddle between that and the next constructional mound (as was Garden of Eden #3).

Time	Depth	Head	X	Y	Description
1459	2532		13982	59739	On bottom, landed on hackly lava flows. Light sediment cover with minor Mn-coating.
1601	2533		13978	59741	Testing the 3-chip camera, panorama of local lava flow.
1607	2533		13975	59740	Completed local lava panorama with the 3-chip.
1612	2533		13976	59740	The Kang probe is working, but the time it is registering is 10 seconds ahead of GMT according to the sub clock.
1620	2533		13870	59600	New X,Y from ship survey. Transiting north towards the ridge.
1623	2531		13870	59605	Underway towards WP2 travelling over jumbled and curtain folded sheet flows.
1624	2531	3.5	13865	59628	Heading to WP2. Now into pillow lavas marking the contact with the sheet flow we landed on. Pillows are large, decorated, and with a bit more sediment cover.
1627	2521	4.5	13850	59684	Climbing upslope over pillows. Heavier sediment cover.
1629	2528		13835	59732	Into a region of collapsed broken lava, no sign of pillows, a little less sediment cover.
1631	2529		13821	59781	Back into pillows. We went over a sedimented pillow ridge, we are now in a collapsed lobate sheet flow between the pillow ridge and the large axial mound.
1633	2521		13805	59835	Still climbing up through pillows, elevation is increasing steadily.
1635	2511		13786	59907	Hitting our initial launch target, now heading due north to the axial pillow ridge.

Time	Depth	Head	X	Y	Description
1636	2506		13787	59933	Still in heavily sedimented pillows. There was a bit of lobate lava, but now back into pillows.
1639	2487		13791	60014	Still climbing up through pillows, the slope is a little bit steeper. Starting to flatten out, we may be reaching the top of the rise.
1641	2478		13795	60077	Just crossed over a fissure, dropped a target. In front of thus there is additional walls.
1642	2477	040	13797	60115	Crossed over another narrow fissure, less than 1 m across. At the top of the rise we've seen two fissures so far, both relatively narrow. Trending in the E-W direction. Now dropping over the other side of the pillow ridge.
1643	2477		13798	60145	At the 'master' fissure. Can see cut-off cross-sections of pillows in the fissure wall. The wall is 3-4 m high.
1645	2470		13793	60186	Crossing over the 'master' fissure. Huge, broken-up pillows with white staining on the pillow edges. There is a talus slope in front of us at the base of a very steep wall.
1649	2460		13782	60262	Crossed over the crest of the ridge, heading slightly downhill on the north side. Now heading back to the target we dropped at the 'master' fissure.
1653	2465		13794	60258	We saw dead mussels between the pillows, decided it wasn't worth the effort to set down and sample. Now heading back to the master fissure to follow it to the west.
1656	2466		13794	60194	Coming over the master fissure. Can see broken pillows with white staining on them.

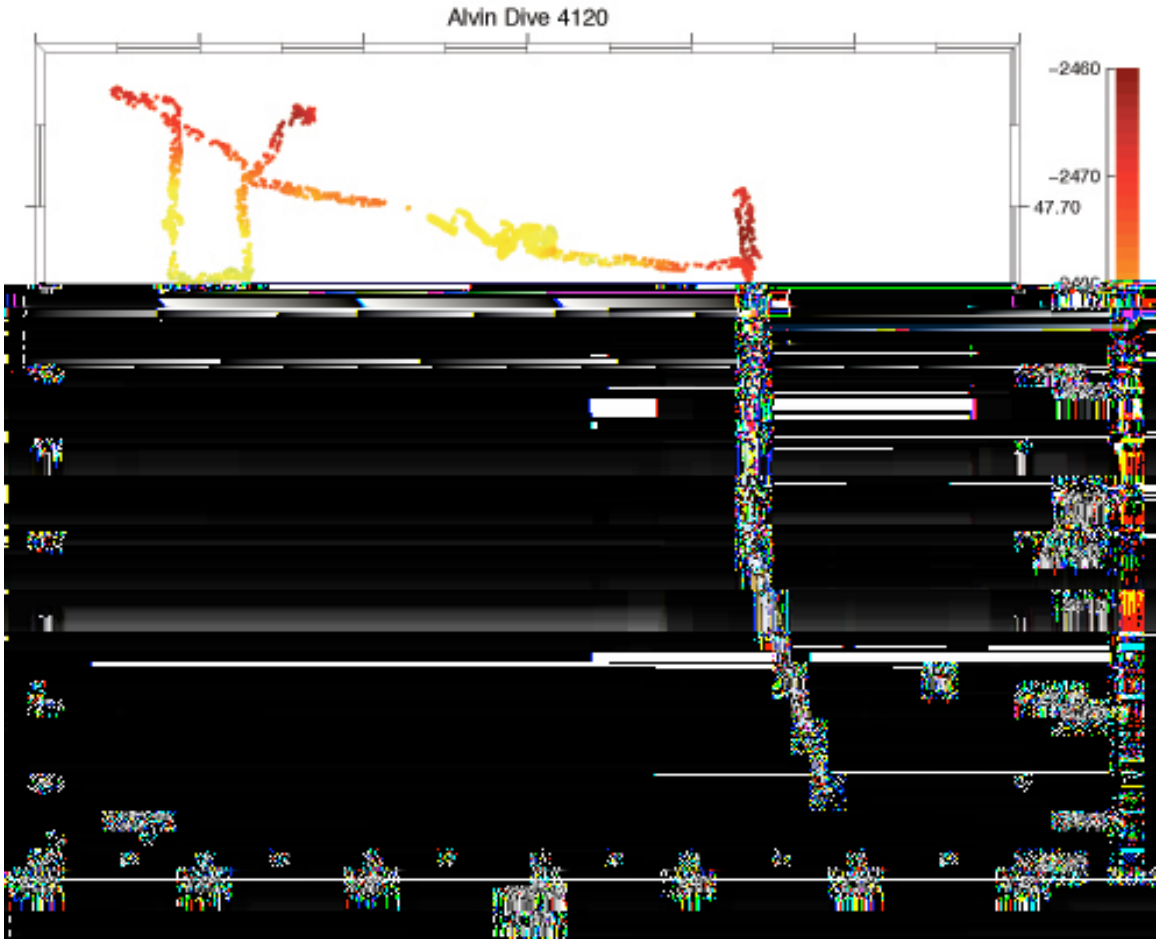
Time	Depth	Head	X	Y	Description
1658	2466		13757	60193	Flying along the fissure. It's about 2 sub lengths wide, but narrowing.
1703	2484		13630	60197	Travelling along the fissure, there is a big slice sticking up in the middle of it.
1707	2485		13566	60206	Tons of serpulids on the fissure walls. Smoke in the water. We have a live vent community. Lots of crabs, worms, riftia.
1709	2488		13542	60212	Definite shimmering water. We're going to survey the extent of this site.
1711	2487		13527	60220	Saw a crab trap beneath us.
1712	2486		13524	60231	Found a settlement panel experiment, surveying around the site.
1719	2488		13512	60209	Sitting in front of the large clump of riftia. We are going to do some sampling, ghost busting, then survey the scene with imagenex and downlooking camera.
1726	2488		135??	60209	Using the GhostBuster to get the water temperature.
1729	2488		13512	60209	Getting temperature readings of 18.5˚C, using the Hi-T probe to verify that.
1737	2489		13512	60209	Readings of 19.5˚C on the Ghostbuster. Will let it run for 10 min. to get continuous data.
1749	2488		13512	60209	Moving to other side of riftia clump to see if we can get higher temperature readings.
1754	2488		13522	60218	We just reset the doppler to the new XY position from the ship survey.

Time	Depth	Head	X	Y	Description
1759	2489	072	13516	60220	Western side of the tubeworm clump (VT 39). We're going to do another Ghostbuster reading.
1802	2488	071	13516	60220	Getting another sample with the Ghostbuster. The primary riftia clump is narrow and trends E-W.
1812	2488	071	13517	60221	Stopped Ghostbusting (max T of 13˚C). Going to move back to the E side of the clump to get higher T readings and take a major pair.
1826	2488	341	13522	60219	Back to original sampling site. Using T reading on major pair sampler to look for high T and take a water sample.
1828	2488	340	13522	60220	Getting T readings on major pair sampler near 20, going to take a sample here.
1830	2488		13522	60220	Major pair sample completed with a high temperature of 18˚C.
1831	2488		13522	60220	Collecting animals, in biobox.
1844	2489	095	13519	60220	Sampling riftia, in biobox.
1849	2489	095	13519	60220	Collected ~9 riftia.
1855	2488	012	13520	60220	Setting up from red slurp at base of community near riftia sample location.
1857					Slurp initiated, sucked up a crab.
1859	2488				Slurp completed.
1905	2488		13521	60219	Deploying marker Q at the riftia clump.
1912	2488	125	13539	60222	Slurped a floating worm (green slurp).

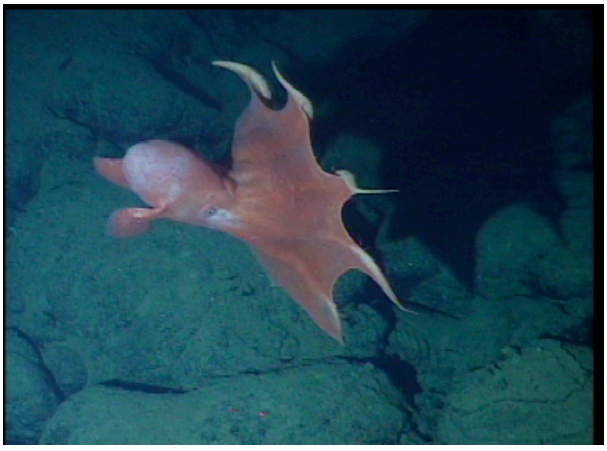
Time	Depth	Head	X	Y	Description
1919	2489	207	13557	60220	Found clumps of mussels, fuzzy galatheids and rocks. Going to get a T measurement and sample the mussels.
1921	2489	207	13557	60220	Getting a max T of 5˚C.
1928	2489	215	13557	60219	Collected approximately 6-10 mussels in the port forward chamber (blue RNA chamber). Going to deploy a marker, P at VT 30.
1933	2489	105	13552	60215	Setting down to slurp bacterial mat and collect a fuzzy rock sample.
1941	2490	168	13563	60218	Slurping bacterial mat into the white chamber.
1950	2488	250	13562	60231	Heading 270 to do a survey of GoE ~5m off-bottom. Started at VT 31.
2001	2482	185	13570	60217	Doing a 'mow-the-lawn' type survey over the field.
2003	2485	271	13549	60210	Spotted Alvin weights with the dive number 993.
2014	2438	206	13463	60245	Stopping to pick up a rock sample from the ridge axis (lightly sedimented lobate lava).
2023	2419	215	13456	60231	VT 32 collected a piece of lobate crust from the edge of a collapse captured with 3-chip video and still imagery out the stbd viewport.
2028	2484	282	13419	60252	Heading towards expected temperature anomaly sites. We don't have a fissure to follow. We are heading up a ridge of pillows. The mound to the west of the saddle where we found Garden of Eden.

Time	Depth	Head	X	Y	Description
2034	2477	276	13314	60271	Heading up a slope of sedimented pillows, may be reaching the top, see a lone galatheid crab.
2039	2475		13222	60287	Reached target for the T-anomaly, didn't find any venting. We are going to head south and search around a bit. We are in lightly sedimented pillows.
2044	2487	217	13227	60181	Found what appears to be a large fissure, following it to the west. Lobate flows surround fissure.
2046	2487	266	13206	60181	Lava pillars in the fissure appear 2-3 m high.
2051	2485	358	13142	60196	Spent some time in a large collapse feature full of lava pillars. Heading north now to continue looking for the T-anomaly.
2109	2468	301	13143	60377	No signs of venting at the top of the rise. Conitnuing west along the fissure. We are in moderately sedimented pillows with lots of decoration.
2112	2466	121	13091	60382	Heading back east along the fissure towards where we had the towcam T-anomaly.
2133	2464	241	13282	60364	Grabbed a sample from the pillow ridge (VT 33). In port, aft biobucket.
2136	2463	223	13282	60363	Rock sample we attempted to grab before fell to the base of the ridge. It is now in the back of the bottle basket.
2142	2462	242	13274	60358	Firing off the blue major pair bottle. Weights away. Leaving the bottom.

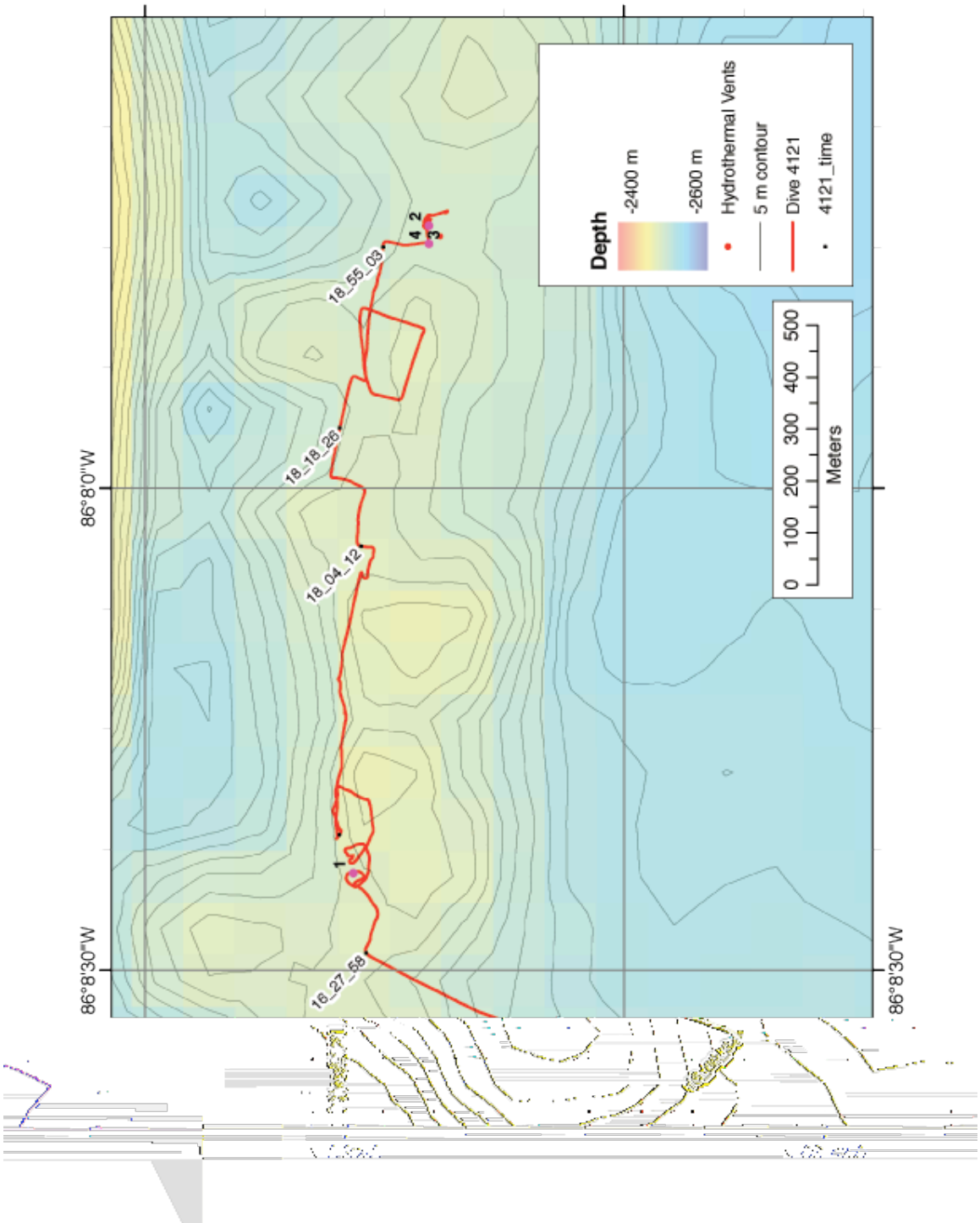
Dive 4120 – Imagenex



Dive 4120 – Pictures



Dive 4121- Dive Track



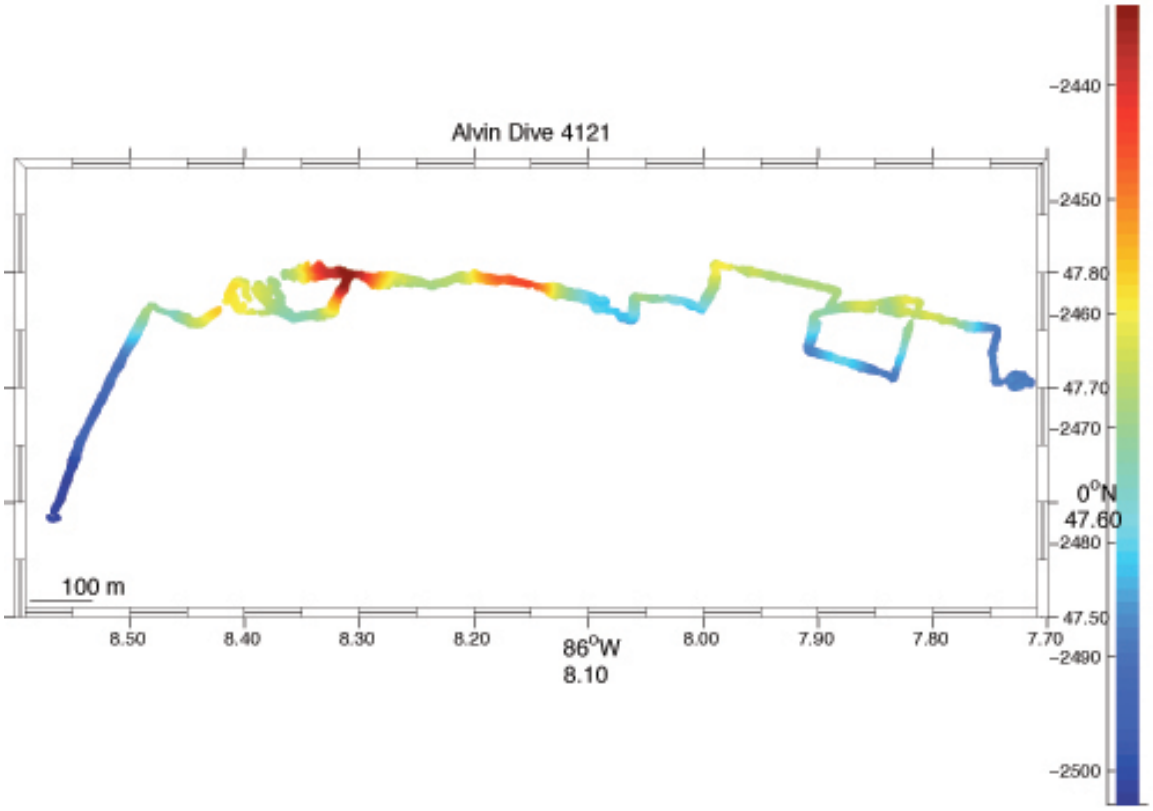
Dive Summary – Stbd Observer

Dive 4121- May 28, 2005
Pilot: Pat Hickey Port obs: Tim Shank Stbd obs: Breea Govenar

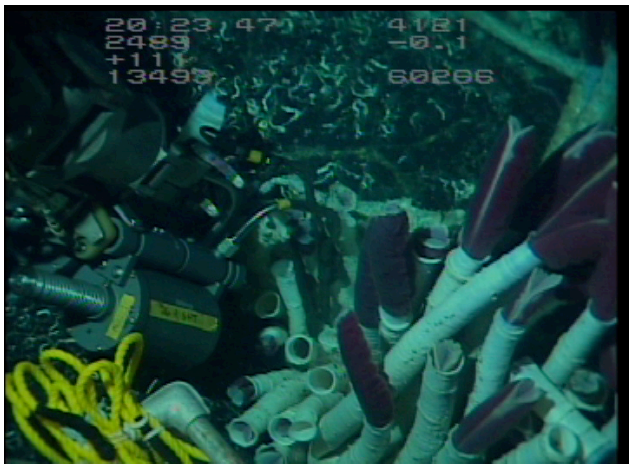
1538 On bottom (d: 2499), begin survey from ship, collect rock with sediment (placed in bottle basket)
1601 Survey finished (x: 11940, y: 60050, d: 2517)
1605 Driving NNE to temperature anomaly (h: 12- 24), sedimented lobate basalt-passing ophiuroids, shrimp, holothurians (several morphs- sometimes different morphs in close association with each other), seastars (several morphs)
1627 Following the fissure on top of the ridge (x: 12104, y: 60386, d: 2469), less sediment here
1635 Approaching dead bed of mussels and clams (x: 12217, y: 60399, d: 2458)…Is this Clambake?, heavy sediment in pockets between rocks, spaghetti worms, shrimp, hydroids? Starting to box in the perimeter… (x: 12244, y: 60433, d: 2460) brachyurans and galatheids on perimeter, more serpulid cover on W edge… (x: 12286, y: 60425) heading N, passing E-W fissure
1711 Finishing perimeter (x: 12269, y: 6048, d: 2462)—we only got about 3/4 of the way around but can see where the lines will connect on DVLNAV track, taking a few down-looking stills and then we're on our way to head E along fissure
1727 Heading SE from Clambake (x: 12313, y: 60444, d: 2467)
1738 On E side of mound, having a hard time dropping down from peak to slope (can't see bottom for a few minutes)
1759 Following depth and looking for features, noting benthos for any indication of nearby hydrothermal activity
1822 Heading S to come up over the ridge from the NW again
1824 Found fissure again, heading back E (h: 84- 79), following fissure E
1832 Going S… looking for temperature anomaly detected by TowCam (x: 13314, y: 6033)
1841 Going N and climbing back up the mound (x: 13296, y: 60338, d: 2465)
1848 Finding that we are about ~300 m from Garden of Eden and running low on power from driving around, we decide to head to Garden of Eden for the rest of the dive
1858 At Garden of Eden (x: 13469, y: 60267, d: 2481)…although I don't see anything out my viewport yet…
1900 See large trap—rectangular with green vexar mesh
1920 Starting panorama and driving 360° around Riftia patch, marker Q (x: 13487, y: 60267, h: 64, d: 2487)
1932 Setting up to start sampling (x: 13488, y: 60271, d: 2489)… Start with Ghostbuster-ing at Riftia plume height, then base (time: 1943) of same Riftia… Then again at plume height (time: 1953) and base (time: 1958) of a different clump of Riftia that will be easier to collect
2012 Grabbing Riftia—several too large for biobox, but manage to get in ~ 10 medium sized ones
2019 Slurping base of Riftia clump where grab was taken… no obvious scar on the substrate, but can see where Riftia were removed on video

2021 Firing major pair (yellow) in same sampling “scar”, ICL isn’t working, but the highest temperature at the base during Ghostbuster sampling was 15.9
2026 Firing major pair (blue) in same spot, again ICL isn’t working
2032 After finishing sampling Riftia patch, we are low on power and decide to grab a fuzzy rock—crack covered in “fuzz” is full of Bythitid fish—and Pat managed to get one!
2043 More fish footage swimming and in cracks covered in fuzz… trying to get fuzzy rocks, but they keep crumbling (two small rocks make it to green ES chamber)
2051 All weights away.

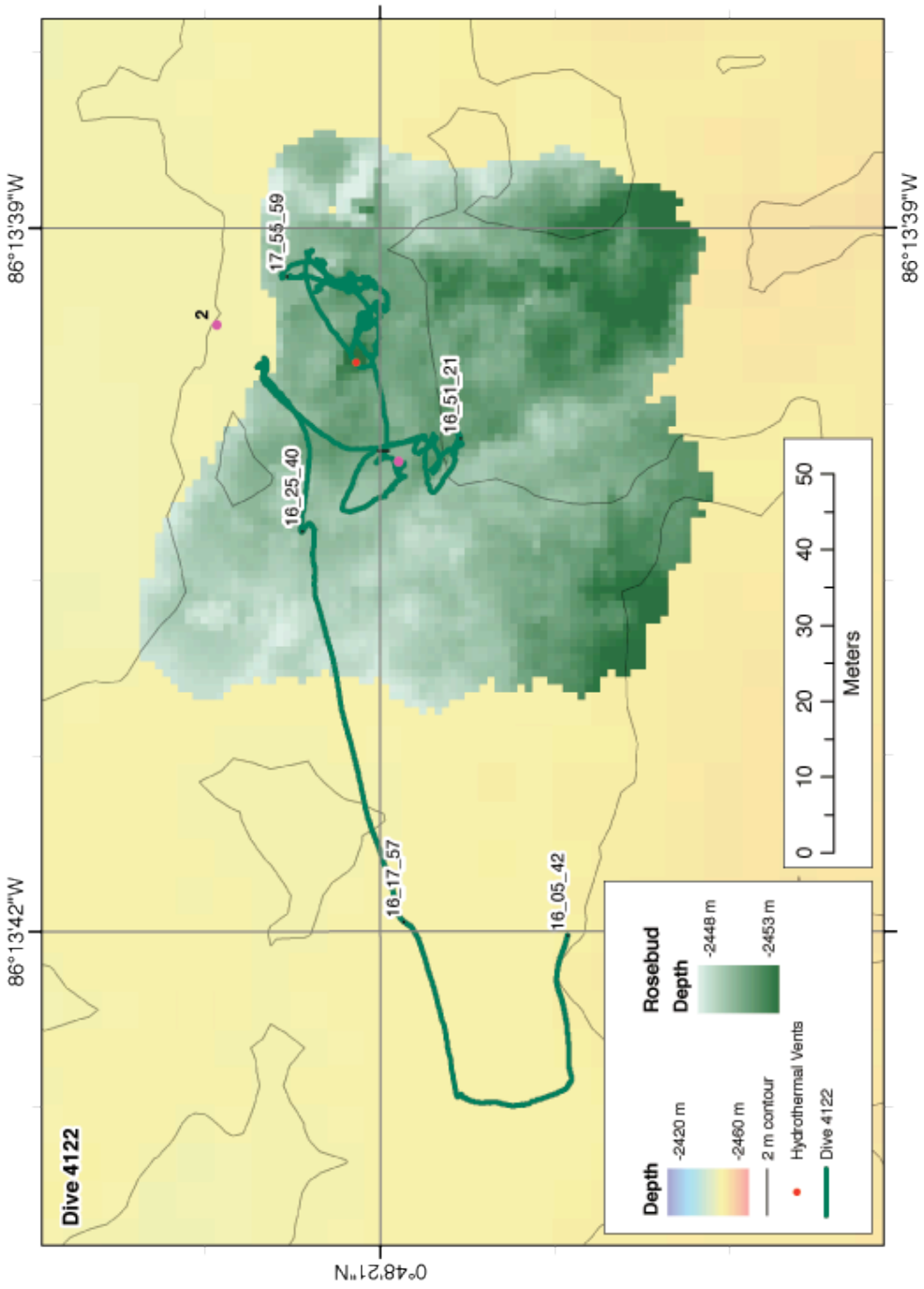
Dive 4121 – Imagenex



Dive 4121 – Pictures



Dive 4122 – Dive Track



Dive Summary – Port Observer

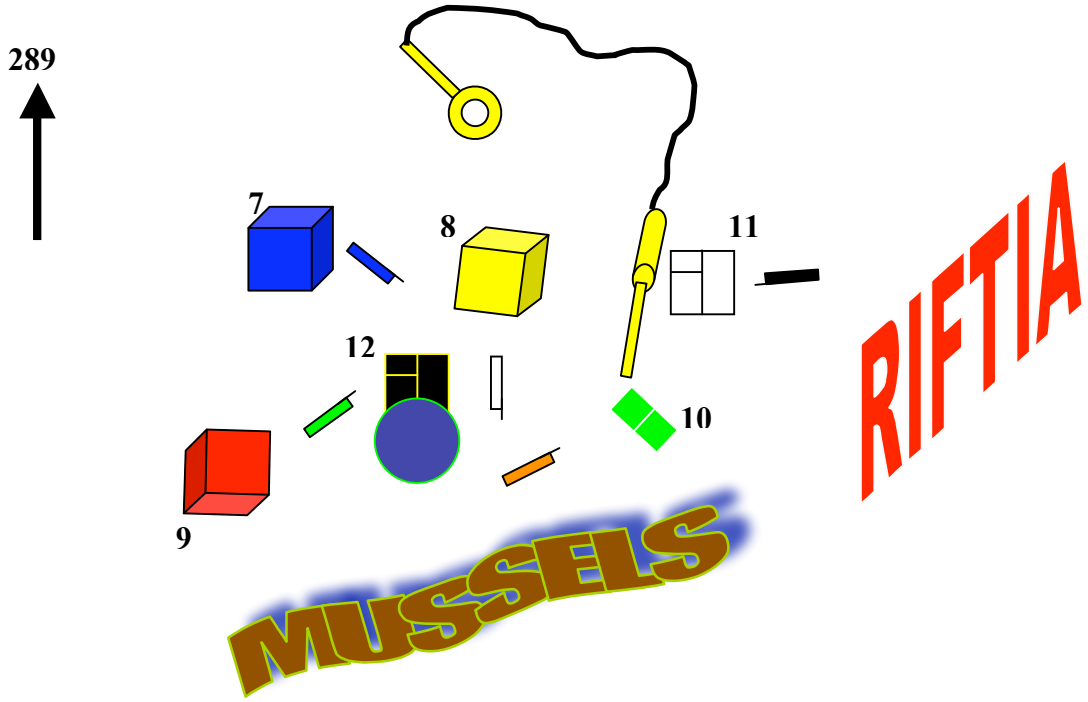
Alvin Dive 4122 – Report A. Knee – Rosebud vent site, Galápagos Rift
29 May 2005

Pilot: Gavin Eppard
Port Observer: Abigail Knee

Starboard Observer: Naomi Ward

GMT 1353 – in water
GMT 1358 – Alvin diving
GMT 1417 – 387m depth, fly heading 070
GMT 1420 – 420m depth, flash Alvin lights and could see bioluminescence engulfing the sub; Maggie is on
GMT 1424 – 500m depth
GMT 1427 – N. Ward power up Kang probe (= Ghostbuster), A/C power to computer for Ghostbuster trial
GMT 1428 – Ghostbuster on and functional
GMT 1437 – 716m depth (within SOFAR channel 600-800m), secure power to A/C and Kang probe
GMT 1452 – 1009m depth, begin spin to starboard for Maggie (= M. Tivey's magnetometer)
GMT 1454 – one circle to starboard complete (2 min duration)
GMT 1456 – 1077m depth, two circles to starboard complete; begin circling to port (2 spins)
GMT 1458 – one circle to port complete
GMT 1501 – second circle to port complete
GMT 1508 – **(x: 2482**, **y: 61565**) 1296m depth, computers on
GMT 1513 – from Pat: target is 450m away at heading 280
GMT 1525 – **(x: 2348**, **y: 61408**) from P. Hickey: target is 150m away at heading 270
GMT 1530 – 1700m depth, approaching site (Rosebud) from east; will pass Marker B
GMT 1542 – **(x: 2616**, **y: 61407**) 1965m depth
GMT 1545 – cameras on: 3-chip, DanCam, port and starboard pan and tilts
GMT 1547 – **(x: 2577**, **y: 61381**) from P. Hickey: drive west for one minute as the sub is drifting towards the moorings
GMT 1548 – 2100m depth, frame grabber grabbing
GMT 1550 – **(x: 2562**, **y: 61391**) +262 heading, 2145m depth, secure driving
GMT 1552 – power Ghostbuster back on, return A/C power to computer
GMT 1554 – Imagenix, digitals, DanCam, strobes on; will start video tape upon 100m approach
GMT 1559 – Ghostbuster error (130˚C?), but self-corrected
GMT 1600 – **(x: 2423**, **y: 61383**) +355 heading, 2347m
GMT 1606 – 2442m, bottom in sight
GMT 1607 – **(x: 2405**, **y: 61413**) 9.7m altitude, +356 heading, 2442m, error on Ghostbuster so cycling power
GMT 1614 – **(x: 2439**, **y: 61384**) 2.5m altitude, 2448m depth, curtain sheet flows into lobate
GMT 1619 – passing by large purple/pink holothurians, small enteropneusts

GMT 1620 – **(x: 2433**, **y: 61464**) 1.7m altitude, 2448m depth, coming up slope to large collapse
GMT 1622 – possible sighting of Mkr C ahead (Alvin Waypoint #3), serpulids, brachyurans, mussels increasing in density and abundance
GMT 1623 – Mkr M to port
GMT 1625 – Mrk L in front
GMT 1626 – 50m offset in LBL
GMT 1627 – 2489m depth, Mkr B off starboard, Mkr L to starboard
GMT 1630 – at Mkr J, which is F (marked by rusty, dilapidated bucket lid); boom strobes in
GMT 1640 – **(x: 2479**, **y: 61446**) +122 heading, 2450m depth, Ghostbust at J in search of high temperature reading; only reaches 6.2˚C, so repositioning
GMT 1647 – fly over Mkr I to reposition at J
GMT 1650 – **(x: 2478**, **y: 61443**) 0.5m altitude, 2450m depth, at Mkr J/F
GMT 1654 – still cannot find high temperature at Mkr J mussel patch, reaches 5.2˚C
GMT 1656 – **(x: 2474**, **y: 61447**) turn at +51 heading to Mkr I, Ghostbust in mussels (2.3˚C, high of 10.5˚C), move sub to reposition
GMT 1706 – +287 heading, 2450m depth, high temperature off starboard of ~13˚C, but need to reposition to take Major Pair and deploy the logger
GMT 1707 – reposition at I
GMT 1710 – **(x: 2473**, **y: 61457**) move Ghostbuster probe into mussels
GMT 1713 – temperature of 4.9˚C
GMT 1718 – **(x: 2475**, **y: 61451**) high temperature of 11.2˚C amid Riftia and mussels
GMT 1718 - 1725 *– Ghostbuster station #1, facing Mkr J at I*
GMT 1725 – secure Kang Probe (Ghostbuster)
GMT 1727 – **(x: 2474**, **y: 61452**) +129 heading, 2449m depth, at same location as Ghostbusted, prepare for Blue Major (which is entangled on slurp pump)
GMT 1732 – **(x: 2475**, **y: 61452**) Mkr J visible out port
GMT 1736 – ICL on Major gives a Log Formula Error, which is a ground on the ICL so shut down and fire Blue Major regardless
GMT 1738 – 17:41 *– fire Blue Major*
GMT 1744 – detangle Blue Datalogger
GMT 1747 - 1748 *– **(x: 2478, y: 61453)** position and deploy Blue Datalogger amid mussel/Riftia cluster where Blue Major taken and Ghostbusted; leave site*
GMT 1751 – at Mkr B approach from south, then reposition
GMT 1754 – **(x: 2499**, **y: 61458**) 2450m depth, pick up RatCam and back off from experiment
GMT 1758 *– Ratcam pin released and away*
GMT 1805 – **(x: 2498**, **y: 61461**) 0.1m altitude, 2450m depth, at Mkr B
GMT 1806 – change video tape decks (then pan VCR 1 camera over Mkr B site, or before?)
GMT 1815 – **(x: 2493**, **y: 61475**) +289 heading, 2450m depth, strobes off



GMT 1844 – at Mrk B, prepare to Ghostbust Block #9 (non-native, red tape on eyebolt)
GMT 1845 – grab Block #9 by the string-line to lift off and insert Ghostbuster
GMT 1846 - 1851 *– Ghostbust where Block #9 was sitting*
GMT 1855 – place Block #9 in port biobox chamber, but can't release marker after pull pin pulled as line is looped through eyebolt
GMT 1903 – **(x: 2492**, **y: 61476)** +267 heading, 2450m depth, continue block recovery
GMT 1905 - 1910 – *Ghostbust at Block #10 (line tangled with 12 and 8), native basalt 1/2 glass panel (white handle with red tape) sitting atop Yellow Datalogger (7.2˚C)*
GMT 1912 - 1915 – pull pin on Block #10 with difficulty but release after shaking line; place Block #10 by handle in enzymatic sampler chamber 2
GMT 1916 – reposition sub to reach other blocks
GMT 1917 – RatCam at surface
GMT 1919 – **(x: 2492**, **y: 61477)** +243 heading, 2450m depth
GMT 1920 - 1925 *– Ghostbust next to base of Block #12 (native basalt with yellow handle and black tape) near glass planet Earth*
GMT 1928 – pull pin on Block #12 and place in enzymatic sampler chamber 3
GMT 1934 *– **(x: 2492**, **y: 61477)** retrieve green Vemco (handle beneath glass planet) and place in fish trap on bottle basket*
GMT 1941 – sub powered down while Ghostbusting at Block #7 (non-native, blue tape on eyebolt, marker lost)
GMT 1945 – power restored
GMT 1947 – 2450m depth, position Ghostbuster back in place at Block #7
GMT 1948 - 1953 *– **(x: 2493**, **y: 61475)** +82 heading, 0.3m altitude, Ghostbust at Block #7*
GMT 1950 – RatCam on deck of R/V Atlantis

GMT 1954 – bring DanCam (at image 668), Imagenix, Insite cameras back on line
GMT 1957 – DanCam, Imagenix, Insite, Maggie back on and video decks recording
GMT 2002 – retrieve Block #7 and place in starboard biobox compartment (outboard)
GMT 2003 – no handle or line by which to pick up Block #7, so must grab block itself (eyebolt is too small to hook through)
GMT 2005 – close biobox on Block #9 line
GMT 2007 – change video tape deck tapes
GMT 2011 *– close bungee on biobox, orange Vemco into fish trap (manipulator punched through neoprene top)*
GMT 2012 *– retrieve blue Vemco to fish trap*
GMT 2013 *– retrieve white Vemco to fish trap*
GMT 2017 - 2022 *– Ghostbust at Block #8 (non-native, basalt with yellow tape on eyebolt)*
GMT 2025 – release Block #8 pull pin but line caught through eyebolt, so place block (holding three entangled bucket lid wedge markers) in enzymatic sampler chamber 1 and closed with line and markers hanging over edge
GMT 2030 – **(x: 2494**, **y: 61472**) +65 heading, 2450m depth
GMT 2035 - 2037 *– **(x: 2497, y: 61474)** +225 heading, Ghostbust at Block #11 (native with white handle and white/black tape) alongside yellow Datalogger*
GMT 2036 – low on battery, permission to drop weights when ready
GMT 2040 – **(x: 2497**, **y: 61474**) +253 heading, 0.1m altitude, grab and drag yellow Datalogger to retrieve
GMT 2041 – place Block #11 in enzymatic sampler chamber
GMT 2044 *– place yellow Datalogger in bottle basket (black Vemco also retrieved prior to this into fish trap)*
GMT 2036 – 2249m depth, all weights away

Dive Summary – Stbd Observer

Galápagos Rift 2005
AT11-27

Dive 4122 May 29, 2005

Bottom target: Rosebud – 00°48.35'N 86°13.659'W
Pilot: Gavin Eppard
Port: Abigail Knee
Stbd: Naomi Ward (dive report)

Basket Load [water weight]
Ghostbuster Probe [12]
Double biobox [8]
4-barrel enzymatic sampler [13]
1 major pair (ICLs) [22]
hydraulic fish sampler with trap
blue Seyfried logger to be deployed

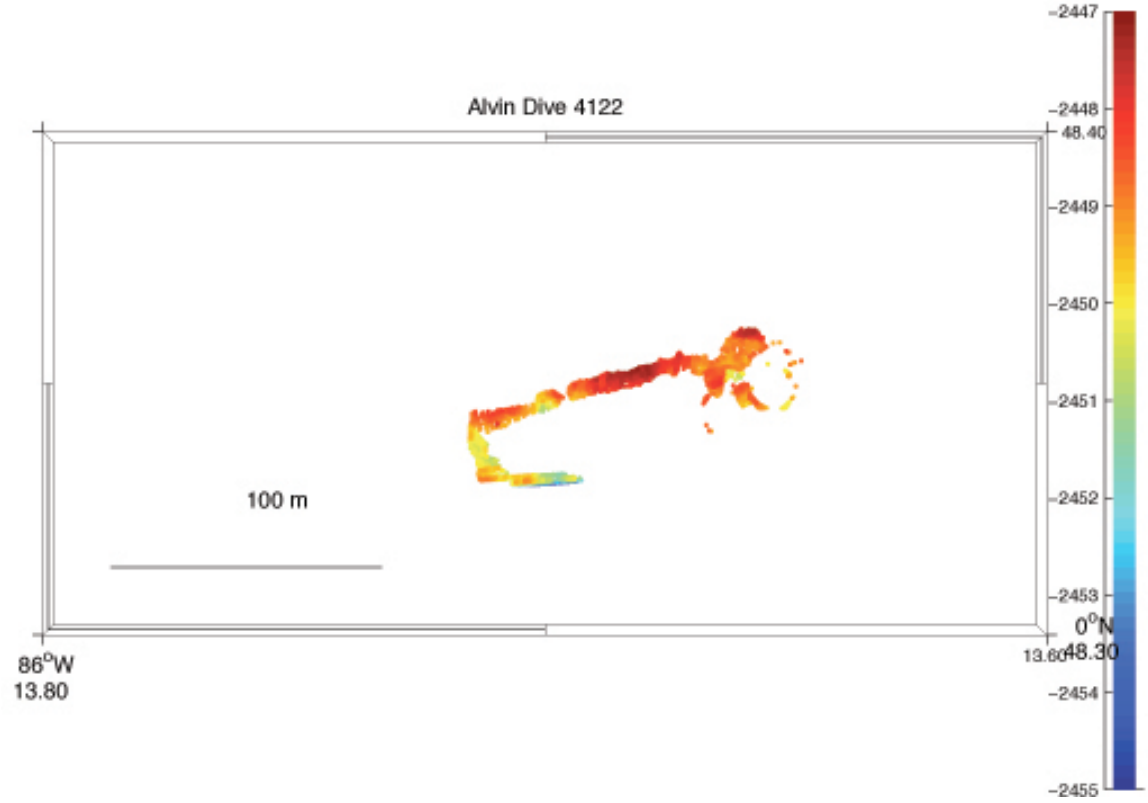
Dive objectives
The major objectives of this dive were to:

1. deploy the blue Seyfried logger
2. release RatCam to the surface
3. recover the yellow Seyfried logger
4. recover 6 basalt panels at Marker B
5. recover the 5 Vemco probes
6. Ghostbuster chemistry at "B" marker community where yellow logger
7. complete downlooking survey

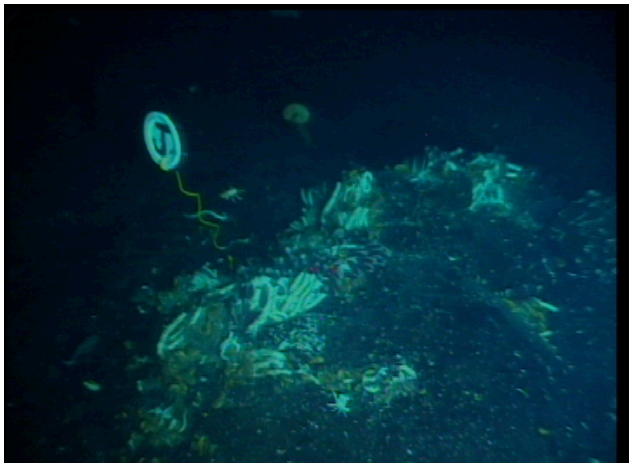
Time	Depth	
	549	Ghostbuster tested – seems to be working fine
	706	Ghostbuster turned off
	1009	Commence Maggie spins to the right
	1075	Commence Maggie spins to the left
	1141	Done with Maggie
15:52	2187	Ghostbuster turned on
15:59		Ghostbuster error ("framing error occurred during transfer"). Hit "continue" and data collection resumed
16:07		Ghostbuster error. Tried exiting and cycling power, then restart.
16:14		Started transit to Marker F
16:15		Ghostbuster error. These continued to occur every couple of minutes for the first ca. 3 hours of the dive, then errors slowed and ceased
16:24	2447	Saw Marker L. X,Ys are off, 50m offset
16:27		Saw Marker N, Ratcam. Headed for Marker J

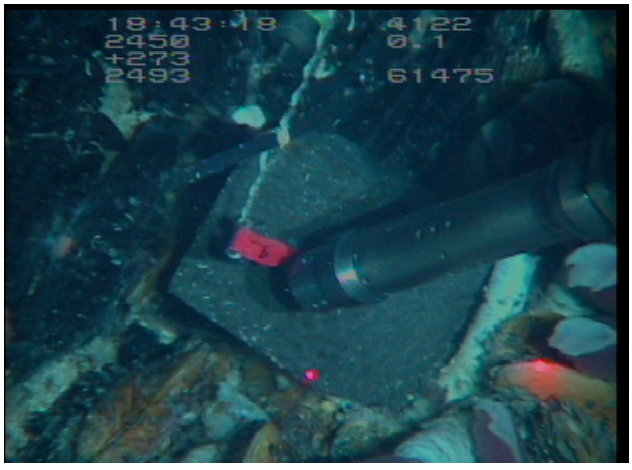
16:41		Ghostbusting at J. Can't find water with temp > 6C at front of patch. No shimmering water at back of patch
16:52		Ghostbuster max temp 3.3C
16:55		Headed for Marker I
16:59		Ghostbusting at I. Temps ranging from 3.8 to 13.3C
17:18	2449	Started timed Ghostbusting at I at 11.2C
17:29		Observed filamentous bacteria adhering to Riftia plumes at I. Took picture with in-ball camera
17:37	2449	Fired major pairs at I for 3 min
17:45	2449	Deployed blue logger
17:52		Arrived at Ratcam
17:57		Pulled pin on Ratcam
18:45	2450	Ghostbusting Marker B red non-native (#9)
		Recovered Marker B red non-native (#9) to port biobox
19:05	2450	Ghostbusting Marker B white-and-red native (#10) on top of yellow logger
19:14	2450	Recovered Marker B white-and-red native (#10) on top of yellow logger to ES2
19:20	2450	Ghostbusting Marker B yellow-and-black native (#12#)
19:29	2450	Recovered Marker B yellow-and-black native (#12) to ES3
19:34	2450	Recovered green Vemco to fishtrap
19:41		Boat dropped
19:48	2450	Ghostbusting Marker B green non-native (#7)
20:03	2450	Recovered Marker B green non-native (#7) to stbd biobox
20:12	2450	Recovered orange and blue Vemcos to fishtrap
20:13	2450	Recovered white Vemco to fishtrap
20:17	2450	Ghostbusting Marker B yellow non-native (#8)
		Recovered Marker B yellow non-native (#8) in ES1
20:29	2450	Recovered black Vemco to fishtrap
20:35	2450	Ghostbusting Marker B white-and-black native (#11)
20:41	2450	Recovered Marker B white-and-black native (#11) in ES
20:41	2450	Recovered yellow logger in bottle basket
20:46		Weights away

Dive 4122 – Imagenex

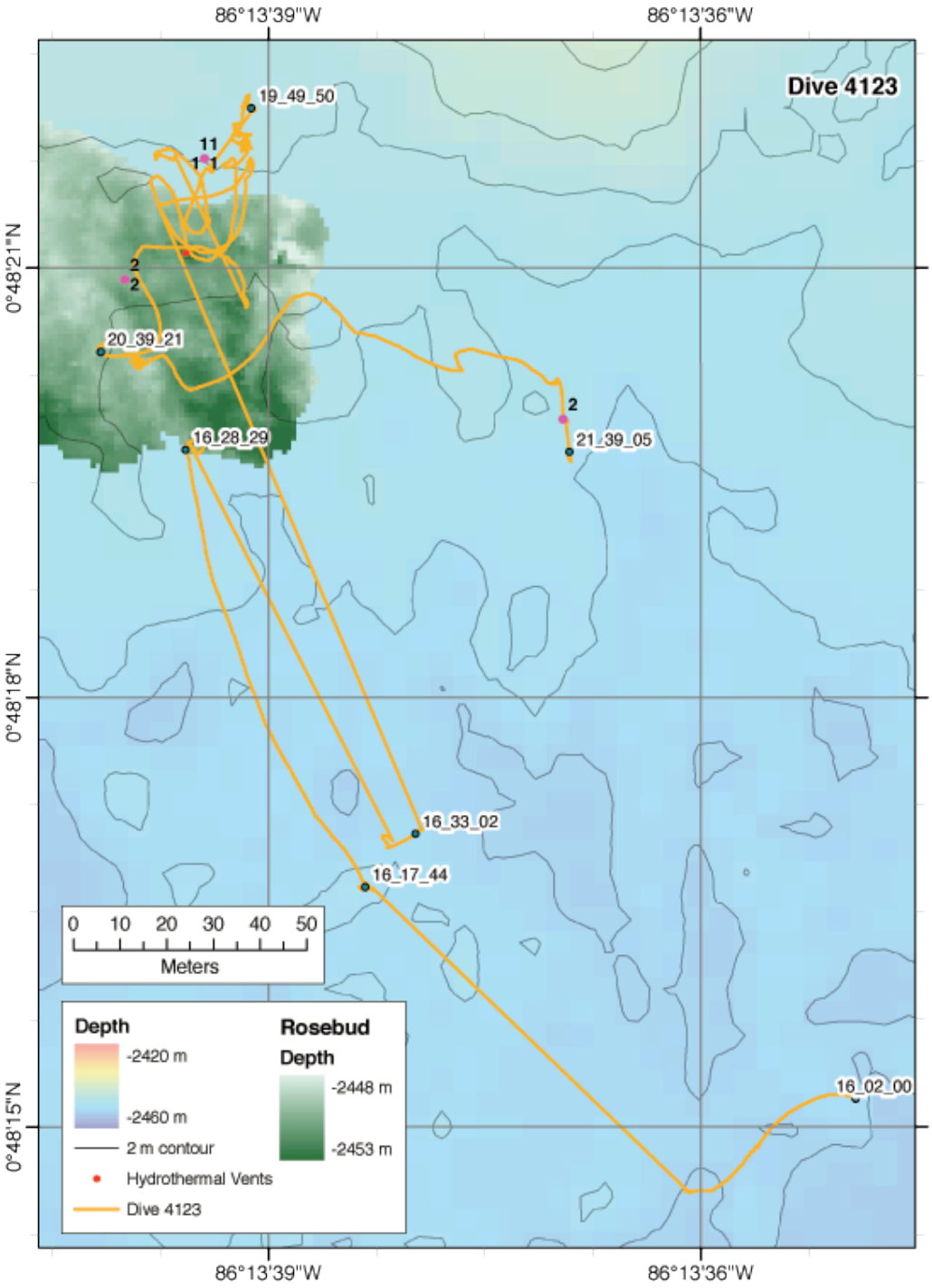


Dive 4122 – Pictures





Dive 4123 – Dive Track

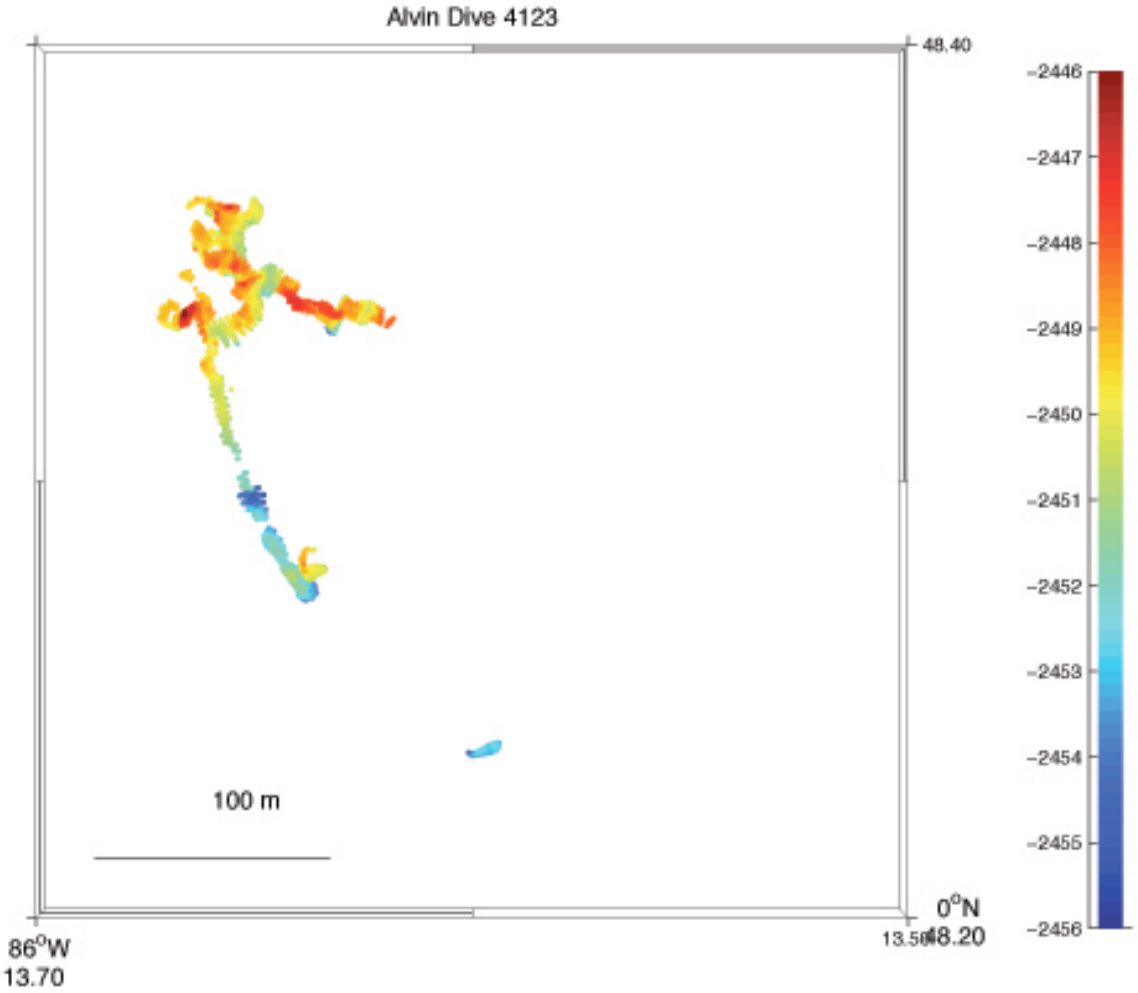


Dive Summary – Port Observer

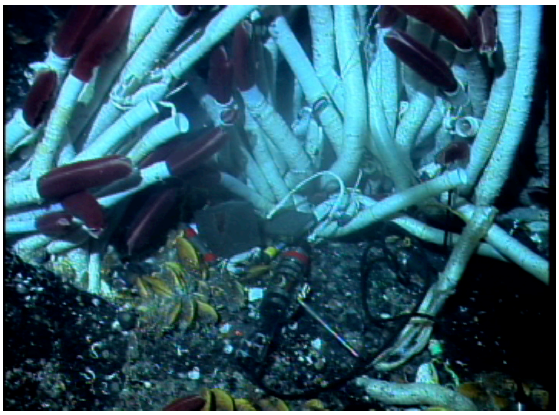
Dive 4123
30 May 2005
Pilot: A. Tarantino
Port: K. Buckman
Pit: M. Spear

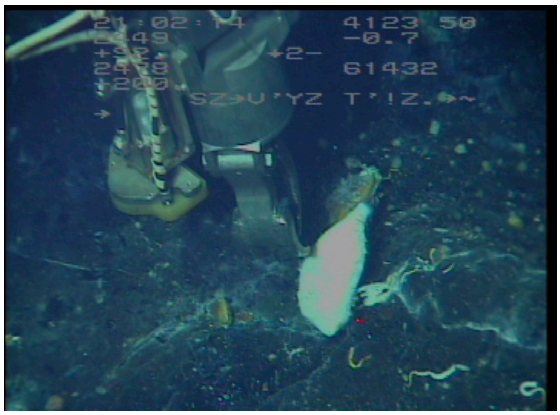
1447 650m Ghostbuster turned on
1501 990m Maggie on (2.5 spins to R, 2 spins to L)
1550 Imagenex on
1605 2450m on bottom (2605 61259) very jumbly, hackly flow w/ some sediment
1614 reset Doppler to LBL
1642 released first larval trap
1708 set up at B for samping/collecting
1737-1745 Ghostbust red vemco/red block combo underneath block high 3.1°C
1800-1807 Ghostbust yellow vemco/white plate combo on bottom side high 2.1°C
1812-1814 Ghostbust black plate on top in tubeworms (accidentally unplugged serial port)
1827-1834 Ghostbust yellow plate on back edge high 2.1°C
1838-1845 Ghostbust green block on bottom edge high 2.1°C
1848-1855 Ghostbust blue block touching side high 2.1°C
1902-1909 Ghostbust black plate again high 7.3°C
1910 collecting plates: White plate #6 into ES 3(green), Yellow plate #5 in ES 4 (blue), Black plate #1 in ES 1(white) w/ crab, red block #2 in ES 2(yellow)
1944 recovered red, yellow, white, and green vemcos into bottle basket
2007-2012 Ghostbust at red probe tip high 16.2°C then recovered probe into bottle basket
2027 reset Doppler to 2501 61445 (we were directly on top of mkrA and could see mkrB about 3 meters away)
2046-2051 Ghostbust blue probe at mkr I then recover it to bottle basket; collect "clamicle" tubeworm into port biobox
2113 start strobes during transit to eastish, recording 3-chip downlooking as go
2127 2450m sample rock from collapse just off of fissure into stbd biobox 2569 61421
2137 weights away
2145 Ghostbuster probe off

Dive 4123 – Imagenex

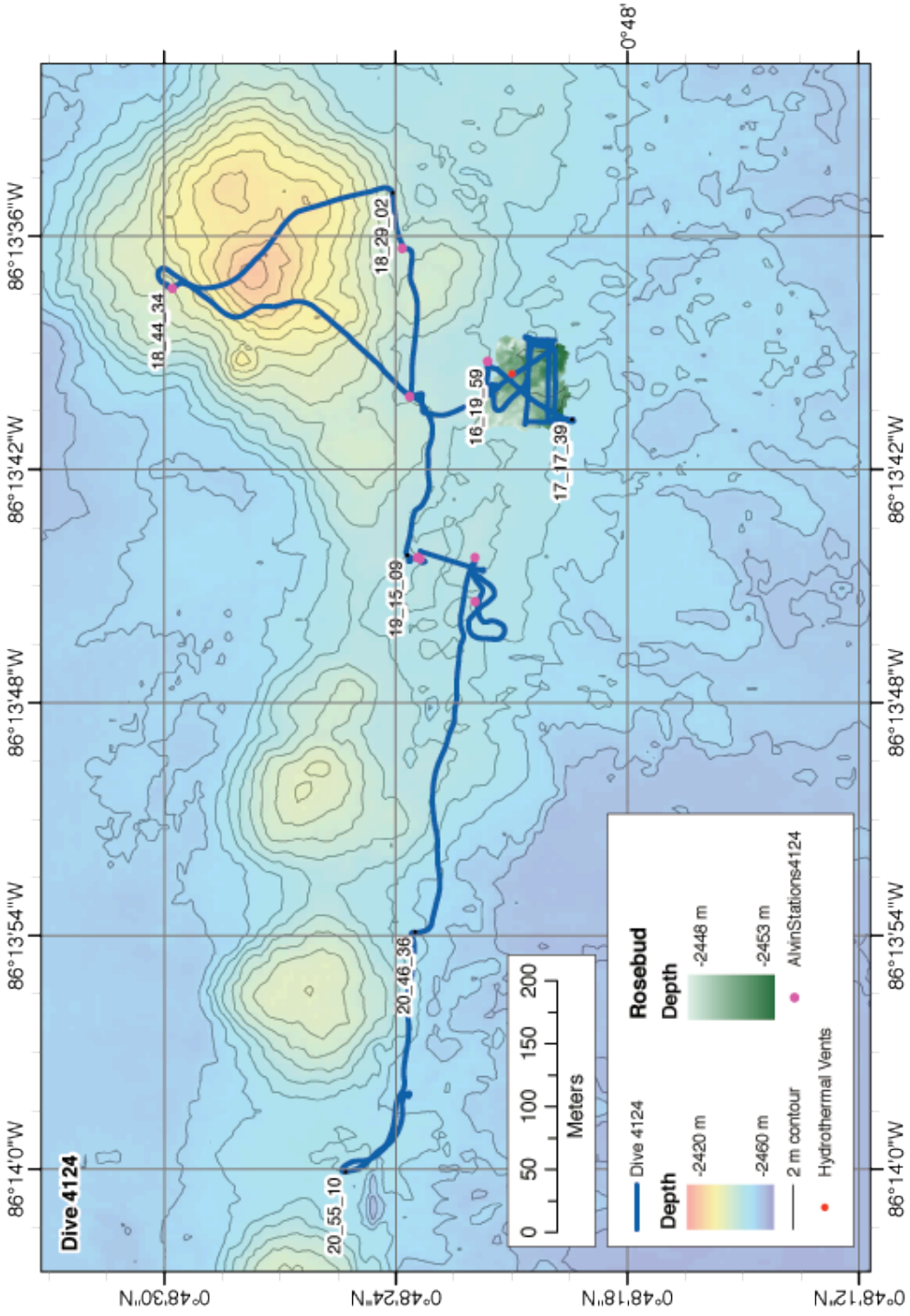


Dive 4123 – Pictures





Dive 4124 – Dive Track



Dive 4124 – Port Observer

May 31, 2005

Pilot: Strickrott

Port: Soule

Stbd: Ward

Dive Summary

The goals of this dive were to recover the remaining experiments at Rosebud (Marker B), finish the downlooking camera survey, and constrain the geologic origins of the lava flow hosting the Rosebud vent site.

The dive began within the Rosebud site. We searched for and found Marker B, negating the necessity of a survey on the sub by the ship (probably save 20 minutes). We Ghostbusted the two remaining settlement panels (blue and yellow) before recovering them along with the blue vemco temperature sensor. We then took a major pair at Marker B and collected some mussels and fuzzy rocks. Next, we completed the downlooking survey with a box pattern that extended the area of coverage to the west, north, east, and south. We drove north of the Rosebud site looking for geologic evidence of the vent from which the flow issued. We saw only sedimented lobate flows to the north (sample). Driving east we came upon a small rise comprised of sedimented pillow lava (sample). We drove NNW up the 20 m high mound N of Rosebud and found more sedimented pillows (sample). We decided to drive down the hill towards the Rosebud site. On the way we came upon an east-west trending fissure. The fissure varied in width from 1-5 m and depth from 2->8 m. The inner walls of the fissure were lined with bathtub rings indicating it was filled with lava that drained back down into the fissure within the recent past. As we followed the fissure we saw a nearly continuous area of fresh sheet flows emanating from the fissure and flowing south. There were areas where the sheet flows showed clear channels with lineated-sheet morphologies indicating the direction of flow. ~300-400 m west of Rosebud we noticed smoke in the water and started to see signs of vent fauna. Within 5-10 m wide collapse features south of the fissure we found serpulid worms, blankets of small anemones, mussels, clams, and riftia. These critters were distributed along the fissure, but were particularly concentrated within a collapse ~700 m west of Rosebud that we called ‘Rose Bowl’. We sampled rocks, mussels, and riftia at this site as well as measured water temperature and took a major pair.

Time	Depth	Head	X	Y	Description
1424					Testing Ghostbuster (1426 GB on, no reading, restarting software).
1426-1428					Ghostbuster working.
1443	985 m				Spinning from maggie.
1450					Completed 2 maggie turns.
1452					Spinning R (opposite of before) for maggie.
1500					Done spinning
1513					Imagenex gain set to 9 dB (there will be lots of blank data).
1537					Turning on Ghostbuster (near bottom)
1543					Imagenex sees the bottom
1547					Observers see the bottom.
1550	2451				Sitting on a jumbled flow within the Rosebud vent field. Pressure = 2219, T = 1.5˚C.
1603					Found marker B, settlement panels, vemco, globe.
1608					Imaged marker B
1609	2452		2492	61475	Positioning to Ghostbust and recover
1613					Ghostbusted blue block (max T = 7.3, done 1620).

Time	Depth	Head	X	Y	Description
1620					Ghostbusted blue block again (max T = 6.9, done 1627).
1628					Ghostbusted yellow block (max T = 3.4, done 1627).
1635					Positioning to recover.
1637					Blue block in port, aft chamber.
1638					Yellow block in stbd, aft chamber
1639					Blue vemco in bottle basket
1640					Flooding stbd chamber with poison, no confirmed poison release.
1641					Flooding port chamber with poison.
1646					Hi-T probe found max T of 16˚C
1651					Fired off major pair (yellow) at 16.9˚C near block locations.
1654					Mussel grab into port, forward chamber (~10 mussels).
1700					Fuzzy rock grab into stbd forward chamber (3 small pieces)
1709					Starting downlooking survey.
1745					still surveying, clams out stbd viewport
1755					Downlooking survey completed.

Time	Depth	Head	X	Y	Description
1808			2455	61521	Transited through Rosebud to a target N to start geology survey. Arrived in moderately sedimented lobate lava.
		331	2491	61449	Transiting to the N to look for the source of the Rosebud flow. Animals seem to concentrate on high points (kipukas?) within the flow.
1802					Textures indicate that lava was flowing due south through the rosebud site.
1805	2446	21	2458	61527	Gone from flat lineated sheets to more curtain folded and lobate flows.
1808	2447		2470	61538	Collected a sample of lobate crust around a collapes just to the north of the NW corner of the Rosebud site. (2)
1812	2445		2507	61534	Still over lobates with a moderate sediment cover.
1813	2446		2528	61532	As we get to the edge of the rise we're seeing gigantic pillows that seem to be slightly less sedimented than the lobate flow we were just on.
1815	2442		2561	61537	At the top of the rise, we're still in pillows.
1819	2445		2581	61521	Sampling a pillow bud from the mound in portside biobox. (3)
1827	2443	060	2590	61543	Continuing E over the pillows looking for a contact with another flow type.
1829	2445		2634	61552	Lobate flows abut the pillowy hill
1830	2443	355	2629	61584	Heading towards the seamount and coming into pillows. The contact between them and the lobates was indistinct.

Time	Depth	Head	X	Y	Description
1832	2437	355	2624	61606	Coming up the slope of the pillow mound. Large pillows are somewhat extended in the down-slope direction.
1834	2433	313	2603	61641	Still going up the slope. Still large pillows with no directed flow downslope.
1838	2426		2556	61703	1 m wide fracture running about 019 over the top of the mound. Virtual target 23.
1847	2432		2556	61727	Sampling pillow buds from the top of the mound, into the stbd biobox chamber (4).
1857	2431		2553	61676	Following the fissure that's at the top of the mound. It splits apart and anastamoses in places. It's not too wide 1-2 m across. Pillows on the walls of the fissure are not cut. Still in an area of massive pillows, decorated and striated.
1900	2437	212	2535	61606	Heading downhill towards Rosebud. Still in pillows. Looking for contact between older pillows and younger Rosebud lava.
1903	2444	215	2501	61567	Slope has flattened out. In lobates that don't look any fresher than pillows on the mound. There is no distinct contact between the pillows and lobates. Gradational.
1905	2446	227	2476	61544	Now in large collapse features where we took a sample before. A little less sediment than up on top of the mound. Still too much to be Rosebud flow.
1908	2448	295	2434	61521	Now in a sheet flow. There's smoke in the water. Big hole (collapse) with serpulids lining it.
1909					Look for T or sulfide indicator on the Kang probe.

Time	Depth	Head	X	Y	Description
1910	2448	279	2403	61522	Looks like we're in fresh flow similar to Rosebud. Smoke in the water. Vent animals, carpets of anemone. Serpulids, crabs.
1913	2447	282	2369	61536	Still following a deep fissure that has hot water and vent communities. Probably the along axis fissure. Likely source of the Rosebud flow, lava is much fresher.
1915	2448	257	2344	61540	Found a community of ~50 mussels along the base of the collapse. The collapse wall is white.
1918	2448		2339	61526	Collecting a sample of the lava from the vent area that fed Rosebud presumably. Kind of an EPR like collapse trough, i.e. lava coating a tectonically developed fissure.
1919					Collected a big plate of the lava crust that has drips on the underside. (5)
1932	2448		2342	61532	Getting ready to fire the blue major pair in some of the warm fluids and then do a fauna grab.
2008	2446		2307	61475	Another collapse with lots of riftia, mussels, and other vent animals. Edges of collapse have the highest concentration of animals. Lots of smoke in the water.
2010	2446		2292	61491	Dropped target 30 at another collapse in a large sheet flow carpeted with anenomes. Sheet flows are lineated and have an undulating surface. Lots of evidence of drainback. Lots of pillars and there are bathtub rings on the collapse and fissure walls.
2012	2448		2286	61642	Fresh jumbled sheet flow (a lot like rosebud). Not much vent life, but were getting further from the fissure.

Time	Depth	Head	X	Y	Description
					In a channel with nice, ropy folds on the surface. There's bathtub rings on the walls. The channel is heading almost due south. Looks like the rift was active along a long length (1 km) and a number of little flows came off to the south (rosebud being one of them). Heading back to the cul-de-sac collapse 'Rose Bowl'.
2015	2448		2307	61485	Setting down at a clump of riftia to sample.
2041	2446	286	2168	61518	Going over the fissure. Coated with bathtub rings. Lots of evidence of drainback. Fissure has varied from pretty narrow (<1 m) to more than a subs width. Imagenex will show depth. Now lobate flows coming out of the fissure. We may have reached the end of the fissure.
2042	2443		2142	61519	We've reached the end of the fissure segment. Gone from sheet flows into lobate and pillow flows (VT 32). There's a small offset ~2 m to the south and the fissure begins again in the same orientation.
2043	2446		2096	61515	Elevation is dropping a little bit. We're still over the fissure. Still see sheet flows coming off to the south.
2045	2447		2049	61512	Fissure ended under a big ass sheet flow that had some serious channels in it.
2053	2446	303	1877	61555	Following the fissure we've come to a large area of collapse and jumbled sheet flow. (VT 34)
2058			1915	61538	Weights away.

Galápagos Rift 2005
AT11-27

Dive 4124 May 31, 2005

Bottom target: Rosebud – 00°48.35'N 86°13.659'W
Pilot: Bruce Strickrott
Port: Adam Soule
Stbd: Naomi Ward (dive report)

Basket Load [water weight]
Ghostbuster Probe [12]
Double biobox [8]
4-barrel enzymatic sampler [13]
2 major pairs (ICLs) [44]
hydraulic fish sampler with trap

Dive objectives
The major objectives of this dive were to:

1) Recover two basalt blocks in aft 2 preservation chambers
2) Recover 1 vemco probe
3) Mussels from Marker B RatCam in chamber
4) Complete downlooking survey
5) Geologic survey to the cone northeast of Rosebud

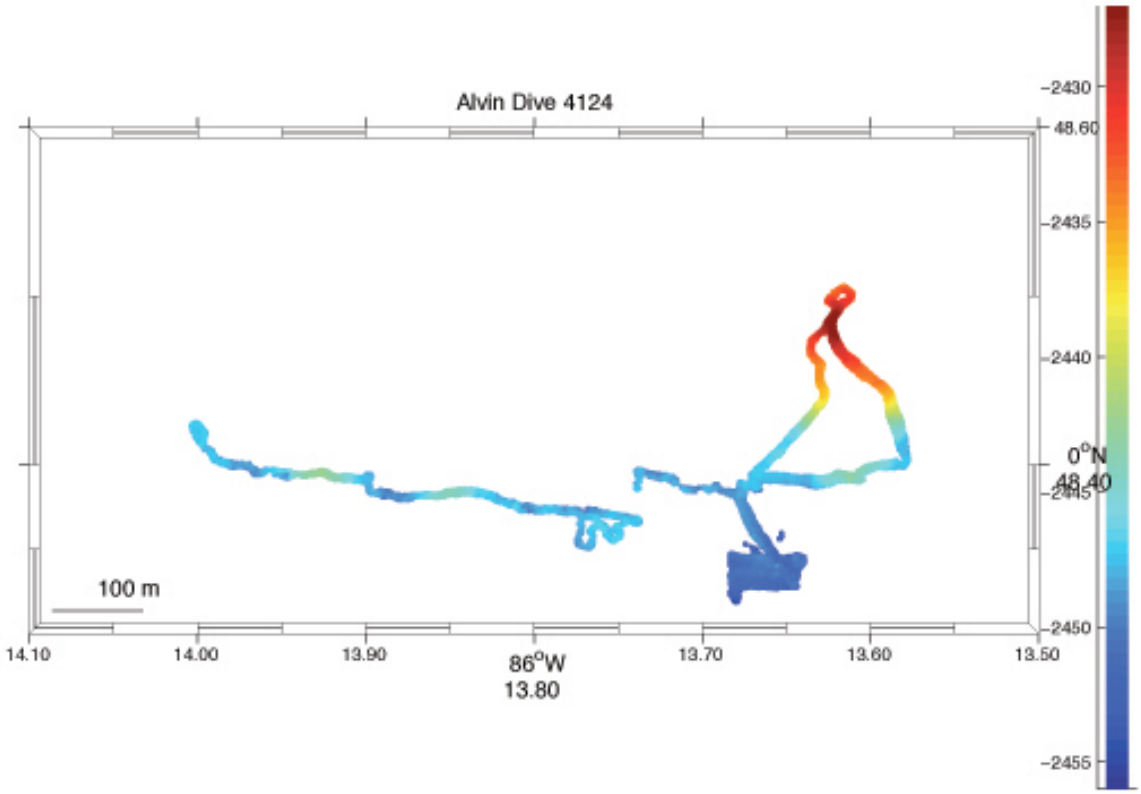
Time	Depth	
	500	Ghostbuster tested – seems to be working fine
14:43	985	First Maggie spin to the left
	1062	Second Maggie spin to the left
	1179	Top lab indicates we are positioned over Rosebud
	1194	Maggie spins to the right
	1369	Finished with Maggie spins
	1711	No navigation yet
	1753	Top lab indicates we are positioned slightly northeast of Rosebud, not worth driving
15:25	1965	Software started up, video systems on, coms good
15:36	2220	Top lab indicates we are within 20-30m of target
15:39	2285	Ghostbuster turned on and left on for remainder of dive
15:42	2353	100m from bottom
15:43	2398	Imagenex data collection starts
15:47	2449	On bottom 20m east of target (X2515, Y61434), jumbled flow, lots of glass
15:50	2451	Still heavy, trimming. Anemones, shrimp
15:53	2451	Driving northwest. Crabs

15:56	2452	Serpulids. Ghostbuster error
15:57	2451	At Marker J
16:05	2452	At Marker B blocks. Imaging.
16:13	2452	Ghostbusting next to blue block (X2494, Y61475). Max temp 7.3C
16:21	2452	Second ghostbust above blue block. (X2498, Y61476) Max temp 6.2C
16:28	2452	Ghostbusting yellow block. (X2498, Y61530) Max temp 3.4C
16:36		Blue block retrieved to aft port chamber
16:38		Yellow block retrieved to aft stbd chamber. Vemco retrieved.
16:39		RNA pump T handle turned so red tape is towards pilot's viewport. Aft stbd chamber flooded with sodium cacodylate-glutaraldehyde solution
16:41		RNA pump T handle turned so red tape is to port. Aft port chamber flooded with sodium cacodylate-glutaraldehyde solution
16:43		Went back to fill aft stbd chamber with any remaining solution. T handle turned so red tape points fwd
16:49	2452	Major pair (yellow) fired. ICL temp 16.6-16.9C (X2499, Y61475)
16:57		Mussel grab to fwd port chamber
17:00		3 furry rocks to fwd stbd chamber
17:03		Trimming up for downlooking survey
17:13		Started downlooking survey at 5.8m. Biological observations below
17:29		Transponder on deck, halfway through survey
17:36		Observe white staining on rock
17:40		Crab
17:44		White fish
17:45		Clam or mussel shells
17:46-17:50		Crabs
17:51		Fish
17:52		Clams observed through downlooking camera
17:54		Crab
17:55		Finished downlooking survey
17:59		Transiting to geology survey start, driving to 330
18:00		Crabs, serpulids, Marker B sites to our port side
18:03		Sheet flow
18:04		Staining on rock, collapsed lobates. Turning east
18:09	2448	Collected crust of lobate to bottle basket (X2470, Y61538)
18:12		Giant pillow (less sedimented than lobates), edge of the rise. Fish, crab
18:14		Bamboo (?) coral
18:15		Fish
18:16		Holothurians
18:18		White sponge (?), mushroom-shaped
18:19		Collected small glassy rocks to port biobox
18:23		Fish
18:25	2445	Collected pillow bud to port biobox (X2588, Y61544)
18:27	2444	Fish (X2603, Y61548)
18:28	2444	Crab (X2609, Y61549)
18:29		Turning 330, north and west. Holothurians

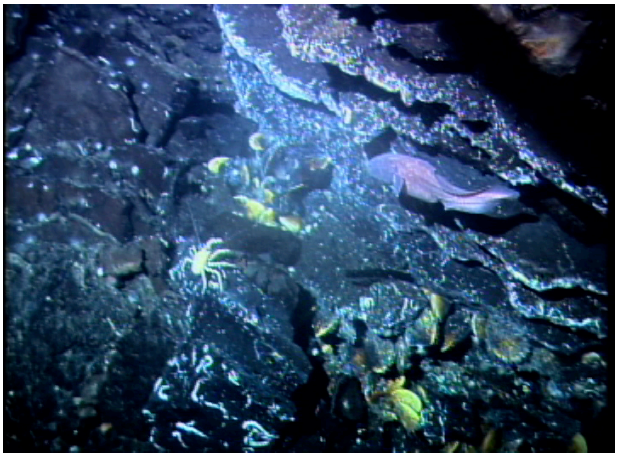
18:30	2444	Big anemone, swimming red holothurian (caped appearance)
18:31	2439	Big white brittle star (?) (X2625, Y61600)
18:32	2436	Holothurians, fish (X2630, Y61618)
18:34		White crinkly sponge (?) (X2602, Y61642)
18:38	2427	Fracture. Coral (?). Brittle star (?) (X2557, Y61710)
18:39	2432	Long narrow fish with "snout" (X2562, Y61736)
18:46	2432	Collected 2x pillow bud to stbd biobox (X2556, Y61727)
18:57	2431	Following fissure at top of mound
18:58	2434	Bamboo coral (X2543, Y61639)
18:59	2435	Sea urchin (?) (X2546,Y61624)
19:00		Geology survey finished. Heading towards Rosebud to locate source of Rosebud flow
19:03	2444	Bamboo coral (X2504, Y61572)
19:04	2445	Holothurian, crab (X2486, Y61554)
19:05		New lava flow. Fish, anemone, holothurian (X2463, Y61527)
19:07	2448	Fractured sheet flow. Anemones, serpulids (X2438, Y61530)
19:08		Observed new diffuse flow site. Shimmering water, anemone carpet, serpulids, lots of smoke, crabs
19:15	2447	Mussels (X2344, Y61537). Observing diffuse flow every ca. 20m.
19:19	2448	Drippy rock with serpulids. Large collapse over erupted fissure – source of Rosebud flow? About 1 meter deep. Fauna concentrated at edge of collapse (X2338, Y61526)
19:30		Three young Riftia observed off stbd side. Took picture with in-ball camera
19:32		Took panorama with stbd pan-and-tilt
19:33	2448	Blue major pair fired. ICL temp 7.6 (X2342, Y61532)
19:38	2448	Mussel grab to fwd stbd chamber (X2342, Y61486)
19:46	2448	Ghostbusting mussels at new vent site (X2341, Y61530) Max temp 11.7
20:01		Trimming up
20:07		Clumps of Riftia
20:10		Lava pillows, larger fissure
20:12		Fresh jumbled lava, not much vent life
20:13		Mussel mound, fish
20:15		Riftia clump. Mussels off to the right
20:19		Moving rock off biobox to allow Riftia collection
20:23	2448	Riftia grab to stbd biobox (X2307, Y61486)
20:25		Finished sampling of Riftia
20:27		Trimming up. Replaced rock on biobox
20:33		Turning, going west
20:34		Following fissure
20:35		Fissure widening
20:36		Jumbled end to fissure. Followed another fissure to right. Smoke, rock staining
20:45		Fissure ended
20:46		Started following another fissure, still heading west

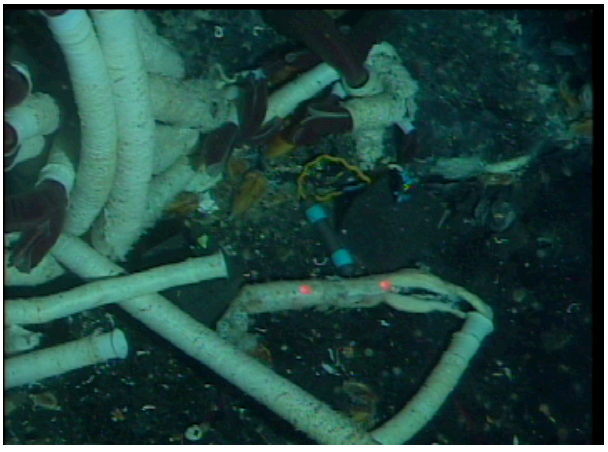
20:51		Brachyuran
20:53		Following fissure west. Collapse, staining
20:58		Weights away (X1916, Y61538)
		Lids of aft chambers removed for seawater flush after leaving bottom
	414	Lids of aft chambers replaced after seawater flush.

Dive 4124 – Imagenex



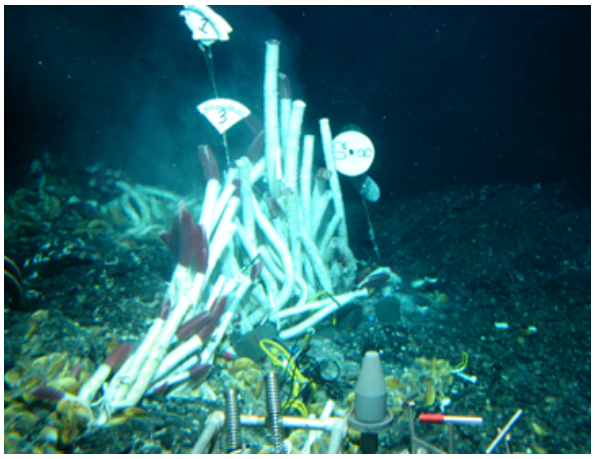
Dive 4124 – Pictures

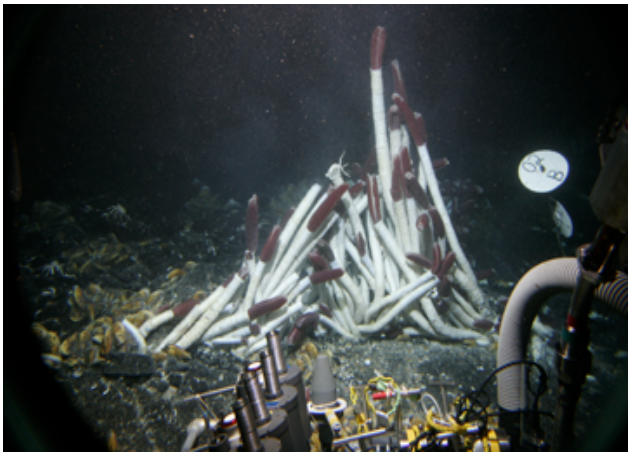


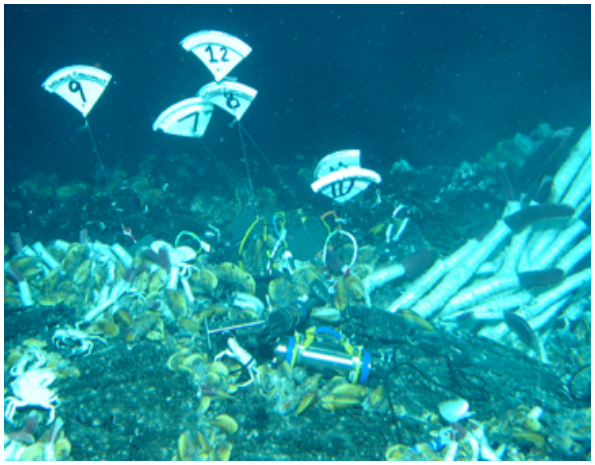


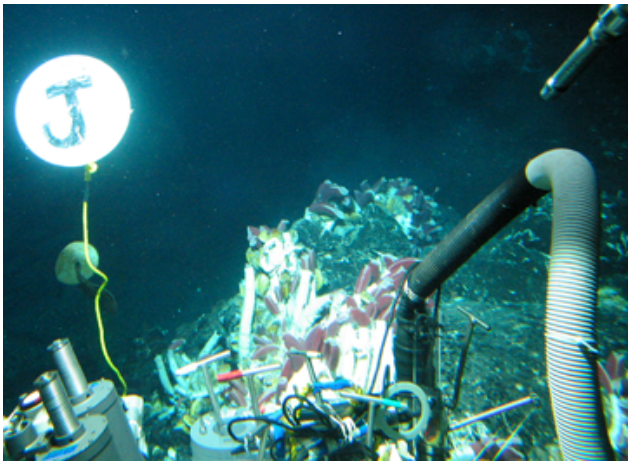
6. Plates

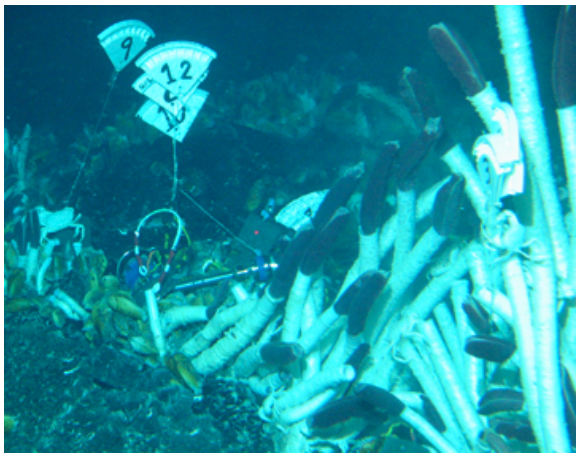
6.1 Rosebud Markers



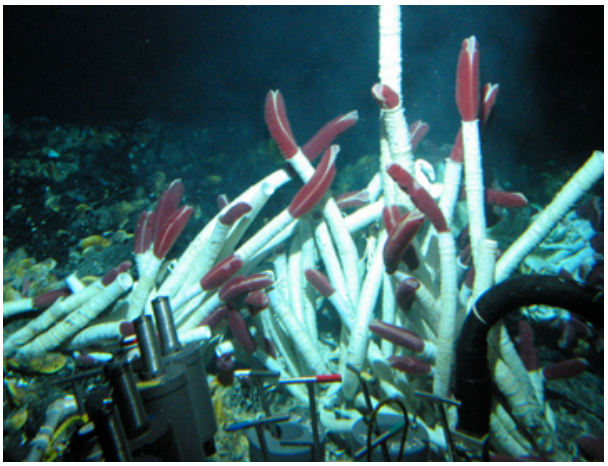


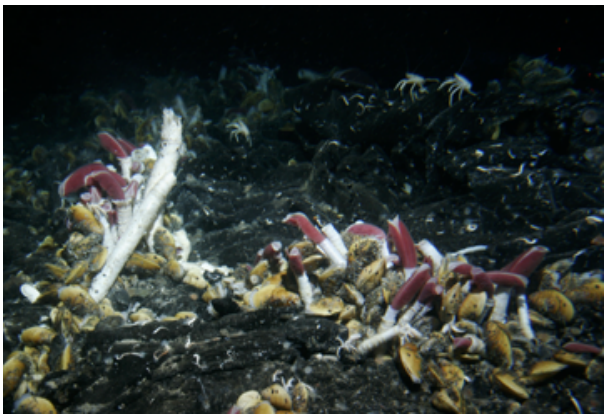


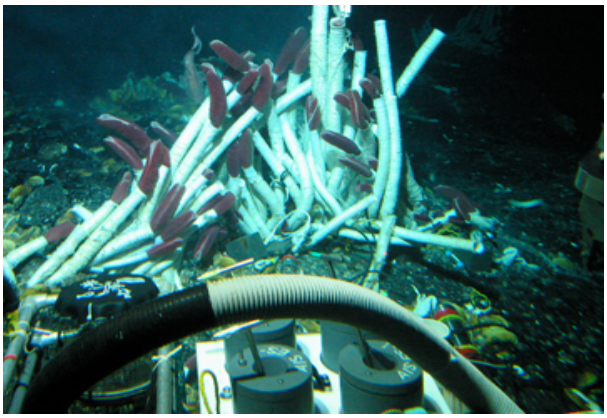


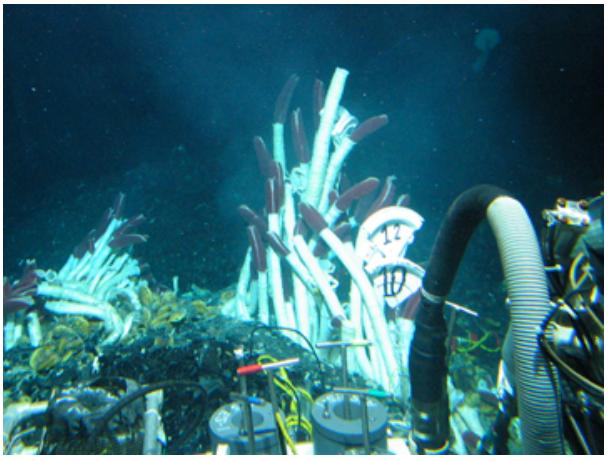


6.2 Rosebud Images

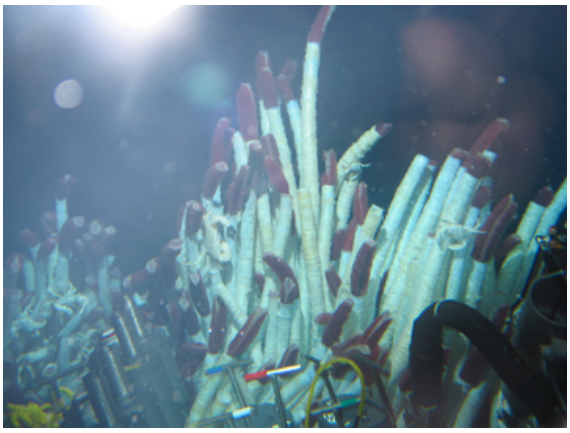


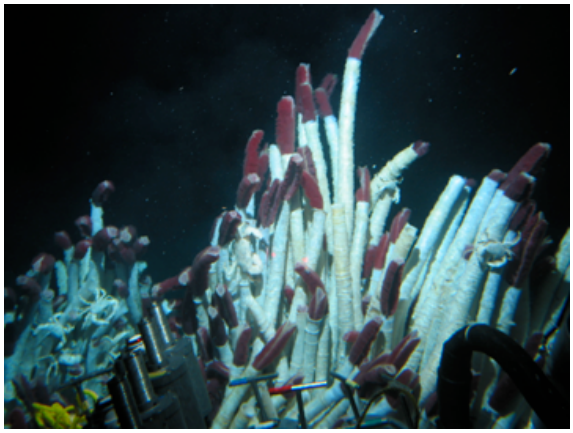


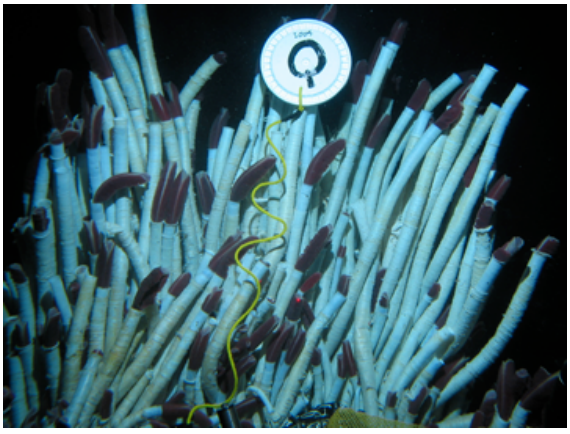


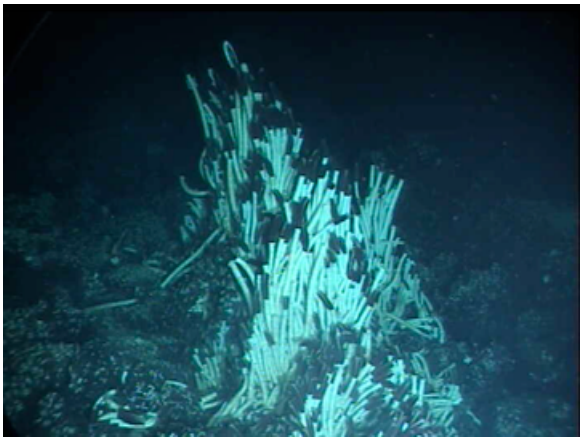


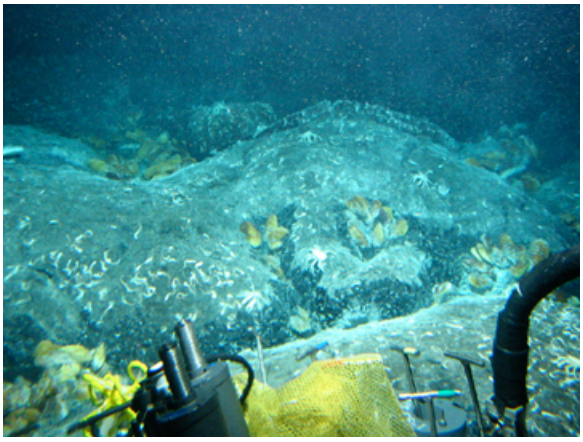
6.3 Garden of Eden Images



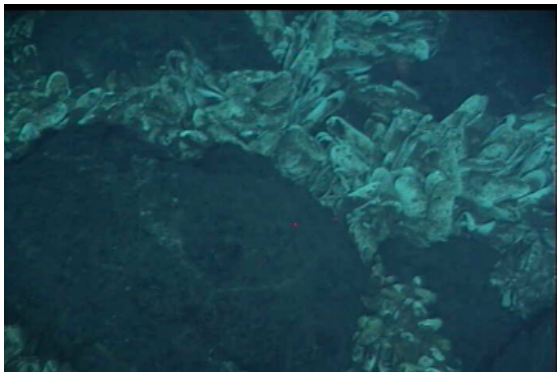








6.4 Clambake II Images



7. References

Ding, K., W.E. Seyfried, and Z. Zhang (2002) An effective solid state sensor for *in-situ* measurement of the chemical and thermal environment near vent biota-preliminary results from the Galapagos Expedition. Eos Trans. AGU, 83 (47), Fall Meet. Suppl., Abstract T11C-1259

Fornari, D.J., J. Howland, S. Lerner, S. Gegg, B. Walden, A. Bowen, M. Lamont, and D. Kelley (2003). Upgrades to NDSF vehicle camera systems and development of a prototype system for migrating and archiving video data in the National Deep Submergence Facility Archives at WHOI. Eos Trans. AGU, 84 (46), Fall Meet. Suppl., Abstract OS32A-0232

Fornari, D.J., Shank, T.M., Von Damm, K.L., Gregg, T.K.P., Lilley, M.D., Levai, G., Bray, A., Haymon, R., Perfit, M., and R.A. Lutz (1998) Time-Series Temperature Measurements at High-Temperature Hydrothermal Vents, East Pacific Rise 9 °49'-51'N: Monitoring a Crustal Cracking Event. Earth and Planetary Science Letters, 160:419-431.

Hessler R. R., W. M. Smithey, M. A. Boudrias, C. H. Keller, R. A. Lutz and J. J. Childress (1988) Temporal change in megafauna at the Rose Garden hydrothermal vent (Galápagos Rift; eastern tropical Pacific). Deep-Sea Res., 35, 1681-1709.

Mullineaux, L.S., C.R. Fisher, C.H. Peterson, and S.W. Schaeffer (2000) Tubeworm succession at hydrothermal vents: use of biogenic cues to reduce habitat selection error? *Oecologia* 123 (2): 27-284.

Shank, T.M., D. Fornari, D. Yoerger et al. (2003) Deep submergence synergy – Alvin and ABE explore the Galapagos Rift at 86°W. EOS, Trans. AGU 84 (46): 425-433.

Shank, T.M., D.J. Fornari, K.L. Von Damm, M.D. Lilley, R.M. Haymon, and R.A. Lutz (1998) Temporal and spatial patterns of biological community development at nascent deep-sea hydrothermal vents (9°50'N, East Pacific Rise). Deep-Sea Res II 45 (1-3): 465-515.

Whitcomb, L.L., J.C. Kinsey, D.R. Yoerger, C.L. Taylor, A.D. Bowen, B.B. Walden, and D.J. Fornari (2003)_Navigation upgrades to the National Deep Submergence Facility Vehicles D.S.V. Alvin, Jason 2, and the DSL-120A. Eos Trans. AGU, 84 (46), Fall Meet. Suppl., Abstract OS32A-0225

Van Dover, C.L. (2000) The Ecology of Deep-Sea Hydrothermal Vents. Princeton University Press, Princeton, NJ.

8. Appendices

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Daniel Dubno Guest	CBS News New York, NY 10019

R/V ATLANTIS (MS 4836 KP)
USA FLAG IMO # 9105798
T. SHANK, CHIEF SCI

VOYAGE 11 LEG 27
PUNTARENAS, CR TO
PUNTARENAS, CR
DEPART: 19 MAY 2005

***** CREWLIST *****

NO.	*NAME*	*RATING*	*D.O.B.*	*PP#*	*CITIZEN OF*
1.	SILVA, GEORGE P.	MASTER	20 JAN 55	203149442	USA
2.	CRANE, MARGARET M.	1ST MATE	21 JUL 48	155858701	USA
3.	DICKSON, CRAIG D.	2ND MATE	19 JUN 54	102185617	USA
4.	FLEMMING, JACOB M.	3rd MATE	28 OCT 81	203039437	USA
5.	HEIMBERGER, RAYMOND E.	COM/ET	07 JUL 37	402168054	USA
6.	BAILEY, WAYNE A.	BOSUN	09 JUN 51	212627973	USA
7.	GRAHAM, JERRY M.	AB	21 JAN 55	204594980	USA
8.	MARTINEZ, RAUL	AB	18 SEP 66	103810531	USA
9.	ARTHUR, ROBERT V.	AB	14 JAN 50	153347060	USA
10.	THREADGOLD, G. KEVIN	OS	02 OCT 53	204420840	USA
11.	BARRETT, ROBERT S.	OS	11 NOV 82	104362724	USA
12.	MULKERN, MICHAEL V.	OS	08 AUG 81	203084947	USA
13.	LITTLE, JEFFREY C.	CHIEF ENGR	23 SEP 49	209023336	USA
14.	SCHUBERT, JAMES A.	1ST ENGR	15 SEP 69	103689232	USA
15.	VIEIRA, MARCEL	2ND ENGR	06 APR 62	102661148	USA
16.	STRAND, KEITH L.	3RD ENGR	31 MAY 62	575772973	USA
17.	MEACHAM, STUART A.	ELECTRICI	16 APR 56	015813676	USA
18.	FARRINGTON, ALLEN J.	OILER	09 DEC 61	205670504	USA
19.	APUDO, CHARLES O.	OILER	11 FEB 67	A850439	KENYA
20.	WOOD, CARL O.	STEWARD	12 MAY 56	085655362	USA
21.	DALOMBA, ALBERT P.	COOK	30 JUL 57	155474703	USA
22.	RICARDO RIOS	MESS ATTN	27 DEC 59	132084160	USA
Alvin Crew:					
23.	HICKEY. J. PATRICK	EXPD LDR	22 AUG 55	211415808	USA
24.	STRICKROTT, W. BRUCE	PILOT	18 DEC 64	102453208	USA
25.	TARANTINO, ANTHONY P.	PILOT	24 JUL 71	101864595	USA
26.	EPPARD, GAVIN W.	PILOT	05 JUL 70	055851174	USA
27.	BERRY, ANTHONY P.	TECH	02 SEP 79	103146248	USA
28.	SPEAR, MARK O.	TECH	13 MAR 55	205937714	USA
Scientists:					
29.	SHANK, TIMOTHY M.	CHIEF SCI	29 MAY 65	153376040	USA
30.	FORNARI, DANIEL J.	SCIENTIST	15 SEP 50	153827168	USA
31.	HUMPHRIS, SUSAN E.	SCIENTIST	12 AUG 51	300919095	USA
32.	SEYFRIED, WILLIAM E. JR.	SCIENTIST	31 JUL 48	075324335	USA
33.	DING, KANG	SCIENTIST	01 SEP 56	148190569	CHINA
34.	FOUSTOUKOS, DIONUSIOS	SCIENTIST	24 JUN 75	N7556067	GREECE
35.	PETER, NICHOLAS J.	SCIENTIST	27 APR 78	074950647	USA
36.	WARD. NAOMI L.	SCIENTIST	04 MAY 71	704160889	UK
37.	PENN, KEVIN M.	SCIENTIST	13 APR 77	035832069	USA
38.	SOULE, SAMUEL A.	SCIENTIST	03 FEB 75	212952779	USA
39.	RZHANOV, YURI	SCIENTIST	24 NOV 57	036634560	UK
40.	BEAULIEU, STACEY E.	SCIENTIST	10 JUN 71	206848874	USA
41.	WALLER, RHIAN G.	SCIENTIST	10 JUN 78	026942084	UK
42.	BUCKMAN, KATE L.	SCIENTIST	13 OCT 78	201623753	USA
43.	KNEE, ABIGAIL J.	SCIENTIST	25 MAR 78	103895643	USA
44.	CHO, WALTER, W.	SCIENTIST	28 JUL 79	303937961	USA
45.	NEVALA, AMY E.	SCIENTIST	03 JUL 72	212838995	USA
46.	STEURMER, DANIEL H.	SCIENTIST	28 MAY 48	157351950	USA
47.	GALLO, DAVID G.	SCIENTIST	11 DEC 52	101925679	USA
48.	GOVENAR, BREEA	SCIENTIST	09 JUL 78	086809757	USA
49.	KHOSLA, VINOD K.	SCIENTIST	28 JAN 55	054613135	USA
50.	NOMIKOS, PETROS, C.M.	SCIENTIST	16 MAY 79	761087733	UK
51.	DUBNO, DANIEL N.	SCIENTIST	18 AUG 59	155999716	USA
52.	BABA, KAZUMI	SSSG TECH	19 MAR 70	TG6230501	JAPAN
53.	FELDMAN, KENNETH S.	SSSG TECH	07 OCT 65	038684787	USA

TOTALS: SHIP'S CREW (22)
ALVIN CREW (6)
SCIENTISTS (25)
TOTAL P.O.B. (53)

G.P SILVA, MASTER

8.2 Alvin Master Sample List

Alvin Dive	Date	Pilot	Port	Stbd	Sampler	Station	Type	Time	Temp (oC)	Depth (m)	Heading	X	Y	Marker	Notes
4114	21-May-05	Eppard	Shank	Ding	Ghostbuster	1	Chemistry	1927	10.4	2452		2498.044277	61451.11495	B	
					Grab	1	Biology	2124		2451	250	NaN	NaN	B	Mussels
					Major Pair	1	Chemistry	2014		2452	296	2498.280373	61451.34557	B	
					Grab	2	Biology	2128		2451	250	2483.419086	61452.07607	B	Riftia
4115	22-May-05	Tarantino	Humphris	Seyfried	Ghostbuster	1	Chemistry	1638	16.1	2451		2502.378728	61454.43983	B	
					Major Pair	1	Chemistry	1716	14.5-15	2453	265	2504.133883	61453.81237	B	
					Major Pair	1	Chemistry	1729	15	2453	265	2501.172055	61451.67483	B	
					Ghostbuster	2	Chemistry	2024	7	2450		2468.323311	61436.35899		
					Grab	2	Biology	2045	3-10	2450		2469.902573	61436.81387		Mussels
					Slurp	3	Biology	2105	3-4	2451		2478.505531	61435.71951		
					Grab	3	Biology	2119	3-4	2451		NaN	NaN		Riftia
					Grab	3	Geology	2122	3-4	2451		2479.449536	61435.54826		Lava
4116	23-May-05	Strickrott	Shank	Khosla	Ghostbuster	1	Chemistry	1806	8.2	2450		2470.758021	61463.65548	M	
					Slurp	1	Biology	1836	7.8	2451	269	2471.452898	61463.28636	M	
					Grab	1	Geology	18.51	8.4	2451	273	2470.892275	61464.25606	M	sheet
					Ghostbuster	2	Chemistry	1807	7.9	2450		2470.757359	61463.66547	M	
					Grab	2	Biology	1842	7.8	2451	268	2470.93553	61464.60511	M	mussels
					Slurp	3	Biology	1937	14	2452	146	2502.86465	61455.84751	N	
					Grab	4	Biology	1946	15	2452	146	2500.318891	61455.87801	N	Riftia
					Slurp	5	Biology	2028	7.22	2433	56	2498.837467	61437.36659	K	
					Grab	6	Biology	2033	7.22	2453	72	2498.529344	61437.22026	K	mussels
					Grab	6	Geology	2034		2453	59	2498.461354	61436.84345	K	hackley
					Grab	7	Biology	2110		2451	250	2461.821204	61445.33681	L	tevnia
4117	24-May-	Hickey	Fornari	Dubno	Grab	1	Biology	1900		2451		2469.751355	61466.28643	L	riftia, mussels

	05														
					Ghostbuster	2	Chemistry	1915		2451		2468.480757	61442.05787	I	
					Major Pair	2	Chemistry	1948	13.8-14.7	2451		2470.5277	61444.3081	I	
					Major Pair	2	Chemistry	1949	13.8-14.8	2451		2470.521426	61444.2439	I	
					Grab	2	Geology	2008		2451		2472.833387	61442.51507	I	
					Grab	2	Biology	2013		2451		2473.08125	61442.63827	I	mussels
					Ghostbuster	2	Chemistry	2019	2.8	2451		2472.944565	61442.3697	I	
					Grab	3	Geology	2047		2452		2495.911017	61446.39966		curtain fold
					Grab	4	Geology	2106		2450		NaN	NaN		lobate crust
4118	25-May-05	Berry	Humphris	Eppard	Slurp	1	Biology	1816		2476		10810.05052	60508.25186		
					Grab	2	Biology	1942		2483		10763.64524	60515.68952		dead shells
					Grab	2	Geology	1944		2483		10764.12029	60515.50548		
					Grab	3	Biology	2032		2481		10772.81133	60502.0691		dead shells
					Grab	4	Geology	2100		2489		11313.0208	60504.70375		lobates
4119	26-May-05	Tarantino	Fornari	Nomikos	Grab	1	Biology	1707	5.24	2450		2489.845327	61458.77928		clams, mussels
					Grab	2	Geology	1923		2450		2039.313936	61572.20926		curtain fold
					Grab	3	Geology	1953		2453		1836.134505	61415.0838		
					Slurp	4	Biology	2020		2454		1510.982432	61400.01298		holothurians
					Grab	4	Geology	2025		2454		1512.869247	61399.8449		lobate crust
					Major Pair	5	Chemistry	2054		2447		1376.406324	61588.56583		
					Major Pair	5	Chemistry	2054		2447		1376.406324	61588.56583		
					Slurp	5	Biology	2101		2447		NaN	NaN		holothurian
					Grab	5	Geology	2104		2447		1371.699565	61587.54826		curtain fold
4120	27-May-05	Strickrott	Beaulieu	Soule	Ghostbuster	1	Chemistry	1726	18.5			13512.60691	60208.81576	Q	
					Ghostbuster	1	Chemistry	1736	20		330	13512.41833	60209.19114	Q	
					Ghostbuster	1	Chemistry	1802	12.8			13516.30486	60220.49481	Q	
					Ghostbuster	2	Chemistry	1819			238	13523.85971	60220.46029	Q	

					Major Pair	2	Chemistry	1825	18			13521.9921	60219.36267	Q	
					Grab	2	Biology	1834	18			13522.14826	60219.49916	Q	Riftia
					Slurp	2	Biology	1855	18			13519.76786	60219.86819	Q	
					Slurp	2	Biology	1911				13532.4041	60221.04138	Q	non-vent worm
					Grab	3	Biology	1921	5	2489		13556.6	60219.81686	P	Mussels
					Slurp	3	Biology	1939				NaN	NaN	10m of P	
					Grab	4	Geology	2021		2489		13456.41695	60230.47305		lobate collapse
					Grab	5	Geology	2131		2464		13285.46891	60361.07967		pillow
					Grab	5	Geology	2136		2464		13281.45062	60364.0361		pillow
					Major Pair	6	Chemistry	2141				13273.93295	60356.99024		not near vent
4121	28-May-05	Hickey	Shank	Govenar	Grab	1	Geology	1543	2.02	2517	280	11555.85695	60214.18405		lobate
					Grab	1	Biology	1642	2	2462	326	NaN	NaN	Q	Clam/Mussel shells
					Grab	2	Biology	2006	15.9	2489	109	13503.68678	60263.45214	Q	Riftia
					Slurp	3	Biology	2020	15.9	2489	110	13492.79376	60265.97586	Q	
					Fish Trap	4	Biology	2045		2489		13504.11791	60272.80495	Q	Bythitid
4122	29-May-05	Eppard	Knee	Ward	Ghostbuster	1	Chemistry	1718	13.4	2449		2474.406688	61450.17619	I	
					Major Pair	1	Chemistry	1737		2449		2474.568878	61451.28228	I	
					Ghostbuster	2	Chemistry	1845	3.3	2450		2497.794644	61455.68386	B	Block 9
					Ghostbuster	2	Chemistry	1905	12.1	2450		2497.587927	61456.27547	B	Block 10
					Ghostbuster	2	Chemistry	1920	4.5	2450		2497.470274	61456.77717	B	block 12
4123	30-May-05	Tarantino	Buckman	Spear	Ghostbuster	1	Chemistry	1737	3.1	2450		2501.926571	61481.9991	B	red vemco
					Ghostbuster	1	Chemistry	1800	2.1	2450		2499.70615	61483.80055	B	yellow vemco
					Ghostbuster	1	Chemistry	1812		2450		2500.699143	61488.4021	B	black block
					Ghostbuster	1	Chemistry	1827	2.1	2450		2501.226619	61489.54881	B	yellow block
					Ghostbuster	1	Chemistry	1838	2.1	2450		2501.402476	61489.60662	B	green block
					Ghostbuster	1	Chemistry	1848	2.1	2450		2500.966	61488.8791	B	blue block
					Ghostbuster	1	Chemistry	1902	7.3	2450		2500.477524	61487.84662	B	black block

															again
					Ghostbuster	1	Chemistry	2007	16.2	2450		2502.255619	61487.13343	B	red probe tip
					Ghostbuster	2	Chemistry	2046		2450		2477.552286	61434.82243	I	blue probe tip
					Grab	2	Biology	2046		2450		2477.552286	61434.82243	I	
					Rock Grab	2	Rock	2127		2450		2569.484857	61420.82091		collapse off fissure
4124	31-May-05	Strickrott	Soule	Ward	Ghostbuster	1	Chemistry	1623	7.3	2452m		2498.36881	61476.05491	B	blue block
					Ghostbuster	1	Chemistry	1624	6.2	2452m		2498.385476	61476.11686	B	blue block
					Ghostbuster	1	Chemistry	1628	3.4	2452m		2498.519238	61476.285	B	yellow block
					Major Pair	1	Chemistry	1649	16.6-16.9	2452m		2498.653263	61475.32442	B	
					Grab	1	Biology	1657		2452m		2499.272238	61474.87405	B	mussels
					Grab	1	Geology	1700		2452m		2499.52555	61475.48455	B	
					Survey		Photographic	1713		5.8m alt		2481.36681	61456.21562		
					Grab	2	Geology	1809		2448m		2469.754667	61538.31795		lobate
					Grab	3	Geology	1825		2445m		2587.574095	61544.27195		pillow
					Grab	4	Geology	1846		2432m		2556.00281	61727.24433		pillow
					Major Pair	5	Chemistry	1933	7.6	2448m		2341.90481	61532.03105	new site	
					Grab	5	Geology	1938		2448m		2341.916238	61531.90038	new site	drips
					Ghostbuster	5	Chemistry	1946	11.7	2448m		2341.588857	61530.00724	new site	
					Grab	5	Biology	2023		2448m		2307.066286	61486.25148	new site	Riftia/mussels

8.3.1 WHOI Biology Samples

Species	no	Dive	Area	Marker	Sample Type	Date
A. galapagensis	58	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
A. rosacea	1	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
amphipod, unknown	1	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
anemone	1	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
B. symmytilida 2	1	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
B. symmytilida 3	1	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
B. thermophilus 1	1	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
B. thermophilus 2	1	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
B. thermophilus 3	1	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
B. thermophilus, juvenile	3	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
B. thermophilus, juvenile/small	5	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
beetle, w/foraminiferan	1	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
copepod	1	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
E. vitrea	13	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
G. aristata? (phyllodocid sp.)	1	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
G. aristata? (phyllodocid sp.)	11	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
H. vestimentifera	2	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
L. ovalis?	3	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
Lepetodrilus sp.	3	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
Lepetodrilus sp.	10	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
nemertean, red-purple	2	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
nemertean, thin white	35	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
Oasisia (morph)	2	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
R. pachyptila, juveniles/babies	4	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
serpulid	4	4114	Rosebud	Mkr A, north of	mussel grab	21-May-05
A. galapagensis	22	4114	Rosebud	Mkr A, north of	Riftia grab	21-May-05
A. rosacea	79	4114	Rosebud	Mkr A, north of	Riftia grab	21-May-05
anemone	3	4114	Rosebud	Mkr A, north of	Riftia grab	21-May-05
B. symmytilida 5	2	4114	Rosebud	Mkr A, north of	Riftia grab	21-May-05
B. thermophilus 4	1	4114	Rosebud	Mkr A, north of	Riftia grab	21-May-05
B. thermophilus 5	1	4114	Rosebud	Mkr A, north of	Riftia grab	21-May-05
B. thermophilus, juvenile/small	9	4114	Rosebud	Mkr A, north of	Riftia grab	21-May-05

E. vitrea		7	4114	Rosebud	Mkr A, north of	Riftia grab	21-May-05
gastropod, baby?		1	4114	Rosebud	Mkr A, north of	Riftia grab	21-May-05
H. vestimentifera		6	4114	Rosebud	Mkr A, north of	Riftia grab	21-May-05
L. pustulosus		3	4114	Rosebud	Mkr A, north of	Riftia grab	21-May-05
nemertean?, thin white		46	4114	Rosebud	Mkr A, north of	Riftia grab	21-May-05
O. akessoni		7	4114	Rosebud	Mkr A, north of	Riftia grab	21-May-05
polynoid, unknown		1	4114	Rosebud	Mkr A, north of	Riftia grab	21-May-05
R. pachyptila		1	4114	Rosebud	Mkr A, north of	Riftia grab	21-May-05
R. pachyptila, juveniles		2	4114	Rosebud	Mkr A, north of	Riftia grab	21-May-05
unknown brown "bivalved" spheroids		4	4114	Rosebud	Mkr A, north of	Riftia grab	21-May-05
unknown brown spheroid	2?		4114	Rosebud	Mkr A, north of	Riftia grab	21-May-05
V. sulfuris		1	4114	Rosebud	Mkr A, north of	Riftia grab	21-May-05
A. rosacea		50	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
anemone		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. symmytilida 1		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. symmytilida 10		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. symmytilida 12		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. symmytilida 14		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. symmytilida 15		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. symmytilida 4		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. symmytilida 5		2	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. symmytilida 7		2	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. symmytilida 8		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. symmytilida 9		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. thermophilus 1		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. thermophilus 10		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. thermophilus 11		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. thermophilus 12		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. thermophilus 13		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. thermophilus 14		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. thermophilus 15		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. thermophilus 16		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. thermophilus 17		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. thermophilus 2		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. thermophilus 3		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. thermophilus 4		1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05

B. thermophilus 5	1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. thermophilus 6	1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. thermophilus 7	1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. thermophilus 8	1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
B. thermophilus 9	1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
C. delectus	1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
E. vitrea	65	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
H. vestimentifera	12	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
L. ovalis	10	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
L. pustulosus	100	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
megalope	2	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
nemertean	2	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
Provanna sp.	1	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
V. sulfuris	9	4115	Rosebud	Mkr I (= Mkr C)	mussel grab, slurp	22-May-05
A. rosacea	29	4115	Rosebud	Mkr I (= Mkr C)	mussel slurp	22-May-05
aplacophoran	1	4115	Rosebud	Mkr I (= Mkr C)	mussel slurp	22-May-05
B. grasslei	4	4115	Rosebud	Mkr I (= Mkr C)	mussel slurp	22-May-05
B. hessleri	1	4115	Rosebud	Mkr I (= Mkr C)	mussel slurp	22-May-05
B. sandersi	3	4115	Rosebud	Mkr I (= Mkr C)	mussel slurp	22-May-05
B. thermophilus 61	1	4115	Rosebud	Mkr I (= Mkr C)	mussel slurp	22-May-05
brachyuran crab	10	4115	Rosebud	Mkr I (= Mkr C)	mussel slurp	22-May-05
E. vitrea	4	4115	Rosebud	Mkr I (= Mkr C)	mussel slurp	22-May-05
H. vestimentifera	25	4115	Rosebud	Mkr I (= Mkr C)	mussel slurp	22-May-05
L. plicata	1	4115	Rosebud	Mkr I (= Mkr C)	mussel slurp	22-May-05
L. pustulosus	6	4115	Rosebud	Mkr I (= Mkr C)	mussel slurp	22-May-05
megalope	4	4115	Rosebud	Mkr I (= Mkr C)	mussel slurp	22-May-05
N. sandersi	1	4115	Rosebud	Mkr I (= Mkr C)	mussel slurp	22-May-05
O. akessoni	2	4115	Rosebud	Mkr I (= Mkr C)	mussel slurp	22-May-05
O. alvinus	5	4115	Rosebud	Mkr I (= Mkr C)	mussel slurp	22-May-05
polynoid, unknown	28	4115	Rosebud	Mkr I (= Mkr C)	mussel slurp	22-May-05
shrimp, unknown	1	4115	Rosebud	Mkr I (= Mkr C)	mussel slurp	22-May-05
V. sulfuris	9	4115	Rosebud	Mkr I (= Mkr C)	mussel slurp	22-May-05
"Ramen-head" worm	2	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
"Ramen-head" worm	2	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
"Ramen-head" worm	2	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
"Ramen-head" worm tube	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05

A. galapagensis	98	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
A. galapagensis	5	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
A. rosacea	150	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
A. rosacea	49	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
A. rosacea	4	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
amphipod, unknown	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
anemone, pink	3	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
anemone, yellow	3	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
anemone, yellow	16	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
anemone, yellow = green	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
aplacophoran	5	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
aplacophoran	3	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. symmytilida	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. symmytilida 21	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. symmytilida 22	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. symmytilida 23	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. symmytilida 24	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. symmytilida 29	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. symmytilida 30	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. symmytilida 31	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. symmytilida 32	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. thermophilus 20	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. thermophilus 21	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. thermophilus 22	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. thermophilus 23	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. thermophilus 24	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. thermophilus 25	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. thermophilus 26	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. thermophilus 27	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. thermophilus 28	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. thermophilus 29	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. thermophilus 30	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. thermophilus 31	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. thermophilus 32	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. thermophilus 33	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. thermophilus, juvenile	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05

B. thermophilus, juvenile	25	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. thermophilus, juvenile/very small	66	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
brachyuran crab, small	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
D. calderiensis	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
E. mytilus	4	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
E. vitrea	60	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
E. vitrea	18	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
G. aristata	8	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
G. aristata	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
gastropod, unknown	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
H. vestimentifera	64	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
H. vestimentifera	11	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
hirudinian, deep red (piscicolid)	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
hirudinian, deep red (piscicolid)	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
L. elevatus	26	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
L. elevatus	7	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
L. pustulosus	30	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
L. pustulosus	24	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
L. williamsae	5	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
limpet, mixed lepetodrilids	300	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
megalope	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
megalope	2	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
N. ardwidssoni	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
N. arwidessoni	5	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
N. fretterae	153	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
N. fretterae	4	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
N. sandersi	31	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
N. sandersi	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
nemertean	4	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
nemertean	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
O. akessoni	17	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
O. akessoni	3	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
O. alvinae	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
O. alvinus	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
ostracod	3	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
polynoid, unknown sp. 1	3	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05

polynoid, unknown sp. 2		22	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
polynoid, unknown sp. 3		4	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
Provanna sp.		2	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
pycnogonid		3	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 1		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 10		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 11		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 12		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 13		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 14		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 15		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 16		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 17		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 18		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 19		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 2		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 20		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 21		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 22		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 23		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 24		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 25		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 3		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 4		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 5		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 6		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 7		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 8		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila 9		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila, juveniles/babies		6	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
R. pachyptila, juveniles/babies		7	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
serpulid	?		4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
V. sulfuris		17	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab	22-May-05
B. symmytilida 38		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. symmytilida 39		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. symmytilida 41		1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05

B. symmytilida 43	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. symmytilida 46	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. symmytilida 47	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. symmytilida 48	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. symmytilida 50	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. symmytilida 51	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. symmytilida 52	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. symmytilida 54	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. symmytilida 55	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. symmytilida 56	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. symmytilida 57	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. symmytilida 58	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. symmytilida 59	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 34	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 35	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 36	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 37	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 38	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 39	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 40	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 41	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 42	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 43	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 44	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 45	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 46	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 47	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 48	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 49	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 50	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 51	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 52	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 53	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 54	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 55	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 56	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05

B. thermophilus 57	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 58	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 59	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus 60	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus, juvenile	62	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
B. thermophilus, small	21	4115	Rosebud	Mkr J (= Mkr F)	Riftia grab basalt	22-May-05
A. galapagensis	18	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
A. lusca	47	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
A. rosacea	16	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
amphipod, unknown gray	12	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
anemone	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
B. grasslei	12	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
B. hessleri	6	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
B. sandersi	15	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
B. thermophilus 18	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
B. thermophilus 19	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
B. thermophilus, juvenile	14	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
brachyuran crab	3	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
copepod	36	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
D. calderiensis	4	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
E. mytilus	2	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
E. vitrea	8	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
G. aristata	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
H. vestimentifera	3	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
hesionid	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
L. elevatus	25	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
L. ovalis	13	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
L. pustulosus	47	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
L. williamsae	6	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
Levensteiniella sp.	5	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
limpet, little unknowns	6	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
megalope	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
nemertean	1	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
O. alvinus	8	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
polynoid, unknown sp. 1	8	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
polynoid, unknown sp. 2	6	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05

polynoid, unknown sp. 3	11	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
V. sulfuris	33	4115	Rosebud	Mkr J (= Mkr F)	Riftia slurp	22-May-05
A. galapagensis	3	4115	Rosebud		slurp overflow	22-May-05
A. lusca	2	4115	Rosebud		slurp overflow	22-May-05
A. rosacea	18	4115	Rosebud		slurp overflow	22-May-05
brachyuran crab	1	4115	Rosebud		slurp overflow	22-May-05
Branchinotogluma sp.	1	4115	Rosebud		slurp overflow	22-May-05
copepod, larger white	10	4115	Rosebud		slurp overflow	22-May-05
copepod, mixed	106	4115	Rosebud		slurp overflow	22-May-05
E. mytilus	1	4115	Rosebud		slurp overflow	22-May-05
G. aristata	4	4115	Rosebud		slurp overflow	22-May-05
H. vestimentifera	11	4115	Rosebud		slurp overflow	22-May-05
L. elevatus	1	4115	Rosebud		slurp overflow	22-May-05
L. pustulosus	2	4115	Rosebud		slurp overflow	22-May-05
O. akessoni	1	4115	Rosebud		slurp overflow	22-May-05
polychaete, unknown	7	4115	Rosebud		slurp overflow	22-May-05
polynoid, unknown	1	4115	Rosebud		slurp overflow	22-May-05
V. sulfuris	31	4115	Rosebud		slurp overflow	22-May-05
"Tevnia" morph	1	4116	Rosebud	Mkr L	"Tevnia" grab	23-May-05
"Tevnia" morph	3	4116	Rosebud	Mkr L	"Tevnia" grab	23-May-05
A. galapagensis	11	4116	Rosebud	Mkr L	"Tevnia" grab	23-May-05
A. rosacea	35	4116	Rosebud	Mkr L	"Tevnia" grab	23-May-05
anemone, yellow	4	4116	Rosebud	Mkr L	"Tevnia" grab	23-May-05
B. symmytilida 1	1	4116	Rosebud	Mkr L	"Tevnia" grab	23-May-05
B. symmytilida 2	2	4116	Rosebud	Mkr L	"Tevnia" grab	23-May-05
B. thermophilus 1	1	4116	Rosebud	Mkr L	"Tevnia" grab	23-May-05
B. thermophilus 2	1	4116	Rosebud	Mkr L	"Tevnia" grab	23-May-05
B. thermophilus, juvenile	5	4116	Rosebud	Mkr L	"Tevnia" grab	23-May-05
E. vitrea	2	4116	Rosebud	Mkr L	"Tevnia" grab	23-May-05
H. vestimentifera	1	4116	Rosebud	Mkr L	"Tevnia" grab	23-May-05
L. pustulosus	8	4116	Rosebud	Mkr L	"Tevnia" grab	23-May-05
Levensteiniella sp.	1	4116	Rosebud	Mkr L	"Tevnia" grab	23-May-05
pycnogonid	1	4116	Rosebud	Mkr L	"Tevnia" grab	23-May-05
vestimentiferan	3	4116	Rosebud	Mkr K	basalt rock grab pickings	23-May-05
A. rosacea	12	4116	Rosebud	Mkr M	mussel grab	23-May-05
B. thermophilus 1	1	4116	Rosebud	Mkr M	mussel grab	23-May-05

B. thermophilus 10	1	4116	Rosebud	Mkr M	mussel grab	23-May-05
B. thermophilus 11	1	4116	Rosebud	Mkr M	mussel grab	23-May-05
B. thermophilus 12	1	4116	Rosebud	Mkr M	mussel grab	23-May-05
B. thermophilus 2	1	4116	Rosebud	Mkr M	mussel grab	23-May-05
B. thermophilus 3	1	4116	Rosebud	Mkr M	mussel grab	23-May-05
B. thermophilus 4	1	4116	Rosebud	Mkr M	mussel grab	23-May-05
B. thermophilus 5	1	4116	Rosebud	Mkr M	mussel grab	23-May-05
B. thermophilus 6	1	4116	Rosebud	Mkr M	mussel grab	23-May-05
B. thermophilus 7	1	4116	Rosebud	Mkr M	mussel grab	23-May-05
B. thermophilus 8	1	4116	Rosebud	Mkr M	mussel grab	23-May-05
B. thermophilus 9	1	4116	Rosebud	Mkr M	mussel grab	23-May-05
H. vestimentifera	1	4116	Rosebud	Mkr M	mussel grab	23-May-05
L. elevatus	1	4116	Rosebud	Mkr M	mussel grab	23-May-05
A. rosacea	5	4116	Rosebud	Mkr K	mussel grab	23-May-05
B. thermophilus 1	1	4116	Rosebud	Mkr K	mussel grab	23-May-05
B. thermophilus 2	1	4116	Rosebud	Mkr K	mussel grab	23-May-05
B. thermophilus 3	1	4116	Rosebud	Mkr K	mussel grab	23-May-05
B. thermophilus 4	1	4116	Rosebud	Mkr K	mussel grab	23-May-05
B. thermophilus 5	1	4116	Rosebud	Mkr K	mussel grab	23-May-05
E. vitrea	11	4116	Rosebud	Mkr K	mussel grab	23-May-05
H. vestimentifera	2	4116	Rosebud	Mkr K	mussel grab	23-May-05
L. elevatus	1	4116	Rosebud	Mkr K	mussel grab	23-May-05
L. ovalis	5	4116	Rosebud	Mkr K	mussel grab	23-May-05
"Ramen-head" worm	1	4116	Rosebud	Mkr K	mussel slurp	23-May-05
A. lusca	1	4116	Rosebud	Mkr K	mussel slurp	23-May-05
A. rosacea	50	4116	Rosebud	Mkr K	mussel slurp	23-May-05
B. sandersi	1	4116	Rosebud	Mkr K	mussel slurp	23-May-05
H. vestimentifera	2	4116	Rosebud	Mkr K	mussel slurp	23-May-05
L. elevatus	2	4116	Rosebud	Mkr K	mussel slurp	23-May-05
L. ovalis	2	4116	Rosebud	Mkr K	mussel slurp	23-May-05
L. williamsae	1	4116	Rosebud	Mkr K	mussel slurp	23-May-05
Levensteiniella sp.	1	4116	Rosebud	Mkr K	mussel slurp	23-May-05
A. rosacea	30	4116	Rosebud	Mkr M	mussel slurp	23-May-05
anemone, yellow	1	4116	Rosebud	Mkr M	mussel slurp	23-May-05
C. delectus	1	4116	Rosebud	Mkr M	mussel slurp	23-May-05
E. mytilus	1	4116	Rosebud	Mkr M	mussel slurp	23-May-05

E. vitrea	1	4116	Rosebud	Mkr M	mussel slurp	23-May-05
H. vestimentifera	8	4116	Rosebud	Mkr M	mussel slurp	23-May-05
L. plicata	2	4116	Rosebud	Mkr M	mussel slurp	23-May-05
L. pustulosus morph	3	4116	Rosebud	Mkr M	mussel slurp	23-May-05
L. williamsae	4	4116	Rosebud	Mkr M	mussel slurp	23-May-05
Levensteiniella sp.	3	4116	Rosebud	Mkr M	mussel slurp	23-May-05
megalope	3	4116	Rosebud	Mkr M	mussel slurp	23-May-05
O. alvinus	1	4116	Rosebud	Mkr M	mussel slurp	23-May-05
Provanna sp.	3	4116	Rosebud	Mkr M	mussel slurp	23-May-05
A. galapagensis	428	4116	Rosebud	Mkr N	Riftia grab	23-May-05
A. rosacea	2	4116	Rosebud	Mkr N	Riftia grab	23-May-05
anemone	1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
B. grasslei	4	4116	Rosebud	Mkr N	Riftia grab	23-May-05
B. hessleri	1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
B. thermophilus, small	64	4116	Rosebud	Mkr N	Riftia grab	23-May-05
bacterial slough scraped off Riftia tube	1-1.5ml tube	4116	Rosebud	Mkr N	Riftia grab	23-May-05
brachyuran crab	9	4116	Rosebud	Mkr N	Riftia grab	23-May-05
E. mytilus	1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
E. vitrea	9	4116	Rosebud	Mkr N	Riftia grab	23-May-05
eggs on Riftia tube	~50	4116	Rosebud	Mkr N	Riftia grab	23-May-05
eggs on Riftia tube	~50	4116	Rosebud	Mkr N	Riftia grab	23-May-05
eggs on Riftia tube	~50	4116	Rosebud	Mkr N	Riftia grab	23-May-05
eggs scraped off Riftia tube	1-1.5ml tube	4116	Rosebud	Mkr N	Riftia grab	23-May-05
G. aristata	182	4116	Rosebud	Mkr N	Riftia grab	23-May-05
G. aristata	7	4116	Rosebud	Mkr N	Riftia grab	23-May-05
H. vestimentifera	4	4116	Rosebud	Mkr N	Riftia grab	23-May-05
hirudinian, deep red (piscicolid)	14	4116	Rosebud	Mkr N	Riftia grab	23-May-05
hirudinian, deep red (piscicolid)	32	4116	Rosebud	Mkr N	Riftia grab	23-May-05
L. ovalis morph	16	4116	Rosebud	Mkr N	Riftia grab	23-May-05
L. pustulosus morph	186	4116	Rosebud	Mkr N	Riftia grab	23-May-05
L. riftense	5	4116	Rosebud	Mkr N	Riftia grab	23-May-05
L. williamsae	7	4116	Rosebud	Mkr N	Riftia grab	23-May-05
Lepidonotopodium sp.	3	4116	Rosebud	Mkr N	Riftia grab	23-May-05
Levensteiniella sp.	5	4116	Rosebud	Mkr N	Riftia grab	23-May-05

megalope		7	4116	Rosebud	Mkr N	Riftia grab	23-May-05
N. fretterae		5	4116	Rosebud	Mkr N	Riftia grab	23-May-05
N. sandersi		5	4116	Rosebud	Mkr N	Riftia grab	23-May-05
nemertean		2	4116	Rosebud	Mkr N	Riftia grab	23-May-05
O. akessoni		2	4116	Rosebud	Mkr N	Riftia grab	23-May-05
O. akessoni		8	4116	Rosebud	Mkr N	Riftia grab	23-May-05
O. alvinus		2	4116	Rosebud	Mkr N	Riftia grab	23-May-05
P. pandorae	?		4116	Rosebud	Mkr N	Riftia grab	23-May-05
polynoid, unknown spp.		6	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 1		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 10		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 11		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 12		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 13		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 14		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 15		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 16		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 17		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 18		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 19		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 2		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 20		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 21		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 22		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 23		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 24		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 25		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 26		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 27		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 28		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 29		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 3		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 4		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 5		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 6		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 7		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05

R. pachyptila 8		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila 9		1	4116	Rosebud	Mkr N	Riftia grab	23-May-05
R. pachyptila, juveniles/babies		7	4116	Rosebud	Mkr N	Riftia grab	23-May-05
sievings, unsorted "small stuff"	1 jar		4116	Rosebud	Mkr N	Riftia grab	23-May-05
V. sulfuris		35	4116	Rosebud	Mkr N	Riftia grab	23-May-05
A. galapagensis		3	4116	Rosebud	Mkr N	Riftia slurp	23-May-05
A. lusca		1	4116	Rosebud	Mkr N	Riftia slurp	23-May-05
A. rosacea		2	4116	Rosebud	Mkr N	Riftia slurp	23-May-05
anemone, yellow		1	4116	Rosebud	Mkr N	Riftia slurp	23-May-05
B. cupreus		1	4116	Rosebud	Mkr N	Riftia slurp	23-May-05
B. hessleri		1	4116	Rosebud	Mkr N	Riftia slurp	23-May-05
copepod, tiny red	~50		4116	Rosebud	Mkr N	Riftia slurp	23-May-05
L. pustulosus		18	4116	Rosebud	Mkr N	Riftia slurp	23-May-05
L. williamsae		2	4116	Rosebud	Mkr N	Riftia slurp	23-May-05
megalope		2	4116	Rosebud	Mkr N	Riftia slurp	23-May-05
ostracod		1	4116	Rosebud	Mkr N	Riftia slurp	23-May-05
polynoid, unknown		1	4116	Rosebud	Mkr N	Riftia slurp	23-May-05
V. sulfuris		1	4116	Rosebud	Mkr N	Riftia slurp	23-May-05
A. galapagensis		3	4116	Rosebud		slurp overflow	23-May-05
A. rosacea		21	4116	Rosebud		slurp overflow	23-May-05
anemone, white		1	4116	Rosebud		slurp overflow	23-May-05
B. thermophilus 1		1	4116	Rosebud		slurp overflow	23-May-05
copepod, larger white		15	4116	Rosebud		slurp overflow	23-May-05
copepod, tiny red	~150		4116	Rosebud		slurp overflow	23-May-05
foraminifera		12	4116	Rosebud		slurp overflow	23-May-05
G. aristata		1	4116	Rosebud		slurp overflow	23-May-05
H. vestimentifera		9	4116	Rosebud		slurp overflow	23-May-05
Levensteiniella sp.		1	4116	Rosebud		slurp overflow	23-May-05
nemertean		3	4116	Rosebud		slurp overflow	23-May-05
polynoid, unknown tiny		1	4116	Rosebud		slurp overflow	23-May-05
V. sulfuris		19	4116	Rosebud		slurp overflow	23-May-05
A. galapagensis		1	4117	Rosebud	Mkr I (= Mkr C)	bacterial slurp	24-May-05
A. rosacea		8	4117	Rosebud	Mkr I (= Mkr C)	bacterial slurp	24-May-05
copepod, larger white		3	4117	Rosebud	Mkr I (= Mkr C)	bacterial slurp	24-May-05
hesionid		1	4117	Rosebud	Mkr I (= Mkr C)	bacterial slurp	24-May-05
"Ramen-head" worm		1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05

"Ramen-head" worm	4	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
A. galapagensis	34	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
A. galapagensis	6	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
A. rosacea	5	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
A. rosacea	29	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
anemone, yellow	17	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
anemone, yellow	5	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
anemone, pink	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
anemone, pink	3	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. symmytilida	2	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. symmytilida 12	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. symmytilida 14	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. symmytilida 15	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. symmytilida 17	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. symmytilida 20	2	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. symmytilida 22	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. thermophilus 10	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. thermophilus 11	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. thermophilus 12	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. thermophilus 13	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. thermophilus 14	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. thermophilus 15	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. thermophilus 16	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. thermophilus 17	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. thermophilus 18	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. thermophilus 19	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. thermophilus 20	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. thermophilus 21	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
B. thermophilus 22	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
E. vitrea	26	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
E. vitrea	17	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
H. vestimentifera	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
hirudinian	4	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
hirudinian	9	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
L. ovalis	4	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
L. pustulosus	2	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05

L. pustulosus	9	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
Lepidonotopodium sp.	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
megalope	1	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
N. ardwissoni	2	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
polynoid, unknown posteriors	5	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
serpulid	3	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
vestimentiferan	4	4117	Rosebud	Mkr I (= Mkr C)	basalt grab	24-May-05
Actinaugi sp.	1	4117	Rosebud		glassy basalt	24-May-05
A. galapagensis	32	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
A. rosacea	7	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
anemone	4	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
B. symmytilida 1	1	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
B. symmytilida 2	1	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
B. symmytilida 3	1	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
B. symmytilida 4	1	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
B. symmytilida 5	2	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
B. symmytilida 7	1	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
B. symmytilida 9	1	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
B. thermophilus 1	1	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
B. thermophilus 2	1	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
B. thermophilus 3	1	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
B. thermophilus 4	1	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
B. thermophilus 5	1	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
B. thermophilus 6	1	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
B. thermophilus 7	1	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
B. thermophilus 8	1	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
B. thermophilus 9	1	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
B. thermophilus, juvenile	34	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
E. vitrea	49	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
H. vestimentifera	3	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
hirudinian, deep red	?	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
L. elevatus	17 (13?)	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
L. ovalis	35	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
L. pustulosus	104	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
L. williamsae	2	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
Lepidonotopodium sp.	2	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05

Levensteiniella sp.		1	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
N. fretterae		90	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
N. sandersi		1	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
nemertean, white		1	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
Provanna sp.		1	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
R. pachyptila, juveniles/babies		8	4117	Rosebud	Mkr I (= Mkr C)	mussel grab	24-May-05
A. galapagensis	~200		4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
A. galapagensis	~150		4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
A. lusca		22	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
A. rosacea		14	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
anemone, yellow = green		3	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
aplacophoran		5	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. grasslei		2	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. sandersi		2	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. symmytilida 1		2	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. symmytilida 10		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. symmytilida 11		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. symmytilida 12		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. symmytilida 13		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. symmytilida 2		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. symmytilida 3		2	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. symmytilida 4		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. symmytilida 5		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. symmytilida 6		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. symmytilida 7		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. symmytilida 8		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. thermophilus 1		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. thermophilus 10		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. thermophilus 11		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. thermophilus 12		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. thermophilus 13		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. thermophilus 2		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. thermophilus 3		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. thermophilus 4		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. thermophilus 5		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. thermophilus 6		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05

B. thermophilus 7		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. thermophilus 8		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. thermophilus 9		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. thermophilus, juvenile		41	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
copepod, tiny red	~40		4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
E. vitrea		3	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
G. aristata		5	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
H. vestimentifera		5	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
hirudinian, deep red (piscicolid)		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
L. elevatus		16	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
L. ovalis		5	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
L. pustulosus		4	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
L. riftense		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
L. williamsae		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
N. sandersi		12	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
O. akessoni		7	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
polynoid, unknown		6	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
Provanna sp. (#1)		2	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
Provanna sp. (#2)		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
pycnogonid		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
R. pachyptila 1		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
R. pachyptila 10, small		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
R. pachyptila 11		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
R. pachyptila 12, small		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
R. pachyptila 13, small		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
R. pachyptila 14, small		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
R. pachyptila 2		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
R. pachyptila 3		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
R. pachyptila 4		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
R. pachyptila 5		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
R. pachyptila 6		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
R. pachyptila 7, small		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
R. pachyptila 8, small		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
R. pachyptila 9, small		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
R. pachyptila, juveniles/babies		11	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
sievings, unsorted "small stuff"	1 jar		4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05

V. sulfuris		1	4117	Rosebud	Mkr L	Riftia and mussel grab	24-May-05
B. thermophilus, dead mussel hinge		1	4118	Musselbed (dead)		mussel and clam grab	25-May-05
B. thermophilus, dead mussel hinge		1	4118	Musselbed (dead)		mussel and clam grab	25-May-05
B. thermophilus, dead mussel hinge		1	4118	Musselbed (dead)		mussel and clam grab	25-May-05
B. thermophilus, empty shells	2 bags		4118	Musselbed (dead)		mussel and clam grab	25-May-05
C. magnifica, empty shell		1	4118	Musselbed (dead)		mussel and clam grab	25-May-05
A. rosacea		8	4119	Rosebud	Mkr B?	incidental slurp chasing fish	26-May-05
amphipod, white		1	4119	Rosebud	Mkr B?	incidental slurp chasing fish	26-May-05
B. grasslei		1	4119	Rosebud	Mkr B?	incidental slurp chasing fish	26-May-05
B. sandersi		1	4119	Rosebud	Mkr B?	incidental slurp chasing fish	26-May-05
brachyuran crab, small		2	4119	Rosebud	Mkr B?	incidental slurp chasing fish	26-May-05
Branchinotogluma sp. *(actually Levensteiniella sp.)		2	4119	Rosebud	Mkr B?	incidental slurp chasing fish	26-May-05
E. mytilus		1	4119	Rosebud	Mkr B?	incidental slurp chasing fish	26-May-05
L. williamsae		2	4119	Rosebud	Mkr B?	incidental slurp chasing fish	26-May-05
Provanna sp.		1	4119	Rosebud	Mkr B?	incidental slurp chasing fish	26-May-05
B. symmytilida 1		2	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. symmytilida 10		2	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. symmytilida 3		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. symmytilida 4		2	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. symmytilida 5		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. symmytilida 6		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. symmytilida 7		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. symmytilida, stray commensal		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. thermophilus 1		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. thermophilus 10		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. thermophilus 2		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. thermophilus 3		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. thermophilus 4		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. thermophilus 5		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. thermophilus 6		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. thermophilus 7		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. thermophilus 8		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. thermophilus 9		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. thermophilus, empty shell		0.5	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. thermydron		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05

C. magnifica 1		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
C. magnifica 2		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
C. magnifica 3		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
C. magnifica 4		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
C. magnifica 5		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
C. magnifica 6		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
C. magnifica 7		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
C. magnifica 8		1	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
C. magnifica, empty shells		2	4119	Rosebud	Mkr B	mussel and clam grab	26-May-05
B. thermophilus 11		1	4119	unknown		rock grab	26-May-05
holothurian #3		1	4119	Rosebud, west of, non-venting		slurp	26-May-05
holothurian #1		1	4119	Rosebud, west of, non-venting		slurp	26-May-05
holothurian #1		1	4119	Rosebud, west of, non-venting		slurp	26-May-05
holothurian #2		1	4119	Rosebud, west of, non-venting		slurp	26-May-05
holothurian #2		1	4119	Rosebud, west of, non-venting		slurp	26-May-05
holothurian #4		1	4119	Rosebud, west of, non-venting		slurp	26-May-05
holothurian #5		1	4119	Rosebud, west of, non-venting		slurp	26-May-05
holothurian #5		1	4119	Rosebud, west of, non-venting		slurp	26-May-05
A. rosacea		2	4119	Rosebud and West		washings	26-May-05
anemone, pink		5	4119	Rosebud and West		washings	26-May-05
anemone, yellow		14	4119	Rosebud and West		washings	26-May-05
B. hessleri		2	4119	Rosebud and West		washings	26-May-05
B. symmytilida		1	4119	Rosebud and West		washings	26-May-05
basalt chips, unsorted	1 bag		4119	Rosebud and West		washings	26-May-05
E. vitrea		12	4119	Rosebud and West		washings	26-May-05
H. vestimentifera		8	4119	Rosebud and West		washings	26-May-05
megalope		2	4119	Rosebud and West		washings	26-May-05
polynoid, unknown		5	4119	Rosebud and West		washings	26-May-05
"Ramen-head" worm		1	4120	Garden of Eden (#3)	Mkr P	bacterial slurp	27-May-05
A. galapagensis		5	4120	Garden of Eden (#3)	Mkr P	bacterial slurp	27-May-05
A. rosacea		3	4120	Garden of Eden (#3)	Mkr P	bacterial slurp	27-May-05
aplacophoran		1	4120	Garden of Eden (#3)	Mkr P	bacterial slurp	27-May-05
B. thermophilus, juvenile		2	4120	Garden of Eden (#3)	Mkr P	bacterial slurp	27-May-05
basalt chips, "fuzzy"	1 bag		4120	Garden of Eden (#3)	Mkr P	bacterial slurp	27-May-05
gastropod, turrid		1	4120	Garden of Eden (#3)	Mkr P	bacterial slurp	27-May-05
H. vestimentifera		5	4120	Garden of Eden (#3)	Mkr P	bacterial slurp	27-May-05

I. risensis		1	4120	Garden of Eden (#3)	Mkr P	bacterial slurp	27-May-05
Levensteiniella sp., light colored		2	4120	Garden of Eden (#3)	Mkr P	bacterial slurp	27-May-05
A. galapagensis		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
A. rosacea		20	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
B. symmytilida 1		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
B. symmytilida 2		2	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
B. symmytilida 3		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
B. symmytilida 4		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
B. symmytilida 5		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
B. symmytilida 6		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
B. thermophilus 1		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
B. thermophilus 2		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
B. thermophilus 3		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
B. thermophilus 4		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
B. thermophilus 5		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
B. thermophilus 6		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
B. thermophilus 7		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
B. thermophilus 8		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
E. vitrea	~50		4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
H. vestimentifera		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
L. elevatus		3	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
L. elevatus		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
L. ovalis		30	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
L. pustulosus		125	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
L. riftense		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
Levensteiniella sp.		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
N. sandersi		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
nemertean, white		2	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
O. akessoni		3	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
polychaete, juvenile		9	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
R. pachyptila, juvenile/baby		1	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
V. sulfuris		2	4120	Garden of Eden (#3)	Mkr P	mussel grab	27-May-05
A. galapagensis		74	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
A. galapagensis		11	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
B. thermophilus, juvenile		11	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
E. mytilus		2	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05

E. vitrea	5	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
G. aristata	16	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
G. aristata	5	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
H. vestimentifera	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
L. elevatus	10	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
L. pustulosus	58	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
L. williamsae	3	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
N. fretterae	5	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
O. akessoni	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
R. pachyptila 1	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
R. pachyptila 10	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
R. pachyptila 11	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
R. pachyptila 12	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
R. pachyptila 13	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
R. pachyptila 14	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
R. pachyptila 15	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
R. pachyptila 16	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
R. pachyptila 2	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
R. pachyptila 3	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
R. pachyptila 4	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
R. pachyptila 5	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
R. pachyptila 6	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
R. pachyptila 7	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
R. pachyptila 8	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
R. pachyptila 9	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
R. pachyptila, juvenile/baby	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
R. pachyptila, juvenile/baby	9	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
spionid	1	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
V. sulfuris	15	4120	Garden of Eden (#3)	Mkr Q	Riftia grab	27-May-05
H. vestimentifera	1	4120	Garden of Eden (#3)	Mkr Q	slurp	27-May-05
polychaete, large pelagic, Stace's "weird worm"	1	4120	Garden of Eden (#3)	Mkr Q	slurp	27-May-05
V. sulfuris	1	4120	Garden of Eden (#3)	Mkr Q	slurp	27-May-05
A. lusca	5	4120	Garden of Eden (#3)	Mkr Q	slurp	27-May-05
B. hessleri	1	4120	Garden of Eden (#3)	Mkr Q	slurp	27-May-05
B. thermydron	3	4120	Garden of Eden (#3)	Mkr Q	slurp	27-May-05
E. mytilus	3	4120	Garden of Eden (#3)	Mkr Q	slurp	27-May-05

E. vitrea		1	4120	Garden of Eden (#3)	Mkr Q	slurp	27-May-05
L. pustulosus		23	4120	Garden of Eden (#3)	Mkr Q	slurp	27-May-05
Levensteiniella sp.		1	4120	Garden of Eden (#3)	Mkr Q	slurp	27-May-05
O. alvinus		1	4120	Garden of Eden (#3)	Mkr Q	slurp	27-May-05
V. sulfuris		121	4120	Garden of Eden (#3)	Mkr Q	slurp	27-May-05
A. rosacea		3	4120	Garden of Eden (#3)		slurp overflow	27-May-05
aplacophoran		2	4120	Garden of Eden (#3)		slurp overflow	27-May-05
foraminifera	~10		4120	Garden of Eden (#3)		slurp overflow	27-May-05
H. vestimentifera		2	4120	Garden of Eden (#3)		slurp overflow	27-May-05
polychaete, juvenile		5	4120	Garden of Eden (#3)		slurp overflow	27-May-05
polynoid, unknown		1	4120	Garden of Eden (#3)		slurp overflow	27-May-05
V. sulfuris		46	4120	Garden of Eden (#3)		slurp overflow	27-May-05
B. hollisi?, bythitid fish		1	4121	Garden of Eden (#3) (near)		fish slurp	28-May-05
G. aristata		1	4121	Garden of Eden (#3)		fuzzy rock	28-May-05
galatheid crab, with eggs		1	4121	n/a		incidental	28-May-05
A. galapagensis		35	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
B. thermophilus, juvenile		7	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
E. mytilus		4	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
E. vitrea		17	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
G. aristata		4	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
L. elevatus		84	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
L. pustulosus		54	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
N. sandersi		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
nemertean		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
O. akessoni		3	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
polynoid, unknown		4	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
R. pachyptila 1		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
R. pachyptila 10		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
R. pachyptila 11		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
R. pachyptila 12		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
R. pachyptila 13		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
R. pachyptila 14		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
R. pachyptila 15		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
R. pachyptila 16		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
R. pachyptila 17		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
R. pachyptila 18		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05

R. pachyptila 19		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
R. pachyptila 2		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
R. pachyptila 3		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
R. pachyptila 4		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
R. pachyptila 5		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
R. pachyptila 6		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
R. pachyptila 7		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
R. pachyptila 8		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
R. pachyptila 9		1	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
R. pachyptila, juvenile/baby		5	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
V. sulfuris		15	4121	Garden of Eden (#3)	Mkr Q	Riftia grab	28-May-05
A. galapagensis		12	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
A. lusca		2	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
A. rosacea		50	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
B. grasslei		1	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
B. hessleri		4	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
B. thermophilus, juvenile		45	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
D. calderiensis		1	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
E. mytilus		4	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
G. aristata		40	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
H. vestimentifera	?		4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
L. cristatus		1	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
L. elevatus		8	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
L. ovalis		1	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
L. pustulosus		45	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
L. williamsae		2	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
megalope		4	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
N. sandersi		3	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
O. akessoni		1	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
O. alvinus		3	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
ostracod		1	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
polynoid, unknown		19	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
spionid		2	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
V. sulfuris		22	4121	Garden of Eden (#3)	Mkr Q	Riftia slurp	28-May-05
B. thermophilus, empty shells	1 bag		4121	Clambake (#2? #3?)		shell net	28-May-05
C. magnifica, empty shells	6 bags		4121	Clambake (#2? #3?)		shell net	28-May-05

shell hash	2 bags	4121	Clambake (#2? #3?)		shell net	28-May-05
foraminifera	2	4122	Rosebud	Mkr B	mussel colonization experiment, Block 10	29-May-05
foraminifera	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 10	29-May-05
foraminifera	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 10	29-May-05
foraminifera	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 10	29-May-05
foraminifera	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 10	29-May-05
foraminifera	3	4122	Rosebud	Mkr B	mussel colonization experiment, Block 10	29-May-05
foraminifera	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 10	29-May-05
foraminifera	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 10	29-May-05
foraminifera	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 10	29-May-05
hirudinian	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 10	29-May-05
tube, mucous	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 10	29-May-05
tube, white	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 10	29-May-05
foraminifera	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 11	29-May-05
foraminifera	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 11	29-May-05
limpet w/filamentous bacteria	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 11	29-May-05
polychaete, w/mucous	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 11	29-May-05
recruit, bivalve	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 11	29-May-05
recruit, in pore	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 11	29-May-05
tube, white	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 11	29-May-05
A. galapagensis	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 12	29-May-05
foraminifera	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 12	29-May-05
foraminifera	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 12	29-May-05
foraminifera	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 12	29-May-05
foraminifera	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 12	29-May-05
foraminifera and unknown organic specimen	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 12	29-May-05
recruit, limpet-like	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 12	29-May-05
tube, worm-like empty and foraminifera	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 12	29-May-05
"mushroom"	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 7	29-May-05
A. galapagensis?	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 7	29-May-05
ciliate	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 7	29-May-05
E. vitrea	2	4122	Rosebud	Mkr B	mussel colonization experiment, Block 7	29-May-05
foraminifera	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 7	29-May-05
foraminifera	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 7	29-May-05
foraminifera, pink	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 7	29-May-05
tube, foraminifera	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 7	29-May-05

colonist, bivalve	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 8	29-May-05
recruit	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 8	29-May-05
E. vitrea	4	4122	Rosebud	Mkr B	mussel colonization experiment, Block 9	29-May-05
foraminifera	1	4122	Rosebud	Mkr B	mussel colonization experiment, Block 9	29-May-05
E. vitrea	9	4122	Rosebud	Mkr B	mussel colonization experiment, block washings	29-May-05
L. pustulosus	1	4122	Rosebud	Mkr B	mussel colonization experiment, block washings	29-May-05
E. vitrea	2	4122	Rosebud	Mkr B	mussel colonization experiment, block washings	29-May-05
limpet, crushed	1	4122	Rosebud	Mkr B	mussel colonization experiment, block washings	29-May-05
polynoid, unknown	1	4122	Rosebud	Mkr B	mussel colonization experiment, block washings	29-May-05
E. vitrea	11	4122	Rosebud	Mkr B	mussel colonization experiment, washings	29-May-05
B. sandersi	1	4122	Rosebud	Mkr B	mussel colonization experiment, washings	29-May-05
L. pustulosus	12	4122	Rosebud	Mkr B	mussel colonization experiment, washings	29-May-05
copepod, calanoid	1	4122	Rosebud	Mkr B	mussel colonization experiment, washings	29-May-05
E. vitrea	1	4122	Rosebud	Mkr B	mussel colonization experiment, washings	29-May-05
V. sulfuris	2	4122	Rosebud	Mkr B	mussel colonization experiment, washings	29-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 1	30-May-05
limpet	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 1	30-May-05
tube	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 1	30-May-05
A. galapagensis	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 2	30-May-05
E. vitrea	4	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 2	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 2	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 2	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 2	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 2	30-May-05
hirudinian	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 2	30-May-05
hirudinian	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 2	30-May-05
Lepetodrilus sp.	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 2	30-May-05
tube, chaff	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 2	30-May-05
B. thermophilus	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
B. thermophilus	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
egg-like attachment	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05

foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera	2	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera, "common" white	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
foraminifera, yellow/golden	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 5	30-May-05
B. thermophilus larva	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
E. vitrea	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
foraminifera	2	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05

foraminifera	2	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
foraminifera	2	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
foraminifera	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
L. elevatus-like	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
organic "blob"	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
recruit, B. thermophilus	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
recruit, B. thermophilus (broken)	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
recruit, bivalve	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
tube, in pore	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
tube, small	1	4123	Rosebud	Mkr B	Riftia colonization experiment, Block 6	30-May-05
B. thermydron	1	4123	Rosebud	Mkr B	Riftia colonization experiment, block washings	30-May-05
E. vitrea	2	4123	Rosebud	Mkr B	Riftia colonization experiment, block washings	30-May-05
hirudinian, deep red	1	4123	Rosebud	Mkr B	Riftia colonization experiment, block washings	30-May-05
L. elevatus	4	4123	Rosebud	Mkr B	Riftia colonization experiment, block washings	30-May-05
L. ovalis	4	4123	Rosebud	Mkr B	Riftia colonization experiment, block washings	30-May-05
L. pustulosus	1	4123	Rosebud	Mkr B	Riftia colonization experiment, block washings	30-May-05
L. riftense	3	4123	Rosebud	Mkr B	Riftia colonization experiment, block washings	30-May-05
sphere, unknown black	1	4123	Rosebud	Mkr B	Riftia colonization experiment, block washings	30-May-05
foraminifera	2	4123	drip basalt washings			30-May-05
A. galapagensis	5	4123	Rosebud	Mkr I, near		30-May-05
A. rosacea	1	4123	Rosebud	Mkr I, near		30-May-05
copepod, calanoid	3	4123	Rosebud	Mkr I, near		30-May-05
copepod, red	5	4123	Rosebud	Mkr I, near		30-May-05

R. pachyptila 1	1	4123	Rosebud	Mkr I, near		30-May-05
A. rosacea	1	4124	Rock station #2?**		?	31-May-05
anemone, yellow	1	4124	Rosebud	Mkr B	fuzzy rock	31-May-05
A. galapagensis	12	4124	Rosebud	Mkr B	mussel grab	31-May-05
A. rosacea	13	4124	Rosebud	Mkr B	mussel grab	31-May-05
anemone, pink	2	4124	Rosebud	Mkr B	mussel grab	31-May-05
anemone, yellow	8	4124	Rosebud	Mkr B	mussel grab	31-May-05
B. symmytilida	1	4124	Rosebud	Mkr B	mussel grab	31-May-05
B. symmytilida 1	3	4124	Rosebud	Mkr B	mussel grab	31-May-05
B. symmytilida 3	1	4124	Rosebud	Mkr B	mussel grab	31-May-05
B. symmytilida 5	1	4124	Rosebud	Mkr B	mussel grab	31-May-05
B. symmytilida 6	1	4124	Rosebud	Mkr B	mussel grab	31-May-05
B. symmytilida 7	1	4124	Rosebud	Mkr B	mussel grab	31-May-05
B. symmytilida 8	1	4124	Rosebud	Mkr B	mussel grab	31-May-05
B. thermophilus 1	1	4124	Rosebud	Mkr B	mussel grab	31-May-05
B. thermophilus 2	1	4124	Rosebud	Mkr B	mussel grab	31-May-05
B. thermophilus 3	1	4124	Rosebud	Mkr B	mussel grab	31-May-05
B. thermophilus 4	1	4124	Rosebud	Mkr B	mussel grab	31-May-05
B. thermophilus 5	1	4124	Rosebud	Mkr B	mussel grab	31-May-05
B. thermophilus 6	1	4124	Rosebud	Mkr B	mussel grab	31-May-05
B. thermophilus 7	1	4124	Rosebud	Mkr B	mussel grab	31-May-05
B. thermophilus 8	1	4124	Rosebud	Mkr B	mussel grab	31-May-05
B. thermophilus 9	1	4124	Rosebud	Mkr B	mussel grab	31-May-05
B. thermophilus, juvenile	22	4124	Rosebud	Mkr B	mussel grab	31-May-05
E. vitrea	61	4124	Rosebud	Mkr B	mussel grab	31-May-05
L. ovalis	13	4124	Rosebud	Mkr B	mussel grab	31-May-05
L. pustulosus	25	4124	Rosebud	Mkr B	mussel grab	31-May-05
Levensteiniella sp.	2	4124	Rosebud	Mkr B	mussel grab	31-May-05
megalope	1	4124	Rosebud	Mkr B	mussel grab	31-May-05
polynoid, unknown juvenile	1	4124	Rosebud	Mkr B	mussel grab	31-May-05
B. symmytilida	1	4124	"new vent"		mussel grab	31-May-05
B. symmytilida 1	1	4124	"new vent"		mussel grab	31-May-05
B. thermophilus 1	1	4124	"new vent"		mussel grab	31-May-05
B. thermophilus 2	1	4124	"new vent"		mussel grab	31-May-05
B. thermophilus 3	1	4124	"new vent"		mussel grab	31-May-05
B. thermophilus 4	1	4124	"new vent"		mussel grab	31-May-05

A. galapagensis	1	4124	Rosebud	Mkr B	mussel grab & fuzzy rock, washings	31-May-05
A. rosacea	17	4124	Rosebud	Mkr B	mussel grab & fuzzy rock, washings	31-May-05
anemone, yellow	3	4124	Rosebud	Mkr B	mussel grab & fuzzy rock, washings	31-May-05
B. thermophilus, juvenile	3	4124	Rosebud	Mkr B	mussel grab & fuzzy rock, washings	31-May-05
E. vitrea	8	4124	Rosebud	Mkr B	mussel grab & fuzzy rock, washings	31-May-05
H. vestimentifera	9	4124	Rosebud	Mkr B	mussel grab & fuzzy rock, washings	31-May-05
hirudinian, deep red (piscicolid)	1	4124	Rosebud	Mkr B	mussel grab & fuzzy rock, washings	31-May-05
L. pustulosus	10	4124	Rosebud	Mkr B	mussel grab & fuzzy rock, washings	31-May-05
ostracod	1	4124	Rosebud	Mkr B	mussel grab & fuzzy rock, washings	31-May-05
A. galapagensis	1	4124	Rosebud	Mkr B	Riftia colonization experiment, Block 3	31-May-05
A. galapagensis	1	4124	Rosebud	Mkr B	Riftia colonization experiment, Block 3	31-May-05
recruit, B. thermophilus	1	4124	Rosebud	Mkr B	Riftia colonization experiment, Block 3	31-May-05
recruit, B. thermophilus	1	4124	Rosebud	Mkr B	Riftia colonization experiment, Block 3	31-May-05
tube, attached	1	4124	Rosebud	Mkr B	Riftia colonization experiment, Block 3	31-May-05
Lepetodrilus sp.	1	4124	Rosebud	Mkr B	Riftia colonization experiment, Block 3	31-May-05
aplacophoran	1	4124	Rosebud	Mkr B	Riftia colonization experiment, Block 4	31-May-05
recruit, bivalve	1	4124	Rosebud	Mkr B	Riftia colonization experiment, Block 4	31-May-05
R. pachyptila 1	1	4124	"new vent"		Riftia grab	31-May-05
R. pachyptila 2	1	4124	"new vent"		Riftia grab	31-May-05
R. pachyptila 3	1	4124	"new vent"		Riftia grab	31-May-05
"Tevnia"/"Oasisia" morph	18	4124	"new vent"		Riftia grab washings	31-May-05
A. galapagensis	200-250	4124	"new vent"		Riftia grab washings	31-May-05
B. thermophilus, juvenile	28	4124	"new vent"		Riftia grab washings	31-May-05
E. vitrea	1	4124	"new vent"		Riftia grab washings	31-May-05
G. aristata	2	4124	"new vent"		Riftia grab washings	31-May-05
H. vestimentifera	3	4124	"new vent"		Riftia grab washings	31-May-05
hirudinian, deep red (piscicolid)	1	4124	"new vent"		Riftia grab washings	31-May-05
L. pustulosus	8	4124	"new vent"		Riftia grab washings	31-May-05
O. akessoni	2	4124	"new vent"		Riftia grab washings	31-May-05
R. pachyptila, juveniles	20	4124	"new vent"		Riftia grab washings	31-May-05
foraminifera	?	4124	Rock station #3		Rock station #3	31-May-05
Actinaugi sp.	2	4124	Rosebud	Mkr B	rock station 5	31-May-05
Actinaugi sp.	6	4124	Rosebud	Mkr B	rock station 5	31-May-05

8.3.2 TIGR Biology Samples

Species	no	Alvin Dive #	Area	Sample Type	Date	Treatment
RIFTIA						
Riftia pachyptila 1	1	4114	Western edge, Rosebud	enz. sampler #3	21/5/05	3 sites scraped, frozen
Riftia pachyptila 2 (baby, attached near #1,site #3)	1	4114	Western edge, Rosebud	enz. sampler #3	21/5/05	1 site scraped, frozen
Riftia pachyptila 1	1	4115	Marker J, Rosebud	biobox	22/5/05	3 sites scraped, frozen
Riftia pachyptila 2	1	4115	Marker J, Rosebud	biobox	22/5/05	3 sites scraped, frozen
Riftia pachyptila 3	1	4115	Marker J, Rosebud	biobox	22/5/05	3 sites scraped, frozen
Riftia pachyptila 4	1	4115	Marker J, Rosebud	biobox	22/5/05	3 sites scraped, frozen trophosome
Riftia pachyptila 5 (baby, attached to Riftia #4)	1	4115	Marker J, Rosebud	biobox	22/5/05	1 site scraped, frozen
Riftia pachyptila 1	1	4116	Marker N, Rosebud	biobox	23/5/05	3 sites scraped, frozen
Riftia pachyptila 2	1	4116	Marker N, Rosebud	biobox	23/5/05	3 sites scraped, frozen
Riftia pachyptila 3	1	4116	Marker N, Rosebud	biobox	23/5/05	3 sites scraped, frozen
Riftia pachyptila 4	1	4116	Marker N, Rosebud	biobox	23/5/05	3 sites scraped, frozen
Riftia pachyptila 1	1	4117	Marker L, Rosebud	biobox	24/5/05	3 sites scraped, frozen
Riftia pachyptila 2	1	4117	Marker L, Rosebud	biobox	24/5/05	3 sites scraped, frozen
Riftia pachyptila 3	1	4117	Marker L, Rosebud	biobox	24/5/05	3 sites scraped, frozen
Riftia pachyptila 4	1	4117	Marker L, Rosebud	biobox	24/5/05	3 sites scraped, frozen
Riftia pachyptila 5	1	4117	Marker L, Rosebud	biobox	24/5/05	3 sites scraped, frozen
Riftia pachyptila 6	1	4117	Marker L, Rosebud	biobox	24/5/05	3 sites scraped, frozen
Riftia pachyptila 1	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	3 sites scraped, frozen
Riftia pachyptila 2	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 3	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 4	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 5 (had attached baby)	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 6 (had attached baby)	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 7 (leaking green stuff)	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	1 site (middle) scraped, frozen

Riftia pachyptila 8	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 9 (had attached baby)	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	1 site (middle) scraped, frozen
R. pachyptila trophosome	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	frozen whole
Riftia pachyptila 1 (had attached baby, middle tube)	1	4121	Garden of Eden	biobox	28/5/05	3 sites ? scraped, frozen
Riftia pachyptila 2	1	4121	Garden of Eden	biobox	28/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 3 (had 7 babies, middle tube)	1	4121	Garden of Eden	biobox	28/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 4	1	4121	Garden of Eden	biobox	28/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 5	1	4121	Garden of Eden	biobox	28/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 6	1	4121	Garden of Eden	biobox	28/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 7	1	4121	Garden of Eden	biobox	28/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 8	1	4121	Garden of Eden	biobox	28/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 9	1	4121	Garden of Eden	biobox	28/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 1	1	4124	New site	stbd biobox	31/5/05	1 site (middle) scraped, frozen
R. pachyptila trophosome from #1	1	4124	New site	stbd biobox	31/5/05	frozen whole
Riftia pachyptila 2	1	4124	New site	stbd biobox	31/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 3	1	4124	New site	stbd biobox	31/5/05	1 site (middle) scraped, frozen
MUSSELS						
Bathymodiolus thermophilus 1	1	4114	Western edge, Rosebud	enz. sampler #2	21/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 2	1	4114	Western edge, Rosebud	enz. sampler #2	21/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 3	1	4114	Western edge, Rosebud	enz. sampler #2	21/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 1	1	4115	Marker I, Rosebud	enz. sampler	22/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 2	1	4115	Marker I, Rosebud	enz. sampler	22/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 3	1	4115	Marker I, Rosebud	enz. sampler	22/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 4	1	4115	Marker I, Rosebud	enz. sampler	22/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 1	1	4116	Marker K, Rosebud	enz. sampler #2 + RNAlater	23/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 2	1	4116	Marker K, Rosebud	enz. sampler #2 + RNAlater	23/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 3	1	4116	Marker M, Rosebud	enz. sampler #1 + RNAlater	23/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 4	1	4116	Marker M, Rosebud	enz. sampler #1 + RNAlater	23/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 1	1	4117	Marker L, Rosebud	biobox	24/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 2	1	4117	Marker L, Rosebud	biobox	24/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 3	1	4117	Marker L, Rosebud	biobox	24/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 4	1	4117	Marker L, Rosebud	biobox	24/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 5	1	4117	Marker L, Rosebud	biobox	24/5/05	whole mussel scraped, frozen

Bathymodiolus thermophilus 6	1	4117	Marker L, Rosebud	biobox	24/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 1	1	4119	Marker B, Rosebud	biobox	26/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 2	1	4119	Marker B, Rosebud	biobox	26/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 3	1	4119	Marker B, Rosebud	biobox	26/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 4	1	4119	Marker B, Rosebud	biobox	26/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 5	1	4119	Marker B, Rosebud	biobox	26/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 6	1	4119	Marker B, Rosebud	biobox	26/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 1	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 2	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 3	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 4	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 5	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 6	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 7	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	whole mussel scraped, frozen
B. thermophilus gill 1	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	frozen whole
B. thermophilus gill 2	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	frozen whole
B. thermophilus gill 3	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	frozen whole
Bathymodiolus thermophilus 1	1	4124	New site	enz. sampler #3	31/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 2	1	4124	New site	enz. sampler #3	31/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 3	1	4124	New site	enz. sampler #3	31/5/05	whole mussel scraped, frozen
B. thermophilus shell 1	1	4118	Mussel Bed	biobox	25/5/05	whole piece scraped, frozen
B. thermophilus shell 2	1	4118	Mussel Bed	biobox	25/5/05	whole piece scraped, frozen
B. thermophilus shell 3	1	4118	Mussel Bed	biobox	25/5/05	whole piece scraped, frozen
B. thermophilus shell 4	1	4118	Mussel Bed	biobox	25/5/05	whole piece scraped, frozen
B. thermophilus shell 5	1	4118	Mussel Bed	biobox	25/5/05	3 sites scraped, frozen
CLAMS						
Calyptogena magnifica 1	1	4118	Mussel Bed	biobox	25/5/05	3 exterior scrapings, frozen
mud associated with C. magnifica 1	1	4118	Mussel Bed	biobox	25/5/05	2 mud samples, frozen
Calyptogena magnifica 1	1	4119	Marker B, Rosebud	biobox	26/5/05	whole clam scraped, frozen
Calyptogena magnifica 2	1	4119	Marker B, Rosebud	biobox	26/5/05	whole clam scraped, frozen
Calyptogena magnifica 3	1	4119	Marker B, Rosebud	biobox	26/5/05	whole clam scraped, frozen
Calyptogena magnifica 4	1	4119	Marker B, Rosebud	biobox	26/5/05	whole clam scraped, frozen
Calyptogena magnifica 5	1	4119	Marker B, Rosebud	biobox	26/5/05	whole clam scraped, frozen

Calyptogena magnifica 6	1	4119	Marker B, Rosebud	biobox	26/5/05	whole clam scraped, frozen
C. magnifica gill 1	1	4119	Marker B, Rosebud	biobox	26/5/05	frozen
C. magnifica gill 2	1	4119	Marker B, Rosebud	biobox	26/5/05	frozen
C. magnifica gill 3	1	4119	Marker B, Rosebud	biobox	26/5/05	frozen
OTHER ANIMALS						
shrimp	1	4115	??	??	22/5/05	entire animal frozen
Tevnia-like worm 1	1	4116	Marker L, Rosebud	enz. sampler #3	23/5/05	3 sites scraped, frozen
Tevnia-like worm 2	1	4116	Marker L, Rosebud	enz. sampler #3	23/5/05	2 sites scraped, frozen
Tevnia-like worm 3	1	4116	Marker L, Rosebud	enz. sampler #3	23/5/05	2 sites scraped, frozen
Tevnia-like worm 4	1	4116	Marker L, Rosebud	enz. sampler #3	23/5/05	2 sites scraped, frozen
Furry Galatheid	1	4121	in Alvin skin	in Alvin skin	28/5/05	1 site scraped, frozen 1 entire leg frozen 1 leg into glutaraldehyde
L. pustulosus	1	4120 or 21?	Garden of Eden Riftia grab	biobox		
Tevnia-like worm 1 (attached to Riftia)	1	4124	New site	stbd biobox	31/5/05	1 site scraped, frozen
ROCKS						
rock	1	4115	??	??	22/5/05	1 site scraped, frozen
furry rock	1	4117	Marker I, Rosebud	enz. sampler #1 + RNAlater (N.B. chamber was open)	24/5/05	2 sites scraped, frozen
slurp of furry rock	1	4117	Marker I, Rosebud	white slurp chamber	24/5/05	50um,0.2um filtered
rock	1	4118	Mussel Bed	biobox?	25/5/05	3 sites scraped, frozen
lava from station #3	1	4119	Station #3, Rosebud	enz. sampler #2 (RNA?)	26/5/05	1 sites scraped, frozen
curtain lava from station #5? (900m SW)	1	4119	Station #5, Rosebud	enz. sampler #4 (RNA?)	26/5/05	1 sites scraped, frozen
rock #2	1	4120	Garden of Eden	enz. sampler #1 (RNA?)	27/5/05	1 sites scraped, frozen
furry basalt chips	1	4120	Marker P, Garden of Eden	black slurp	27/5/05	2 sites scraped, frozen 1 site scraped/chipped into glut remaining pieces frozen
furry rock #1	1	4124	Marker B, Rosebud	enz. sampler #3	31/5/05	1 sites scraped, frozen
furry rock #2	1	4124	Marker B, Rosebud	enz. sampler #3	31/5/05	1 sites scraped, frozen
COLONIZATION PANELS/BLOCKS						

Block #7 (non-native) side II	1	4122	Marker B mussels, Rosebud	biobox stbd	29/5/05	scraped two sites
Block #7 (non-native) side III	1	4122	Marker B mussels, Rosebud	biobox stbd	29/5/05	scraped two sites
Block #8 (non-native) top	1	4122	Marker B mussels, Rosebud	enz. sampler #1 (RNA?)	29/5/05	scraped two sites
Block #8 (non-native) side III	1	4122	Marker B mussels, Rosebud	enz. sampler #1 (RNA?)	29/5/05	scraped two sites
Block #9 (non-native, red) top	1	4122	Marker B mussels, Rosebud	biobox port	29/5/05	scraped two sites
Block #9 (non-native, red) side II	1	4122	Marker B mussels, Rosebud	biobox port	29/5/05	scraped 1 site
Block #9 (non-native, red) side III	1	4122	Marker B mussels, Rosebud	biobox port	29/5/05	scraped two sites
Panel #10 (native, glass vs cut) top	1	4122	Marker B mussels, Rosebud	enz. sampler #2 (RNA?)	29/5/05	scraped 1 site
Panel #10 (native, glass vs cut) bottom	1	4122	Marker B mussels, Rosebud	enz. sampler #2 (RNA?)	29/5/05	scraped two sites
Panel #11 (native, white handle, black tape) top	1	4122	Marker B mussels, Rosebud	enz. sampler #4 (RNA?)	29/5/05	scraped two sites
Panel #11 (native, white handle, black tape) bottom	1	4122	Marker B mussels, Rosebud	enz. sampler #4 (RNA?)	29/5/05	scraped two sites
Panel #12 (native, yellow handle, black tape) top	1	4122	Marker B mussels, Rosebud	enz. sampler #3 (RNA?)	29/5/05	scraped two sites
Panel #12 (native, yellow handle, black tape) bottom	1	4122	Marker B mussels, Rosebud	enz. sampler #3 (RNA?)	29/5/05	scraped two sites
**** native panels split and frozen after scraping						
**** non-native panels frozen whole after scraping						
Panel #1 (native, glass vs cut) top	1	4123	Marker B Riftia, Rosebud	enz. sampler #1 (RNA?)	30/5/05	scraped two sites
Panel #1 (native, glass vs cut) bottom	1	4123	Marker B Riftia, Rosebud	enz. sampler #1 (RNA?)	30/5/05	scraped two sites
Block #2 (non-native, red) top	1	4123	Marker B Riftia, Rosebud	enz. sampler #2 (RNA?)	30/5/05	scraped 1 site
Block #2 (non-native, red) side II	1	4123	Marker B Riftia, Rosebud	enz. sampler #2 (RNA?)	30/5/05	scraped 1 site
Panel #5 (native, yellow handle, yellow tape) top	1	4123	Marker B Riftia, Rosebud	enz. sampler #4 (RNA?)	30/5/05	scraped three sites
Panel #5 (native, yellow handle, yellow tape) bottom	1	4123	Marker B Riftia, Rosebud	enz. sampler #4 (RNA?)	30/5/05	scraped three sites
Panel #6 (native, white handle, white tape) top	1	4123	Marker B Riftia, Rosebud	enz. sampler #3 (RNA?)	30/5/05	scraped three sites
Panel #6 (native, white handle, white tape) bottom	1	4123	Marker B Riftia, Rosebud	enz. sampler #3 (RNA?)	30/5/05	scraped four sites
**** native panels split and frozen after scraping						
**** non-native panels frozen whole after scraping						
**** negative control panels also frozen whole						
Block #4 (non-native) side unknown (eye removed)	1	4124	Marker B Riftia, Rosebud	enz. sampler + Na-cac	31/5/05	scraped 1 site into Na-cac

WATER

bottom water	1	4119	?	major pairs	26/5/05	filtered thru 0.2, retentate frozen
"Niskin 1", 2375m depth, 5.7m alt, 0 46.95N 86 13.66W	1	night op		niskin on TowCam	30/5/05	filtered thru 0.2, filter frozen
"Niskin 2", 2365m depth, 6.5m alt, 0 46.98N 86 13.66W	1	night op		niskin on TowCam	30/5/05	filtered thru 0.2, filter frozen

Species	no	Alvin Dive #	Area	Sample Type	Date	Treatment
RIFTIA						
Riftia pachyptila 1	1	4114	Western edge, Rosebud	enz. sampler #3	21/5/05	3 sites scraped, frozen
Riftia pachyptila 2 (baby, attached near #1,site #3)	1	4114	Western edge, Rosebud	enz. sampler #3	21/5/05	1 site scraped, frozen
Riftia pachyptila 1	1	4115	Marker J, Rosebud	biobox	22/5/05	3 sites scraped, frozen
Riftia pachyptila 2	1	4115	Marker J, Rosebud	biobox	22/5/05	3 sites scraped, frozen
Riftia pachyptila 3	1	4115	Marker J, Rosebud	biobox	22/5/05	3 sites scraped, frozen
Riftia pachyptila 4	1	4115	Marker J, Rosebud	biobox	22/5/05	3 sites scraped, frozen trophosome
Riftia pachyptila 5 (baby, attached to Riftia #4)	1	4115	Marker J, Rosebud	biobox	22/5/05	1 site scraped, frozen
Riftia pachyptila 1	1	4116	Marker N, Rosebud	biobox	23/5/05	3 sites scraped, frozen
Riftia pachyptila 2	1	4116	Marker N, Rosebud	biobox	23/5/05	3 sites scraped, frozen
Riftia pachyptila 3	1	4116	Marker N, Rosebud	biobox	23/5/05	3 sites scraped, frozen
Riftia pachyptila 4	1	4116	Marker N, Rosebud	biobox	23/5/05	3 sites scraped, frozen
Riftia pachyptila 1	1	4117	Marker L, Rosebud	biobox	24/5/05	3 sites scraped, frozen
Riftia pachyptila 2	1	4117	Marker L, Rosebud	biobox	24/5/05	3 sites scraped, frozen
Riftia pachyptila 3	1	4117	Marker L, Rosebud	biobox	24/5/05	3 sites scraped, frozen
Riftia pachyptila 4	1	4117	Marker L, Rosebud	biobox	24/5/05	3 sites scraped, frozen
Riftia pachyptila 5	1	4117	Marker L, Rosebud	biobox	24/5/05	3 sites scraped, frozen
Riftia pachyptila 6	1	4117	Marker L, Rosebud	biobox	24/5/05	3 sites scraped, frozen
Riftia pachyptila 1	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	3 sites scraped, frozen
Riftia pachyptila 2	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 3	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 4	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 5 (had attached baby)	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 6 (had attached baby)	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 7 (leaking green stuff)	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 8	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	1 site (middle) scraped, frozen

Riftia pachyptila 9 (had attached baby)	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	1 site (middle) scraped, frozen
R. pachyptila trophosome	1	4120	Marker Q, Garden of Eden	biobox	27/5/05	frozen whole
Riftia pachyptila 1 (had attached baby, middle tube)	1	4121	Garden of Eden	biobox	28/5/05	3 sites ? scraped, frozen
Riftia pachyptila 2	1	4121	Garden of Eden	biobox	28/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 3 (had 7 babies, middle tube)	1	4121	Garden of Eden	biobox	28/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 4	1	4121	Garden of Eden	biobox	28/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 5	1	4121	Garden of Eden	biobox	28/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 6	1	4121	Garden of Eden	biobox	28/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 7	1	4121	Garden of Eden	biobox	28/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 8	1	4121	Garden of Eden	biobox	28/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 9	1	4121	Garden of Eden	biobox	28/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 1	1	4124	New site	stbd biobox	31/5/05	1 site (middle) scraped, frozen
R. pachyptila trophosome from #1	1	4124	New site	stbd biobox	31/5/05	frozen whole
Riftia pachyptila 2	1	4124	New site	stbd biobox	31/5/05	1 site (middle) scraped, frozen
Riftia pachyptila 3	1	4124	New site	stbd biobox	31/5/05	1 site (middle) scraped, frozen
MUSSELS						
Bathymodiolus thermophilus 1	1	4114	Western edge, Rosebud	enz. sampler #2	21/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 2	1	4114	Western edge, Rosebud	enz. sampler #2	21/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 3	1	4114	Western edge, Rosebud	enz. sampler #2	21/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 1	1	4115	Marker I, Rosebud	enz. sampler	22/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 2	1	4115	Marker I, Rosebud	enz. sampler	22/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 3	1	4115	Marker I, Rosebud	enz. sampler	22/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 4	1	4115	Marker I, Rosebud	enz. sampler	22/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 1	1	4116	Marker K, Rosebud	enz. sampler #2 + RNAlater	23/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 2	1	4116	Marker K, Rosebud	enz. sampler #2 + RNAlater	23/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 3	1	4116	Marker M, Rosebud	enz. sampler #1 + RNAlater	23/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 4	1	4116	Marker M, Rosebud	enz. sampler #1 + RNAlater	23/5/05	3 sites scraped, frozen
Bathymodiolus thermophilus 1	1	4117	Marker L, Rosebud	biobox	24/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 2	1	4117	Marker L, Rosebud	biobox	24/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 3	1	4117	Marker L, Rosebud	biobox	24/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 4	1	4117	Marker L, Rosebud	biobox	24/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 5	1	4117	Marker L, Rosebud	biobox	24/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 6	1	4117	Marker L, Rosebud	biobox	24/5/05	whole mussel scraped, frozen

Bathymodiolus thermophilus 1	1	4119	Marker B, Rosebud	biobox	26/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 2	1	4119	Marker B, Rosebud	biobox	26/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 3	1	4119	Marker B, Rosebud	biobox	26/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 4	1	4119	Marker B, Rosebud	biobox	26/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 5	1	4119	Marker B, Rosebud	biobox	26/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 6	1	4119	Marker B, Rosebud	biobox	26/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 1	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 2	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 3	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 4	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 5	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 6	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 7	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	whole mussel scraped, frozen
B. thermophilus gill 1	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	frozen whole
B. thermophilus gill 2	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	frozen whole
B. thermophilus gill 3	1	4120	Marker P, Garden of Eden	enz. sampler #2 + RNAlater	27/5/05	frozen whole
Bathymodiolus thermophilus 1	1	4124	New site	enz. sampler #3	31/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 2	1	4124	New site	enz. sampler #3	31/5/05	whole mussel scraped, frozen
Bathymodiolus thermophilus 3	1	4124	New site	enz. sampler #3	31/5/05	whole mussel scraped, frozen
B. thermophilus shell 1	1	4118	Mussel Bed	biobox	25/5/05	whole piece scraped, frozen
B. thermophilus shell 2	1	4118	Mussel Bed	biobox	25/5/05	whole piece scraped, frozen
B. thermophilus shell 3	1	4118	Mussel Bed	biobox	25/5/05	whole piece scraped, frozen
B. thermophilus shell 4	1	4118	Mussel Bed	biobox	25/5/05	whole piece scraped, frozen
B. thermophilus shell 5	1	4118	Mussel Bed	biobox	25/5/05	3 sites scraped, frozen
CLAMS						
Calyptogena magnifica 1	1	4118	Mussel Bed	biobox	25/5/05	3 exterior scrapings, frozen
mud associated with C. magnifica 1	1	4118	Mussel Bed	biobox	25/5/05	2 mud samples, frozen
Calyptogena magnifica 1	1	4119	Marker B, Rosebud	biobox	26/5/05	whole clam scraped, frozen
Calyptogena magnifica 2	1	4119	Marker B, Rosebud	biobox	26/5/05	whole clam scraped, frozen
Calyptogena magnifica 3	1	4119	Marker B, Rosebud	biobox	26/5/05	whole clam scraped, frozen
Calyptogena magnifica 4	1	4119	Marker B, Rosebud	biobox	26/5/05	whole clam scraped, frozen
Calyptogena magnifica 5	1	4119	Marker B, Rosebud	biobox	26/5/05	whole clam scraped, frozen
Calyptogena magnifica 6	1	4119	Marker B, Rosebud	biobox	26/5/05	whole clam scraped, frozen

C. magnifica gill 1	1	4119	Marker B, Rosebud	biobox	26/5/05	frozen
C. magnifica gill 2	1	4119	Marker B, Rosebud	biobox	26/5/05	frozen
C. magnifica gill 3	1	4119	Marker B, Rosebud	biobox	26/5/05	frozen
OTHER ANIMALS						
shrimp	1	4115	??	??	22/5/05	entire animal frozen
Tevnia-like worm 1	1	4116	Marker L, Rosebud	enz. sampler #3	23/5/05	3 sites scraped, frozen
Tevnia-like worm 2	1	4116	Marker L, Rosebud	enz. sampler #3	23/5/05	2 sites scraped, frozen
Tevnia-like worm 3	1	4116	Marker L, Rosebud	enz. sampler #3	23/5/05	2 sites scraped, frozen
Tevnia-like worm 4	1	4116	Marker L, Rosebud	enz. sampler #3	23/5/05	2 sites scraped, frozen
Furry Galatheid	1	4121	in Alvin skin	in Alvin skin	28/5/05	1 site scraped, frozen
						1 entire leg frozen
						1 leg into glutaraldehyde
L. pustulosus	1	4120 or 21?	Garden of Eden Riftia grab	biobox		
Tevnia-like worm 1 (attached to Riftia)	1	4124	New site	stbd biobox	31/5/05	1 site scraped, frozen
ROCKS						
rock	1	4115	??	??	22/5/05	1 site scraped, frozen
furry rock	1	4117	Marker I, Rosebud	enz. sampler #1 + RNAlater	24/5/05	2 sites scraped, frozen
				(N.B. chamber was open) white slurp		
slurp of furry rock	1	4117	Marker I, Rosebud	chamber	24/5/05	50um,0.2um filtered
rock	1	4118	Mussel Bed	biobox?	25/5/05	3 sites scraped, frozen
lava from station #3	1	4119	Station #3, Rosebud	enz. sampler #2 (RNA?)	26/5/05	1 sites scraped, frozen
curtain lava from station #5? (900m SW)	1	4119	Station #5, Rosebud	enz. sampler #4 (RNA?)	26/5/05	1 sites scraped, frozen
rock #2	1	4120	Garden of Eden	enz. sampler #1 (RNA?)	27/5/05	1 sites scraped, frozen
furry basalt chips	1	4120	Marker P, Garden of Eden	black slurp	27/5/05	2 sites scraped, frozen
						1 site scraped/chipped into glut
						remaining pieces frozen
furry rock #1	1	4124	Marker B, Rosebud	enz. sampler #3	31/5/05	1 sites scraped, frozen
furry rock #2	1	4124	Marker B, Rosebud	enz. sampler #3	31/5/05	1 sites scraped, frozen

COLONIZATION PANELS/BLOCKS

Block #7 (non-native) side II	1	4122	Marker B mussels, Rosebud	biobox stbd	29/5/05	scraped two sites
Block #7 (non-native) side III	1	4122	Marker B mussels, Rosebud	biobox stbd	29/5/05	scraped two sites
Block #8 (non-native) top	1	4122	Marker B mussels, Rosebud	enz. sampler #1 (RNA?)	29/5/05	scraped two sites
Block #8 (non-native) side III	1	4122	Marker B mussels, Rosebud	enz. sampler #1 (RNA?)	29/5/05	scraped two sites
Block #9 (non-native, red) top	1	4122	Marker B mussels, Rosebud	biobox port	29/5/05	scraped two sites
Block #9 (non-native, red) side II	1	4122	Marker B mussels, Rosebud	biobox port	29/5/05	scraped 1 site
Block #9 (non-native, red) side III	1	4122	Marker B mussels, Rosebud	biobox port	29/5/05	scraped two sites
Panel #10 (native, glass vs cut) top	1	4122	Marker B mussels, Rosebud	enz. sampler #2 (RNA?)	29/5/05	scraped 1 site
Panel #10 (native, glass vs cut) bottom	1	4122	Marker B mussels, Rosebud	enz. sampler #2 (RNA?)	29/5/05	scraped two sites
Panel #11 (native, white handle, black tape) top	1	4122	Marker B mussels, Rosebud	enz. sampler #4 (RNA?)	29/5/05	scraped two sites
Panel #11 (native, white handle, black tape) bottom	1	4122	Marker B mussels, Rosebud	enz. sampler #4 (RNA?)	29/5/05	scraped two sites
Panel #12 (native, yellow handle, black tape) top	1	4122	Marker B mussels, Rosebud	enz. sampler #3 (RNA?)	29/5/05	scraped two sites
Panel #12 (native, yellow handle, black tape) bottom	1	4122	Marker B mussels, Rosebud	enz. sampler #3 (RNA?)	29/5/05	scraped two sites
**** native panels split and frozen after scraping						
**** non-native panels frozen whole after scraping						
Panel #1 (native, glass vs cut) top	1	4123	Marker B Riftia, Rosebud	enz. sampler #1 (RNA?)	30/5/05	scraped two sites
Panel #1 (native, glass vs cut) bottom	1	4123	Marker B Riftia, Rosebud	enz. sampler #1 (RNA?)	30/5/05	scraped two sites
Block #2 (non-native, red) top	1	4123	Marker B Riftia, Rosebud	enz. sampler #2 (RNA?)	30/5/05	scraped 1 site
Block #2 (non-native, red) side II	1	4123	Marker B Riftia, Rosebud	enz. sampler #2 (RNA?)	30/5/05	scraped 1 site
Panel #5 (native, yellow handle, yellow tape) top	1	4123	Marker B Riftia, Rosebud	enz. sampler #4 (RNA?)	30/5/05	scraped three sites
Panel #5 (native, yellow handle, yellow tape) bottom	1	4123	Marker B Riftia, Rosebud	enz. sampler #4 (RNA?)	30/5/05	scraped three sites
Panel #6 (native, white handle, white tape) top	1	4123	Marker B Riftia, Rosebud	enz. sampler #3 (RNA?)	30/5/05	scraped three sites
Panel #6 (native, white handle, white tape) bottom	1	4123	Marker B Riftia, Rosebud	enz. sampler #3 (RNA?)	30/5/05	scraped four sites
**** native panels split and frozen after scraping						
**** non-native panels frozen whole after scraping						

**** negative control panels also frozen whole

Block #4 (non-native) side unknown (eye removed)	1	4124	Marker B Riftia, Rosebud	enz. sampler + Na-cac	31/5/05	scraped 1 site into Na-cac

WATER

bottom water	1	4119	?	major pairs	26/5/05	filtered thru 0.2, retentate frozen
"Niskin 1", 2375m depth, 5.7m alt, 0 46.95N 86 13.66W	1	night op		niskin on TowCam	30/5/05	filtered thru 0.2, filter frozen
"Niskin 2", 2365m depth, 6.5m alt, 0 46.98N 86 13.66W	1	night op		niskin on TowCam	30/5/05	filtered thru 0.2, filter frozen

8.4 Chemistry Samples

ALKALINITY DATA, ALVIN DIVES # 4114-4123- GALAPAGOS RIFT 2005

Dive #	Sample #	[ALK]-meq/L, error ± 0.	pH
4114	M-4114-23	2.5	7.62
	M-4114-24	2.5	7.76
	M-4114-25	2.41	7.12
	M-4114-26	2.4	No Data
4115	M-4115-23	2.72	7.38
	M-4115-24	2.59	7.48
	M-4115-25	2.45	7.35
	M-4115-26	2.43	7.29
4116	M-4116-23	2.42	7.13
	M-4116-24	2.41	7.11
	M-4116-25	2.37	7.07
	M-4116-26	2.33	7.06
4117	M-4117-23	2.46	7.02
	M-4117-24	2.17	6.74
	M-4117-25	2.24	6.77
	M-4117-26	2.4	7.29
4118	No Data Reported		
4119	M-4119**	2.64	7.79
4120	M-4120-25	2.38	7.37
	M-4120-26	2.27	7.12
4121	M-4121-23	2.45	7.05
	M-4121-24	No Data	7.23
	M-4121-25	2.53	7.04
	M-4121-26	2.4	7.2
4122	M-4122-23	2.21	6.86
	M-4122-24	2.42	7.08
4124	M-4124-23	2.51	7.64
	M-4124-24	2.44	7.35
	M-4124-25	2.27	6.9
	M-4124-26	2.43	7.4

** Denotes Average Bottom Water Sample

8.4 Chemistry Samples

ALKALINITY DATA, ALVIN DIVES # 4114-4123- GALAPAGOS RIFT 2005

Dive #	Sample #	[ALK]-meq/L, error ± 0.	pH
4114	M-4114-23	2.5	7.62
	M-4114-24	2.5	7.76
	M-4114-25	2.41	7.12
	M-4114-26	2.4	No Data
4115	M-4115-23	2.72	7.38
	M-4115-24	2.59	7.48
	M-4115-25	2.45	7.35
	M-4115-26	2.43	7.29
4116	M-4116-23	2.42	7.13
	M-4116-24	2.41	7.11
	M-4116-25	2.37	7.07
	M-4116-26	2.33	7.06
4117	M-4117-23	2.46	7.02
	M-4117-24	2.17	6.74
	M-4117-25	2.24	6.77
	M-4117-26	2.4	7.29
4118	No Data Reported		
4119	M-4119**	2.64	7.79
4120	M-4120-25	2.38	7.37
	M-4120-26	2.27	7.12
4121	M-4121-23	2.45	7.05
	M-4121-24	No Data	7.23
	M-4121-25	2.53	7.04
	M-4121-26	2.4	7.2
4122	M-4122-23	2.21	6.86
	M-4122-24	2.42	7.08
4124	M-4124-23	2.51	7.64
	M-4124-24	2.44	7.35
	M-4124-25	2.27	6.9
	M-4124-26	2.43	7.4

** Denotes Average Bottom Water Sample

8.5 Geological Samples

Locations of *Alvin* Rock Samples from the Galapagos Rift (A11-27)

Sample #	x	y	Lat (°N)	Long (°W)	Depth (m)	General Location Description
4115-3	2475	61428	00°48.33'	86°13.66'	2451	Rosebud -- Marker F/J
4116-1	2471	61456	00°48.35'	86°13.67'	2451	Rosebud -- Marker M
4116-2	2498	61429	00°48.33'	86°13.65'	2453	Rosebud -- Marker K
4117-2	2479	61433	00°48.33'	86°13.66'	2451	Rosebud -- Marker C/I
4117-3	2502	61436	00°48.34'	86°13.65'	2452	Rosebud -- near middle
4117-4	2449	61469	00°48.36'	86°13.68'	2450	Lobates at W. margin of Rosebud
4118-2	10805	60497	00°47.83'	86°09.18'	2483	Mussel Bed
4118-4	11320	60508	00°47.84'	86°08.90'	2489	~500 m E. of Mussel Bed
4119-2	2045	61554	00°48.40'	86°13.90'	2450	500 m W. of Rosebud
4119-3	1842	61397	00°48.32'	86°14.01'	2453	~700 m W. of Rosebud
4119-4	1521	61382	00°48.31'	86°14.18'	2454	~950 m W. of Rosebud
4119-5	1378	61570	00°48.41'	86°14.26'	2447	~1100 m W. of Rosebud
4120-1	13456	60230	00°47.68'	86°07.75'	2489	Garden of Eden
4120-2	13283	60362	00°47.76'	86°07.84'	2464	Garden of Eden
4120-3	13281	60363	00°47.76'	86°07.84'	2464	Garden of Eden
4121-1	11555	60214	00°47.68'	86°08.77'	2501	Landing site
4121-Bio-1	13492	60266	00°47.70'	86°07.73'	2489	Garden of Eden
4121-2	13488	60271	00°47.71'	86°07.73'	2489	Garden of Eden, Marker Q
4123-1	2569	61421	00°48.33'	86°13.62'	2450	Rosebud
4124-1	2499	61475	00°48.36'	86°13.65'	2451	Rosebud -- Marker B
4121-2	2469	61538	00°48.39'	86°13.67'	2447	NW of Rosebud
4121-3	2587	61544	00°48.40'	86°13.61'	2445	N.of Rosebud going up pillow mound
4121-4	2556	61727	00°48.50'	86°13.62'	2432	Top of volcanic mound to N. of Rosebud
4121-5	2338	61526	00°48.39'	86°13.74'	2448	Same lava flow as Rosebud

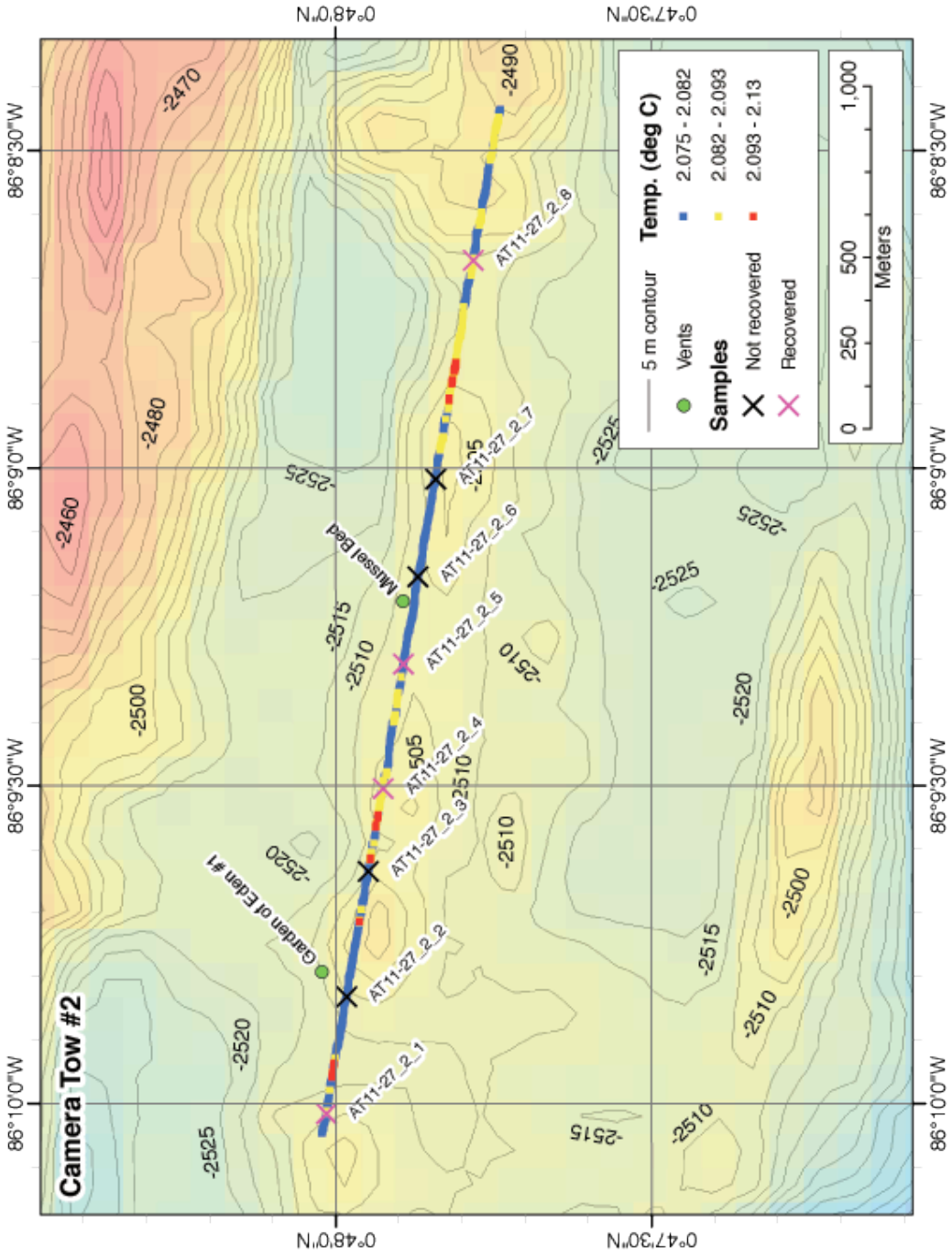
Rock Description Sheet

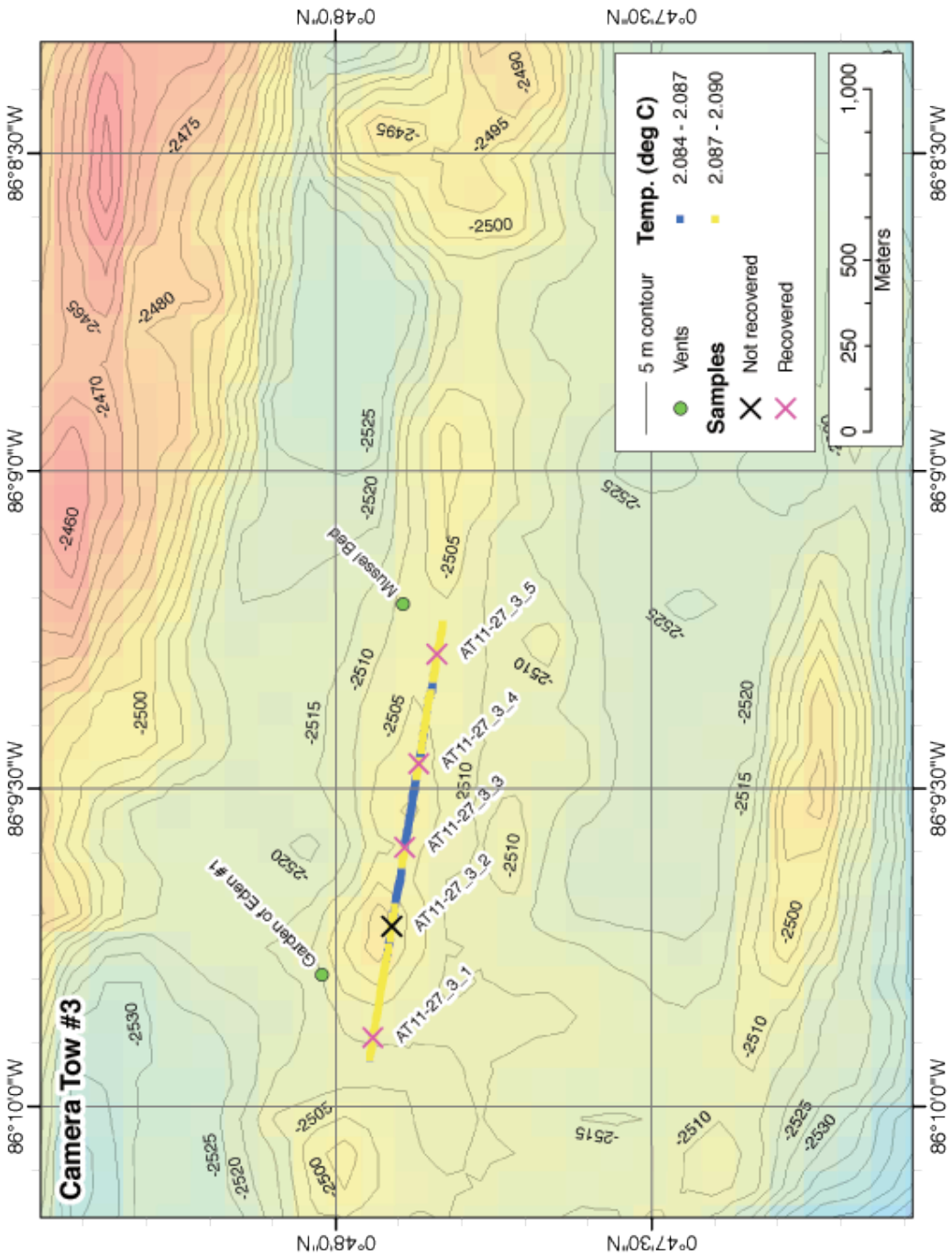
Cruise: AT11-27: Described by: Susan Humphris

Alvin Dive Samples Area: Galápagos Rift Lat: 00°48.35'N Long. 86°13.659'W (Variable) Date: May-June 2005

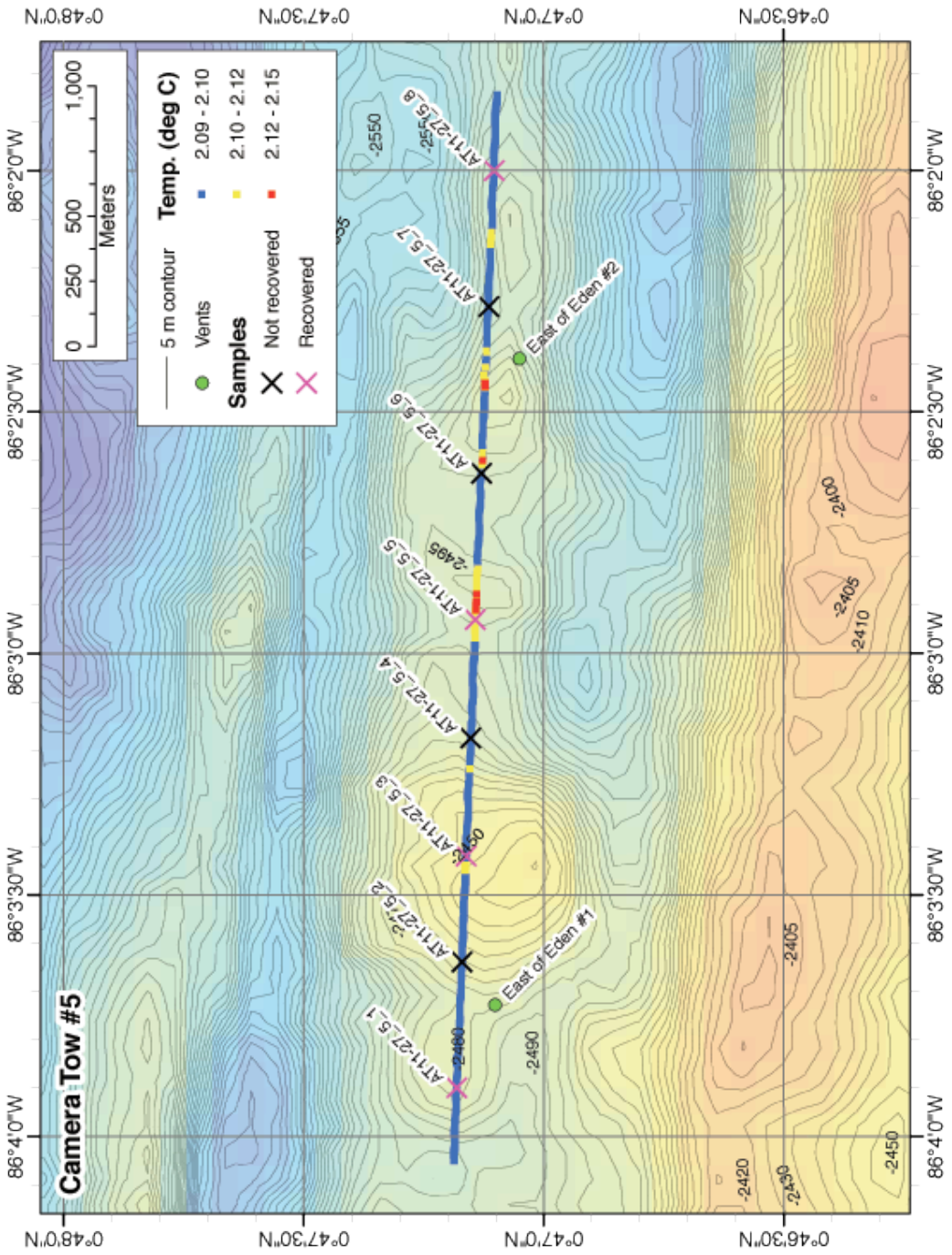
Sample #	Lithology	G.S.	Wt. kilos	Mineralogy	Pheno-crysts	Ve	am	Mn	We	Alteration	Glass	Cut/ slab	Comments
4115-3	Sheet Flow	G/A	10	--	<1% ol.	--	--	--	F	--	xx	--	A. Soule has subsample
4116-1	Basalt	A	3	--	--	--	--	--	L	--	--	--	Weathered glass with mussel threads
4116-2	Sheet Flow	G	<1	--	--	--	--	--	F	--	xx	--	A. Soule has subsample
4117-2	Sheet Flow	G/A	5	--	<1% pg., ol	--	--	--	F	--	xx	--	A. Soule has subsample
4117-3	Sheet Flow	G/A	5	--	--	--	--	--	F	--	xx	--	Glass on both sides; A. Soule has subsample
4117-4	Sheet Flow	G/A	>20	--	--	--	--	--	F	--	xx	--	A. Soule has subsample
4118-2	Basalt	A	5	--	--	--	--	--	L	--	--	--	1 piece: Mn coating 1 piece: oxidized surface
4118-4	Glassy bud	G	1	--	--	--	--	--	F	--	xx	--	A. Soule has whole sample
4119-2	Ropy Sheet Flow	G/A	20	--	--	--	--	--	F	--	xx	--	4 pieces; A. Soule has subsample
4119-3	Sheet Flow	G/A	3	--	--	--	--	--	F	--	xx	--	A.Soule has subsample
4119-4	Glassy bud	G/A	<1	--	--	--	--	--	F	--	xx	--	A. Soule has whole

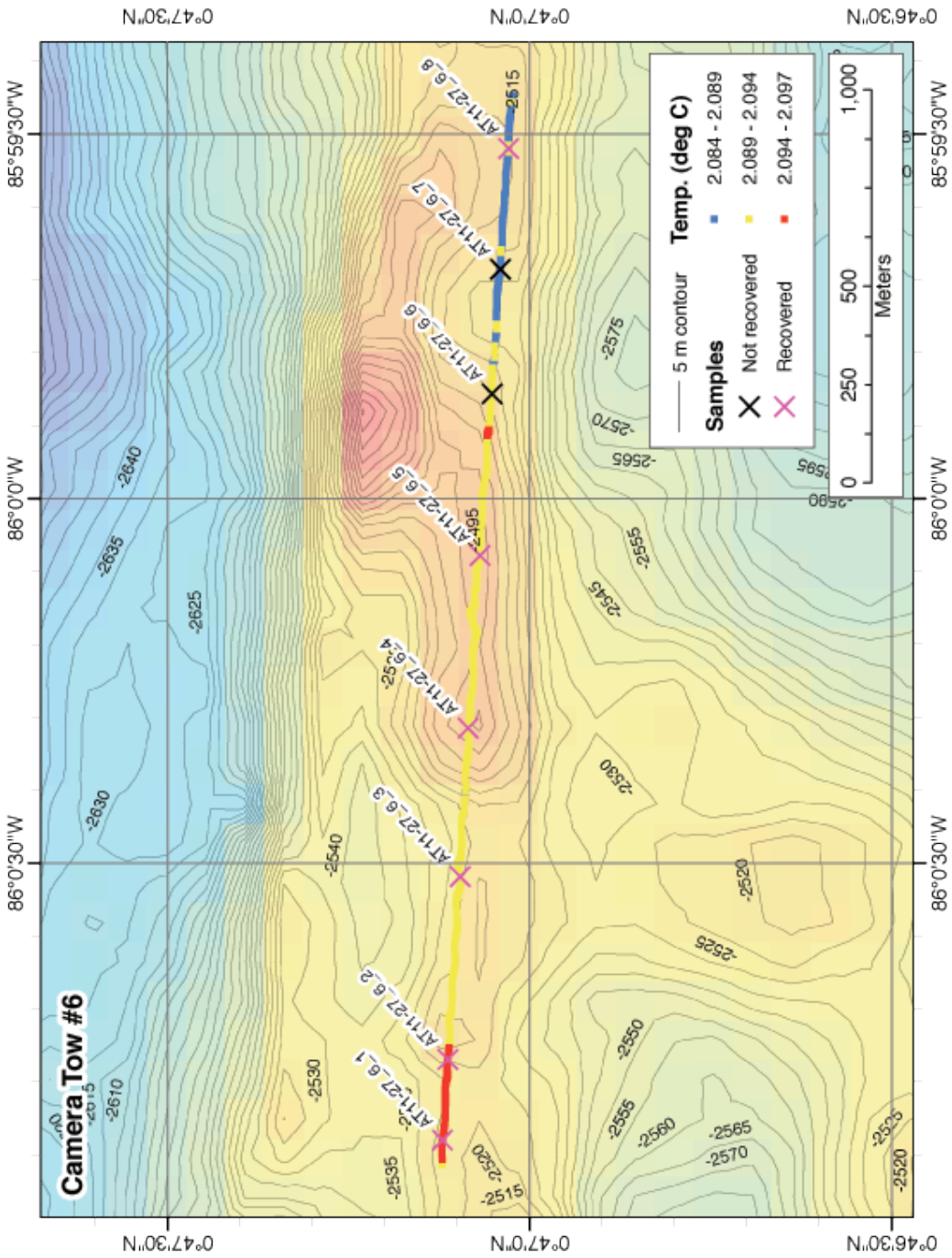
8.6 TowCam Dive Maps

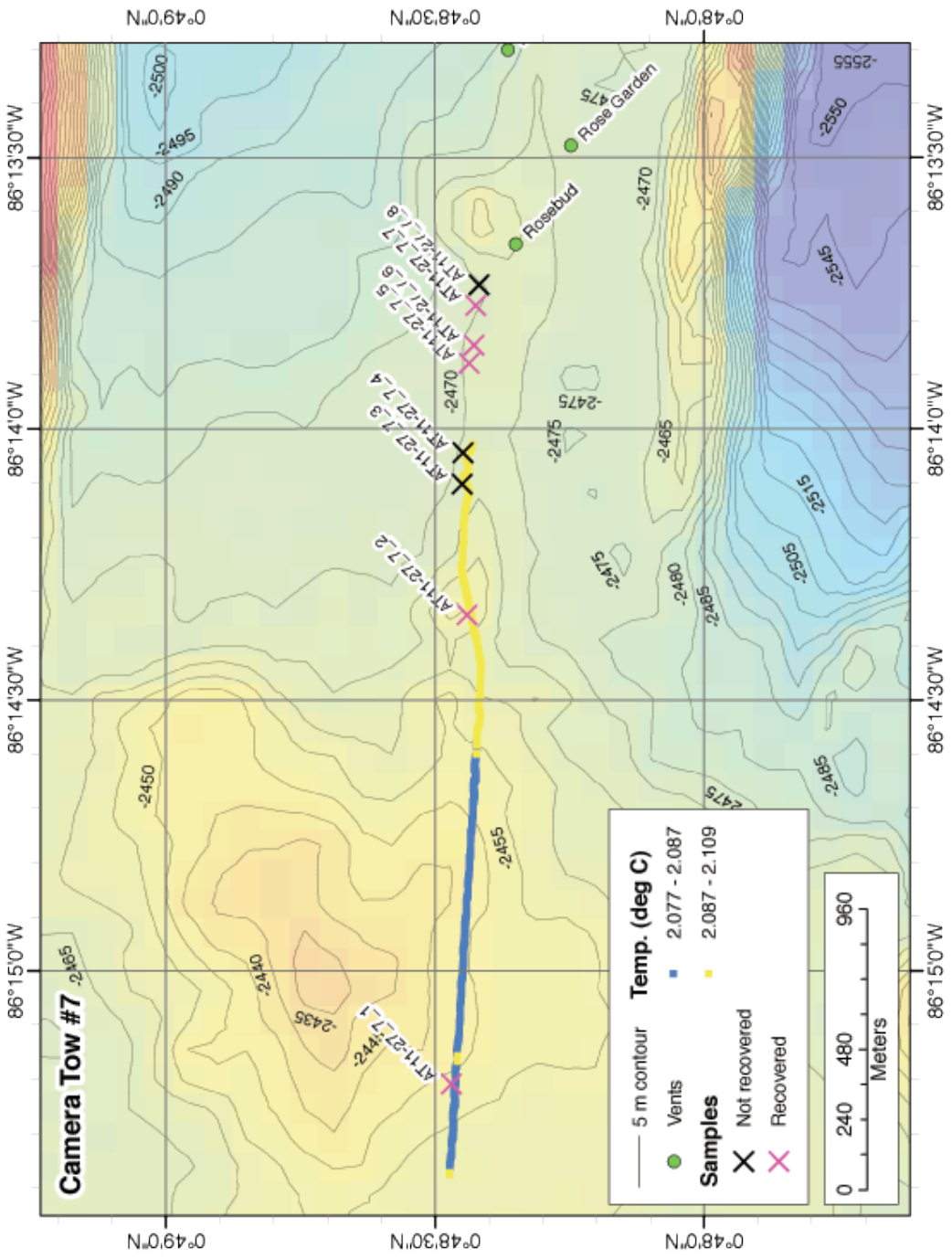


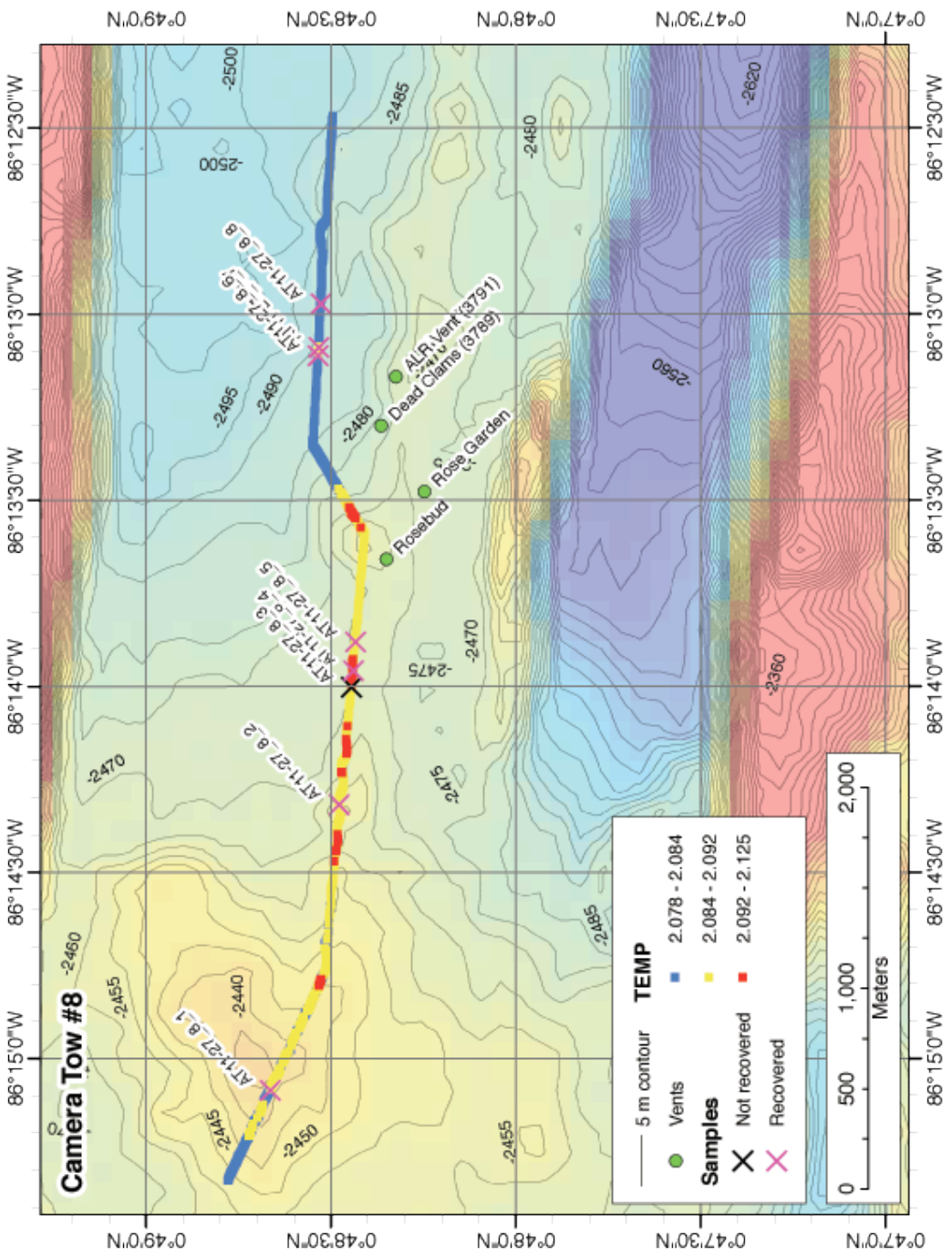

Camera Tow #3
Temp. (deg C)
2.084 - 2.087
2.087 - 2.090
5 m contour
Vents
Samples
Not recovered
Recovered
0
250
500
1,000
Meters
Mussel Bed
Garden of Eden #1
AT11-27_3_5
AT11-27_3_4
AT11-27_3_3
AT11-27_3_2
AT11-27_3_1
0°48'0"N
0°47'30"N
86°8'30"W
86°9'0"W
86°9'30"W
86°10'0"W

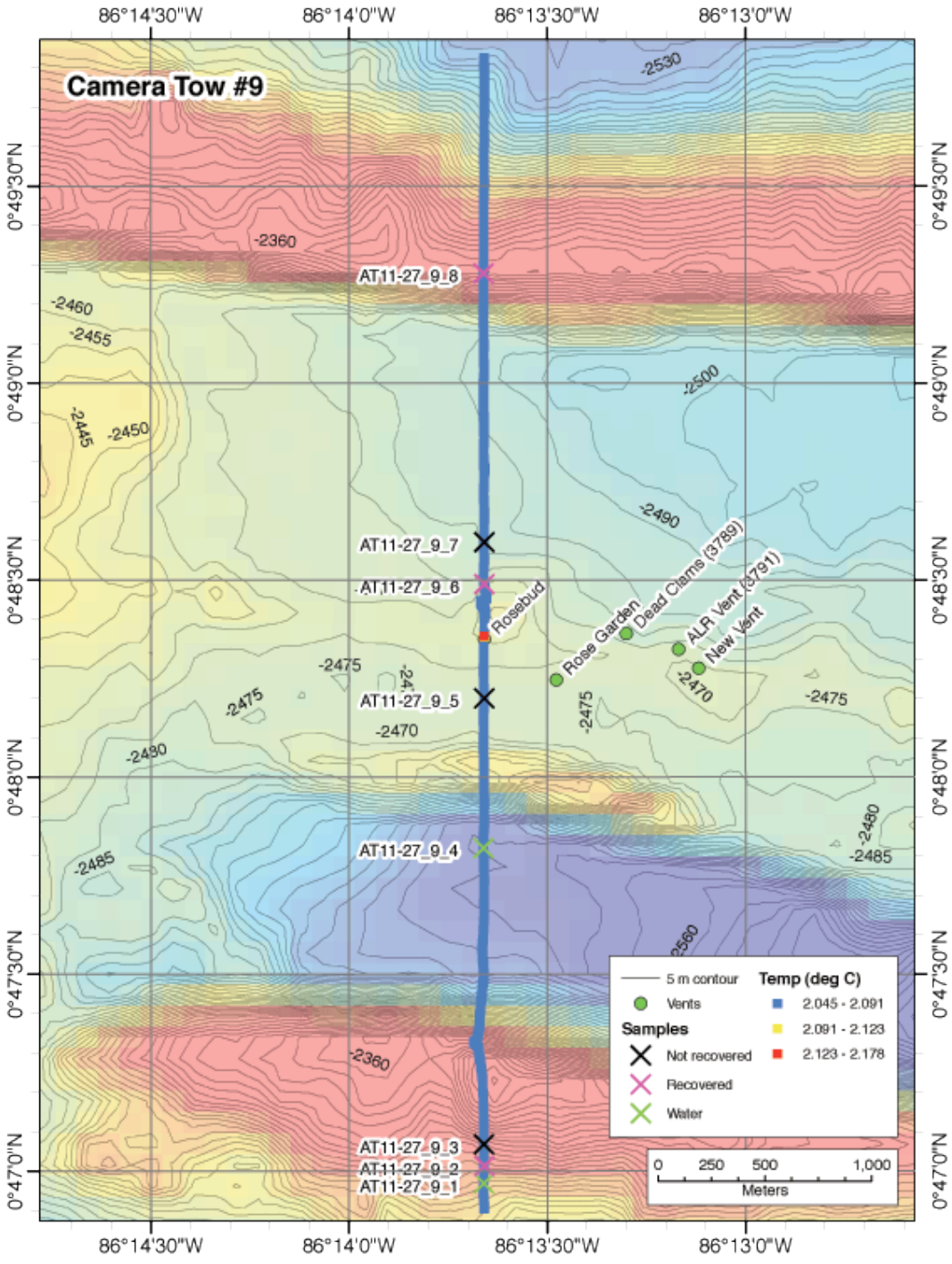
Camera Tow #4
0°47'30"N
0°48'0"N
86°7'0"W
86°7'30"W
86°8'0"W
86°8'30"W
Garden of Eden #3
AT11-27_4_8
AT11-27_4_7
AT11-27_4_6
AT11-27_4_5
AT11-27_4_4
AT11-27_4_3
AT11-27_4_2
AT11-27_4_1
-2485
-2495
-2505
-2510
-2515
-2535
-2540
-2550
-2460
-2455
-2465
-2520
-2525
-2545
Temp. (deg C)
2.07 - 2.09
2.09 - 2.13
2.13 - 2.32
5 m contour
Vents
Samples
Not recovered
Recovered
0
250
500
1,000
Meters


Camera Tow #5
Temp. (deg C)
2.09 - 2.10
2.10 - 2.12
2.12 - 2.15
Samples
Not recovered
Recovered
Vents
5 m contour
0 250 500 1,000
Meters
East of Eden #1
East of Eden #2
AT11-27_5.1
AT11-27_5.2
AT11-27_5.3
AT11-27_5.4
AT11-27_5.5
AT11-27_5.6
AT11-27_5.7
AT11-27_5.8
0°48'0"N
0°47'30"N
0°47'0"N
0°46'30"N
86°4'0"W
86°3'30"W
86°3'0"W
86°2'30"W
86°2'0"W


Camera Tow #6
Temp. (deg C)
2.084 - 2.089
2.089 - 2.094
2.094 - 2.097
Samples
Not recovered
Recovered
5 m contour
0
250
500
1,000
Meters
AT11-27_6.9
AT11-27_6.8
AT11-27_6.7
AT11-27_6.6
AT11-27_6.5
AT11-27_6.4
AT11-27_6.3
AT11-27_6.2
AT11-27_6.1
0°47'30"N
0°47'0"N
0°46'30"N
85°59'30"W
86°0'0"W
86°0'30"W


Camera Tow #7
Rose Garden
Rosebud
5 m contour
Temp. (deg C)
2.077 - 2.087
2.087 - 2.109
Vents
Samples
Not recovered
Recovered
0 240 480 960
Meters
0°49'0"N
0°48'30"N
0°48'0"N
86°13'30"W
86°14'0"W
86°14'30"W
86°15'0"W


Camera Tow #8
ALR Vent (3791)
Dead Clams (3789)
Rose Garden
Rosebud
TEMP
2.078 - 2.084
2.084 - 2.092
2.092 - 2.125
5 m contour
Vents
Samples
Not recovered
Recovered
0
500
1,000
2,000
Meters
0°49'0"N
0°48'30"N
0°48'0"N
0°47'30"N
0°47'0"N
86°12'30"W
86°13'0"W
86°13'30"W
86°14'0"W
86°14'30"W
86°15'0"W


Camera Tow #9
86°14'30"W
86°14'0"W
86°13'30"W
86°13'0"W
0°49'30"N
0°49'0"N
0°48'30"N
0°48'0"N
0°47'30"N
0°47'0"N
-2530
-2360
-2460
-2455
-2445
-2450
-2500
-2490
-2475
-2470
-2480
-2485
-2560
AT11-27_9_8
AT11-27_9_7
AT11-27_9_6
AT11-27_9_5
AT11-27_9_4
AT11-27_9_3
AT11-27_9_2
AT11-27_9_1
Rosebud
Rose Garden
Dead Clams (3789)
ALR Vent (3791)
New Vent
5 m contour
Vents
Samples
Not recovered
Recovered
Water
Temp (deg C)
2.045 - 2.091
2.091 - 2.123
2.123 - 2.178
0
250
500
1,000
Meters

8.7 Alvin Video Clip Inventory

Dive number	Date	Video clip Filename	Video clip Time start (GMT)	Video clip Time end (GMT)	Location/feature	Activity / animal / event
4114	21-May-05	AT11_27_4114_182834_enteropneusts	18:28:34	18:29:05	Approach Rosebud	enteropneusts on basalt
4114	21-May-05	AT11_27_4114_190224_approachA	19:02:24	19:02:39	Rosebud	approach to Mkr A
4114	21-May-05	AT11_27_4114_190239_approachB	19:02:39	19:03:22	Rosebud	approach to Mkr B
4114	21-May-05	AT11_27_4114_191424_MkrB	19:14:24	19:14:54	Rosebud	Mkr B site
4114	21-May-05	AT11_27_4114_192433_mussels	19:24:33	19:25:01	Rosebud	Mkr B mussels in fissure, zoomed in
4114	21-May-05	AT11_27_4114_191951_MkrBRiftia	19:19:51	19:20:12	Rosebud	Mkr B Riftia patch
4114	21-May-05	AT11_27_4114_202211_Riftia	20:22:11	20:22:33	Rosebud	Mkr B Riftia, zoomed in
4114	21-May-05	AT11_27_4114_193802_Ghostbuster	19:38:02	19:38:32	Rosebud	Ghostbuster at Mkr B
4114	21-May-05	AT11_27_4114_201234_BlueMajor	20:12:34	20:13:04	Rosebud	Blue Major Pair at Mkr B
4114	21-May-05	AT11_27_4114_201927_YellowMajor	20:19:27	20:19:50	Rosebud	Yellow Major Pair at Mkr B
4114	21-May-05	AT11_27_4114_202725_YellowDatalogger	20:27:25	20:28:03	Rosebud	Yellow datalogger at Mkr B
4114	21-May-05	AT11_27_4114_203644_Block6	20:36:44	20:37:01	Rosebud	Block 6 before deployment
4114	21-May-05	AT11_27_4114_204219_LoggerVemcoBlock6	20:42:19	20:43:41	Rosebud	Block 6 in place with Vemco and Yellow datalogger at Mkr B
4114	21-May-05	AT11_27_4114_205216_NativeBasaltPanels	20:52:16	20:52:40	Rosebud	Native basalt panels at Mkr B
4114	21-May-05	AT11_27_4114_211011_YellowICLrelease	21:10:11	21:10:48	Rosebud	Release of yellow ICL at Mkr B basalt colonization panel assembly
4114	21-May-05	AT11_27_4114_212548_musselgrab	21:25:48	21:26:05	Rosebud	Mussel grab north of Mkr A
4114	21-May-05	AT11_27_4114_212741_Riftiagrab	21:27:41	21:28:27	Rosebud	Riftia grab north of Mkr A
4114	21-May-05	AT11_27_4114_203447_crabzilla	20:34:47	20:35:17	Rosebud	"Crab-zilla," zoom of brachyuran crab crossing over anemones on basalt
4115	22-May-05	AT11_27_4115_171638_yellowDataloggerAssembly	17:16:38	17:16:58	Rosebud	Mkr B yellow datalogger set-up
4115	22-	AT11_27_4115_171914_BlueMajor	17:19:14	17:19:34	Rosebud	Blue Major Pair

	May-05					
4115	22-May-05	AT11_27_4115_181317_blueDataloggerAssembly	18:13:17	18:14:03	Rosebud	Mkr B blue datalogger set-up
4115	22-May-05	AT11_27_4115_184948_communitytransect	18:49:48	18:50:30	Rosebud	transect over basalt and small communities near Mkr A
4115	22-May-05	AT11_27_4115_202322_musselGB	20:23:22	20:43:22	Rosebud	Ghostbuster among mussels
4115	22-May-05	AT11_27_4115_204414_MkrCmusselgrab	20:44:14	20:44:34	Rosebud	mussel grab at Mkr C
4115	22-May-05	AT11_27_4115_204942_deployMkrI	20:49:42	20:50:01	Rosebud	deployment of Mkr I
4115	22-May-05	AT11_27_4115_205634_MkrF	20:56:34	20:57:02	Rosebud	Mkr F community
4115	22-May-05	AT11_27_4115_205955_RiftiaGB	20:59:55	21:00:15	Rosebud	Ghostbuster among Mkr F Riftia
4115	22-May-05	AT11_27_4115_210825_Riftiaslurp	21:08:25	21:08:47	Rosebud	Riftia slurp at Mkr F
4115	22-May-05	AT11_27_4115_212902_fishhunt	21:29:02	21:29:25	Rosebud	bythitid fish "hunt" with hydraulic slurp
4116	23-May-05	AT11_27_4116_174001_Ratcam	17:40:01	17:40:28	Rosebud	Ratcam in position at Mkr B with blue datalogger and basalt blocks
4116	23-May-05	AT11_27_4116_154435_bluelogger	15:44:35	15:44:58	Rosebud	blue datalogger zoom out to ICL
4116	23-May-05	AT11_27_4116_160008_yellowICLcrayon	16:00:08	16:00:28	Rosebud	yellow datalogger trying to communicate on sub "crayon"
4116	23-May-05	AT11_27_4116_184705_musselclaw	18:47:05	18:47:46	Rosebud	Alvin "claws" plucking mussel grab into enzymatic sampler chamber 1
4116	23-May-05	AT11_27_4116_181455_anemoneGB	18:14:55	18:15:15	Rosebud	Ghostbuster at base of anemone at Mkr M
4116	23-May-05	AT11_27_4116_180225_anemoneflow	18:02:25	18:02:56	Rosebud	zoom in on anemone in diffuse flow
4116	23-May-05	AT11_27_4116_191412_bythitidGB	19:14:12	19:14:54	Rosebud	bythitid fish investigating Ghostbuster at Mkr N
4116	23-May-05	AT11_27_4116_194737_Riftiaclumpgrab	19:47:37	19:48:27	Rosebud	Riftia grab of intertwined Mkr N community
4116	23-May-05	AT11_27_4116_200544_RiftiaBlueMajor	20:05:44	20:06:04	Rosebud	Blue Major Pair sampling at base of removed Riftia clump
4116	23-May-05	AT11_27_4116_202818_musselslurp	20:28:18	20:28:38	Rosebud	slurp at Mkr K discrete mussel cluster
4116	23-May-05	AT11_27_4116_210455_Tevnialike	20:04:55	21:05:35	Rosebud	"Tevnia" in crevice at Mkr L
4117	24-May-05	AT11_27_4117_161639_MkrNtoB	16:16:39	16:16:58	Rosebud	scan of Mkr N, fish, larval trap 1, Mkr B, Ratcam
4117	24-	AT11_27_4117_161928_MkrBRatcam	16:19:28	16:19:51	Rosebud	Ratcam at Mkr B

	May-05					
4117	24-May-05	AT11_27_4117_165431_crabfrenzy	16:54:31	16:54:50	Rosebud	crab frenzy on newly-deployed red datalogger
4117	24-May-05	AT11_27_4117_182640_approachJ	18:26:40	18:27:01	Rosebud	approach to Mkr J
4117	24-May-05	AT11_27_4117_183231_crabtrap	18:32:31	18:32:51	Rosebud	rusty crab trap
4117	24-May-05	AT11_27_4117_182358_seafloor	18:23:58	18:24:28	Rosebud	geological transect
4117	24-May-05	AT11_27_4117_200005_bacterialslurp	20:00:05	20:00:35	Rosebud	bacterial slurp
4117	24-May-05	AT11_27_4117_204230_larvaltrap	20:42:30	20:42:49	Rosebud	deployment of larval trap
4117	24-May-05	AT11_27_4117_210247_curtainflow	21:02:47	21:03:07	Rosebud	sampling curtain flow
4117	24-May-05	AT11_27_4117_210640_slabofcurtain	21:06:40	21:07:00	Rosebud	large curtain flow sample
4118	25-May-05	AT11_27_4118_170321_staining	17:03:21	17:03:41	Approach to Musselbed	iron staining of slightly sedimented glassy pillows
4118	25-May-05	AT11_27_4118_174602_sedpillows	17:46:02	17:46:22	Approach to Musselbed	sedimented pillows with ophiuroid and anemone
4118	25-May-05	AT11_27_4118_175417_collapsedpit	17:54:17	17:54:34	Approach to Musselbed	crossing collapsed pit/fissure
4118	25-May-05	AT11_27_4118_175729_shellperiphery	17:57:29	17:57:48	Musselbed	outskirts of empty clam shells
4118	25-May-05	AT11_27_4118_182722_seastarslurp	18:27:22	18:27:38	Musselbed	attempted slurp of seastar
4118	25-May-05	AT11_27_4118_184030_signpost	18:40:30	18:40:47	Musselbed	approach to signpost
4118	25-May-05	AT11_27_4118_184325_signpostzoom	18:43:25	18:43:32	Musselbed	zoom in on deteriorating signpost
4118	25-May-05	AT11_27_4118_184915_clamshells	18:49:15	18:49:35	Musselbed	patches of empty clam and mussel shells between pillows
4118	25-May-05	AT11_27_4118_190248_highT	19:02:48	19:03:08	Musselbed	High T probe around sedimented empty clam shells
4118	25-May-05	AT11_27_4118_193352_brachyurans	19:33:52	19:34:12	Musselbed	two brachyuran crabs amid galatheids
4118	25-May-05	AT11_27_4118_202351_shellgrab	20:23:51	20:24:14	Musselbed	grab of empty clamshells (will go into Enzymatic Sampler chamber 2)
4119	26-May-05	AT11_27_4119_174238_Ratcam	17:42:38	17:42:58	Rosebud	Ratcam at Mkr. B
4119	26-May-05	AT11_27_4119_175456_MkrBblock	17:54:56	17:55:24	Rosebud	final set up of Mkr. B Ratcam colonization panels
4119	26-	AT11_27_4119_183731_netfishing	18:37:31	18:37:52	Rosebud	fishing with net #2

	May-05					
4119	26-May-05	AT11_27_4119_205834_holothurian1	20:58:34	20:58:54	West of Rosebud	holothurian slurp 1
4119	26-May-05	AT11_27_4119_210015_holothurian2	21:00:15	21:00:36	West of Rosebud	holothurian slurp 2
4120	27-May-05	AT11_27_4120_171147_pagodapanels	17:11:47	17:12:07	Garden of Eden (3)	rediscovered "pagoda" of settlement panels
4120	27-May-05	AT11_27_4120_161752_ deepseashrimp	16:17:52	16:18:12	Garden of Eden (3)	zoom on deep sea shrimp
4120	27-May-05	AT11_27_4120_184334_Riftiagrab	18:43:34	18:43:53	Garden of Eden (3)	Riftia grab at base of Riftia clump
4120	27-May-05	AT11_27_4120_190905_markerQ	19:09:05	19:09:24	Garden of Eden (3)	Mkr Q at Garden of Eden Riftia
4120	27-May-05	AT11_27_4120_192432_musselgrab	19:24:32	19:24:53	Garden of Eden (3)	mussel grab
4120	27-May-05	AT11_27_4120_192955_markerP	19:29:55	19:30:15	Garden of Eden (3)	Mkr P at Garden of Eden mussels
4120	27-May-05	AT11_27_4120_174332_Riftiazoom	17:43:32	17:43:52	Garden of Eden (3)	zoom on Riftia
4120	27-May-05	AT11_27_4120_205652_octopus	20:56:52	20:57:12	Garden of Eden (3)	cirroteuthid octopus
4121	28-May-05	AT11_27_4121_164325_clamgrab	16:43:25	16:43:46	Clambake (3)	clam shell grab
4121	28-May-05	AT11_27_4121_200751_Riftiagrab	20:07:51	20:08:10	Garden of Eden (3)	Riftia grab
4121	28-May-05	AT11_27_4121_202336_YellowMajor	20:23:36	20:23:55	Garden of Eden (3)	firing yellow Major Pair among Riftia
4121	28-May-05	AT11_27_4121_203201_fishhole	20:32:01	20:32:21	Garden of Eden (3)	fish hole
4121	28-May-05	AT11_27_4121_204134_dandelion	20:41:34	20:41:49	Garden of Eden (3)	"Galapagos dandelion"
4122	29-May-05	AT11_27_4122_164827_MkrJF	16:48:27	16:48:58	Rosebud	pan over Riftia, mussels, falling galatheids at Mkr J/F
4122	29-May-05	AT11_27_4122_173450_BlueMajor	17:34:50	17:35:10	Rosebud	fire blue Major Pair at Mkr I
4122	29-May-05	AT11_27_4122_182015_MkrBmussel	18:20:15	18:20:35	Rosebud	side view of colonization blocks at Mkr B mussels
4122	29-May-05	AT11_27_4122_190209_jelly	19:02:09	19:02:21	Rosebud	jelly (medusa) pulsing over Mkr B blocks
4122	29-May-05	AT11_27_4122_194922_Block7	19:49:22	19:49:32	Rosebud	Block 7 with shrimp (Alvinocaris lusca?)
4122	29-May-05	AT11_27_4122_194939_Block8	19:49:39	19:49:46	Rosebud	Block 8

4122	29-May-05	AT11_27_4122_184318_Block9	18:43:18	18:43:31	Rosebud	Block 9
4122	29-May-05	AT11_27_4122_183949_Block10	18:39:49	18:39:56	Rosebud	Block 10
4122	29-May-05	AT11_27_4122_203505_Block11logger	20:35:05	20:35:31	Rosebud	Block 11 and yellow Datalogger
4122	29-May-05	AT11_27_4122_192259_Block12vemcos	19:22:59	19:23:06	Rosebud	Block 12 with green and orange Vemcos
4122	29-May-05	AT11_27_4122_192833_pullpinBlock12	19:28:33	19:29:09	Rosebud	pull pin release of Block 12
4123	30-May-05	AT11_27_4123_171353_whiteVemco	17:13:53	17:14:13	Rosebud	white Vemco at Mkr B Riftia colonization blocks
4123	30-May-05	AT11_27_4123_171552_MkrBRiftia	17:15:52	17:16:22	Rosebud	Mrk B Riftia block assembly
4123	30-May-05	AT11_27_4123_210159_clamicle	21:01:59	21:02:14	Rosebud	collection of odd, stunted Riftia ("clamicle")
4124	31-May-05	AT11_27_4124_160723_Riftiablocks	16:07:23	16:07:42	Rosebud	zoom on Mkr B remaining Riftia colonization blocks
4124	31-May-05	AT11_27_4124_163752_yellowBlock	16:37:52	16:38:12	Rosebud	recovery of second (yellow) block
4124	31-May-05	AT11_27_4124_193450_BlueMajor	19:34:50	19:35:09	new vent site	firing of blue Major Pair
4124	31-May-05	AT11_27_4124_192834_newmussels	19:28:34	19:28:54	new vent site	new vent mussel site
4124	31-May-05	AT11_27_4124_195348_crabfeeding	19:53:48	19:44:08	new vent site	crab feeding as Ghostbusting
4124	31-May-05	AT11_27_4124_195741_musselfish	19:57:41	19:58:01	new vent site	mussels and fish
4124	31-May-05	AT11_27_4124_201453_youngRiftia	20:14:53	20:15:14	new vent site	young Riftia in crack
4124	31-May-05	AT11_27_4124_205741_bathtub	20:57:41	20:58:01	new vent site	"bathtub rings" in collapsed pit

8.8 Message to the Crew

Message to the Crew

To: The Captain and Crew of the Atlantis and the Alvin Group
From: The Science Participants of the Return to Galápagos Rift 2005 Expedition

On behalf of the participants of the Galápagos Rift Expedition, we would to thank you for an outstanding and successful cruise. In less than 12 days on station, this cruise saw the successful completion of 11 Alvin dives, 9 TowCam Tows, 2 larval sediment trap deployments/recoveries, and a time-lapse camera deployment/recovery. Without your dedication, hard work, and thoughtful accommodation, this simply would not have been possible. Once again, the ship's crew and Alvin group have gone above and beyond to make this cruise both a pleasure and an achievement. We really appreciate the flexibility that has been shown by everyone that has allowed us to maximize our scientific productivity over such a short time. We also recognize that we had guests among our science party and appreciate the professional manner in which our operations were conducted. We thank the Steward and his galley crew for their terrific food and accommodations, as well as the SSSGs for their continued hard work and dedication.

We have revisited the Rosebud vent site we discovered together in 2002 to assess the temporal changes in biological community structure, vent fluid chemistry, and microbial communities and launch an integrated time-series study. Through these studies we successfully collected data that will help us determine the role microbial communities and chemical nutrients play in the process of invertebrate colonization. Our exploration of the Rift for other vent fields was successful- we located some of the first sites to be discovered over 25 years ago, including the historic Mussel Bed site, Garden of Eden and Clambake sites. We collected numerous geological, biological, and chemical samples that will keep us all busy for years to come and will no doubt result in a new understanding of hydrothermal processes along the Galápagos Rift. We hope that this cruise will provide a springboard to future expeditions on the Galápagos Rift and nearby areas.

We also know that this has been a successful and productive cruise with regard to education and outreach. We very much appreciate your efforts and patience with these efforts, and your willingness to participate in these activities. We hope you and your families have enjoyed being able to see the daily updates and news on Dive and Discover and CBS News web sites. We believe we have a strong case to return here for a longer dive program and more detailed integrated mapping, sampling, and exploration. So we look forward to working with you all again in the near future.

Thank you again for all your hard work and efforts that made this cruise a great success!

Tim Shank