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Investigations of Chemosynthetic Communities on the Lower Continental Slope of the Gulf of Mexico

Contract No.: ***1435-01-05-39187***

DEEP CHEMOSYNTHETIC COMMUNITY CHARACTERIZATION CRUISE REPORT

7 May – 2 June 2006

October 2006

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Deep Chemosynthetic Community Characterization
CRUISE REPORT
7 May – 2 June 2006

for

Investigations of Chemosynthetic Communities on the Lower Continental Slope of the Gulf of Mexico

by

TDI-BROOKS INTERNATIONAL, INC.

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DEEP CHEMOSYNTHETIC COMMUNITY CHARACTERIZATION CRUISE REPORT
R/V ATLANTIS: 7 May – 2 June 2006

for

Investigations of
Chemosynthetic Communities On the Lower Continental Slope
of the Gulf of Mexico

OVERVIEW

This document represents the TDI-Brooks International, Inc. Deep Chemosynthetic Community Characterization (DCCC) Post-Cruise Report for contract number: 1435-01-05-39187, issued by the U.S.Department of the Interior, Minerals Management Service "Investigations of Chemosynthetic Communities on the Lower Continental Slope of the Gulf of Mexico" (CHEMO III). The Deep Chemosynthetic Community Characterization Cruise was conducted on the Wood's Hole Oceanographic Institute (WHOI) research vessel R/V ATLANTIS and the ALVIN Deep Submergence Vehicle (DSV) from 7 May – 2 June 2006, and was the second cruise conducted for this contract. The cruise mobilized and embarked from Key West, Florida, and de-mobilized at Galveston, Texas. This report compiles detailed information regarding operational procedures, stations occupied, and sampling activity. Results reported were obtained by analysis of the sampling information and data during the cruise and immediately afterward. Results will possibly be revised . This report is a preliminary product of the contract.

BACKGROUND

The largest oil reserves in the continental United States are found in the Gulf of Mexico. The Mineral Management Service (MMS) is responsible for overseeing the responsible extraction of these natural resources. By the early 1980s, energy companies had developed the technology to explore and extract oil and gas in waters up to 1,000 m deep.

During the mid to late 1980s, MMS contracted with the Geochemical and Environmental Research Group (GERG) at Texas A&M University (TAMU) to collect animals from areas of the deep sea floor associated with active oil and gas seeps. The original expectations of both the MMS and the scientists involved were that few animals would be found associated with these "toxic" sea floor environments, and that perhaps the few that were found would be unhealthy at best. However, when the trawls came to the surface over Bush Hill a site that became one of the best studied seep sites in the world, they were so full of animals the nets could only be brought on board with the help of an extra crane. In addition, the animals were not the usual fauna of the deep Gulf of Mexico. The nets were full of giant tubeworms and mussels, which had only recently been discovered at deep-sea hydrothermal vents in the Pacific Ocean. Since that time similar (but different) cold-seep and hydrothermal-vent communities have been discovered in many different geological settings in the world's oceans.

Over the last 20 years these animals and communities have been studied at moderate depths in the Gulf of Mexico (GoM), along with the geology, geochemistry, and microbiology that allows

them to flourish. As a result, the hydrocarbon seep communities in less than 1,000 m on the Upper Louisiana Slope of the Gulf of Mexico, are the most intensively studied and most understood of any deep-sea cold-seep communities in the world. The basic biology of the dominant animals, their life histories, and the biodiversity and biogeography of the seep and coral communities on the Upper Louisiana Slope is now understood. The successional processes that lead to the eventual development of coral communities on carbonates created during periods of active hydrocarbon seepage is understood. Also discovered are some amazing communities, such as the ice worms that inhabit methane ice and the mussels that ring the Brine Pool NR-1.

Meanwhile, energy companies have continued to develop the technology to extract oil and gas from deeper and deeper water and now have the capability to drill oil wells in all water depths in the GoM Outer Continental Slope. Although several GoM hydrocarbon seep sites at depths greater than 1,000 m have been visited by scientists, only a single site has been the focus of more than a few exploratory dives. This site, at 2,200 m in Alaminos Canyon, has lush communities of tubeworms and mussels that are reminiscent of the shallower sites that are well known. However, the underlying geology and almost all of the species present are different. Preliminary studies indicate that the structure of the communities associated with the tubeworms and mussels is also quite different. The normal “background” fauna are different at this depth, and different patterns of interaction between these animals and the seep specific animals are expected. Not only is the ecology of this deep community not understood, at this point the types of communities that exist at depths between 1,000 and 2,200 m are not known. Advances in this understanding and knowledge are the goal of this contract.

PURPOSE

The primary purpose of this research cruise was to discover and characterize the sea floor communities that live in association with hydrocarbon seepage and on hard ground in the deep Gulf of Mexico. The sites studied are in areas energy companies will soon drill for oil and gas.

PREPARATION

Preparation for this cruise began in the fall of 2005, when Harry Roberts began to study a variety of types of information that would help discover new hydrocarbon seep and hard-ground communities in the deep Gulf of Mexico. Information was gathered from thousands of cores collected by the TDI-Brooks International, Inc. group, satellite images of persistent oil slicks on the surface of the Gulf, and extensive collections of geophysical data and maps of the sea floor that were made available for this project by the Mineral Management Service. Fourteen sites were identified with a high potential to host lush chemosynthetic and/or deep-water coral communities.

In March of 2006, the first cruise of this program, the Reconnaissance Cruise, began on the RV GYRE. Thousands of pictures of the sea floor were taken at locations identified by Roberts and his team. These pictures provided the first look at the dive sites we were to dive on for the ALVIN mission. Some sites revealed little except a muddy sea floor. At most of the sites there was strong evidence of seepage, and at least scattered occurrence of the types of animals expected at seep sites. In one case there were abundant soft corals, and at a few, there were large communities of seep animals.

Based on the Reconnaissance Cruise Report, the images of the sea floor, previous knowledge of the geophysics and geochemistry of the sites, and a desire to explore over a wide depth and

geographic range, the cruise and dives for the Deep Chemosynthetic Community Characterization expedition were planned and completed.

CRUISE OVERVIEW

The night was used to transit between selected sites. On site, animals were collected using bottom trawls attached to up to two miles of cable. Sediments were also collected at this time, away from the immediate area of the seep sites. At daylight, the dive would begin at the site. Starting at the eastern most sites, the ship worked its way west, then came back to the east, making dives at the selected sites. At the end of the first leg of the cruise, discoveries were reviewed and dives for the remaining two weeks were planned.

At some of the sites, activities were limited to mapping the distribution of the animals, a limited set of chemical and geological characterizations, and a small amount of sampling to provide baseline information about the site and inhabitants. However, at three to four key sites (e.g. GC852, AT340), multiple dives were made and the geology, geochemistry, microbiology and biology of the sites thoroughly characterized. Longer-term studies were established at these sites to determine growth rates of some of the animals, monitor for visitation by mobile deep-sea fauna such as larger fishes and crabs, and follow the fine scale changes in seepage patterns and community composition. A more complete picture of the biodiversity of the communities on the deep hardgrounds and seeps in the Gulf of Mexico, and their relation to the complex geology and geochemistry of the region was obtained. By the end of the cruise next year, a better understanding of the dynamics, distributions, and biogeography of the animals and communities, including a vastly improved ability to predict their occurrence based on geophysical, geochemical and satellite data collected from on and above the surface of the ocean will be avaiable.

A very diverse group of scientists was on board, each with their own sampling needs and often unique sampling tools. In the first dives at each site one of the primary tools were the assorted cameras mounted on ALVIN. This included multiple video cameras as well as digital still cameras used for general imaging. Additionally there was a camera dedicated to taking down-looking pictures that was used to construct mosaics of any new animal communities discovered. These mosaics are the working maps for more detailed studies of individual communities. They also provide a record of changes in the communities for reference in future years. Push cores were collected for geological, geochemical, and microbial analyses and for the study of some of the tiny animals that may live between the sand grains at the deep seep sites. A chemical analyzer was used to characterize new habitats. Collections for study of the larger animals that live at the sites was begun. However, more extensive quantitative collections and experiments will occur on the second part of the expedition (2007) when primary study sites for intensive study are identified.

The second series of dives at selected sites incorporated increased collection and site characterization activities, along with other studies that revealed much more about the relations between the geology and chemistry of the sites, and the communities' changes over time. Some of the communities with full mosaics were revisited and chemical analyzers used to characterize the chemistry in and around individual animals identified in the images. Collections were made directly from these communities to establish a baseline. On the return next year, they will be re-imaged and chemically re-surveyed to measure any natural change. Quantitative collections of other tubeworm communities, mussel beds, and clam beds were made using specialized

collection tools built specifically for this task. For the tubeworms, the hydraulically actuated net, nicknamed the Bushmaster Jr., was used. For the mussels and clams, mechanically operated collection bags inside of an aluminum pot, nicknamed mussel pots were used. Some tubeworms were chosen for growth studies and their tubes stained blue.

In addition to the nighttime trawls to aid in characterizing the more mobile fauna around the sites, traps and cameras were used to capture and identify the visitors to the seep and coral communities being studied. One of these cameras, designed by Ian MacDonald, was left on the bottom for up to a year. This rotary camera is housed in a special glass tube and will periodically "wake up" and take 12 consecutive pictures as it rotates on a turntable. Each set of 12 pictures provides a 360° panorama of whatever animals have wandered onto the site.

This research cruise provided essential information on the ecology and biodiversity of these deep-sea communities to regulatory agencies and energy companies as oil exploration moves into deeper and deeper water.

An overview of the cruise is given in **Table 1**.

Table 1. Cruise overview

Voyage - Leg:	AT 15-3	
Voyage Dates:	7 May - 2 Jun 2006	
Cruise Objective:	Geological, biological, and geochemical sampling of hydrocarbon vents/seeps	
Chief Scientists **Roberts / Fisher**	Harry Roberts Coastal Studies Institute Department of Oceanography and Coastal Sciences Louisiana State Univ., Baton Rouge, LA 70803 225-578-2964 hrober3@lsu.edu	Charles Fisher Pennsylvania State Biology Department 219 Mueller Lab University Park, PA 16802-5301 814-865-3365 cfisher@psu.edu
Science Activities:	23 Dives	
Operations Area:	Gulf of Mexico, 90° W; 26 ° N, 1000-3000 m	
Contact information for the R/V ATLANTIS	Master R/V ATLANTIS Attn: Scientist's Name c/o Seaward Services Truman Annex MOLE Pier, Bldg. 284 Key West, FL 33040	Contact: Peter J. DiPaolo tel: (305) 293-4755, ext. 2003 DSN: 483-4755, ext. 2003 fax: (305) 292-9347 Cell: (305) 360-1077

EQUIPMENT

The R/V ATLANTIS was outfitted with the equipment necessary to conduct the site examination and sample collection as described below and in **Tables 2** through **4**. The researchers, as indicated in **Table 5**, provided some of the equipment, including design specific equipment.

Winches and Wire

R/V ATLANTIS is outfitted with three permanently installed oceanographic winches used to deploy scientific instrumentation. The winches hold UNOLS 'standard' ¼ inch and .322 inch electro-mechanical hydrographic wire, 9/16 inch trawl wire and .68 inch fiber optical cable.The

hydrographic winches share a common overboarding point, the starboard hydro boom, which is described below. The trawl winch wire is overboarded through the starboard aft ship's crane.

The winches are operated from the control center over the submersible hangar. The operator has a clear view of the winches, the sheave train, over the side and the deck work/landing area. The operator has intercom communications with the bridge and laboratories. Winch parameters (line count, line speed and tension) are displayed at the control center, in the labs, and on the bridge.

Dual Traction/Stowage Winch System

The dual traction/ stowage winch is located below decks in the Winch Room under the fantail. This is a dual-drum winch. The cable is led from the winch either through a series of fairlead sheaves mounted below decks to the ship's trawl crane, or through an alternate fairlead sheave train to the port hydro boom. Sensors for the wire monitoring system are mounted on one of the fixed sheaves. Construction of the sheave train prevents the passage of shackles and other fittings. Special rigging is required to handle long net bridles, pendants, and terminations.

The primary winch control is located in the control center over the submersible hangar. The operator has a clear view of the entire main deck work area and instrument landing spots at the stern and the starboard side. The operator has intercom communication with the bridge and laboratories. Winch parameters (line count, line speed, and tension) are displayed at the control center, in the labs, and on the bridge. An auxiliary control stand is located at the winch below decks. Provisions are made for the use of a remote control station which can be placed in the main laboratory or a portable van, as required. A closed-circuit video system allows monitoring of the below-deck winch and sheaves, as well as main deck activities.

One overboarding sheave is mounted on the main shipper boom of the trawl crane. The crane can be positioned either over the stern for towing operations or over the starboard side for coring and instrument recovery operations. The crane boom is raised and rotated to launch/recover instruments. When lowering instruments, the crane boom is placed in a crutch for added strength and to relieve the stress on the hydraulic system. The other overboarding sheave is located on the end of the port hydro-boom, as is most often used for remotely operated vehicle (ROV) towing.

Hydro Booms

The hydro booms serve as common overboarding support structures for the hydro and traction winch cables. The starboard boom overboarding point is located amidships in the area of least ship motion in a seaway. The unit is a McElroy hydraulically powered extendable boom with 15,000 lb. capacity, mounted on the 02 Deck. Two head blocks are hung from the end of the boom. When the boom is retracted, the wire plumbs over the main deck. A bulwark gate can be opened to allow passage of instruments.

The port boom overboarding point is located near the ROV hangar. This unit was also built by McElroy and is mounted on the 02 Deck, and has a capacity of 25,000 lbs. It is designed to launch and recover ROVs and supports the wire from the dual traction winch system.

Oceanographic Cables

Four standard categories of oceanographic cables (trawl, hydrographic, electro-mechanical/CTD,

and fiber optic) are available on board WHOI vessels. Spares exist for each type of oceanographic cable. In general, where space and availability permit, spares are carried aboard. On extended multi-leg cruises, backup cables are always placed aboard.

Table 2. Scientific Instrumentation - ATLANTIS

Ship parameter data logging and display system (Calliope) with Ethernet, video, and RS232 data distribution capability	Navigation displays, winch readouts, meteorological readings in principal laboratory spaces
Isotope van equipped with A/C, water, telephone, fume hood, Triathler single vial scintillation counter	SBE 911+ Deck Unit and CTD Rosette equipped with 24 ea. 10-liter Niskin bottles
SeaBeam 2112 multibeam swath mapping system	RDI VM-150-18HP 150 KHz broadband acoustic Doppler current profiler (ADCP)
RDI OSII75S 75 kHz phased-array ADCP	Ashtech GPS-based ship heading and attitude sensors
Bathymetric systems, 3.5 and 12.0 kHz	Knudsen 320B/R echosounder with digital data logging and EPC graphic recorder
TC-12/34 and TR-109 transducers	IMET meterological sensor system
Wind speed	Air temperature
Barometric pressure	Relative humidity
Short wave solar radiation	Sea surface temperature
Sea surface conductivity	GPS-based precision clock
300 nanosecond accuracy	Outputs: IRIG, RS232 ASCII,1 sec pulse, 1, 5, 10 mHz
On ship's network	Sippican MK 12 XBT with software
Wire release transponder for accurate equipment/elevator deployment	Nautronix RS906 ultrashort/long baseline acoustic navigation system with pingers and tracking transponders
Miscellaneous:	Fume hoods (4)
Refrigerators (2)	-70°C freezers (4)
Scientific walk-in freezer (8' x 10')	Climate controlled chamber (8' x 10')
Deionized distilled water	Transducer well with multiple slots
Wire-mounted 12 kHz pingers	Nitrogen generator
Drying oven	
12 & 3.5 kHz Transducers	ADCP
Box Corer	
Uncontaminated Seawater	CTD/Rosette (Mandy Joy, night casts 1-2 per station)
Hand-held and deck launchers	Seabeam
HighSeas Net	12 khz pinger for trawl wire use

Table 3. Navigation Equipment - ATLANTIS

Loran C	Tigershark
Satellite Navigation	(2) Trimble Tasman P-Code GPS
	(2) Northstar 941 XD differential GPS
	Furuno GP-90D WAAS/dGPS
Speed Log	ODEC Doppler
Radars	Furuno 2825 X-Band with ARPA
	Furuno 2835X S-Band with ARPA
Fathometer	Raytheon RD-500
Transponder Nav	Doppler/GPS Nav
Direction Finder	Taiyo TD-L1620 VHF

Table 4. Scientific Equipment - ALVIN

Altimeter	Computer/Data Display
CTFM Sonar	Depth Measuring
Digital Cameras	Gyro/Mag Compass
Hydraulic System	Manipulators
Navigation/Tracking	Pressure Hull
Propulsion System	Science Basket
Tape Recorders	Trim System
U/W Telephone	Variable Ballast
VHF Radio	Video System
Viewing Light	
Major Water samplers- 2 singles	Large capacity slurp pump - single chamber
Bio Box	Push Cores - sci providing liners
Scoop Nets	Low Temperature probe
CTD - SBE-19 on sail	External digital survey camera - forward looking
Search sonar	Imagenex profiling sonar
Homor-Pro receiver	Niskin bottles
Elevator (~ 3 deployments)	

Table 5. Scientific Equipment - Program-Provided

Chuck Fisher supplied "homer" probes	"Bush-master Jr"
Mussel pots	Macro camera
360 deg imaging camera (glass housing)	Helge's "sniffer"
Beam Trawl (sci) - 500 lbs. - max depth 3,000m - 6,000m of 9/16" trawl wire out -	Bushmaster
MISO downlooking digital camera and strobes from Dan Fornari (JD 3/2)	dredge gear

NAVIGATION

Summary of this discussion: The target positions selected from the initial Reconnaissance Cruise were converted to a format that ALVIN's real-time navigation system could use during a dive. This was done by defining each site's local origin as 0,0 in X,Y (m) and then calculating the corresponding local X,Y positions of each of the seabed targets of interest. These target positions ended up being only 10s or 100s of meters from the defined local origin, so any projection errors generated by interfacing the different navigation systems used on the two cruises were reduced to less than one meter.

In order to achieve the seabed positioning and navigation requirements of the initial Reconnaissance Cruise, RV GYRE was equipped with a C-Nav DGPS system with a moonpool-mounted Simrad HRP-410 USBL transceiver and Simrad MST-342 3,000 m beacons. Precise navigation of the deployed camera system used for seabed reconnaissance on that cruise was obtained from a USBL transponder mounted on the camera frame, with the USBL system interfaced and calibrated with RV GYRE's DGPS system. For the last several years, the TDI-Brooks International, Inc. field group has regularly used this system to take piston and box cores at pre-defined locations and is able to do so routinely within a 5 m radius of the target. TDI-Brooks International, Inc. has developed a system and technique for navigating deployed tools weighing 400^{+} kg over a precise location in X, Y, and Z down to 3,000 m of water. This system is invaluable for sampling or photographing a specified seabed target. This USBL navigation system was interfaced to a motion reference unit and vessel gyro that was in turn interfaced to a WinFrog-based computer navigation system. As a result, real time position of the deployed camera system was displayed on the monitors for the navigator, the helmsman, and the winchman of the Reconnaissance Cruise. Its position in X, Y, and Z was logged digitally each second during deployment.

The operational procedure used to survey sites of interest on the Reconnaissance Cruise was to map a target area based on the proprietary geophysical data provided by MMS. The bathymetric contours of the site and the targeted area were drawn as the background on the navigation computer monitor. The on-going track of the camera platform was visually monitored and evaluated during the deployment period.

The Datum/Projection for MMS provided geophysical data were NAD27 UTM Zone 15 or 16 (in US feet) as appropriate to each site. NAD27 UTM coordinates (in US feet) are also the standard units for oil companies working in the Gulf of Mexico. Therefore, this geodetics configuration was used for the navigation of the Reconnaissance Cruise and as a result, all of the positions fixed on that cruise are in this Datum/Projection. The navigation system on RV ATLANTIS uses the WGS84 Datum. Consequently, target positions brought on-board from the Reconnaissance Cruise to the RV ATLANTIS had to be converted to the WGS84 Datum in order to accurately find the targets with ALVIN.

The navigation of ALVIN, with respect to the mother ship RV ATLANTIS, was developed by the staff at WHOI for their own unique needs and presented another interface challenge. Likely, due to historic needs for ALVIN's navigation, the system on-board RV ATLANTIS incorporates a design that uses arbitrary "local" coordinates in meters for maneuvering ALVIN and fixing

locations in real time. In essence, a point in X,Y space a few km to the southwest of a study location is defined as a local "origin" and all fixes from ALVIN are reported with respect to that local origin. The origin is fixed to the southwest so that all X and Y values will be positive numbers. Such ALVIN fixes result in numerical values as thousands of meters in X and Y. These X,Y pairs represent the offset of ALVIN from this local origin at a point-in-time where a fix is taken. Because that local origin is known (from an initial calibration routine using RV ATLANTIS maneuvers at each site) in WGS84 Latitude/Longitude coordinates, the WGS84 Latitude/Longitude coordinates of the fix were routinely calculated after the dive was over. However, such X,Y (m) offsets from this local origin had to be produced before each dive so that ALVIN could maneuver to the target defined on the Reconnaissance Cruise. Figuring out how to produce these target locations for ALVIN dives, when starting from NAD27 in feet and changing to WGS84 in meters, was a challenge that took a couple of days to resolve at the beginning of this Characterization Cruise.

In an effort to reconcile the local X,Y(m) positions produced by (1) the ALVIN navigation system with (2) the local X,Y positions produced by standard commercially available navigation/mapping programs (*e.g.* WinFrog and ArcView), another issue arose. Using both systems (1 and 2 above) Latitude/Longitude positions were projected to X,Y grid coordinates (in meters) using WGS84 UTM Zone 16 (sometimes Zone 15) specifications. The grid coordinates produced by both systems were identical 0.01 m. This means that both systems must be using the same (UTM default) False Northing and Easting convention for this grid projection, and that the ALVIN navigation system must be using WGS84 UTM Zone 16 as the convention.

A shift to an arbitrary local grid with an X,Y (m) origin in the local area of work using both systems was performed. At this point, the local X,Y coordinate field from the ALVIN navigation system was rotated about 0.63° counterclockwise with respect to the local X,Y field calculated using WGS84 UTM Zone 16 (by simple change of False Northings and Eastings). That is, a line drawn from the local origin to any of the local waypoints using ALVIN navigation is rotated by 0.63° with respect to a corresponding line produced using a standard navigation/mapping program. This shift translated into a difference in position of about 11m per km of ALVIN run from a local origin (this different-offset being perpendicular to the heading of the run) though the run distance remains the same with both systems.

Related to this, the False Northing and Easting calculated from the ALVIN navigation logs is not constant as ALVIN moves around. That system's calculation of local X and Y is not a simple shift of False Northings and Eastings in the X,Y plane. Actually, the azimuth calculated from any two of ALVIN's X,Y pairs is closer to the azimuth calculated from the matching Latitude/Longitude than that produced from the X,Y pairs produced from the standard navigation/mapping software, so the algorithm WHOI is using must be more sophisticated than the standard WGS84 UTM projections to local grids. In essence, when ALVIN (hypothetically) takes off on a purely westerly or easterly line when north of the equator, the ALVIN navigation would better keep the vessel at the right latitude with increasing distance from the origin (actually traveling in a slight north-up curve with the earth). This path is not a truly straight line, which must be the source of the discrepancy between the two systems.

The error between the two systems in defining an X,Y target in a local grid was about 11 m per 11 km away from the origin, so the solution was to place the local origin much closer to the targets of interest at a site. This was done after the first two sites. The previously perceived need to produce only positive values for X and Y (*i.e.*, putting the origin to the southwest) was

abandoned. This placed the local origin right in the heart of each area of interest and reduced the conversion error between the two systems to less than 1 meter. This resolution was found to be acceptable and was employed to produce waypoints for local features of interest, which were termed targets. Tables showing the target positions of each of the sites visited on this Characterization Cruise are presented in **Appendix 1**.

SAMPLING PROCEDURES

CTD and Associated Hydrography

The CTD was deployed at seven sites. Samples were taken to within 2 m of the bottom to characterize the bottom water. The near bottom bottles were sampled for particulate matter, POC, plant pigments, dissolved inorganic nutrients, oxygen and salinity. The oxygen, temperature, salinity, *in vivo* fluorescence, light intensity and light transmission were measured continuously with sensors and recorded aboard ship in real time. The oxygen and salinity were calibrated aboard ship with samples from the bottles. The inorganic nutrients were run with an autoanalyzer aboard ship on the first leg and frozen on the second leg for analysis in the shore-based laboratory. The CTD and Niskin logs are shown in **Appendices 2** and **3**.

Photographic Imaging

The project used two major types of digital photographic images obtained during the ATLANTIS cruise. Down-looking images were taken with a digital camera mounted behind the ALVIN equipment basket and operated by a timer so that a picture was taken every 10 seconds. By merging the time each picture was taken with ALVIN's navigation records, an accurate record of the location of each picture could be compiled. Although image quality was generally excellent or good, it was sometime compromised by disturbed sediment or because the submarine was too far off the bottom to view the bottom. Additionally, when the submarine was at rest on the bottom the repeated images of a small area of seafloor were of no value. The complete set of down-camera images was screened to remove unusable images. The screened subset was termed and labeled "bottom in view" (BIV) images. A second set of digital images was taken using a macro-camera positioned by the ALVIN manipulator. These images show details of animals or geology at selected locations. **Table 6** is an inventory of the down-camera and macro images taken during the ATLANTIS cruise.

Table 6. Digital images taken with the down-looking (down-cam) and macro cameras

Site	Dive	Down-Cam	Macro
AC601	4193	640	29
AC601	4196	707	48
AC645	4194	1005	
AC645	4197		87
AC818	4192	475	
AC818	4195	763	31
AT340	4173	413	
AT340	4179	954	
AT340	4180	620	
AT340	4181	932	
AT340	4183	513	
GC600	4174	755	
GC600	4184	785	
GC852	4177	300	36
GC852	4185	949	
GC852	4186	688	27
GC852	4187	1077	27
GC852	4189	472	84
GC852	4190	248	27
KC243	4176	115	
MC640	4182	932	
WR269	4175	184	
WR269	4191	559	36
Total	**23**	**14086**	**432**

Bottom Trawling

All trawl samples were taken with an eight foot Agassiz-type beam trawl that was lowered and recovered at 50 m/min as tension allowed. Towing speed was one to two knots over ground. The purpose of sampling was to obtain specimens for trophic analysis within 5 km of seep sites.

Trawling was concentrated at study sites AT340, GC825, and AC818. Sampling at GC825 proved problematic due to strong currents. Adequate material was obtained at all three sites.

ADCP

Acoustic Doppler Current Profilers (ADCP) were operated on station and with the ship underway to obtain an integrated picture of current direction and velocity in the upper 1,000 m of the water column. A 38 kHz OS-ADCP was operated for the entire cruise. Data processing is ongoing.

Mapping

Maps were made during the sampling at each site at scales of 10 to 50 km around each site, with topography plotted at 50 m intervals. The locations of each sampling activity were plotted to

show the spatial relationships between each sampling device and sampling replicates.

Microbiology/Biogeochemistry

Water Column Biogeochemistry

Sample Collection and Analysis

At the intensively sampled stations, water samples were collected at 20 depths between the surface and about 3 m above the sediment column using a rosette package. The rosette package consisted of:

1) 20 (10 liter go-flo trace-metal) clean water sampling bottles,
2) SBE9+ CTD (dual SBE3T/SBE4C sensor system plus extra SBE3T temp, SBE4C conductivity, and SBE43 oxygen sensor),
3) Benthos - Datasonics PSA-916 altimeter;
4) 100x gain Wetlabs C-Star transmissometer, and
5) 660 nm wavelength, 25 cm pathlength Wetlabs ECO-AFL chlorophyll fluorometer.

Physical data from sensors 1 through 4 were collected during descent and ascent. The go-flo bottles were remotely triggered at select depths during assent of the rosette except for the second cast at AC601, where bottles were tripped on the descent as well as on the ascent.

Once on deck, the go-flo bottles were opened carefully to collect samples for subsequent quantification of concentrations of dissolved oxygen, dissolved methane, inorganic nutrients (ammonium, nitrate+nitrite, phosphate, and silicate) and dissolved organic carbon. Microbiological samples were also collected to determine microbial abundance (*i.e.*, cell counts) and diversity (detail on these samples is provided in **Microbiology and Molecular Biology**). Oxygen concentrations were determined with a high-sensitivity galvanic oxygen sensor in a closed circulation cell. To quantify dissolved methane concentrations, sonication/vacuum extraction was used to isolate methane and quantify its concentration using gas chromatography (Suess *et al.*, 1999). Nutrient (NO_3^-, PO_4^{3-}, and SiO_2) concentrations were determined using automated flow-injection on a Lachat QuickChem 8000. NH_4^+ concentrations were measured using the phenol hypochlorite method (Solarazano 1969). Dissolved organic carbon was determined using a Shimadzu TOC 5000 (Sharp *et al.*, 1993). Rates of aerobic methane oxidation were measured by incubating triplicate live and dead (Hg-killed) samples in the presence of $^{14}CH_4$ (Joye *et al.*, 1999) for 48 hours. Unreacted $^{14}CH_4$ tracer was removed by purging samples with water-saturated CH_4 and the oxidation product, $H^{14}CO_3^-$, was quantified by liquid scintillation counting (Joye *et al.*, 1999).

Sample Inventory

Seven CTD casts at three stations (two at AT340, three at GC852, and two at AC601; **Table 7**) generated 148 samples for oxygen, methane, nutrient and DOC concentration analyses. Six rate samples were generated for 100 of these water samples, yielding 600 additional samples.

Results and Discussion

Oxygen and methane concentrations were quantified on board ship. Nutrient concentrations were determined within 10 days of returning from the cruise. Other analyses are on-going. All sites

were characterized by a pronounced oxygen minimum (concentrations <4 mg L^{-1} O_2) in the midwater, between about 500 and 1,400 m water depth. This oxygen minimum did not appear to correspond to temperature or salinity anamolies, suggesting it resulted from elevated rates of biological respiration. Within the oxygen minimum zone, nitrate concentrations peaked, suggesting active nitrification in this depth interval. Water column methane concentrations were elevated significantly (between 10 nM and 100 µM) compared to the concentration expected from equilibrium with atmospheric methane (~ 2 nM). Highest methane concentrations were always observed in the deepest samples and the concentrations at depth at AC601 exceeded those at GC852 and AT340 by an order of magnitude. At the AC601 site, methane was supersaturated throughout the 2,300 m water column, even at the surface, suggesting that this site is a source of methane to the atmosphere.

Table 7. Summary of water column sampling program

Date	Site	CTD Cast #	go-flo bottles tripped
5/15/06	AT340	1	23
5/17/06	AT340	2	20
5/20/06	GC852	3	18
5/22/06	GC852	4	20
5/22/06	GC852	5	21
5/29/06	AC601	6	23
5/31/06	AC601	7	23

Sediment Biogeochemistry

Sample Collection and Analysis

Sediment push cores were collected into polycarbonate core liner by positioning the core liner over an appropriate site with the ALVIN's manipulator arm (**Appendices 4 - 7**). Up to 12 cores were collected on each of the coring dives (14 of the 24 dives were coring dives; **Table 8**). Some degassing of methane-laden cores occurred during return to the surface and this was particularly notable at the deepest sites (*e.g.*, AC601). Once the submersible was secure in the hanger, cores (or brine samples) were transferred immediately to the 4 ºC environmental room. Geochemistry cores were sectioned under anaerobic conditions and sub-samples were collected at 2 cm depth intervals for determination of concentrations of the following components: pH, salinity, dissolved gases, dissolved and particulate carbon and sulfur species, dissolved nutrients, metals, and redox metabolites (*e.g.*, hydrogen sulfide and dissolved inorganic carbon). Salinity was determined using a hand-held refractometer. Measurements of pH were done on board ship using an Accumet high precision electrometer that was calibrated with N.B.S. standards (pH 4, 7 and 10).

Concentrations of C_1 to C_5 hydrocarbons were determined on a sediment sub-sample via headspace extraction (done on board the ship) and gas concentration was quantified using gas chromatography (Joye *et al.*, 2004). Concentrations of dissolved hydrogen in the sediment porewater were determined following sediment incubations (~10 days) using a reduction gas analyzer (Orcutt *et al*., 2005). Sediment porosity was determined as weight loss after drying (Joye *et al.*, 2004). Concentrations of dissolved inorganic carbon in the pore water were determined using a high sensitivity infrared gas analyzer.

Concentrations of hydrogen sulfide were determined colorimetrically (Cline 1969). Concentrations of anions (sulfate, chloride, iodide, and bromide) and cations (sodium, potassium, calcium, magnesium and barium) were determined using ion chromatography (Joye *et al.*, 2004). Concentrations of Fe^{2+} and Mn^{2+} were analyzed colorimetrically using the ferrozine and formaldoxime methods, respectively (Stookey 1970, Armstrong *et al.*, 1979). Concentrations of volatile fatty acids (*i.e.*, formate, glycolate, acetate, proprionate, butyrate, lactate, and succinate) were determined following derivitization using HPLC (Albert and Martens 1997). Concentrations of dissolved organic carbon were determined with a Shimadzu TOC 5000 (Sharp *et al.*, 1993). Nutrient concentrations (nitrate+nitrite, phosphate, silicate) were determined using a LACHAT autoanalyzer (Joye *et al.*, 2004) and concentrations of ammonium were determined using the phenol hypochlorite technique (Solarazano 1969). Concentrations of solid phase, organic and inorganic, carbon, nitrogen and sulfur were determined using standard methods on a ThermoFinnigan Flash Elemental Analyzer. Concentrations of methane were determined on board the ship. Nutrient concentrations were determined the week after the cruise. Other geochemical analyses are on-going.

Two to three cores from each set of cores collected were sub-sampled to determine rates of microbial metabolic activity. Rates of sulfate reduction (SR) and the anaerobic oxidation of methane (AOM) were determined for all core sets, while rates of methanogenesis from acetate (Ac-MOG) or bicarbonate/hydrogen (H_MOG) were determined in about half of the core sets. For SR and AOM rate measurements, six plexiglass sub-cores (2.54-cm i.d. x 30 cm long) were collected from a core (~8 cm i.d.) by manual insertion. Three sub-cores were used for SR rate assays while the other three were used for AOM rate assays. The overlying water phase was maintained during sub-coring and the ends of each tube were sealed with black rubber stoppers. Radiotracer (either $^{35}S\text{-}SO_4^{2-}$ or $^{14}CH_4$ dissolved in filter-sterilized (0.1 µm filtered) seawater) was added to pre-drilled, silicone filled holes at 0.5 cm intervals down the length of the core (Joye *et al.*, 2004, Orcutt *et al.*, 2005). For AOM, 100 µL of dissolved $^{14}CH_4$ tracer (about 60,000 dpm) was injected into each silicone-filled port. Cores were incubated for 12 to 24 hours at bottom water temperature. Following incubation, cores were extruded and sub-samples were collected at 1 cm intervals and immediately transferred to a 50 mL plastic centrifuge tube containing 2 mL of 2M NaOH (which served to arrest biological activity and fix $^{14}C\text{-}CO_2$ and $^{14}C\text{-}HCO_3^-$). Each vial was sealed, vortexed to mix the sample and base, and immediately frozen. Time zero samples were fixed immediately after tracer injection. The specific activity of the tracer ($^{14}CH_4$) was determined by injecting 100 µL directly into scintillation cocktail (Scintiverse BD) followed by liquid scintillation counting. The accumulation of ^{14}C product ($^{14}CO_2$) was determined by acid digestion following the method of Joye *et al.* (1999). The AOM rate was calculated using a standard equation (Orcutt *et al.*, 2005).

For SR rate measurements, 100 µL of tracer containing about 2 µCi of $Na_2{}^{35}SO_4$ was added to each port. Cores were incubated and sectioned as described above. Each sediment section was

transferred to a 50 mL centrifuge tube containing 10 mL of 20 percent zinc acetate to halt microbial activity and fix $H_2{}^{35}S$ as $Zn^{35}S$. The accumulation of $H_2{}^{35}S$ product was recovered in a one-step hot chromous acid digestion. The activity of ZnS and sulfate fractions was determined by scintillation counting. The sulfate reduction rate was calculated using a standard equation (Orcutt *et al.*, 2005).

Rates of methanogenesis, both Ac_MOG and H_MOG, were determined by incubating samples in gas-tight, closed-tube vessels without headspace, to prevent the loss of gaseous $^{14}CH_4$ product during sample manipulation. For collection of sub-samples, a polycarbonate manifold containing eight pre-drilled holes that were slightly larger than the diameter of the sample tubes was placed on top of the sediment core. The sediment was extruded into the manifold at two cm intervals and then a stainless steel blade was inserted at the base to isolate the section from the remaining sediment. Next, six to eight glass tubes (20 ml Pyrex® Hungate culture tubes with the rounded end removed) were inserted through the pre-drilled holes into the sediment, stopping at the blade. Tubes were sealed using custom-designed plungers (black Hungate stoppers with the lip removed containing a plastic "tail" that was run through the stopper) inserted at the base of the tube. The sediment was then pushed via the plunger to the top of the tube until a small amount protruded through the tube opening. A butyl rubber septa was then eased into the tube opening to displace sediment in contact with the atmosphere and close the tube. It was sealed with a open-top screw cap. The rubber materials used in these assays were boiled in 1N NaOH for one hour, followed by several rinses in boiling milliQ water, to leach potentially toxic substances.

A volume of radiotracer solution (100 µL of $^{14}C\text{-}HCO_3^-$ tracer (~1 x 10^7 dpm) or 1,2-$^{14}C\text{-}CH_3COO^-$ tracer (~5 x 10^6 dpm)) was injected into each sample. Samples were incubated as described above and then 2 ml of 2N NaOH were injected through the top stopper into each sample to terminate biological activity (time zero samples were fixed prior to tracer injection). Samples were mixed to evenly distribute NaOH through the sample. Production of $^{14}CH_4$ was quantified by stripping methane from the tubes with an air carrier, converting the $^{14}CH_4$ to $^{14}CO_2$ in a combustion furnace, and subsequent trapping of the $^{14}CO_2$ in NaOH as carbonate. Activity of $^{14}CO_2$ was measured subsequently by liquid scintillation counting. The rates of Bi-MOG and Ac-MOG rates were calculated using standard equations (Orcutt *et al.* 2005). Laboratory processing of rate samples is on-going but will be completed by October 2006.

Sample Inventory

Twenty-seven sets (a 'set' is used here to denote four to six replicate cores) of sediment cores were collected from nine sites (**Table 8**):

1. AT340: five sets of cores;
2. GC600: four sets of cores;
3. GC852: four sets of cores;
4. MC853: two sets of cores;
5. MC640: three sets of cores;
6. WR269/270: one set of cores;
7. AC818: two sets of cores;
8. AC645: two set of cores ,
9. AC601: six sets of cores.

For each set of cores, one core was used to generate pore water and solid phase geochemical data; one to two cores were used for rate assays to determine rates of sulfate reduction, methane oxidation and methanogenesis; and one to two sets of cores were sectioned to collect

Table 8. Summary of samples used for geochemistry

Site	Dive	Core Designation	Depth of Sediment (cm)
1. AT340	4173	R1	14
2. AT340	4173	Y1	20
3. GC600	4174	Y2	20
4. GC600	4174	R4	12
5. GC852	4177	R1	22
6. MC853	4178	R4	20
7. MC853	4178	Y2	16
8. AT340	4181	R3	10
9. MC640	4182	R2	18
10. MC640	4182	Y4	16
11. MC640	4182	Y3	6
12. AT340	4183	Y2	22
13. AT340	4183	R2	18
14. GC600	4184	Y6	16
15. GC600	4184	R2	14
16. GC852	4189	Y1	12
17. GC852	4189	R3	12
18. GC852	4189	Y6	16
19. WR269/270	4191	Y5	20
20. AC818	4192	R5	18
21. AC818	4192	Y3	20
22. AC601	4193	Brine fluid	Brine fluid
23. AC601	4193	Y1	20
24. AC601	4193	R2	22
25. AC601	4193	Y6	20
26. AC645	4194	Y6	20
27. AC601	4196	Y5	20
28. AC601	4196	R5	18
29. AC601	4196	Brine Fluid	Brine fluid

microbiology samples (see **Microbiology** section). For each geochemistry core, 11 different subsamples were collected from 4 to 11 depth intervals. A total of 254 depth intervals were

sampled in the 27 geochemistry cores, generating 2,794 individual geochemistry samples.

Thirty-eight cores were used for determination of rates of microbial activity (**Table 9**). About 380 depth intervals were sampled, generating 3,000 individual samples (~1,200 sulfate reduction rate samples, 1,200 methane oxidation rate samples, and 600 methanogenesis rate samples).

Table 9. Summary of samples used for microbial rate assays

Site	Dive	Core Designation
1. AT340	4173	Y4
2. AT340	4173	R4
3. GC600	4174	R4
4. GC600	4174	R1
5. GC852	4177	R5
6. GC852	4177	R6
7. MC853	4178	Y4
8. MC853	4178	Y5
9. MC853	4178	R1
10. MC853	4178	R6
11. AT340	4181	R3
12. AT340	4181	R4
13. MC640	4182	Y5
14. MC640	4182	R3
15. MC640	4182	R4
16. AT340	4183	Y1
17. AT340	4183	R4
18. AT340	4183	R5
19. GC600	4184	Y1
20. GC600	4184	Y3
21. GC600	4184	Y5
22. GC852	4189	R2

Table 9. (cont.)

Site	Dive	Core Designation
23. GC852	4189	Y5
24. WR269/270	4191	R2
25. WR269/270	4191	R3
26. AC818	4192	R6
27. AC818	4192	Y5
28. AC601	4193	Y5
29. AC601	4193	Y2
30. AC601	4193	R6
31. AC645	4194	Y2
32. AC645	4194	Y5
33. AC601	4196	R1
34. AC601	4196	R2
35. AC601	4196	R4
36. AC601	4196	Y1
37. AC601	4196	Y2
38. AC601	4196	Y3

Results and Discussion

Most of the geochemical and rate analyses are on-going, but the pH, salinity and C_1-C_5 concentration data sets are complete as these analyses were conducted on board the ship.

Salinity and pH

Cores were categorized as normal to low salinity (35-40 ‰), intermediate salinity (40 to 75 ‰) and high salnity (>75‰). Most of the cores collected fell into the normal to low salinity range. Three cores (4178-R4 [75 ‰, MC853], 4182-R2 [75‰, MC640] and 4193-R2 [62 ‰, AC601]) were categorized as intermediate salinity and six cores were categorized high salinity (4173-Y1 [122 ‰, AT340], 4178-Y2 [115 ‰, MC853], 4182-Y4 [88 ‰, MC640], 4193-Y1 [90 ‰, AC601], 4196-Y5 [90‰, AC601], and 4196-R5 [76‰, AC601].

Most of these sediments were extremely sulfidic and exhibited peculiar pH profiles. Core to core variability in pH distribution was significant but generally speaking three types of profiles were noted. The lowest pH values (down to 6.5) were observed in the high salinity sediments from AC601. In intermediate salinity sediments, pH tended to increase with depth, possibly because of increased sulfide concentration at depth. In low salinity sediments, a pH maximum was observed in the upper 2-4 cm and the pH decreased below that depth.

Methane concentrations: On dive 4173 to AT340, cores were collected near tubeworm bushes and from near a mussel bed. Methane concentrations in the pore water near the tubeworm bush were low (< 20 µM), while concentrations near the mussel bed were extremely high, up to 3 mM. Most of the cores from dive 4174 to GC600 were oil stained. Both sets of cores were collected from white bacterial mats but the red set was taken near mussel beds and the yellow set was taken near tubeworms. Methane – as well as concentrations of higher alkanes up to C_5 – were extremely high (up to 7 mM CH_4) in the yellow cores; concentrations in the red cores were over an order of magnitude lower (max ~300 µM). Concentrations of methane in the sediment core collected from mussel beds at GC852 (dive 4177) were extremely low (< 20 µM).

Methane concentrations in the cores from MC853 (dive 4178) were extremely elevated (up to 7.5 mM). Ethane (but no alkanes $>C_3$) was also detected in these cores. These cores were collected from areas of dense white bacterial mats. The first set of cores retrieved from AT340 (dive 4181) were from alongside a tubeworm and methane concentrations ranged from 50µM to 1.2 mM. Dive 4182 to site MC640 retrieved two sets of cores from bacterial mats alongside brine flows. Concentrations of methane in these cores was quite high (up to 6 mM). On dive 4183 to AT340, control cores were collected from areas having no oil staining or chemo fauna. The methane concentration in these cores was < 8 µM. Another set of cores was collected from an urchin field. Methane concentrations here were also low (12 to 40 µM). On dive 4184 to GC600, two sets of cores were collected, one from a dead clam bed and one from an area of live clams. Neither set of cores had elevated methane concentrations. In fact, in the upper ~10 cm, methane was below detection and below there concentrations reached only 10 µM.

Site GC852 was home to deep water corals. Two sets of cores were collected here on dive 4189, red cores over 'gray' mats with mussel shell debris in area and yellow cores from an area of patchy white mat. Methane concentrations in both sets of cores were > 1 mM over the entire depth of the core. Dive 4191 was to WR269/270 and cores were retrieved from a Pogonophoran field. Methane concentrations increased over depth, reaching 1.5 mM at 6 cm and having a maximum concentration of 2.6 mM at 12 cm. Dive 4192 at AC818 retrieved a set of cores from an urchin field and a set of cores from a mussel bed. Methane concentrations were low (<50 µM) in the upper 10 to 14 cm but reached concentrations of 1.3 to 1.7 mM at depths >18 cm. On dive 4193 to AC601, three sets of cores were taken. Four control cores were taken at the edge of the site. Methane concentration in the control cores was < 5 µM. Methane concentration in cores collected from the bottom and edge of the brine lake were extremely supersaturated with methane (concentrations > 1.5 mM) even though continual degassing was observed during return of the submersible to the surface. Methane concentrations in the brine (determined in sub-samples obtained using small Niskin bottles) were >1.5 mM.

Dive 4194 retrieved one set of cores from AC645. Methane concentrations were < 30 µM at all depths in this core. Dive 4196 returned to AC601. One set of cores was collected from the 'floc' zone at the edge of the brine lake. Methane concentration in these cores was high, but did not exceed 1 mM. The other set of cores was collected from beneath the brine, about 2 m out into the lake. These cores had much higher methane concentrations (up to 3 mM). All cores degassed significantly during ascent to the surface.

Microbiology and Molecular Biology

Sample Collection, Inventory and Discussion

During the cruise, two types of microbiology samples were collected: water column and sediment. While shipboard, the microbiology samples were fixed for subsequent analysis at the University of Georgia (UGA), Athens, Georgia and the Max Planck Institute (MPI), Bremen, Germany. A summary of the microbiology sample inventory, shipboard preparations, and methods in progress at shore-based facilities, and a discussion of how these procedures contribute to the goals of the CHEMO III program follows.

Approximately 125 water column microbiology samples were collected during seven CTD casts at three different sites (**Table 7**). A majority of the water column samples were acquired during night-time CTD operations. Some additional samples were obtained from niskins mounted on the DSV ALVIN. Water column microbiology samples were from niskin bottles, which were sampled immediately after the rosette was secured on the deck. A 10 mL sub-sample was fixed with a four percent formaldehyde solution for 30 minutes and then frozen at -20 ºC. All water column samples were analyzed using epifluorescence microscopy to determine microbial abundance (via Acridine Orange-Direct Count, AODC) and to determine the abundance of methanotrophs (via Flourescence *in situ* Hybridization, FISH).

Approximately 140 microbiology sediment samples were collected during 23 dives at a diverse group of sites (*e.g.*, brines, mussel beds, clam beds, oil seeps, bacterial mats) (**Table 10**). Molecular sediment samples were collected and fixed for a variety of molecular analyses: AODC, Catalyzed Auto-Reporter Deposition Flourescence *in situ* Hybridization (CARD-FISH), DNA extraction and sequencing, and biomarker analysis. Sediment samples were collected from cores in 2 cm intervals for each of these analyses. At each depth, one cm^3 of sediment was fixed in four percent formaldehyde in filter-sterilized (0.1 µm filtered) Sargasso seawater. The fixed portion was then split for AODC and CARD-FISH. The CARD-FISH split was stored in an ethanol/phosphate buffer at -20 ºC. From each two cm interval, 20-30 grams of wet sediment were stored at -20ºC for DNA extraction. The remainder of the two cm intervals was collected for biomarker analysis. At approximately six sites, live mud was collected and stored under an argon atmosphere at 4 ºC for subsequent laboratory enrichment experiments.

Because one of the major themes of the program is to investigate the biogeography and ecology of the Lower Continental Slope, microbiology methods that allow quantification of microbial abundance as well as the determination of individual microbial (type) distributions (*i.e.*, how many microbes and which microbes are there) were selected. The two cm intervals from which all microbiology samples were collected are paired directly with geochemical and rate samples described in **Sediment Biogeochemistry**. The ability to link all these data is pivotal to revealing what microbes are doing in their environment.

For a general determination of total microbial abundance in sediment, epiflourescence microscopy (AO-DC, Hobbie *et al.*, 1977) was used. Since this is a non-specific method (*i.e.*, the dye illuminates all cells indiscriminately) and the interest is to describe microbial community structure and associations, CARD-FISH will be used to identify specific groups of bacteria and archaea (*e.g.* specific sulfate reducing bacteria and methane oxidizing archaea) and visualize their associations (Amann *et al.*, 1990). In CARD-FISH, probes are used to selectively illuminate microbial cells based on functional genes or 16S rDNA for that specific cell type. CARD-FISH

will be used to determine the abundance of the anaerobic methane oxidiers (ANME) and sulfate reducing bacteria (SRB) consortium (Boetius *et al.*, 2003, Orcutt *et al*., 2005).

The final method used to investigate sediment microbial abundance and identity at the Lower Continental Slope is an analysis of biomarkers. Each microbe has a specific lipid membrane make-up (*i.e.*, glycerol fatty acid esters, isoprenoid glycerol ether, or isoprenoid hydrocarbons). Much like humans, the biomarker composition of a sample offers a microbial 'fingerprint.' The biomarker method quantifies specific lipids to determine which microbes are present and thereby their relative abundance. This method also helps determine the abundance and occurrence of the ANME/SRB consortia, and which ANME archaeans (ANME-1, ANME-2, and ANME-3) and SRB are responsible for the consortia (Niemann, *et al*., 2005).

'Live mud' will be used for manipulating constituent microbes to gain an understanding of their limitations, genetic makeup, and activities in the environment. Preliminary analysis of geochemical samples shows that along the Lower Continental Slope sulfide concentrations are, at some sites, extremely high. One of the potential uses of 'live mud' would therefore be to test the tolerance of *in situ* microorganisms to high sulfide concentrations. Sulfide inhibits the activity of microbes, including SRB that produce sulfide. Locally, the sulfide concentrations can greatly impact the ecology at the respective sites.

Table 10. Inventory of Sediment Microbiology Samples

Dive #	Core ID	# depths	FISH	DNA	AODC	Biomarker
1. 4173	R5	13	x	x	x	x
2. 4173	Y2	11	x	x	x	x
3. 4174	Y4	4	x	x	x	x
4. 4174	R5	10	x	x	x	x
5. 4177	R2	5	x	x	x	x
6. 4178	Y4	9	x	x	x	x
7. 4178	R2	6	x	x	x	x
8. 4183	Y6	3	x	x	x	x
9. 4184	Y1	7	x	x	x	x
10. 4189	R1	4	x	x	x	x
11. 4191	Y4	10	x	x	x	x
12. 4192	Y4	10	x	x	x	x
13. 4192	R4	5	x	x	x	x
14. 4193	R1	12	x	x	x	x
15. 4193	R5	8	x	x	x	x
15. 4193	Y5	9	x	x	x	x
16. 4194	Y3	6	x	x	x	x
17. 4196	Y6	5	x	x	x	x
18. 4196	R1	5	x	x	x	x

RADARSAT Synthetic Aperture Radar Images

Satellite remote sensing images have been used to delineate persistent patches of floating oil slicks released by natural seeps and to predict the seafloor locations of chemosynthetic communities (MacDonald *et al*., 1996; MacDonald *et al*., 2002). Remote sensing data on slicks were part of the material reviewed to select the sites explored during the reconnaissance cruise and subsequently sample with ALVIN. In addition, under a data-sharing agreement with NASA, a series of new RADARSAT synthetic aperture radar images were obtained while R/V ATLANTIS was at sea conducting sampling operations with ALVIN. The data were obtained along orbital paths that covered the individual sampling sites (**Figure 1**). Each frame along the path covers approximately 100x100 km of area. A total of 64 satellite images have been ordered from the data acquisition (**Table 11**). Additional images may be ordered to fill in gaps in coverage.

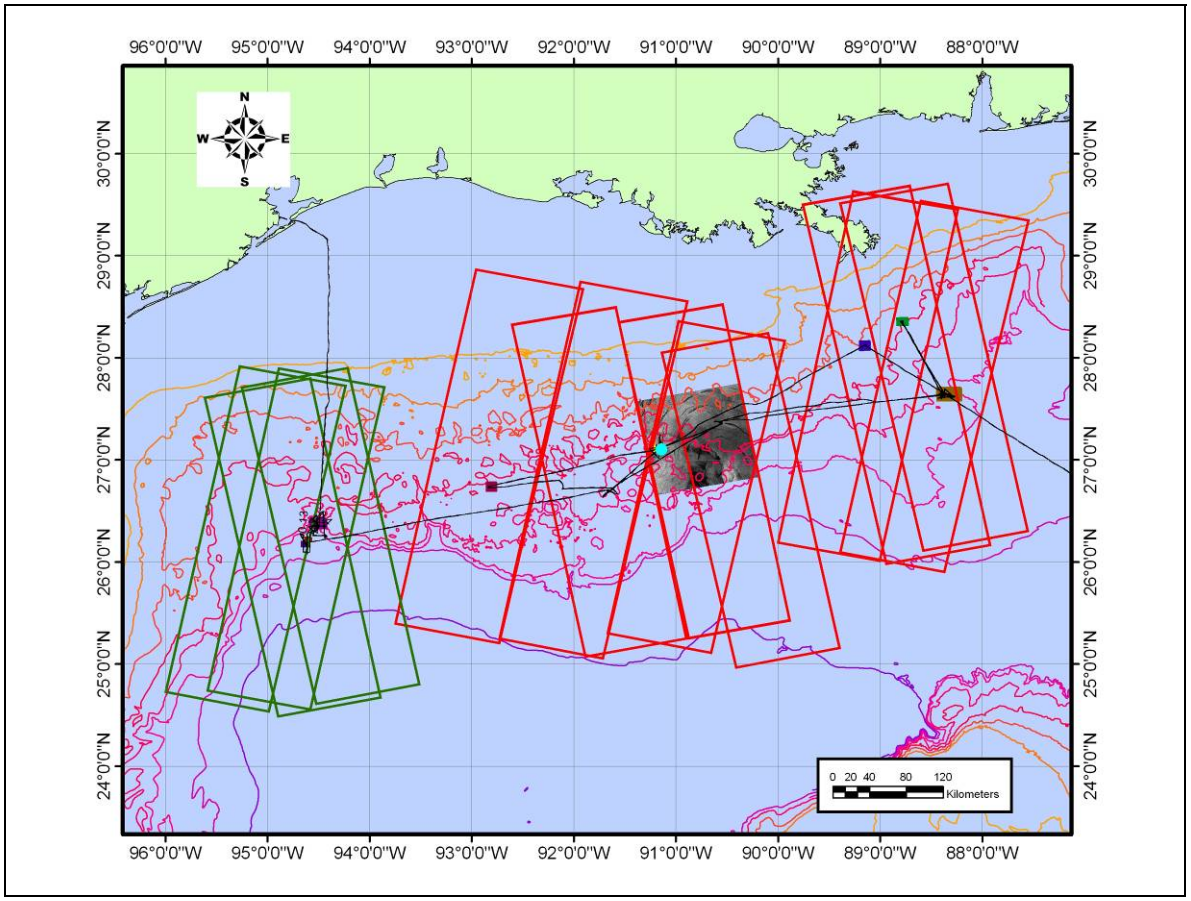

Figure 1. The image swaths covered by the RADARSAT satellite are shown over the northern Gulf of Mexico region. Swaths for the Leg 1 set of stations are outlined in red; Leg 2 stations were covered by the green swaths. Table 11 lists the individual images that have been obtained through NASA.

Analysis of these data will provide information on the occurrence of persistent oil seeps associated with the sampling sites. An example of the application and an illustration of the coverage provided by each SAR image is shown in **Figure 2**. An image (ID R155058_ST3_068) was collected on 23 May at 00:02:14 UTC (22 May 19:00:14 local) while ATLANTIS was operating near the GC852 site. This image is one of four that were taken while ATLANTIS was

within the image coverage area. The GC852 site is captured in the western edge of the image. Numerous oil slicks can be seen throughout the image. A strong clockwise rotation is indicated by the drift path of the oil slicks. More than likely this corresponds to a warm-cored eddy that was located in the region at that time and is consistent with observations of strong currents on the surface and in the submarine. Detail from this image indicates that the georectification data supplied with the image was slightly biased to the east northeast. ATLANTIS shows in the image as a strong radar target. However the GPS position logged by ATLANTIS places it about 3 km to the west of this target. Additional processing will have to be performed on the images to correct these issues.

Table 11. Inventory of satellite images obtained. Leg indicates the grouping of stations. Latitude and longitude are the center points for each ~100x100 km image

Leg	granule (imageID)	time	date	lat	lon	sites covered
1	R154915_ST1_064	23:53:29	12-May-06	25.6	-90.02	GC600 GC868 GC296 GC817
1	R154915_ST1_066	23:53:42	12-May-06	26.4	-90.2	GC600 GC868 GC296 GC817
1	R154915_ST1_068	23:53:56	12-May-06	27.2	-90.39	GC600 GC868 GC296 GC817
1	R154915_ST1_069	23:54:03	12-May-06	27.6	-90.49	GC600 GC868 GC296 GC817
1	R154922_ST1_379	12:14:08	13-May-06	28.4	-92.56	KC514 Kc333 KC243 KC129
1	R154922_ST1_380	12:14:14	13-May-06	28	-92.66	KC514 Kc333 KC243 KC129
1	R154922_ST1_382	12:14:28	13-May-06	27.2	-92.84	KC514 Kc333 KC243 KC129
1	R154922_ST1_384	12:14:42	13-May-06	26.4	-93.03	KC514 Kc333 KC243 KC129
1	R154922_ST1_395	12:15:56	13-May-06	22	-94.04	Campeche Seeps
1	R154922_ST1_396	12:16:03	13-May-06	21.6	-94.13	Campeche Seeps
1	R154958_ST3_064	00:06:00	16-May-06	25.6	-91.47	WR269/270 WR268 WR265 KC216
1	R154958_ST3_066	00:06:14	16-May-06	26.4	-91.65	WR269/270 WR268 WR265 KC216
1	R154958_ST3_068	00:06:27	16-May-06	27.2	-91.82	WR269/270 WR268 WR265 KC216
1	R154958_ST3_070	00:06:41	16-May-06	28	-92	WR269/270 WR268 WR265 KC216
1	R154979_ST1_377	11:57:05	17-May-06	29.2	-88.17	AT340 AT342 MC640
1	R154979_ST1_379	11:57:19	17-May-06	28.4	-88.36	AT340 AT342 MC640
1	R154979_ST1_381	11:57:32	17-May-06	27.6	-88.55	AT340 AT342 MC640
1	R154979_ST1_383	11:57:46	17-May-06	26.8	-88.74	AT340 AT342 MC640
1	R154979_ST1_394	11:59:00	17-May-06	22.4	-89.75	Alacran Reefs
1	R155015_ST2_067	23:49:34	19-May-06	26.8	-88.59	AT340 AT342MC640
1	R155015_ST2_069	23:49:47	19-May-06	27.6	-88.77	AT340 AT342MC640
1	R155015_ST2_070	23:49:54	19-May-06	28	-88.86	AT340 AT342MC640
1	R155015_ST2_071	23:50:01	19-May-06	28.4	-88.95	AT340 AT342MC640
1	R155015_ST2_072	23:50:07	19-May-06	28.8	-89.05	AT340 AT342MC640
1	R155022_ST1_380	12:10:00	20-May-06	28	-91.6	WR269/270 WR268 WR265 KC216
1	R155022_ST1_382	12:10:14	20-May-06	27.2	-91.79	WR269/270 WR268 WR265 KC217
1	R155022_ST1_383	12:10:21	20-May-06	26.8	-91.88	WR269/270 WR268 WR265 KC218
1	R155022_ST1_385	12:10:34	20-May-06	26	-92.07	WR269/270 WR268 WR265 KC219
1	R155022_ST1_387	12:10:48	20-May-06	25.2	-92.25	WR269/270 WR268 WR265 KC220
1	R155022_ST1_390	12:11:08	20-May-06	24	-92.53	Vioska Knolls
1	R155022_ST1_391	12:11:15	20-May-06	23.6	-92.62	Vioska Knolls
1	R155022_ST1_392	12:11:21	20-May-06	23.2	-92.71	Vioska Knolls
1	R155058_ST3_066	00:02:00	23-May-06	26.4	-90.6	GC852 GC812 GC767 GC817 GC868
1	R155058_ST3_068	00:02:14	23-May-06	27.2	-90.77	GC852 GC812 GC767 GC817 GC868
1	R155058_ST3_070	00:02:27	23-May-06	28	-90.95	GC852 GC812 GC767 GC817 GC868

Table 11. (cont.)

Leg	granule (imageID)	time	date	lat	lon	sites covered
1	R155079_ST3_377	11:52:56	24-May-06	29.2	-88.84	MC853 MC640 MC548 MC462
1	R155079_ST3_379	11:53:10	24-May-06	28.4	-89.02	MC853 MC640 MC548 MC463
1	R155079_ST3_381	11:53:23	24-May-06	27.6	-89.2	MC853 MC640 MC548 MC464
1	R155079_ST3_383	11:53:37	24-May-06	26.8	-89.37	MC853 MC640 MC548 MC465
1	R155115_ST1_067	23:45:24	26-May-06	26.8	-88.2	AT340 AT342 MC640
1	R155115_ST1_069	23:45:38	26-May-06	27.6	-88.38	AT340 AT342 MC640
1	R155115_ST1_071	23:45:51	26-May-06	28.4	-88.57	AT340 AT342 MC640
1	R155115_ST1_073	23:46:05	26-May-06	29.2	-88.77	AT340 AT342 MC640
1	R155122_ST1_380	12:05:50	27-May-06	28	-90.55	GC852 GC600
1	R155122_ST1_382	12:06:03	27-May-06	27.2	-90.74	GC852 GC600
1	R155122_ST1_383	12:06:10	27-May-06	26.8	-90.83	GC852 GC600
1	R155122_ST1_384	12:06:17	27-May-06	26.4	-90.93	GC852 GC600
1	R155122_ST1_386	12:06:30	27-May-06	25.6	-91.11	GC852 GC600
1	R155122_ST1_395	12:07:31	27-May-06	22	-91.94	Campeche Seeps
2	R155065_ST1_381	12:22:43	23-May-06	27.6	-94.84	AC601 AC775 AC818
2	R155065_ST1_383	12:22:56	23-May-06	26.8	-95.03	AC601 AC775 AC818
2	R155065_ST1_385	12:23:10	23-May-06	26	-95.21	AC601 AC775 AC818
2	R155065_ST1_387	12:23:24	23-May-06	25.2	-95.4	AC601 AC775 AC818
2	R155101_ST2_063	00:14:19	26-May-06	25.2	-94.52	AC601 AC775 AC818
2	R155101_ST2_065	00:14:32	26-May-06	26	-94.7	AC601 AC775 AC818
2	R155101_ST2_067	00:14:46	26-May-06	26.8	-94.89	AC601 AC775 AC818
2	R155165_ST2_382	12:18:41	30-May-06	27.2	-94.54	AC601 AC775 AC818
2	R155165_ST2_384	12:18:54	30-May-06	26.4	-94.72	AC601 AC775 AC818
2	R155165_ST2_386	12:19:08	30-May-06	25.6	-94.9	AC601 AC775 AC818
2	R155165_ST2_387	12:19:15	30-May-06	25.2	-94.99	AC601 AC775 AC818
2	R155201_ST1_063	00:10:09	2-Jun-06	25.2	-94.12	AC601 AC775 AC818
2	R155201_ST1_065	00:10:23	2-Jun-06	26	-94.31	AC601 AC775 AC818
2	R155201_ST1_067	00:10:37	2-Jun-06	26.8	-94.5	AC601 AC775 AC818
2	R155201_ST1_068	00:10:43	2-Jun-06	27.2	-94.59	AC601 AC775 AC818

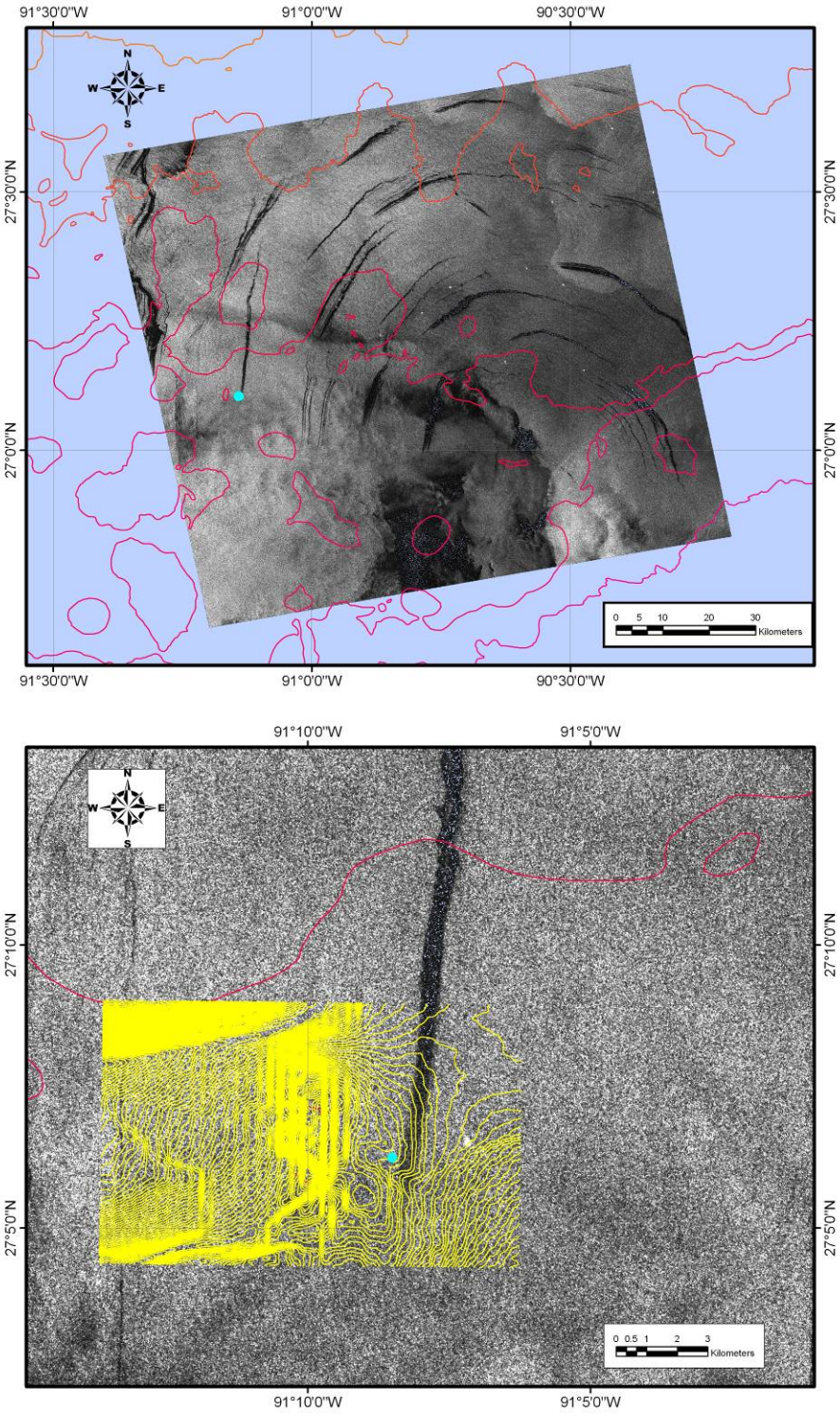

Figure 2. SAR image collected 22 May at 19:02 local time. The full image (upper) shows multiple slicks in a rotating gyre. The GC852 site is located on the western edge of the image (blue dot). Detail of the area around GC852 shows a prominent slick originating at the site, which is consistent with observations of floating oil recorded by the scientific party. However, the offset between the target generated by ATLANTIS (arrow) and the ship position at 19:02 reveals an offset in the image data.

PARTICIPANTS

The R/V ATLANTIS was staffed as shown in **Table 12**.

Table 12. Staffing of ATLANTIS

	Personnel	Affiliation	Citizenship	Position
1	Charles Fisher	PSU	US	C. Scientist
2	Harry Roberts	LSU	US	C. Scientist
3	Ian Macdonald	TAMU-CC	US	Scientist
4	Robert Carney	LSU	US	Scientist
5	Matthew Kupchick	LSU	US	Student
6	Mandy Joye	UGA	US	Scientist
7	Helge Neiman	MPI	German	Scientist
8	Marshall Bowles	UGA	US	Grad Student
9	Vladimir Samarkin	UGA	US	Scientist
10	Jillian Petersen	MPI-Bremen	Sweden	Scientist
11	Erik Cordes	Harvard	US	Scientist
12	Stephane Hourdez	Roscoff	French	Scientist
13	Guy Telesnicki	PSU	Canada	Research Tech
14	Erin Becker	PSU	US	Graduate
15	Stephanie Lessard-Pilon	PSU	Canada	Graduate
16	Adriana Leiva	TAMU-CC	US	Undergrad
17	Elizabeth Goehring	PSU	US	Outreach Coor
18	Cynthia Lee Petersen	St. Hubert HS	US	Outreach/Education
19	Monika Bright	U Of Vienna	Austria	Scientist
20	Kevin Helmle	Nova Univ.	US	Scientist
21	Jeremy Potter	NOAA OE	US	Web Master
22	William Shedd *	MMS	US	Agency Rep.
23	Bernie Bernard **	TDI-Brooks	US	Scientist
24	John Wood *	TAMU-CC	US	Graduate
25	Shannon Strong *	TAMU-CC	US	Undergrad
26	Jesse Hunt **	MMS	US	Agency Rep

Leg II changes: - * left during the mid cruise transfer. ** boarded at the mid-cruise transfer.

CRUISE NARRATIVE

We left from Key West, Florida, early in the morning on Sunday, May 7 to begin our 36 hour transit to our closest and first dive site. We arrived in the early evening, and since we only dive during the daytime, we began with the night operations - an essential part of our exploration program. At night, we worked from the deck of the ship using box cores and bottom trawls attached to up to two miles of cable to make collections of animals and sediments away from the immediate area of the seep sites. The next morning we began our first circuit of dives at the newly discovered sites. Starting at the eastern most sites, we worked our way west, then turned around and came back to the east, making a single dive at each of seven new sites. At the end of

the first leg of the cruise, we reviewed our discoveries and planned the dives for the remaining two weeks.

Our activities were limited at some sites to mapping the distribution of the animals, a limited set of chemical and geological characterizations, and a small amount of sampling to provide us with baseline information about the site and its inhabitants. At three to four key sites, we made multiple dives and thoroughly characterized the geology, geochemistry, microbiology and biology of the sites. We also established longer-term studies at these sites in order to determine growth rates of some of the animals, monitor for visitation by mobile deep sea fauna such as larger fishes and crabs, and follow the fine scale changes in seepage patterns and community composition. At the end of this expedition we will have a much more complete picture of the biodiversity of the communities on the deep hardgrounds and seeps in the Gulf of Mexico and their relation to the complex geology and geochemistry of the region. By the end of our cruise next year, we should have a much better understanding of the dynamics, distributions, and biogeography of the animals and communities, including a vastly improved ability to predict their occurrence based on geophysical, geochemical and satellite data collected from on and above the surface of the ocean.

The Deep Chemosynthetic Community Characterization expedition is the first systematic exploration of hydrocarbon seep communities deeper than 1,000 m in the Gulf of Mexico. In 2006, MMS, the leader in supporting the scientific characterization of seep communities in the Gulf of Mexico, is partnering with the NOAA Ocean Exploration (OE). Together, MMS and OE contracted our diverse group of scientists and provided the tools for us to discover new deep-water hydrocarbon-seep and hard-ground communities. We will continue to study and characterize the sites, animals and communities we discover. The team of scientists we have assembled includes the scientists that have led the exploration, discovery, and study of the Gulf of Mexico cold seeps for the last 20 years. We have also engaged some of the top international seep scientists from Germany, France and Austria to complement our expertise and help us to study what we will discover. On this cruise, geologists and geochemists will be working beside microbiologists, physiologists, and ecologists to maximize what can be learned about the deep Gulf of Mexico cold seeps and coral communities that we visited for the first time during this expedition.

DAILY SUMMARIES

9 May 2006

The transit over was smooth. Upon arriving on station at midnight last night, Bob Carney ran a trawl about 1 Km from the site which recovered a variety of holothurians, shrimp, crabs, and snails. Also recovered were some coal, a small piece of iron or steel, and some wood and perhaps bone. Speculation is running high that we trawled an old shipwreck.

Our first dive went extremely well. We started at Atwater Valley 340 with ALVIN dive number 4173. Bernie Bernard and Erik Cordes were in the sub. It was the very first solo dive for their pilot, and both scientists reported that he is very good and that the dive went very well. Launch was right on time at 8 a.m., and the sub resurfaced about 15 minutes early (16:45) because the battery ran down.

The map that Bernie put together, linking the geophysics data, bathymetry, and targets derived from the photo recon cruise was used to navigate the dive, which seemed to go very efficiently.

They found the site very shortly after arriving on the bottom and were able to sample both mussel beds and tubeworms. They also took two sets of six push cores. One set in a bacterial mat and another near the tubeworm collection. Erik reported that there are 3-4 tubeworm aggregations suitable for staining and bushmaster collection, so this is likely to become one of our alpha sites for intensive study. They did not have time to conduct a formal photo survey for the mosaic on this dive, but did test the down looking camera by running it for about 2 hours of the dive. We will check the pictures after they are downloaded tonight Also attached is the dive plan for this dive. *Submitted, C. Fisher*

11 May 2006

The third dive was heavily impacted by weather. The site was Walker Ridge 269 and the divers were Harry Roberts and Vladimir Samarkin. The launch was delayed until 0900 because of high winds. The dive was called up early for the same reason and was on deck at 1400. Harry and Bill went over the camera tract from the survey cruise and concluded that some features of interest were not covered well and that this site deserved a closer look even though there was no direct evidence of chemo communities evidenced in the survey cruise photos. At the first target they say very little, but did collect what looked like "white fuzz" that turned out to be very thin pogonophorans with an associated community of very small snails and mussels. They moved to the second target on their dive plan, inside the crater, and found a lush community of tubeworms and mussels. Unfortunately, at that point, they were called off the bottom and no physical collections were made at this location. Navigation was excellent and they deployed a benchmark marker. We will revisit this site later in this cruise.

Our second trawl of the cruise was conducted in the early evening of last night, about two miles away from the site. The trawl went very well and recovered a variety of benthic animals including a half dozen very large holothurians.

Several of the scientists have been working with Liz and Cindy on the Classroom to Sea Laboratory they are developing. Their modified experiment will be deployed on May 13, in GC852.

All shipboard laboratory activities are going very well, with efficient sharing of samples and data. The hurdles with merging the various navigational data sets have been overcome, and we are producing integrated GIS products and excellent maps for use during the dives and after. *Submitted, C. Fisher*

12 May 2006

We have had some dive navigation issues, but we should have these worked out now. Nonetheless, the dive was very successful. The biological findings were very interesting. Some of the fauna are the same as we find at shallower sites and some are the same as the deeper sites. This site seems to be right in the depth transition zone. The tubeworms collected are an undescribed species that may be the same as a rare tubeworm collected in Alaminos Canyon. We also collected some mussels that may be a new species, and a galatheid crab we have never seen before. Along with these were two species of shrimp, one which is common at shallow sites and another which is common at deep sites.

The push cores (12) and a mussel pot taken in a clam bed were oily. We will dive at this site one more time, in connection with one of our remaining transits to or from Mississippi Canyon.

The disappointment for the dive was the fact that the Chemical profiler from our German colleagues failed at depth. However, no damage was done, and we will be trying it again on the fourth dive.

Dive 4176 was to the Keithly Canyon 243 site in 1610 m water depth. This was a pilot in training dive, with only a single scientist on board. The scientist was Stephane Hourdez, who has extensive ALVIN experience as well as GoM seep experience. Early in the dive the pilot was reaching for a site marker in the basket and hooked an oil compensation hose for the port manipulator. As a result this manipulator was compromised and could not be used at all during the dive and the oil leakage mandated a much-shortened dive. Several additional problems arose because the port manipulator is the primary manipulator for push coring and delicate tasks.

The seep was located, tubeworms (*Lamelibrachia sp nov*) and mussels (*B. brooksi*) were imaged. A bench marker was deployed. One mussel pot collection was made, and a single push core was taken. In addition a net was used for additional mussel collection. Two carbonates were also collected. The down-looking digital camera was used to collect two lines of images for mosaicing, but time limitations prevented further work. The sub was called up early because of the hydraulic leak and surfaced at 1430. Seawater incursion into the oil compensation system was slight and the sub was ready to dive on schedule on 13 May. *Submitted, C. Fisher*

13 May 2006

Dive 4177 was to the Green Canyon 852 site in 1450 m water depth. Ian Macdonald was the port (senior) observer and Monika Bright the starboard observer. This site has both chemo communities and coral communities. The primary objectives of this dive centered on imaging. MacDonald's rotary time-lapse camera was deployed in an active seep area with both mussels and tubeworms in the field of view. A baited trap was also deployed in the filed of view of the camera. The camera deployment was documented with the down looking digital still camera.

A bench marker was deployed. This was also the first dive with a functioning hand held cool pix macro camera. Thirty-six macro photos of tubeworms and mussels were taken, and the new lighting system produced very nice pictures. A mussel pot was attempted, but the giant size of the mussels at the site made this difficult and operator error resulted in a partially closed pot. A net of mussels and associated fauna was collected as a backup, and six push cores were taken in this area. A small tubeworm collection was also made. Navigation was excellent throughout the dive. Bernie Bernard's ongoing efforts to merge navigation files and improve compatibility between ALVIN and other navigation systems have paid off. The dive ended early because the batteries were depleted. The sub surfaced at 1420. The short dive was in part a result of the fact that the dive was to a relatively shallow site (with resultant longer working bottom time) and in part due to the relative inexperience of the new pilot and a "heavy hand" on the stick. We will revisit this site with 3-4 additional dives. *Submitted, C. Fisher*

14 May 2006

Today's dive revisited MC853, a site ALVIN dove on in 2000. This site is the shallowest site we will visit this cruise with water depths as shallow as 1,050 m. Mandy Joye and Bill Shedd were the divers. The site is a mound interpreted to be a site where the salt dome virtually reaches the surface. Brine was abundant on the top where numerous small mussel patches were found. We worked from the northern edge of the top of the mound, across the mound, down the western

edge and across to the southern edge. The *in-situ* chemical profiler was successfully used. Twelve push cores were taken, six from each of two locations. Four water samples were taken with a Niskin array mounted on the sub. Two mussel pot samples were attempted, and one was fully successful, the other caught a seep fish. In addition, the pilot made several collections with a net and vesicomyid clams were collected (perhaps *Calyptogena ponderosa*). A community of giant *Bathymodiolus brooksi* was also sampled. Neither of these were sampled by the previous cruise. Some *B. brooksi* were so large that they could not be collected with either the mussel pots or the collection nets, and the pilot picked up several with the manipulator. These are the largest mussels sampled to date in the Gulf of Mexico (over 25 cm in length and about 2 pounds in weight) and the known depth range of this species is now the largest of any endemic GoM seep species (from 1,050 to 3,200 m). The rest of the collections are just beginning to be sorted and sampled. This was a very successful dive that will provide important data on depth distributions of numerous species. *Submitted, C. Fisher*

15 May 2006

Last night Bob Carney conducted a trawl off the AT340 site. He was successful in bringing up numerous holothurians, a fish, and minor amounts of other benthic fauna. By dive time, 0800, he had sorted through most of the specimens and sub-sampled the key specimens for isotopic analysis. The ALVIN dived on schedule with Chuck Fisher and Stephanie Lessard-Pilon. The dive was again focused on AT340 at a general depth of 2242 m. This was a very productive dive. We have had some issues resolving the location differences between our seismic surface reflectivity-bathymetry maps and the ship's/sub's navigation net. The first task, once the sub hit the bottom, was to go to our benchmark deployed from another dive and get the x-y position. In addition, a coil of fishing line seen in the March photo survey was found and marked with an x-y position. Bernie Bernard is using these known points to understand and rectify the offset in our two sets of navigation data. Tasks accomplished during the dive included: 1) staining of four tubeworm bushes, 2) acquisition of one Bushmaster sample, 3) collection of mussels by using the scoop, 4) collection of one tiger holothurian, 5) Collection of shrimp and crabs using the slurp gun, 6) collection of water over the seep using a Niskin bottle, 7) shooting of a photo mosaic over the collection sites, and 8) deployment of a baited crab trap for Bob Carney. This was an extremely productive dive with regard to sampling and staining tubeworms for growth rate studies. Tonight will be a busy night processing the samples. After the ALVIN is on deck, Mandy Joye will do a CTD cast over the site in order to assess methane concentrations in the water column over this productive site. So far, the processing of samples acquired by both ALVIN and the trawls has gone smoothly. The total output from this cruise should be impressive. *Submitted, C. Fisher*

16 May 2006

Today's dive (Dive 4180) was again at the AT340 site, one of our prime sampling locations. This site is at an average water depth of 2185 m. It is the easternmost site in our dive progression to the west toward Alaminos Canyon. Previous dives during this cruise, and the reconnaissance photo survey conducted in March, show that this site is highly variable in terms of its seafloor morphology, bottom types, and distribution of benthic communities. Large areas of seafloor are lithified. Authigenic carbonate slabs and blocks are common in the key sampling areas. Well-developed mussel beds and tubeworm communities are distributed throughout this type of terrain. Today, Erik Cordes and Jillian Petersen were the observers. They had a very productive dive that followed the sampling protocols followed during yesterday's dive. A problem developed when they attempted to stain a tubeworm bush for eventual growth rate studies. The

stainer pump did not work so no stain could be put into the chamber. The staining task was aborted, and the dive team moved on to other tasks. The following samples were acquired: 1) one bushmaster sample, 2) one big mussel net scoop, 3) one tubeworm grab sample, 4) two authigenic carbonate samples (a large one and a small one), and 5) four Niskin bottle samples. During the dive a very large and densely populated mussel bed was discovered. Because of its linear shape, the observers name it the "mussel brick road." This was a great dive and there will be plenty of samples to keep everyone busy tonight. After the ALVIN is brought onboard, Bob Carney will take another trawl sample NE of the sampling site along a rather flat stretch of seafloor. Once the trawl is onboard, N-S and E-W multibeam bathymetry swaths will be collected over the AT340 site. *Submitted, C. Fisher*

17 May 2006

We have remainined at the AT340 site now for several dives. Today's dive is the last in this series. Tomorrow we will move to MC640. Before today's dive, we transferred two passengers to the RV GYRE for transport to Fourchon, LA, where two replacement personnel will be picked up and transported to the RV ATLANTIS. Bernie Bernard and Bill Shedd left the ATLANTIS, and Cheryl Morrison and Meaghan Bernier will join us in a couple of days. After the transfer, the ALVIN dived once again on AT340. The pilot was Mark Spear, and the two observers were Harry Roberts and Guy Telesnicki. The purpose of this dive was to investigate a rather distinct reflectivity anomaly in the NW part of the study area. The geophysical data suggested that this site would be a good one, and our interpretations were supported by the results of today's dive. After reaching the bottom, we proceeded to the apex of the NW mound. Upon approaching the mound, the scattered mussel shells and tubeworms suggested that there were interesting things ahead. As we approached the upper part of the mound, it became apparent that the entire mound was composed of one cemented mussel shell horizon after another. The top and upper flanks of the mound were covered with tubeworm bushes and both living and dead mussels. Since we had other areas to sample, we left the mound and traveled to the east where we encountered a brine flow and pool and many associated mussel beds. After sampling the mussels, we moved on to the original benchmark to the SE. At this point, we took cores around a tubeworm bush and picked up *in situ* experiments as well as a fish trap. It was a very instructive and productive dive. The following samples were acquired: 1) one mussel pot, 2) two mussel scoops, 3) three push cores, 4) three Niskin bottle samples, and 5) pick-up of fish trap and small *in-situ* experiments. Even though we thought this would be our last dive at AT340, the new site to the NW was so good that another dive is being planned. *Submitted, C. Fisher*

18 May 2006

Last night we moved from AT340 to MC640. The dive was conducted on schedule with Bob Carney as the lone observer, since this was a dive for pilot training. The pilot was Patrick Hickey and Anton Zafereo was the pilot-in-training. This was our last dive at this site, but we intend to transit back to AT340 this evening for a final dive at this site. Before departing the site last night for today's dive location, a CTD cast was made over the AT340 mound. Today's target area, the MC640 mound, is a bathymetric high that had a moderate seafloor reflectivity pattern on the 3D seismic surface reflectivity map. The seismic profiles demonstrated a clear migration pathway from the deep subsurface, and therefore, the site was considered a potentially good target. The data from the March camera cruise suggested that this target area was primarily characterized by brine flows. The ALVIN observations substantiated this interpretation of the area and added the details of venting craters and many pockmarks. Within the craters were mussel communities but no tubeworms. In addition, there was very little evidence of seafloor lithification. However, one

sizeable rock was collected. Bob mentioned that there was a visibility problem because the bottom was very easily disturbed. Even though there was a current, it took a while for the area to clear once the bottom was encountered. Bob also mentioned that he noticed a "haze" that hung over the craters, perhaps a chemical precipitate. The following samples were collected: 1) one mussel pot, 2) two mussel scoops, 3) one slurp sample, 4) 12 push cores, 5) five Niskin bottle samples, and 6) one large rock. Upon returning to the surface, a CTD cast was initiated at the MC640 site. The transfer of personnel was to take place this morning in Fourchon. We know the new participants made it to Fourchon, but have not heard what time they arrived at the GYRE. *Submitted, C. Fisher*

20 May 2006

The object of today's dive was a NW-SE trending ridge with a distinct mound at the SE end, water depth approximately 1250 m. Gavin Eppard was the pilot and Stephane Hourdez and Marshall Bowles were observers. The dive track started at the SE end of the study area where tubeworms had been spotted from a previous dive by Bob Carney. The dive progresses toward the NW until the sub ran out of power near the extreme NW end of the designated work site. Pockmarks and craters up to 10 m in diameter and over a meter deep were observed at various places along the sub's track. Living mussels were observed in the bottoms of some craters. Authigenic carbonate ledges, blocks and pavements were observed. Tubeworms were frequently spotted growing out of cracks in the carbonates or from the edges of rock exposures. One of the prime tasks of the dive was to use the bushmaster to collect an entire tubeworm colony and all the secondary animals associated with it. This task was not accomplished because a stand alone bush could not be found. Rock samples from the site contained biodegraded crude oil. This area seems to have a rather persistent slick over the site as monitored with radarsat data. There was an oil slick over the site during the dive. The following samples were collected: 1) two samples of the authigenic carbonate, 2) two clams, 3) one scoop of clams, 4) five Niskins, 5) 12 push cores, and 6) one slurp sample of shrimp and crabs. Tonight we are transiting to one of our prime sampling sites, GC852. *Submitted, C. Fisher*

21 May 2006

Today's dive was at GC852. Geologically, this area represents a N-S trending mound that rises sharply above the surrounding seafloor. On 3D seismic surface reflectivity maps, the top of this elongate feature has a very high amplitude response (highly reflective), suggesting hard bottom conditions. Seismic profiles indicate excellent migration pathways to the modern seafloor. A distinct localized mound is located at the southern end of the overall feature. This area has the highest surface reflectivity. However, localized areas of very reflective seafloor are scattered throughout the crustal areas and along the upper flanks of the overall feature. Both photo-reconnaissance and direct observations from a previous ALVIN dive indicate this is a highly variable and productive site regarding the objectives of our studies. This will be one of our prime sampling locations, and we will do several dives here. The pilot for today's dive was Mark Spear. Observers were Monika Bright and Cheryl Morrison. They did quite a lot of reconnaissance of the area looking for coral communities. However, the first activity was to attach floats to Ian MacDonald's camera that was deployed on an earlier dive. The camera floated to the surface, was retrieved with no problems, and pictures were downloaded once on deck. The following samples were acquired during the dive: 1) one crab trap that was in front of the camera, 2) two rocks with attached anemones, 3) one rock with attached sponge, 4) one large crab, and 5) one large soft coral colony. The coral colony was not spotted until the end of the dive. Therefore, only one colony was sampled. We will dive at this site again tomorrow. *Submitted, C. Fisher*

22 May 2006

The dive today was again at GC852, approximately 1150 m water depth. The pilot for today's dive was Pat Hickey. The observers were Chuck Fisher and Erin Becker. The focus area of the dive was the mounded area at the south end of the overall anomaly. This is the area where most of the collections have been made so far. This is also the area where the initial benchmark and Ian's camera were deployed. Somewhere in this region is an active oil seep. Prior to the dive this morning, we watched oil droplets rise to the sea surface spread into elongate shapes as they were acted on by the wind and local surface currents. We have observed oil on the surface all day. Yesterday's dive to this area covered much of the area of today's dive, but no oil or gas seeps were discovered. At the end of the dive, the ALVIN transited to near the crest of the southern mound. A soft coral was collected on a rocky surface, but the dive did not reach the top of the mound where the oil seep is likely occurring. Today the dive objectives centered on staining tubeworms and collecting a whole tubeworm bush with the bushmaster sampler. The following samples were collected: 1) one bushmaster sample, 2) one mussel pot sample, 3) two stained tube worm bushes, 4) one slurp sample containing scale worms and a shrimp, 5) one authigenic carbonate sample. We also deployed the fish trap. We will dive at this very productive site again tomorrow. *Submitted, C. Fisher*

23 May 2006

Again, today's dive was conducted at GC852 in a water depth of approximately 1,450 m. The pilot was Bruce Strickrott, and the observer was Erik Hourdez. Only one observer was on this dive because it was a pilot training dive (PIT). The pilot-in-training was Sean Kelley. The objectives of the dive were to collect tube worms, stain tube worm bushes, take digital pictures with the Cool Pix camera, and explore the areas where soft corals were spotted and sampled on yesterday's dive. Sampling activities centered around the mound-like topographic feature at the southern end of the overall area for surface anomalies identified on the 3D seismic reflectivity maps. Most of the sampling took place close to the benchmark site that was occupied at the beginning of the dive for navigation purposes. Some PIT dives are not very productive because time is spent training the new pilot and sampling may not be as efficient as it could be with an experienced pilot. Today was a notable exception. Many samples were collected and the overall dive turned out to be highly productive. The following samples were collected during Dive 4187: 1) one bushmaster sample of a tubeworm colony, 2) one mussel pot, 3) one scoop of mussels, 4) two stained tubeworm bushes, 5) one authigenic carbonate sample, and 6) a variety of digital and high-resolution photos. At the end of the dive, a mosaic was shot of the hard bottom area at the top of the mound where soft corals were observed and sampled. Tomorrow another dive will be conducted at this site. The GC852 site is one of our prime sampling locations. *Submitted, C. Fisher*

25 May 2006

Again today, we focused our dive on GC852. The pilot was Mark Spear and the observers were Bob Carney and Meaghan Bernier. This has been such a productive site that it is hard to leave. By the end of yesterday's dive the hard coral site had not been found, even though we had a position from Dive 4187. So, today one of the objectives was to find the hard coral site and photograph, as well as sample them. It was thought from previous dive that two species were observed. In addition, during this dive, Ian's camera was to be deployed and the Seas experiment plus the fish trap were to be picked up. Push cores were also to be taken. Unfortunately, because of navigation problems, some of the dive time was spent trying to rectify the sub's navigation

net. The strong current we encountered on previous dives was also a factor. It made positioning the sub for sampling a difficult task. Regardless they were able to sample the soft and hard corals. The hard coral apparently is an unknown species to those onboard. The following samples were collected and tasks performed: 1) two soft corals and one hard coral, 2) picked up the Seas experiments, 3) deployed Ian's camera (will pick up next year), 4) five Niskin bottle samples, 5) took Cool Pix pictures, and 6) picked up fish trap (contained one crab and one isopod). Tomorrow we will dive at WR269 in a water depth of 1,950 m. A final trawl sample will be taken at GC852 before making the 4-hour transit to the Walker Ridge site. *Submitted, C. Fisher*

26 May 2006

Today's dive was in the Walker Ridge lease block area, WR269. A previous dive was made here early in the dive program. It is an unusual area at the northern end of a sedimentary basin. The site is mounded with features that trend toward the west and are interpreted as old mudflows that originated from the mound-like area to the east. With high-resolution bathymetry and a second look at the seismic data, this interpretation may change. The pilot for today's dive was Patrick Hickey, and the observers were Harry Roberts and Matt Kupchik. The dive started on time at 0800 and arrived at the seafloor near our first target which was a field of small pogonophorans on the flank of the eastern mounded area. We set out a benchmark float there the first dive. Even though our navigation seems to have improved, we had a difficult time finding the pogonophoran site. It took the better part of an hour before we found our benchmark. Finding these pogonophorans created quite a buzz among the biologists after the first dive at this site. Many types of samples were requested for today's dive. The first thing accomplished was a mosaic of the area. We took close-up pictures of the pogonophorans and holothurians eating them. Water samples and push cores were also taken. We wanted to "slurp" sample the pogonophorans, but the slurp gun malfunctioned. After finishing at this site, we moved to the central crater area where we sampled tubeworms, mussels, and carbonates. This was a productive dive and a site that we may want to consider for intensive study. The following samples were collected at this site: 1) photos for a photomosaic, 2) close-up pictures of the pogonophorans, 3) five niskin bottle samples, 4) 12 push cores, 5) tube worms, 6) one mussel pot, 7) one scoop of mussels, and 8) one carbonate rock sample. After the sub came up we immediately started a transit to Alaminos Canyon, AC818. This transit takes about 14 hours. *Submitted, C. Fisher*

27 May 2006

Today was the deepest dive we have made this cruise, 2805 m. Last night we made a 14-hour transit to the Alaminos Canyon area, and today we dived on AC818. The pilot for this dive was Bruce Strickrott and the observer was Stephane Hourdez. It was a pilot training dive and Mike McCarthy was the pilot-in-training. This area of chemosynthetic communities was found on a ROV survey near the Tiger Prospect wellhead. It is a site that was interpreted as being very small in plan-view extent from studying the 3D seismic reflectivity map of the area and looking at the associated subsurface data. The community occurs along a regional fault that has very little expression on the surface reflectivity data, but can be clearly identified in subsurface profiles. The ALVIN landed on the seafloor near the wellhead, got navigational information, and then proceeded toward the wellhead which is a known point to which the sub's navigation can be calibrated. On the way to the wellhead, they encountered a clam bed, but all the clams appeared to be dead. After they arrived at the wellhead, it was a short time before they found the chemosynthetic community that had been documented by the ROV. From our coordinates of the site, the community is only about 40 m from the wellhead. The rest of the dive was spent sampling this relatively small area of chemosynthetic communities. The size of this community

is the reason that it does not appear as a distinct anomaly on the 3D seismic reflectivity data. There are probably several of these small communities along the fault. At this one productive community site, the following samples were collected: 1) 12 push cores (six in mussel/ tubeworm areas and six in an urchin area), 2) one mussel pot sample, 3) one scoop sample of mussels, 4) one grab sample of small tubeworms, and 5) one carbonate rock sample. Tomorrow the dive will be in AC601. Before moving to this location, a trawl sample will be taken here at AC818. *Submitted, C. Fisher*

28 May 2006

Today's dive was at a site we visited a year ago with an ROV. At that time, we verified that there were chemosynthetic communities at this site. However, at that time we did not see lush communities and very little hard bottom even though the 3D seismic surface reflectivity maps suggested that hard bottom was certainly indicated. We confirmed that the seismic data were correct with Dive 4193. The pilot for today's dive was Gavin Eppard. The observers were Harry Roberts and Mandy Joye. The objective was a large mound-like feature in the NW part of AC601. Previous side-scan data indicated that the mound had flow deposits radiating from the mound top. However, the expulsion center does not seem to be active now or in the recent past. A depression on the northern side of the mound was found to be a brine lake by the 2005 ROV survey. The ALVIN dive proved that this site is much more productive regarding chemosynthetic communities than the ROV survey data revealed. We found abundant tubeworm colonies around the mound rim, but no mussels. Carbonates, tubeworm colonies, localized bacterial mats, and pogonophoran colonies characterized the mound top. We did not explore the whole top, so there may be more than reported here. Off the mound to the north we found the brine lake. It was an amazing feature with what we think is elemental sulfur floating at the interface and at the "shoreline." We mapped the perimeter of the lake with the sub. It was about 150 m in diameter and roughly circular in plan-view. An urchin field paralleled the shoreline of the lake and was about 5-10 m wide. Numerous urchins inhabited this zone along with some small clumps of mussels. Broad areas of pogonophorans were also observed along the western shoreline of the lake. This was a very interesting dive, and there were many areas that we did not get a chance to observe. I think the area is potentially more productive than we have thus far shown today. The following samples were collected: 1) 12 push cores, 2) one tube worm bush, 3) five niskin samples (in the brine lake), 4) two carbonate rock samples, 5) one scoop mussels and urchins, 6) Cool Pix pictures of tube worm associated fauna, and 7) video of the brine lake and its rafts of crystalline material (maybe elemental sulfur). This was one of the best sites we have visited. Tomorrow's dive will be to AC645. *Submitted, C. Fisher*

29 May 2006

Today's dive was in the Alaminos Canyon area again, AC645. This is a site where previous ALVIN dives have been made. The site is an E-W trending area with a low relief mound on the western end and a higher and more distinct mound on the eastern end. The eastern mound is the one that has been the subject of previous dives. The two mounds are about 1 km apart and in slightly over 2,200 m water depth. The pilot for today's dive was Mark Spear and the observers were Bob Carney and Cynthia Petersen. The dive plan called for the dive to start on the unknown western mound and, if good sites could not be found in this location, to transit to the eastern mound for collections. On 3D seismic surface reflectivity maps, the eastern mound was a "bright star" while the western mound had only a moderate level of reflectivity. Both sites show good migration pathways in the subsurface leading to the seafloor. At the start of the dive, the ALVIN and its observers did not encounter much regarding chemosynthetic communities. After looking

around the top of the western mound, they started the long transit to the eastern mound. Once there, they started a very intense sampling program. The mound is a small feature relative to many mound-like areas we have sampled during this cruise. So, once on-site they did not have to travel far to get all the samples on the dive plan. The following samples were collected: 1) 12 push cores, 2) one tubeworm clump, 3) five niskin bottle samples, 4) 2 rocks, 5) two mussel pots, 6) three soft corals, and 7) one scoop holothurians. Tomorrow we will dive on AC818, our deepest site of the cruise. *Submitted, C. Fisher*

30 May 2006

Today the last dive on the deepest site in our dive schedule was made. The target for Dive 4195 was the rather compact chemosynthetic community close to the wellhead in AC818. The pilot on today's dive was Pat Hickey and the observers were Erik Cordes and Liz Goehring. The objective of the dive was to head to the wellhead area, get navigational information, and then travel north to the northernmost reflectivity anomaly along the regional fault along which the hydrocarbon seepage is occurring. This transit was made without finding densely populated chemosynthetic communities. The sub returned to the known site near the wellhead and started a rather intensive sampling program. The objective was to collect tubeworms and mussels as well as stain tubeworm bushes for growth studies. The following samples were collected: 1) one bushmaster collection, 2) one scoop sample of mussels, 3) one large rock sample, 4) one and-a-half push cores, 5) a slurp sample including a sea cucumber, sea star, squid, crab, and pogonophoran, 6) four stained tube worm bushes, and 7) assorted Cool Pix macro pictures. Although we had planned another dive at this site, Erik advised us that no more meaningful collections could be made at this site. So, we will go back to AC601 tomorrow. *Submitted, C. Fisher*

31 May 2006

Dive 4196 was the last dive taken at the AC601 brine lake and associated hydrocarbon seep communities. The brine lake was such an unusual and interesting feature, we decided that another dive was justified in order to add more detail to the story we had already assembled about the area. The pilot for this dive was Bruce Strickrott and the observers were Chuck Fisher and Jeremy Potter. The main objectives for the dive were to map the perimeter of the lake a second time, to take uncontaminated samples of the brine, and to complete faunal sampling including a bushmaster sample. These objectives were met and it was found that the lake was about 160 m in diameter and that the brine salinity was about 90 psu. Samples were also taken during this dive to determine the origin of the white clots that are floating in the brine and that accumulated at the lake shoreline. Both suction pump sampling and coring addressed this issue. The following samples were collected: 1) one bushmaster sample, 2) two suction pump samples of brine, 3) one slurp sample, 4) 12 push cores, 5) one scoop of mussels, 6) two rocks, and 7) one octopus. This very interesting dive collected some critical data to help understand the characteristics of the brine lake and surrounding area. The last dive of the cruise will go back to AC645 for final collections. *Submitted, C. Fisher*

EDUCATION OUTREACH CRUISE SUMMARY

Liz Goehring, education outreach coordinator, and Cindy Petersen, middle schools science teacher, participated in the cruise, worked with the science party to develop "Classroom to Sea" labs and related classroom materials. The education team interviewed scientists to better understand the background for their specific research as well as the purpose of the activities

during the cruise. The purpose was to find applications for the science classroom. Three "Classroom to Sea" labs were identified: one an existing lab that will be modified to include the seep environment and two new labs.

The existing lab, referred to as the Mussel Lab, involves students in a comparison of shallow-water mussels to deep-sea mussels, in particular focusing on differences in feeding strategies. During the cruise, the education team dissected and measured 152 mussels, from six locations and ten dives. Three mussel species (*Bathymodiolus brooksi, B. childressi,* and *B. heckerae*) are included. This dataset will be added to an existing dataset on vent mussels (*B. thermophilus*) along with new support materials featuring research specific to seeps, and will be added to the SEAS Web site for use in the coming academic year. A new "Scientist Spotlight" page will be created to feature the mussel-related research associated with this cruise, including collection techniques (*e.g.*, Mussel Pots) and photomosaicks to study mussel communities. In addition to volume measurements for the "Classroom to Sea" lab, the team collected tissue samples and shell measurements for other members of the science party.

The education team worked on a second lab, referred to as the RUST Lab. The idea behind this lab is to help students understand oxidation by examining different rates of metal oxidation, as well as some of the factors affecting those rates (*e.g.*, water chemistry, temperature, microbial-facilitated activity). During the cruise, the team set up two deployments of metal strips (Fe, Al, Zn, and Cu), placed in areas near seep flow to expose the metals to sulfides, and retrieved after 9 and 13 days. Change in mass was measured as well as photodocumentation of surface corrosion. The team also set up a parallel experiment on board, soaking metal strips in petri dishes with seawater, "Instant Ocean," distilled water and sediment. The purpose of this parallel trial was to work out details of the classroom version of the lab. Many individuals in the science party were consulted to help explain results from these trials. Data collected during the cruise will be analyzed this summer (2006) and used in a pilot version of the lab in the upcoming academic year.

A third lab was identified, referred to as the Biodiversity Lab. This lab will feature the community ecology work of the science party, focusing students on understanding measures of biodiversity and community processes. During the cruise, the team focused on collecting background information on community studies; images and video of sampling (*e.g.*, Bushmaster collections), sorting and measuring; and images of specific organisms with associated information. The lab will be developed in the upcoming year.

BEAM TRAWL NARRATIVE

The following is the trawl narrative as taken from the log. Additional trawl information is given in **Appendix 8**.

Beam Trawl Sampling #1

Date 5/9/06

Overall Characterization:

The trawl came up with a large amount of mud in the bag itself. The mud did contain a fairly large amount of fauna, which was sieved to separate the mud from the organisms.

Some samples of the *Psycropodes, Benthodytes typica* and *B. lingua* were further processed for muscle tissue. The *Psychropodes* was also processed for gonad tissue.

Number of Lots: 79

Table 13. Samples from beam trawl #1

2 Anemones	Large Shrimp
Brisingid arms	*Pseudostichopus*
Gastropods	*Psychropodes*
Hermit Crabs	*Radiella sol*
Hymenaster spp.	*Scalpe num*
Limpit	Sponge
Ophioroids	Sea stars
Peniagone	Vase sponges
Plant Material → Including: Cane, Rhizome, Sargasum and Shallow Epifauna	*Benthodytes typica*
	Benthodytes lingua
	Fish

Beam Trawl Sampling #2

Date 5/11/06

Overall Characterization:

This trawl came up with some mud, but significantly less when compared to the first trawl. There was also less fauna overall. The *Psychropodes, Benthothuria, Mesothuria* and *Anemone* were sub-sampled for tissue. The *Holothurians* were sampled for muscle tissue.

Number of Lots: 23

Table 14. Samples from beam trawl #2

Benthodytes typical	*Molpadia blakei*
Bivalves	Ophiuroids
Brachipod	Plant Material
Hermit Crab	*Psychropodes longicauclata*
Hymenaster spp.	Sponges
Mesothuria	

Beam Trawl Sampling #3

Date 5/15/06

Overall Characterization:

This trawl came up with some mud, along with a fairly large number of fauna. The *Benthodytes typical, B. lingua* and *Psychropodes* were processed for muscle tissue, and *Psychropodes* were processed for gonad tissue. A fish was also processed for tissue samples.

Number of Lots: 66

Table 15. Samples from beam trawl #3

Assorted Shells	*Pseudostichopus spp.*
Radiella sol	*Paroriza spp.*
Brisingidae	*Benthodytes lingua*
Penaids	*Psychropodes*
Hermit Crab	Bulk Mud
Dytaster spp.	*Umbellula*
Sea Stars	Polycheates
Fish	*Hymenaster spp.*
Anemone	*Molpadia blakei*
Gastropods	Ophioroids
	Plant Material

Beam Trawl Sampling #4

Date 5/16/06

Overall Characterization:

This trawl came up with little mud and relatively few fauna. The Octopus and *Benthodytes typica* were processed for tissue samples, the latter specifically being muscle tissue.

Number of Lots: 21

Table 16. Samples from beam trawl #4

Sea Stars	Holothurian
Ophiuroids	Plant Material
Umbellula	*Benthodytes lingua*
Octopus	Tripod fish
Penaid	Hard “mud stone” bulk
Radiella sol	*Benthodytes typica*

Beam Trawl Sampling #5

Date 5/21/06

Overall Characterization:

This trawl came up with minimal sample suggesting little or no bottom contact, and everything was subsequently bagged and frozen as a collective sample.

Number of Lots: 1

Entire Sample – penaid and polychelid shrimp

Beam Trawl Sampling #6

Date 5/22/06

Overall Characterization:

This trawl came up with little mud but a fairly large amount of faunal diversity. Samples were frozen whole.

Number of Lots: 32

Table 17. Samples from beam trawl #6

Iron stone/ Rust scale	Unknown
Rock	Penaids
Wood	Ophioroids
Asteroidea	Hermit Crabs
Bone	Shells
Psychropodes	*Radiella sol*
Pseudostichopus	Molpadia blakei
Scaphapods	Echiuroid
Bivalves	*Arca*
Pseudostichopus depressus	Viperfish

Beam Trawl Sampling #7

Date 5/23/06

Overall Characterization:

This trawl came up with net inverted, no mud, and a comparative paucity of fauna. There were a large number of *Umbellula* caught by the lower chain of the trawl net. The *Umbellula* specimens were separated between the polyps and the stalks. Other material was frozen whole.

Number of Lots: 24

Table 18. Samples from beam trawl #7

Viperfish	Penaids
Hatchetfish	*Benthodytes typical*
Pseudostichopus depressus	*Umbellula*

Beam Trawl Sampling #8

Date 5/25/06

Overall Characterization:

This trawl came up with no mud and a fair number of seemingly different fauna. Samples were frozen whole. Numerous small *Benthodytes typical* were present

Number of Lots: 25

Table 19. Samples from beam trawl #8

Viperfish	Urchins
Pseudostichopus depressus	Braciopods
Penaids	*Radiella sol*
Benthodytes typical	Holothurian
Umbellula	Sea star
Mesothuria	*Molpadia blakei*
Sponge	Carridian
Bivalves	*Polycheleas*

Beam Trawl Sampling #9

Date 5/27/06

Overall Characterization:

This trawl came up with no mud and a comparatively large number of seemingly different fauna. Only the *Benthothurian* was processed for muscle tissue. Other material was frozen whole.

Number of Lots: 28

Table 20. Samples from beam trawl #9

Penaids	*Ophiomusiam lymani*
Hermit Crabs	Tar
Brachipod	Scaphapods
Bivalve	*Benthodytes lingua*
Moldanids	*Psychropodes*
Sponges	*Asteroidea*
Plant Material	*Molpadia blakei*
Echiurans	*Benthodytes typical*
Sea pens	*Benthothuria*

Beam Trawl Sampling #10

Date 5/30/06

Overall Characterization:

This trawl came up with no mud and a comparatively large number of seemingly different fauna. All samples were frozen whole.

Number of Lots: 37

Table 21. Samples from beam trawl #10

Trpodfish	Rat-tail fish
Sponges	Scaphapods
Hermit Crabs	Galatheid
Bivalves	Pyroosome
Plant Material	Hatchetfish
Tar	Viperfish
Maldanids	Sea pens
Radiella sol	Fish
Benthodytes lingua	Dumbo Octopod
Ophiomusium lymani	Squid
Anemone	Pompanao
Ophiuroids	*Benthodytes typica*
Penaeids	

DIVE SUMMARY

Twenty four dives were completed on ALVIN. At some sites, multiple dives were made while at other sites only a single dive was completed. **Table 22** and **Figure 3** summarize the ALVIN dive activity. Detailed dive information is presented on the pre-dive planning (**Appendix 9**) samples collected (**Appendix 10),** dive activities **(Appendix 11).**

Table 22. Dive summary

DIVE_NUM	Site	Depth(m)	Date	Time	Lat Mean	Lon Mean
4173	AT 340	2216	5/9/2006	14:59	27.64532147	-88.36397849
4174	GC 600	1250	5/10/2006	14:04	27.37043846	-90.56947755
4175	WR 269	1950	5/11/2006	16:20	26.68598286	-91.66054682
4176	KC 243	1610	5/12/2006	14:29	26.73075164	-92.83065783
4177	GC 852	1450	5/13/2006	15:27	27.10628141	-91.16609942
4178	MC 853	1070	5/14/2006	14:35	28.12471393	-89.14148176
4179	AT 340	2200	5/15/2006	14:47	27.64507002	-88.36439901
4180	AT 340	2200	5/16/2006	16:45	27.64477891	-88.36475654
4181	AT 340	2200	5/17/2006	16:22	27.64648744	-88.36891570
4182	MC 640	1410	5/18/2006	15:37	28.35677424	-88.79270267
4183	AT 340	2175	5/19/2006	14:58	27.64634439	-88.37037384
4184	GC 600	1250	5/20/2006	14:25	27.36961335	-90.56930234
4185	GC 852	1410	5/21/2006	14:45	27.10911676	-91.16565528
4186	GC 852	1410	5/22/2006	15:56	27.10614074	-91.16601572
4187	GC 852	1410	5/23/2006	14:19	27.11026061	-91.16568461
4189	GC 852	1410	5/24/2006	16:39	27.11002842	-91.16590412
4190	GC 852	1410	5/25/2006	14:33	27.10836764	-91.16621835
4191	WR 269	1950	5/26/2006	15:25	26.68606157	-91.66147458
4192	AC 818	2740	5/27/2006	16:34	26.18030207	-94.62308449
4193	AC601	2340	5/28/2006	14:27	26.39123684	-94.51446418
4194	AC645	2240	5/29/2006	14:32	26.35448427	-94.49977357
4195	AC 818	2740	5/30/2006	14:42	26.18026385	-94.62294105
4196	AC 601	2330	5/31/2006	15:11	26.39164934	-94.51394832
4197	AC 645	2200	6/1/2006	14:29	26.35403655	-94.49670376

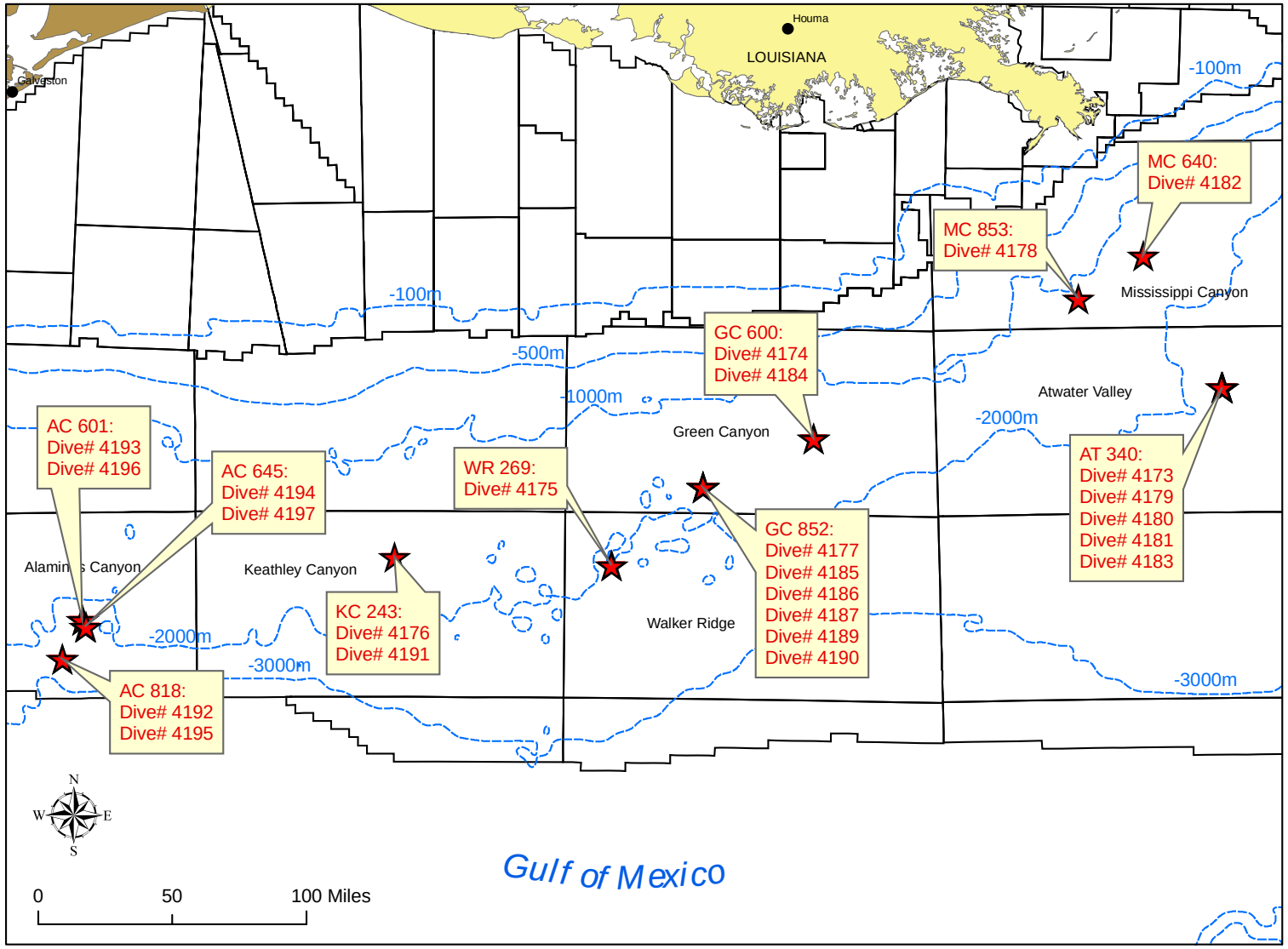

Figure 3. Site locations of ALVIN dives.

SITE CHARACTERIZATION

The following section describes site characteristics and geological settings of the dive site locations visited during the cruise. Dive maps showing ALVIN's track and sampling locations, as well as representative photographs, are presented as individual figures at each site. The 10 dive sites are discussed in the chronological order visited, although later dives could have been made at the same site (**Table 23**).

Table 23. Sites characterized listed in chronological order

Site	DIVE_NUM	Depth(m)	Date	Time	Lat Mean	Lon Mean
AT340	4173	2216	5/9/2006	14:59	27.64532147	-88.36397849
AT340	4179	2200	5/15/2006	14:47	27.64507002	-88.36439901
AT340	4180	2200	5/16/2006	16:45	27.64477891	-88.36475654
AT340	4181	2200	5/17/2006	16:22	27.64648744	-88.36891570
AT340	4183	2175	5/19/2006	14:58	27.64634439	-88.37037384
GC600	4174	1250	5/10/2006	14:04	27.37043846	-90.56947755
GC600	4184	1250	5/20/2006	14:25	27.36961335	-90.56930234
KC243	4176	1610	5/12/2006	14:29	26.73075164	-92.83065783
GC852	4177	1450	5/13/2006	15:27	27.10628141	-91.16609942
GC852	4185	1410	5/21/2006	14:45	27.10911676	-91.16565528
GC852	4186	1410	5/22/2006	15:56	27.10614074	-91.16601572
GC852	4187	1410	5/23/2006	14:19	27.11026061	-91.16568461
GC852	4189	1410	5/24/2006	16:39	27.11002842	-91.16590412
GC852	4190	1410	5/25/2006	14:33	27.10836764	-91.16621835
MC640	4182	1410	5/18/2006	15:37	28.35677424	-88.79270267
MC853	4178	1070	5/14/2006	14:35	28.12471393	-89.14148176
WR269	4175	1950	5/11/2006	16:20	26.68598286	-91.66054682
WR269	4191	1950	5/26/2006	15:25	26.68606157	-91.66147458
AC818	4192	2740	5/27/2006	16:34	26.18030207	-94.62308449
AC818	4195	2740	5/30/2006	14:42	26.18026385	-94.62294105
AC601	4193	2340	5/28/2006	14:27	26.39123684	-94.51446418
AC601	4196	2330	5/31/2006	15:11	26.39164934	-94.51394832
AC645	4194	2240	5/29/2006	14:32	26.35448427	-94.49977357
AC645	4197	2200	6/1/2006	14:29	26.35403655	-94.49670376

Atwater Valley 340

Geologic Summary of AT340

The AT340 dive site is geologically characterized as a bathymetric high along the eastern extension of Mississippi Canyon where it transitions from a canyon to a submarine fan. The site consists of three mounded areas on top of the overall bathymetric high. Geophysical data indicate that the feature is supported by salt in the shallow subsurface. Seismic profiles identify a clear vertical migration pathway for the flux of fluids and gases to the modern seafloor. This pathway is defined by acoustic blanking of the seismic record, suggesting both reflection of acoustic energy by hard bottom conditions at the surface and perhaps gas in the subsurface along the migration route. The surface reflectivity maps, created by analyzing the first return from the seafloor from 3D seismic data, indicate high reflectivity in the areas localized around the three mounded features. Five dives have been made on the overall AT340 feature. Three dives concentrated on the local mounded area in the SE quadrant. On the 3D seismic surface reflectivity maps, this area displayed a complex pattern of high to moderate reflectivity. Observations from ALVIN confirm extensive hard bottom conditions that result from authigenic carbonate precipitation, a by-product of microbial utilization of seeping hydrocarbons. Inspection of these carbonates reveals that they contain abundant mussel shells. In addition, carbonate precipitation occurs around the bases of tubeworm bushes. Scattered among the blocks and pavements of authigenic carbonate are living mussel beds and tube worm colonies. One site named the “mussel brick road” represents an elongate (about 75 m long) and densely packed bed of living mussels forming in a joint or separation in the underlying authigenic carbonate pavement. Between the blocks of carbonates, clumps of tubeworms, and beds of mussels are patches of sediment colonized by urchins (**Figure 4**), a few soft corals, and other sparsely distributed organisms.

Figure 4. Hard urchins were abundant in portions of the AT340 site. These organisms play an active role in the bioturbation of sediments and represent a community component distinct from the tubeworm and mussel aggregations.

In the NW quadrant of the AT340 study area, a distinct mound occurs. On surface reflectivity maps derived from 3D seismic data, this mound stands out as a very high amplitude feature. Two dives on this feature confirm the fact that it is composed almost entirely of hard bottom. Inspection of the areas of lithified seafloor shows that the carbonate block and pavements (**Figure 5**) are composed almost entirely of mussel shells, one layer on top of another.

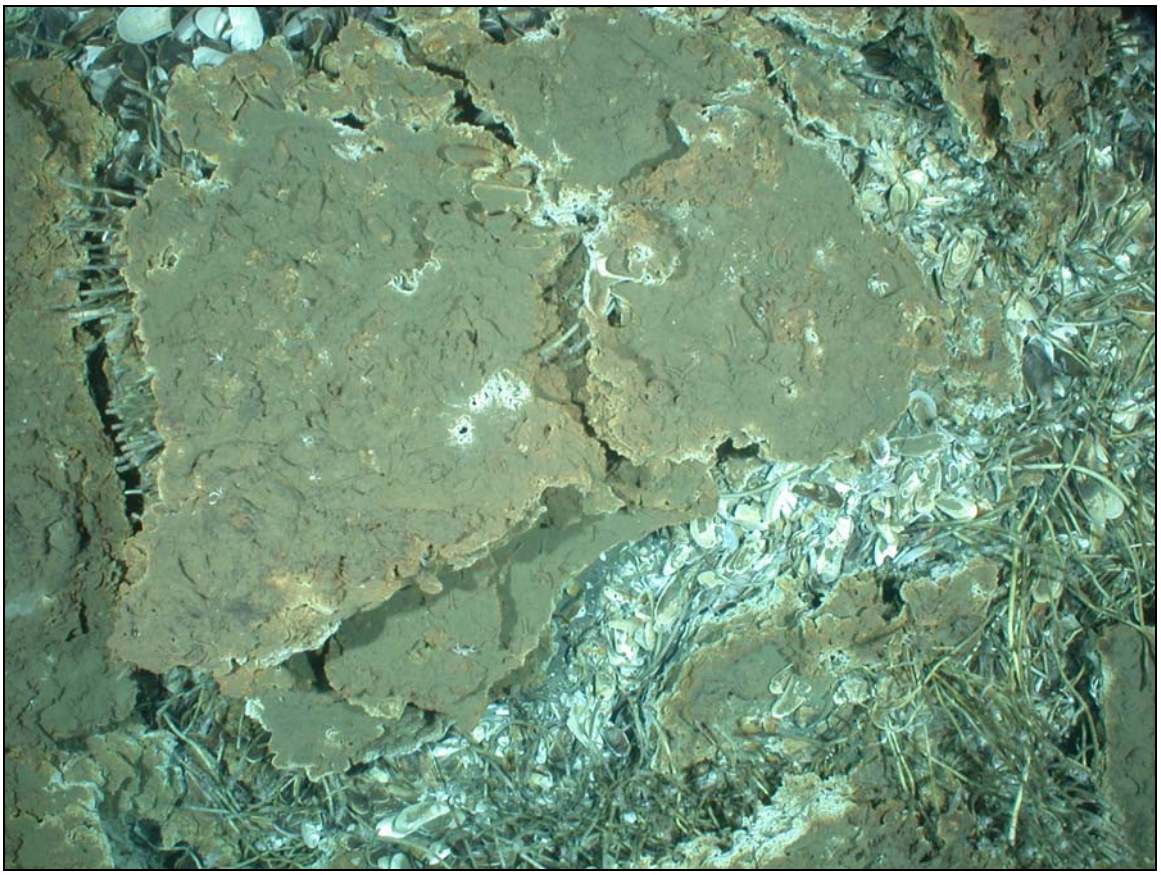

Figure 5. Extensive carbonate pavements indicate protracted seepage. Fracturing and continuing colonization by mussels and tubeworms demonstrates ongoing seepage.

Because of this unique construction we named the site “mussel mound.” Many blocks seemed to have very little sediment matrix, just mussel shells and binding carbonate cements. Although most of the mussel shells did not house live mussels, several patches of live mussels were observed at the apex of the mound. Both the crest areas and flanks of the mound were covered with tubeworms. Many tubeworm colonies occurred beneath and at the edges of carbonate blocks, but free-standing colonies were also present. To the east and off the flank of the mound a brine vent is present. Fluidized sediment, brine, and hydrocarbons are being vented at this site (**Figure 6**).

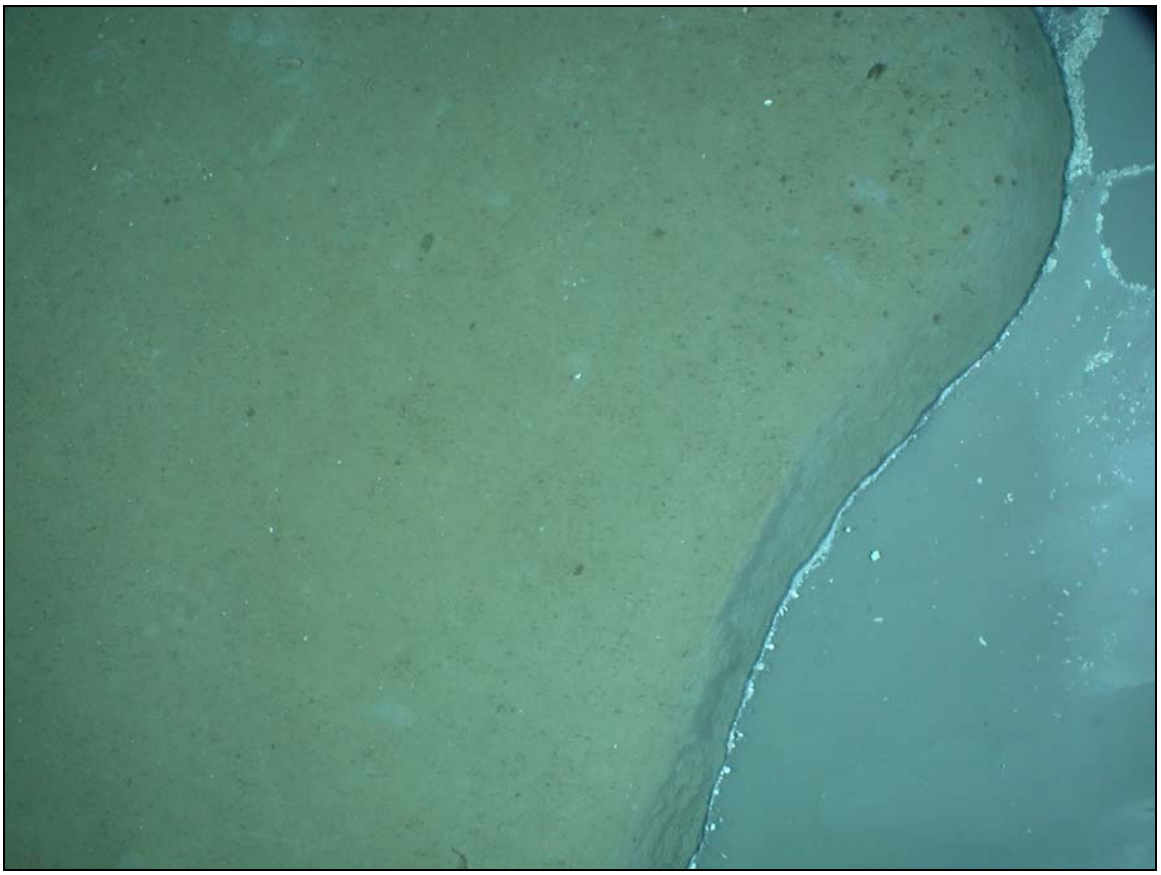

Figure 6. Surface brine flows generate extensive pools and channels that support mussel aggregations at AT340.

Around the vent site and along the flow field there are extensive mussel beds. Seismic profiles across the AT340 feature indicate the presence of salt in the relatively shallow subsurface. The brine is likely coming from the dissolution of this salt body.

Site Summary - Atwater Valley 340

Atwater Valley 340 is a large and complex site with abundant and varied chemosynthetic communities spread over a relatively large area. It has the largest mussel beds of any site yet visited. Two of these were especially spectacular. One is a solid bed of mixed species and sizes of live mussels that we estimate is over 10 m wide and 20 m long, and we nicknamed "Brooksi Banks" (**Figure 7**). The other was a relatively continuous linear bed over 70 m in length that was nicknamed the "Mussel Brick Road." Both of these were imaged intensively enough to allow almost complete photographic reconstruction of the entire features.

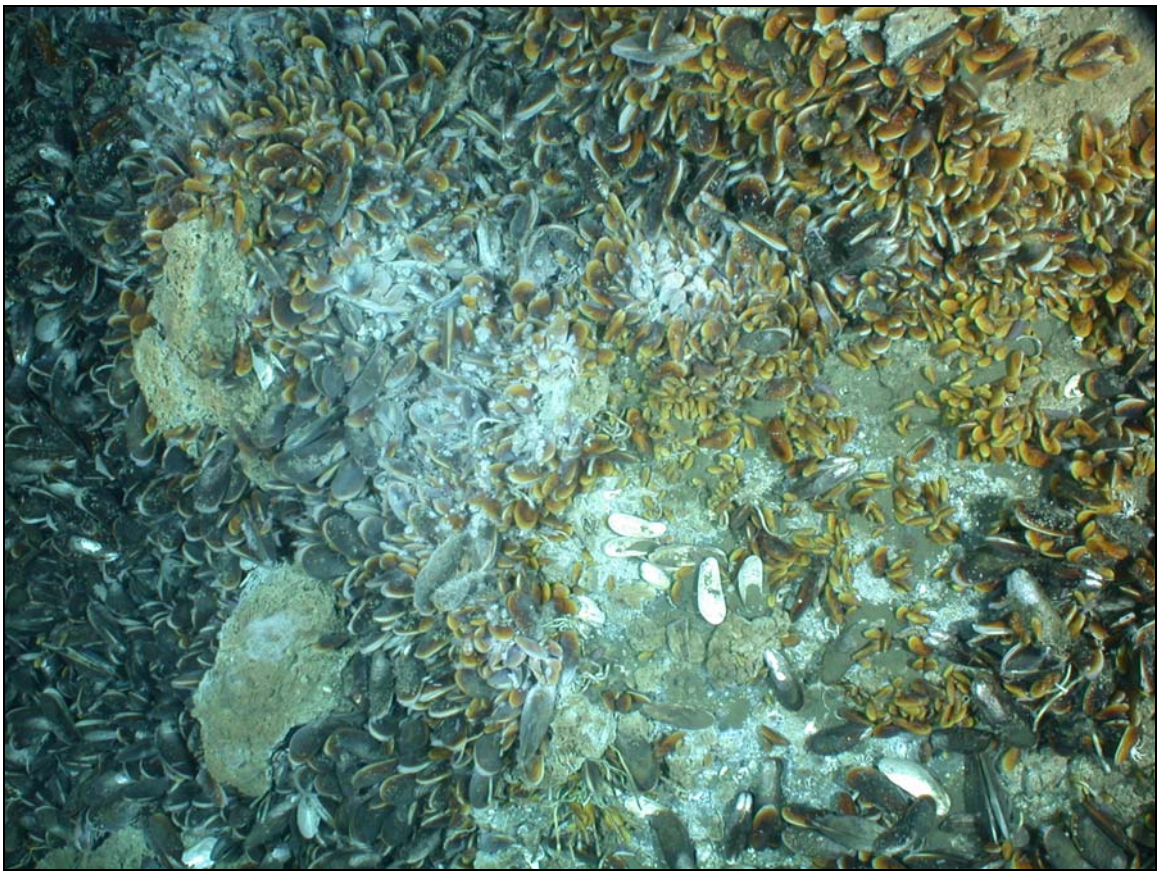

Figure 7. This down-cam image shows two species of seep mussels in a dense bed.

Further detailed study of these beds will be especially informative, as this is the one site where we have collected both *B. heckerae* and *B. brooksi*, the two bathymodioline mussels that harbor both methanotrophic and chemoautotrophic symbionts. It appears from the pictures that *B. childressi* is also present in the large mussel bed, but confirmation will await sampling this bed in 2007. Both of these features are in the SE quadrant of the site. There are patchy small mussel aggregations (of large individuals) in the NE quadrant, and scattered intermediate sized mussel beds near the topographic high in the far W edge of the site and in the bottom of what appears to be 2 m diameter blowout craters in that area.

Tubeworms are also very abundant at this site. They occur in large numbers among the large carbonate slabs in the SE and W portions of the site. *Escarpia laminata* is the dominant species in the aggregations ("bushes") sampled and appears to be dominant in most of the aggregations seen. However, *Lamellibrachia* sp is also quite abundant; as large individuals and in small groups protruding from underneath and between carbonate slabs and in mixed aggregations with *E. laminata*. In addition to two large areas with abundant tubeworms, several smaller ridges with carbonates were also colonized by both species.

The most dominant megafauna species associated with the tubeworm aggregations was the shrimp *Alvinocaris muricola*. This shrimp species was also abundant in the mussel collections, co-occuring with the abundant brittle star *Ophioctenella acies* in this habitat. The *B. heckerae* that were collected also contained the commensal polychaetes *Branchipolynoe seepensis* and a nautillinellid. A large proportion of the *E. laminata* collected contained a phyllodocid polychaete

that is likely a blood-sucking parasite.

Another animal that was abundant (and dominant) in some areas of soft sediment with visual evidence of seep impact was a spatangid heart urchin. Several (at least five) beds of these were found over the course of the five dives to this site. None of these beds were associated with carbonates, but some were close to the other sites or isolated mussel clumps. In areas where the sediments around the urchins were stained black and white, the urchins did not appear to be moving much. In areas where seepage was less apparent, there were often long trails associated with the urchins.

Few colonial cnidarians were seen at this site. However small gorgonian colonies were present near the scattered mussel beds in the NE quadrant of the site and noted on the carbonates in the W edge. Isolated whip corals were present in many areas. In some areas a small colonial anemone was abundant on tubeworm tubes and dead mussel shells. Individual anemones were often noted over non-seep affected sediments and a small crab with an orange anemone was a regular site in the vicinity of the active seep areas. (**Figure 8**)

Figure 8. Anthropogenic debris like this monofilament line was common at AT340.

Five dives were completed at site AT340. **Figures 9-13** show the dive track of ALVIN and activities performed during the dives.

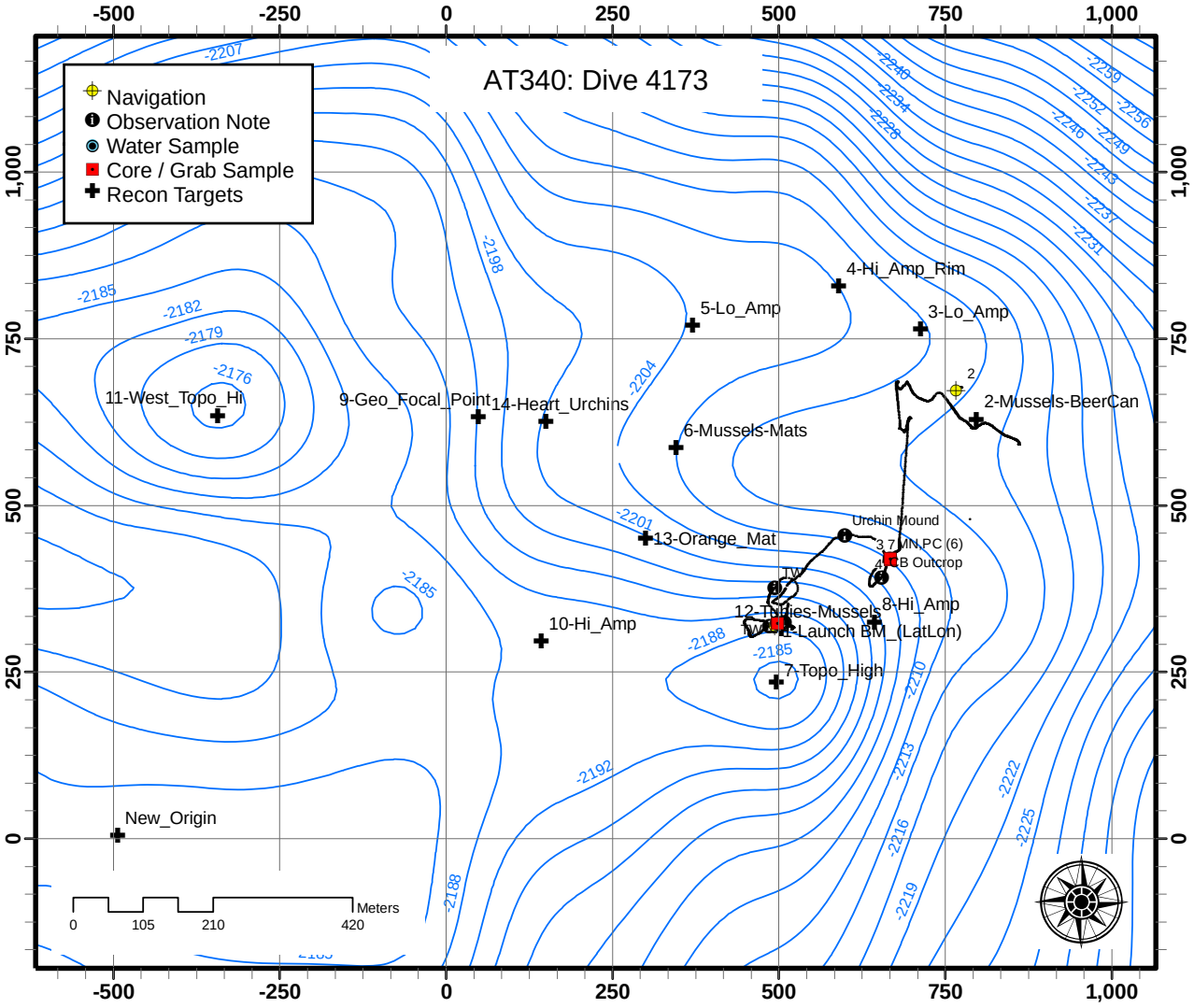

Figure 9. Dive 4173 on 5/9/2006 at an average depth of 2,216 m.

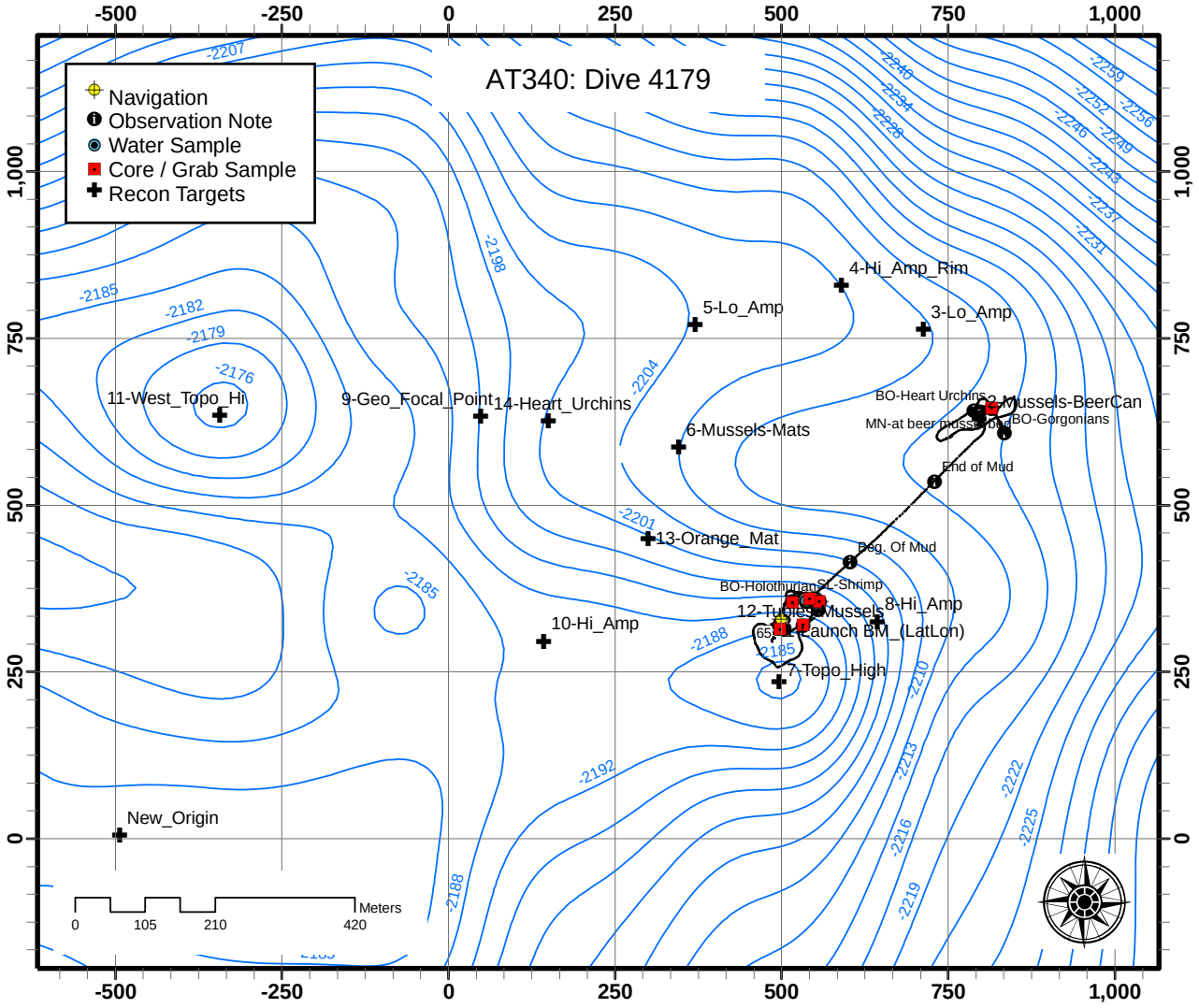

Figure 10. Dive 4179 on 5/15/2006 at an average depth of 2,200 m.

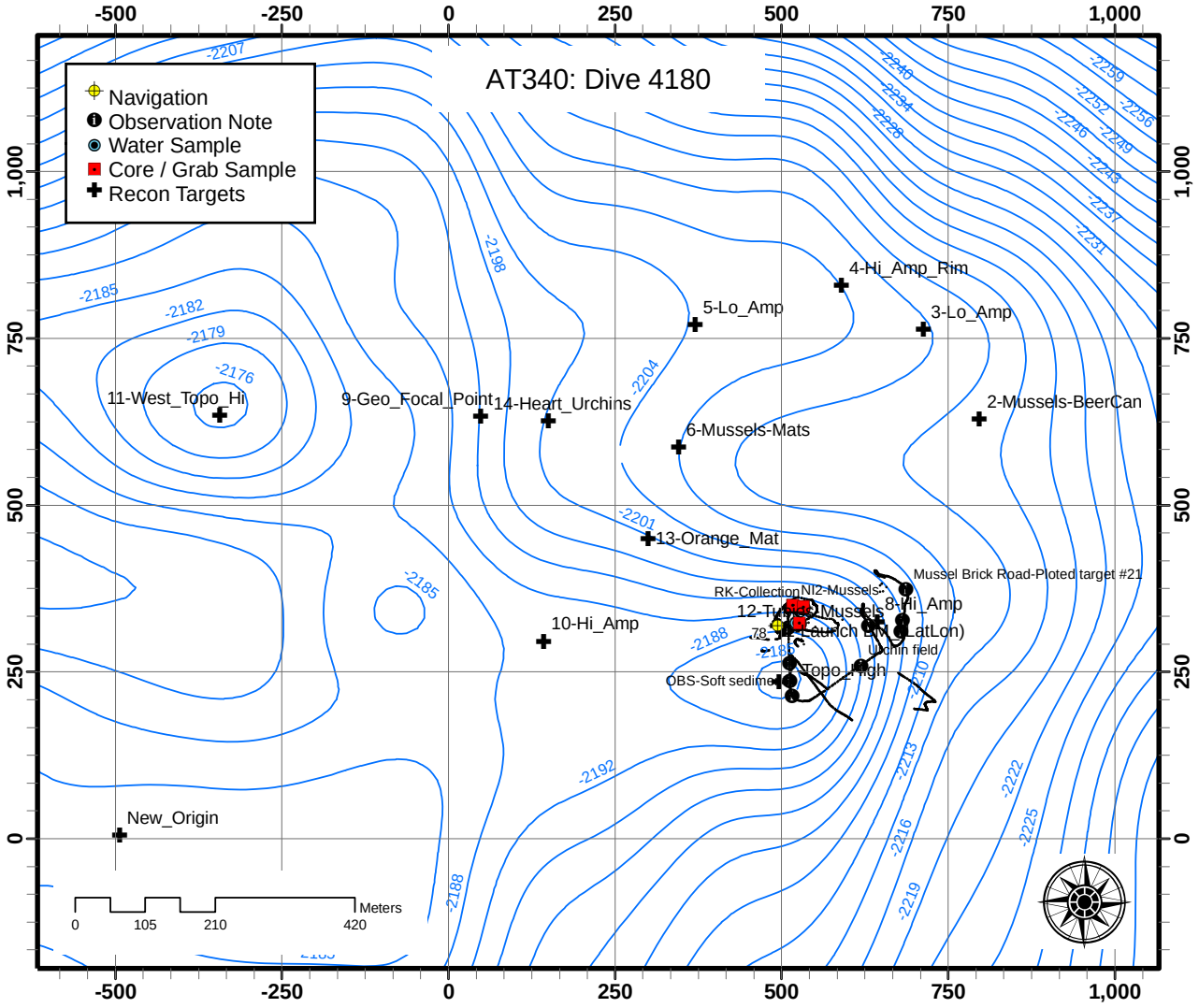

Figure 11. Dive 4180 on 5/16/2006 at an average depth of 2,200 m.

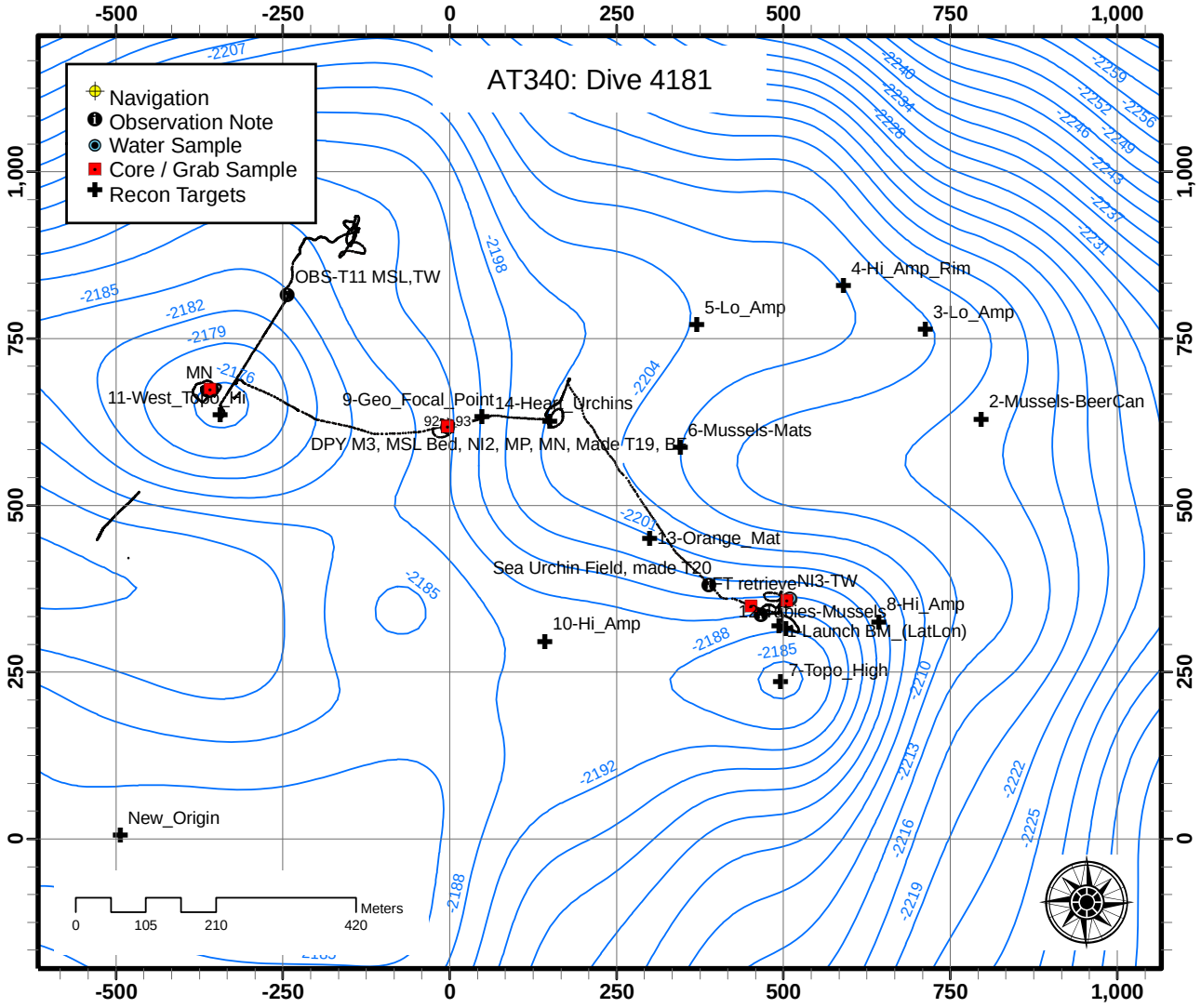

Figure 12. Dive 4181 on 5/17/2006 at an average depth of 2,200 m.

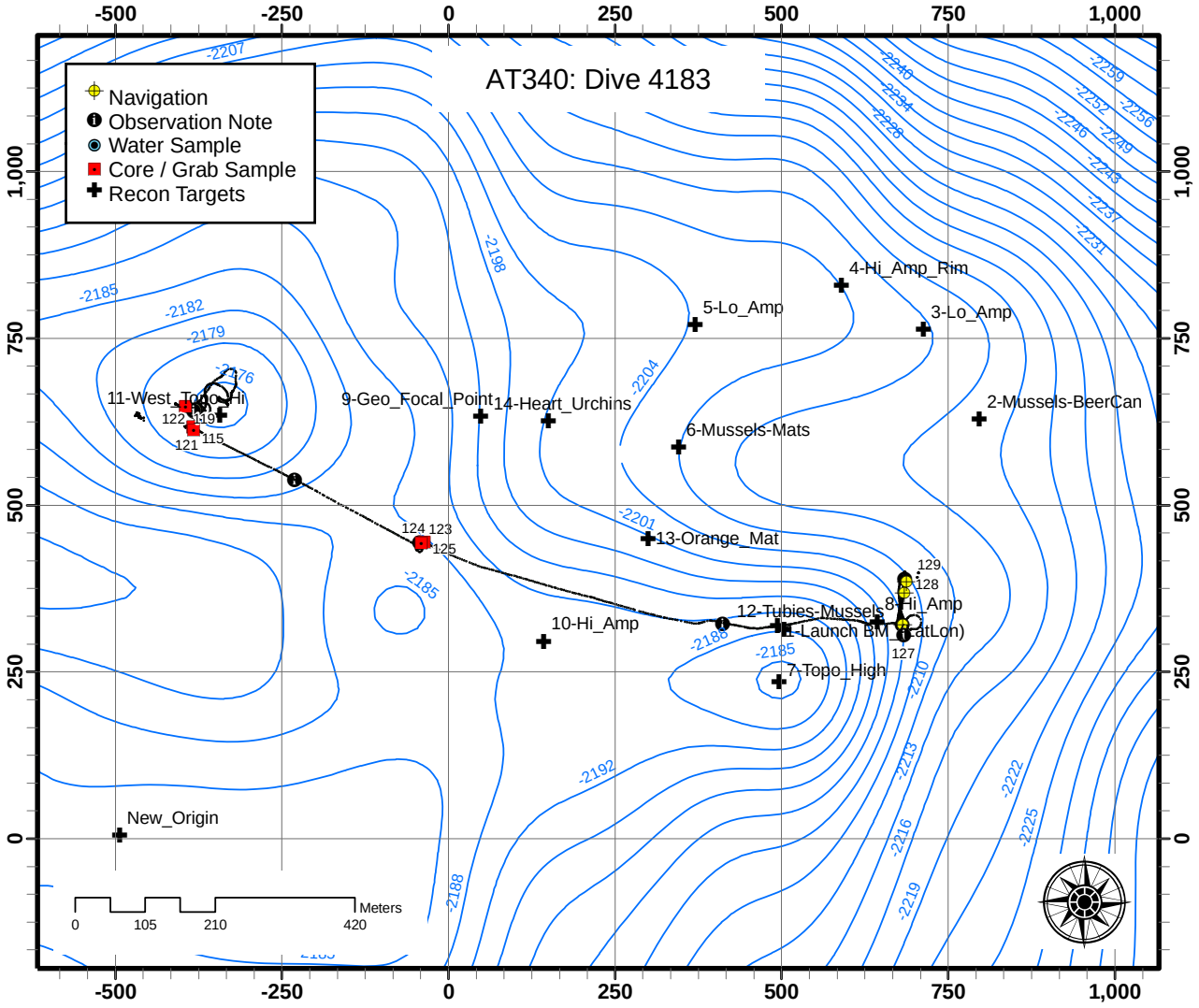

Figure 13. Dive 4183 on 5/19/2006 at an average depth of 2,175 m.

Green Canyon 600

Site Summary - GC600

Depth 1,170-1,200 m**,** explored during ALVIN Dives 4174 and 4184, surveyed during the survey cruise.

Previous data: The GC600 site was selected for consideration as an ALVIN dive site based on several lines of evidence, including characteristics determined from seismic data, the presence of persistent oil slicks on radarsat data, and photo reconnaissance. The site is located in a water depth of approximately 1,180 m on the upper-middle Continental Slope. The overall geometry of the area of interest is an elongate NW-SE trending ridge that separates two intraslope basins. The 3D seismic surface reflectivity maps and accompanying seismic profiles suggest that this is an area of very active expulsion of fluids and gases from the deep subsurface. Clear migration pathways are visible on the seismic profiles and radarsat images of this part of the Gulf show persistent oil slicks originating from the GC600 site. Two areas of high surface reflectivity occur at this site, and these were the objective of the ALVIN dives. The area of complex surface reflectivity anomalies to the NW center around a localized bathymetric high, the apex of which occurs at a water depth of approximately 1,177 m. The second area of high amplitude surface reflectivity anomalies occur to the SE and is also a localized mound, but with very subtle bathymetric relief.

Summary of Dive Observations

This site extends along a NW-SE axis, with about 1 km between the tubeworm area (NW) and the clams and mussel pockmarks (SE), Bench Marker 2 (X264, Y912) in the tubeworm area and Ian marker 5 (X1426, Y167) in the SE pock-mark area with clams and mussels.

Geology

Direct observational data from both photo reconnaissance work using a drift camera system and the ALVIN confirms the geologic and biologic complexity of the area. In the areas of high surface reflectivity mapped from seismic data, massive hydrocarbon seep-related carbonate hardground pavements and isolated blocks occur (**Figure 14**).

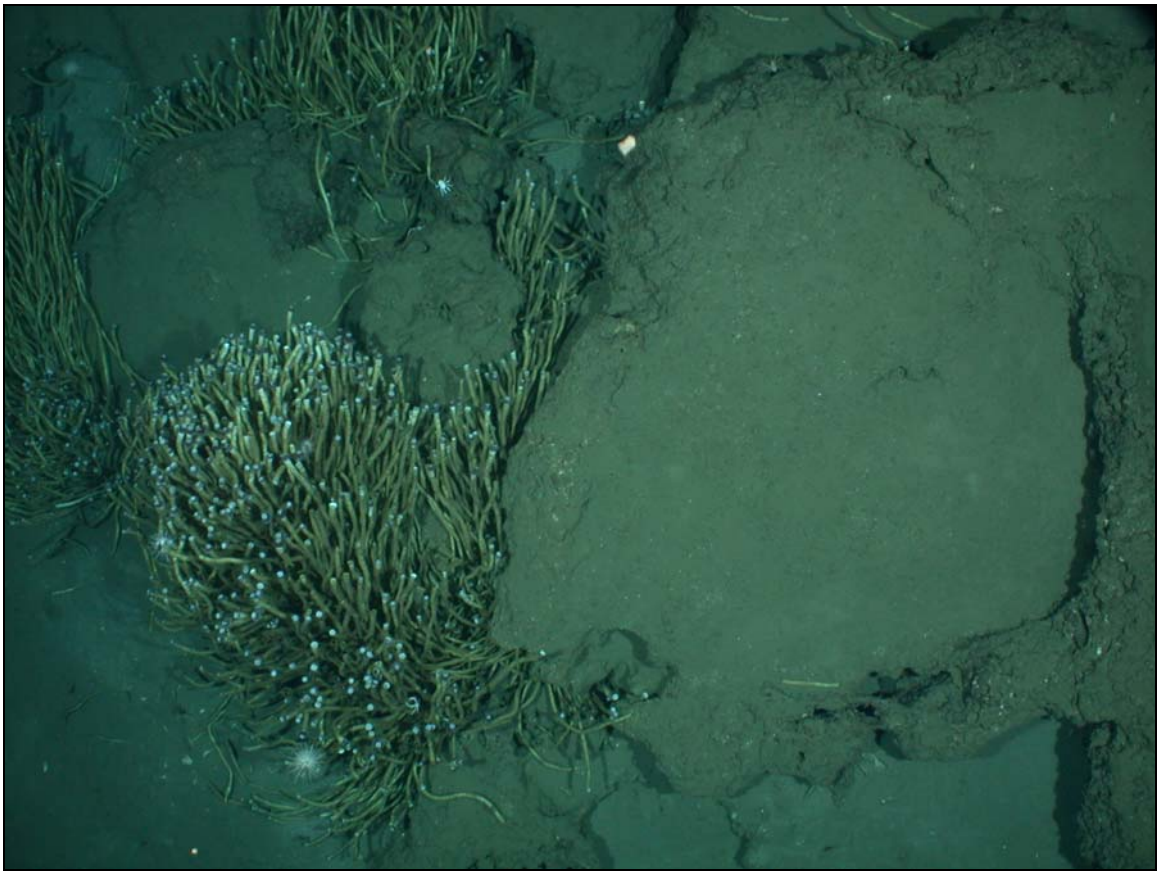

Figure 14. Massive carbonates and sparse tubeworms are characteristic of the GC600 site.

Gas was observed bubbling through cracks in the carbonates on ALVIN Dive 4174. Patches of tubeworms and mussels were observed growing out of fissures in the carbonate pavements. *Beggiatoa* mats and small coverings around open burrows, both white and orange, occurred throughout the area where pockets of sediment occurred between areas of hardground. Pockmarks were observed, some with crude oil bubbling out. Although there were few living communities found, mussel and clam shells littered the area of both mound-like anomalies. Cnidarians (sea pens, sea feathers, and anemones) were observed on the hard substrates.

This site corresponds to a low ridge, with carbonate outcrops at the NW corner, and pockmarks over most of the area. Some small carbonate outcrops sometimes present on the rims of the pockmarks. Due to time limitations, we did not explore the topographic high point. Target 10 (geo target) had a mud bottom only, target 9 had bacterial mats. Gas was observed bubbling through cracks in the carbonates on ALVIN Dive 4174. Pockmarks were observed, some with crude oil bubbling out.

Biology

The tubeworm area was covered extensively during Dive 4184 while searching for a suitable bush tubeworm for collection. It corresponds to a topographic high, with tubeworms as isolated individuals or small groups in cracks. A few bushes were also found. The only species observed on the bottom was *Lamellibrachia* sp. nov. Patches of tubeworms and mussels were observed growing out of fissures in the carbonate pavements (Dive 4174).

Two extensive areas with pockmarks and clams were also covered. Target 11 should have had mussels, but none were seen. At the end of the dive (near target 12, described as clams), large mussels were seen at the bottom of a pockmark. Gorgonians and other cnidarians (anemones) were common close to tubeworms (especially on the NW corner of the tubeworm area) and on some carbonate pieces around pockmarks (**Figure 15**).

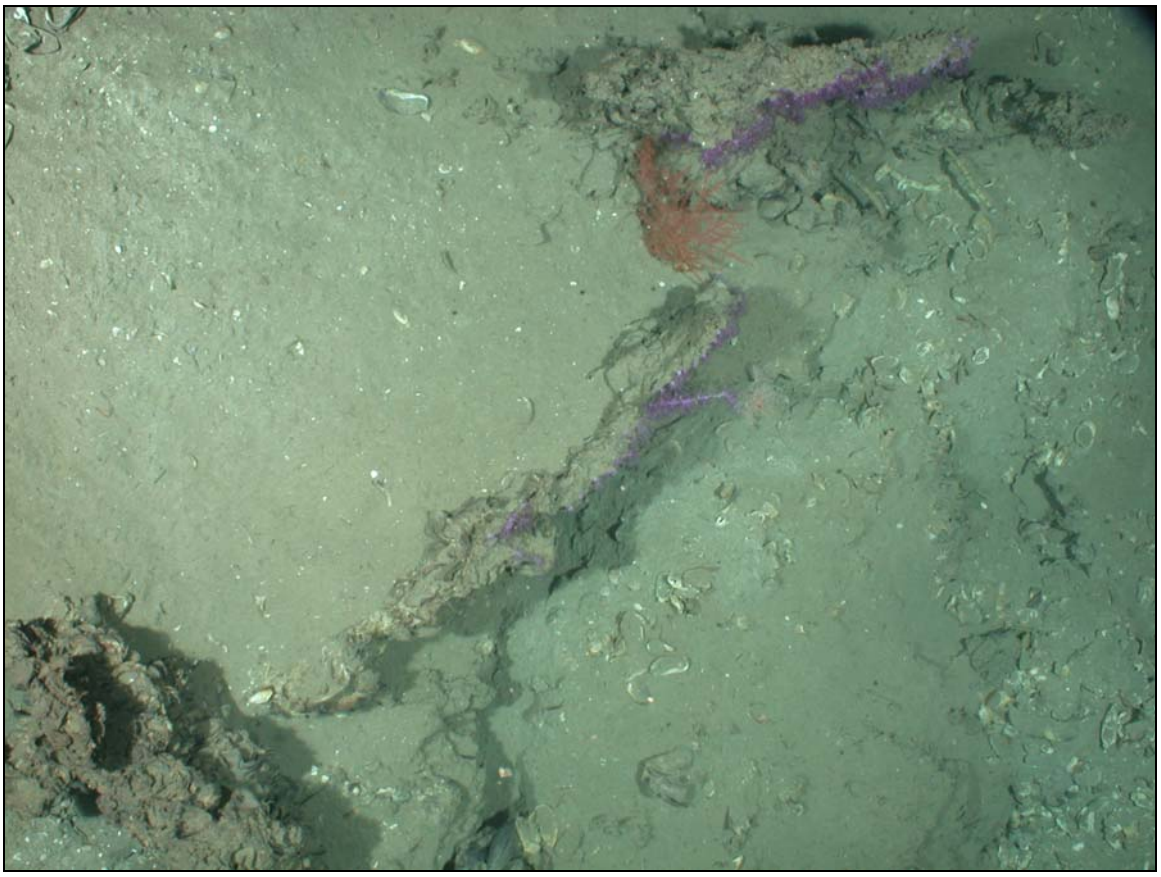

Figure 15. Varieties of soft corals were seen on some of the carbonate boulders, but no significant aggregations were observed during the two dives at the site.

Most of the area surveyed during the dive showed bacterial mats of various sizes. No *Alvinocaris* shrimp were associated to them. The mussel appears to be *B. brooksi*. The clams were *Calyptogena ponderosa*.

Mosaic

No mosaic was done on this site.

Two dives were completed at site GC600. **Figures 16** and **17** show the dive track of ALVIN and activities performed during the dives.

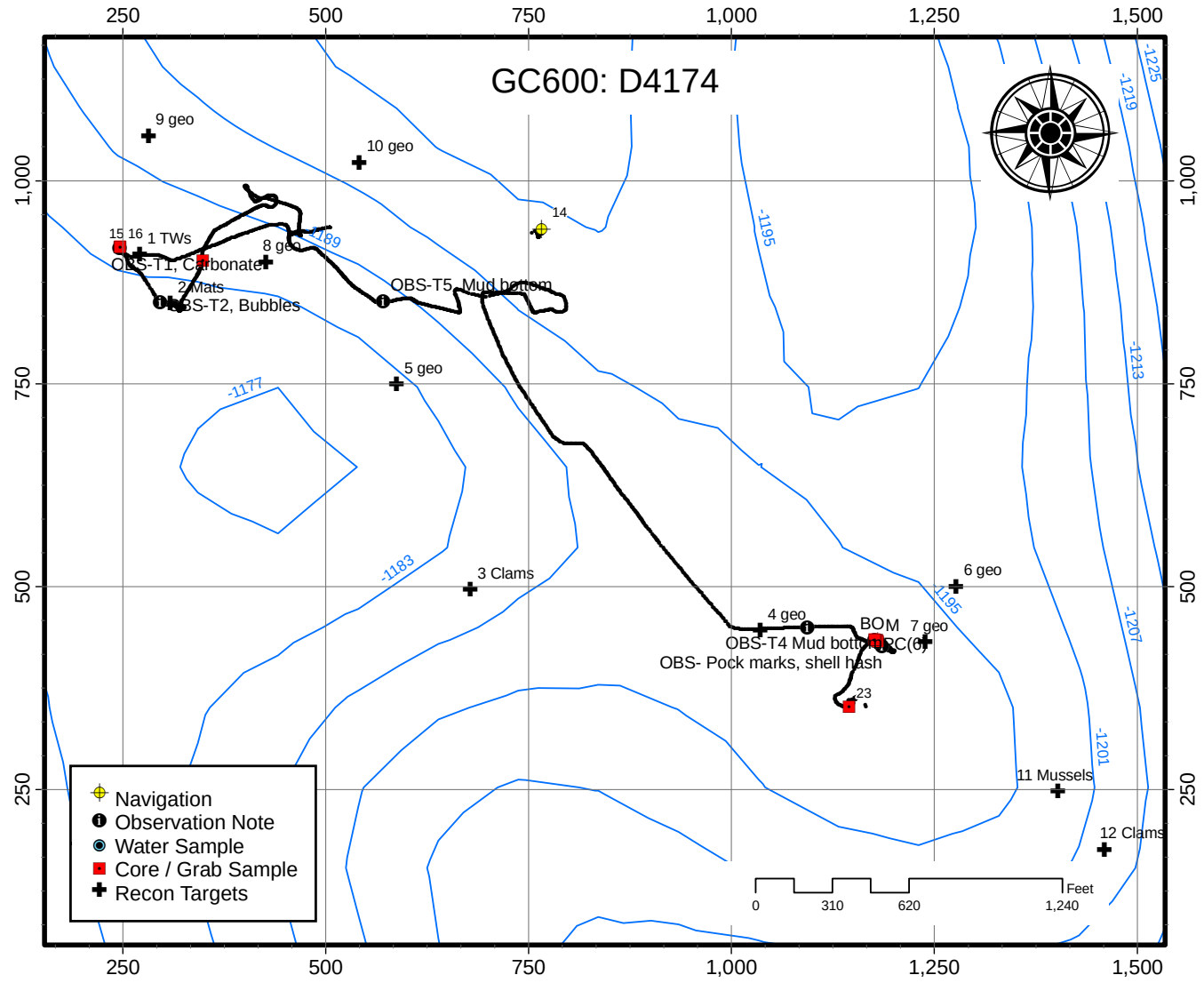

Figure 16. Dive 4174 on 5/10/2006 at an average depth of 1,250 m.

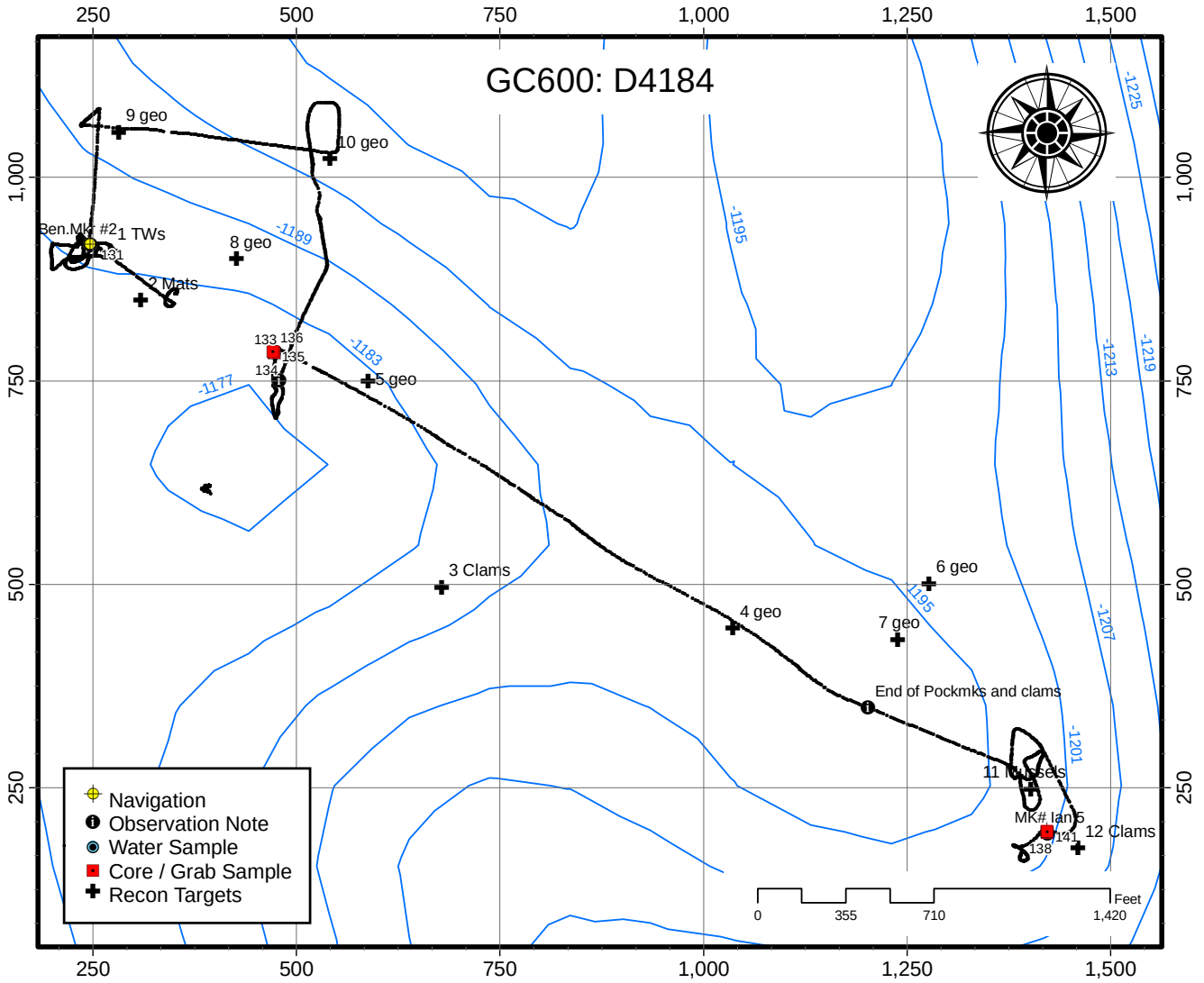

Figure 17. Dive 4184 on 5/20/2006 at an average depth of 1,250 m.

Walker Ridge 269

Geologic Setting for WR269

The dive site is at the northern edge of a suprasalt intraslope basin on the lower Continental Slope, approximately 10 lease blocks away from the Sigsbee Escarpment. The site consists of a series of mound-like areas that extend to the east into WR 270. These mounded features are on a ridge that separates two very distinct intraslope basins that are floored by salt or salt welds.

Previous studies, using high quality 3D seismic data, indicate the presence of a well-defined bottom simulating reflector (BSR) that cuts across stratigraphic reflectors of the basin fill to the south of the area of interest. This feature, which is interpreted to indicate the base of the gas hydrate stability zone, appears to have free gas trapped beneath the BSR. The mounds on the modern seafloor are updips of the interpreted gas hydrates and associated free gas. It appears that gas is bypassing the gas hydrate stability zone along permeable beds that are upturned along the basin margin. The topographic buildups that are the focal points of our investigation are interpreted as being several large expulsion features that have built mounds through the extrusion of fluidized sediment along with other products such as hydrocarbons.

Surface reflectivity maps of the area derived from 3D seismic data suggest the location of several active vents (circular low amplitude zones) and associated flows that have localized areas of high reflectivity. The areas of high reflectivity are interpreted as regions of local seafloor lithification and perhaps fields of clam shells.

The particular area selected for investigation is characterized by rather subtle topography except for a localized mound that rises some 30 m above the surrounding seafloor. The area was selected on the basis of its characteristics on geophysical records. The mound-like feature was interpreted as a sediment extrusion site and the surrounding areas as overlapping mud flows. The surface reflectivity maps suggest that there are some highly reflective zones that surround and are located to the west of this central vent feature. These highly reflective zones are usually lithified seafloor areas or fields of clam shells in this setting.

If the vent is active, fluidized mud is frequently found with bacterial mats usually in abundance. If the vent is not very active, the central crater sites are usually the sites of complex chemosynthetic communities. The fact that the surface reflectivity maps show a low amplitude response in the vent area suggests the presence of gas or soft bottom condition. Small islands of slightly higher reflectivity suggests variable bottom conditions in the area of the vent and a reasonable probability of finding tube worm, mussels, and carbonate rocks. This proved to be the case at this site. Even though the flows themselves may not be highly productive in terms of chemosynthetic communities, there are “hot spots” in the flows that support communities and result in localized cementation of the seafloor. The highly reflective areas to the west of the vent site are interpreted as being of this nature. One of the areas is circular and probably represents an old venting site.

If hydrocarbons are still being migrated to the seafloor in this area, it could support a sizeable area of chemosynthetic communities. Unfortunately, our dive to explore this area was cut short because of weather, and we were not able to ground truth our interpretations of the areas west of the main venting site. Our interpretations of venting sites and highly reflective areas near it were correct (**Figures** 18 and 19).

Figure 18. Although there were extensive areas of seep-affected sediments at the WR269 site, development of tubeworm or mussels aggregations was very restricted.

Figure 19. The surface sediment in the regions of seepage featured a rich assortment of pogonophorans, holothurans, and crustaceans.

Two dives were completed at site WR269. **Figures 20 - 21** show the dive track of ALVIN and activities performed during the dives

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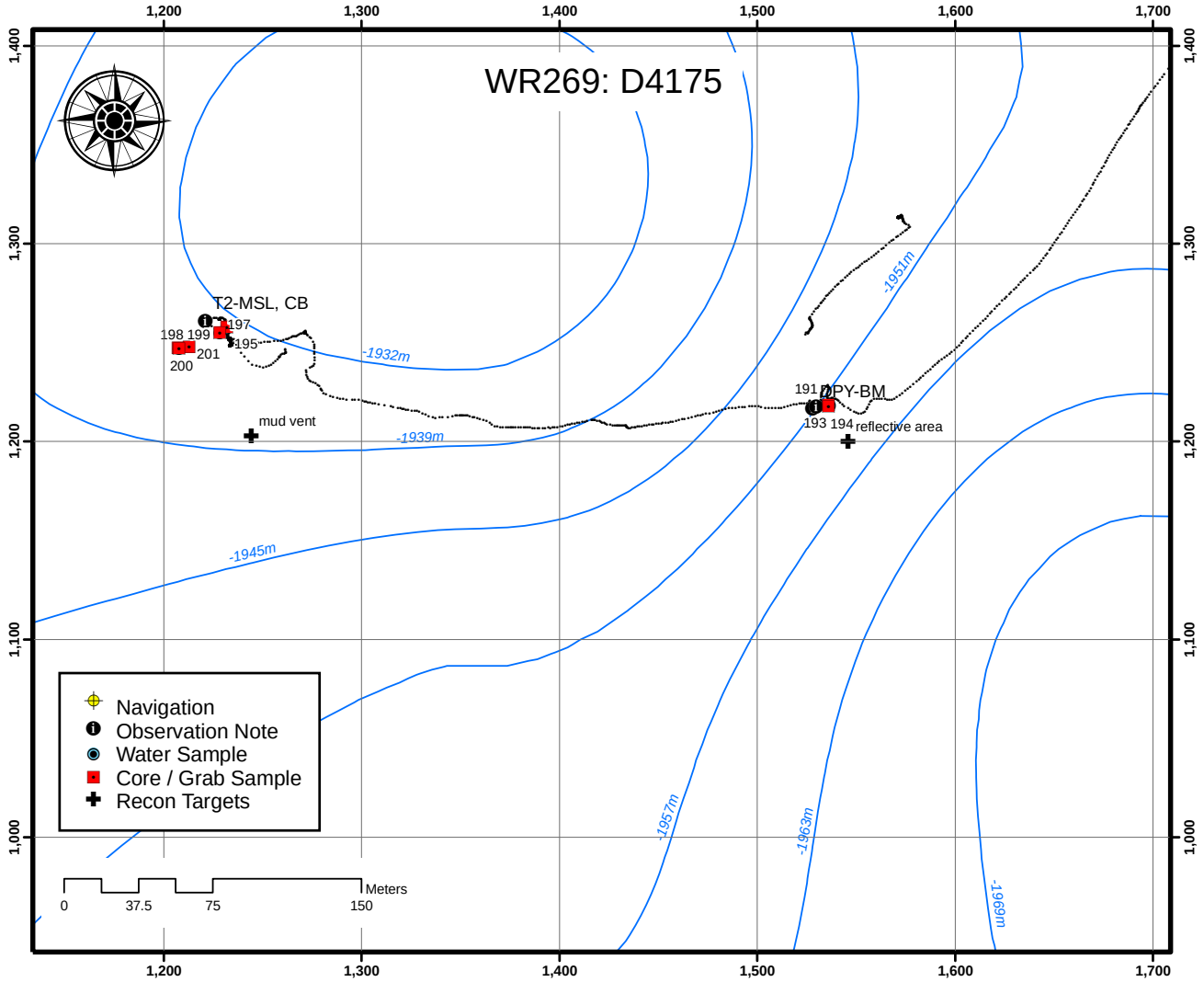

Figure 20. Dive 4175 on 5/11/2006 at an average depth of 1,950 m.

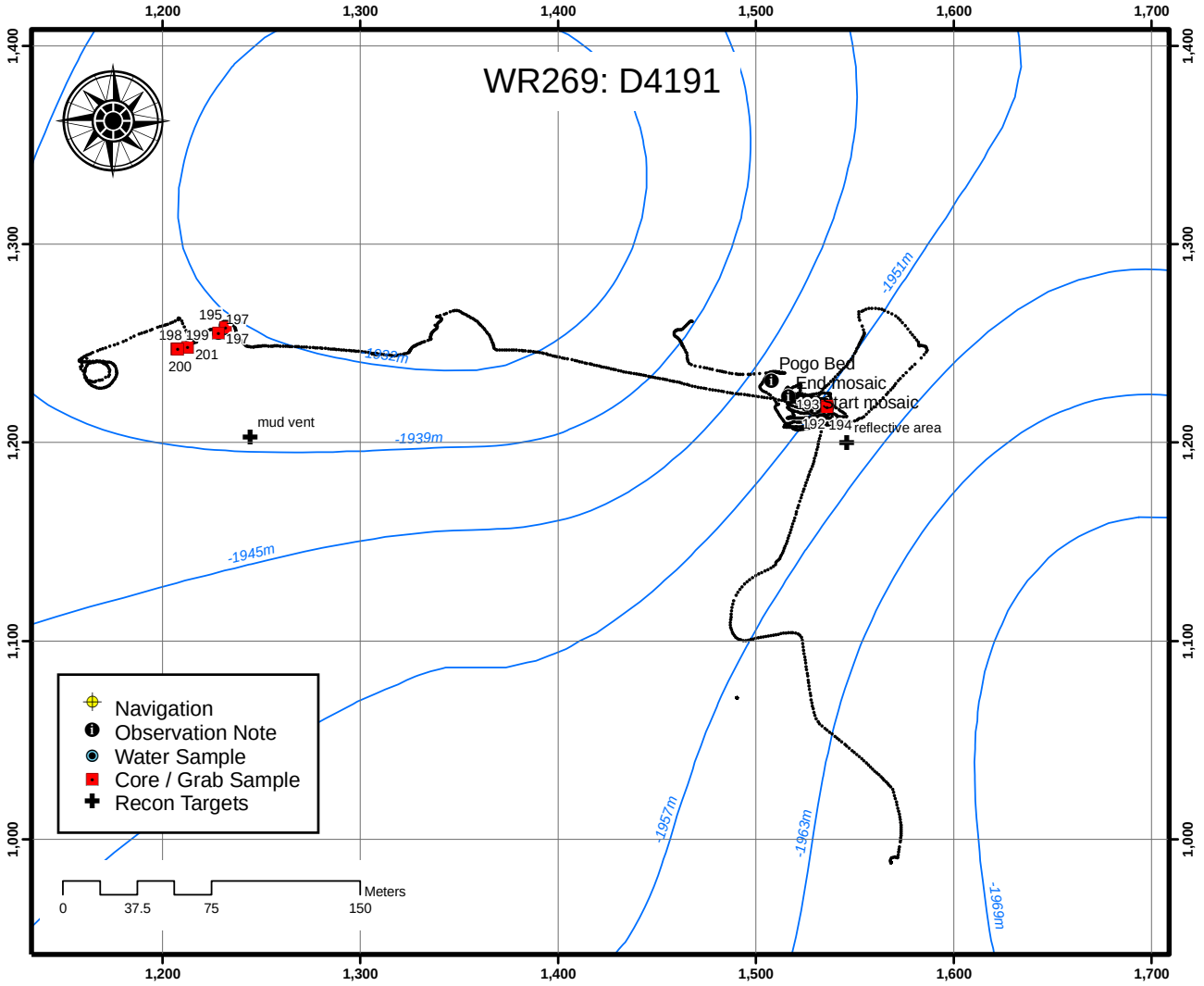

Figure 21. Dive 4191 on 5/26/2006 at an average depth of 1,950 m.

Keathley Canyon 243

Geologic Summary of KC243

This site occurs on a ridge separating a large intraslope basin to the south from three smaller intraslope basins to the north. Surface reflectivity mapping of 3D seismic data indicates two areas of scattered seafloor anomalies along the southeastern and eastern upper flanks of the ridge. Seismic profiles across the ridge indicate well-defined and vertically oriented "chimneys" that have no internal acoustic character, acoustic "wipe-out zones." These features are interpreted as gas-rich migration pathways for fluids and gases to be transported from the deep subsurface to the ocean floor. Photo reconnaissance work prior to the ALVIN cruise confirmed the presence of chemosynthetic organisms in the vicinity of the southern anomaly identified from 3D seismic data. The site is mainly covered by soft sediment. It shows some steep features, with drop-offs and pronounced slopes. Exposed carbonate is frequent, sometimes located at the top of drop offs. The carbonate was mostly forming large slabs, that were cracked and fissured (**Figure 22**).

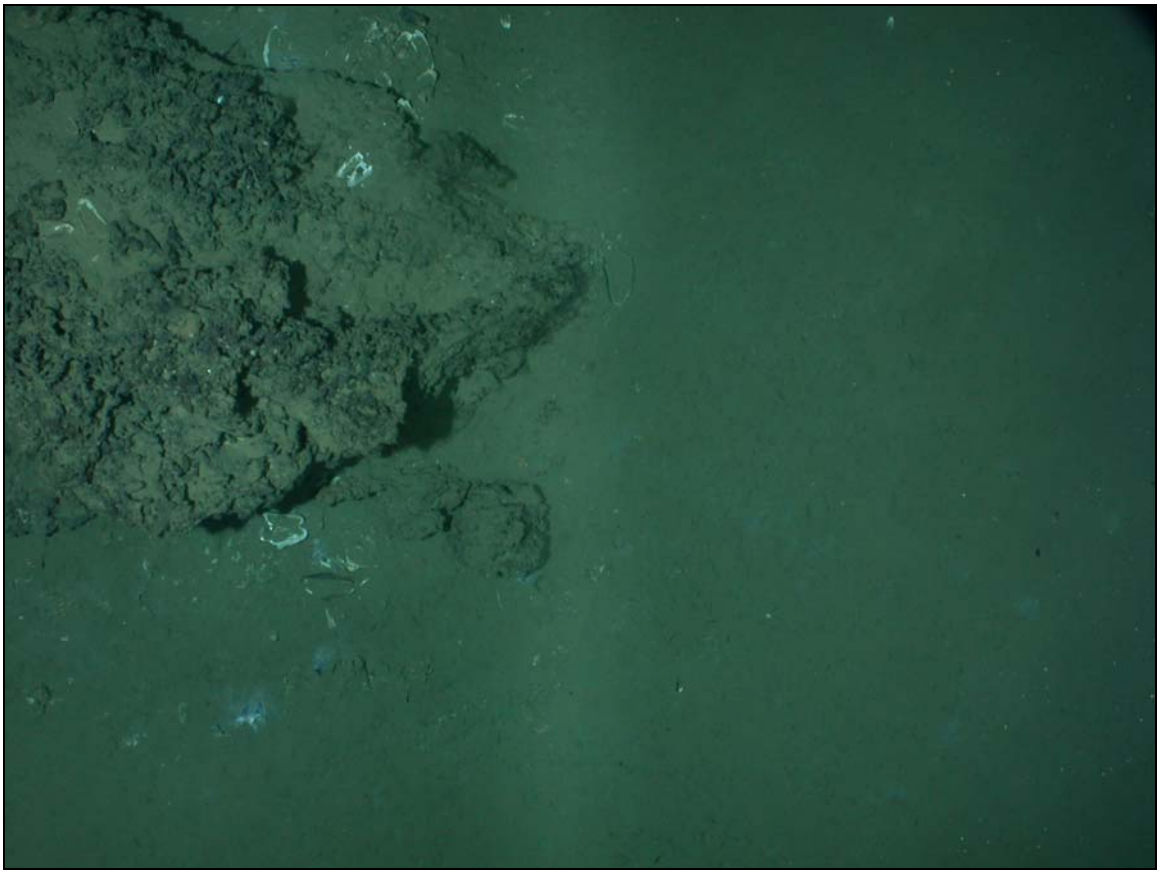

Figure 22. Relatively few carbonate structures were observed, indicating little flux of hydrocarbons.

The carbonates were mainly rubble at the beginning of the dive. No exposed methane hydrate was observed. Small depressions filled with brine were common near mussels and a few other places, including near target 3. No rocks were collected.

Site Summary - KC243

Depth 1650-1600 m, Launch target 26˚43.812'N, 92˚49.835'W.
This site was explored during ALVIN Dive 4176 only (May 12, 2006) and during the survey cruise.

This site is relatively small. We explored only part of it, due to a torn boot at the beginning of the dive and some issues with navigation and target positions. Most of the exploration was centered on markers 1 and 2. ALVIN was called to the surface just after reaching target 3 and little of that area was explored. Bench Marker 1 (X162, Y 293) was dropped at the beginning of the dive, about 160 m W of the mussel beds. A ball marker was dropped on the mussel bed as a reference for a mosaic.

Biology

Scattered mussel shells were found almost everywhere on the dive track. They were denser in some areas. Briny areas were common, with bacterial mats and a restricted area with live mussels stretching NW-SE halfway between the targets. These mussels were most often found in small patches, with a few larger beds (**Figure 23**).

Figure 23. The KC243 site had relatively little development of chemosynthetic communities, comprising sparse mussel beds for the most part.

Tubeworms were seen on a hand-held camera photo after the dive but none were collected. A mussel pot and a mussel scoop in the mussel bed (right next to each other) were collected. The

only species of *Bathymodiolus* was *B. brooksi*. Other species found were: *Ophioctenella acies*, *Harmothoe* sp., *Prionospio* sp., *Capitella* sp., and *Nereis* sp. Other fauna found were: large round sponge, *Chaceon affinis*, *Nematocarcinus*, and *Paralomis sp*.

One dive was completed at site KC243. **Figure 24** shows the dive track of ALVIN and activities performed during the dive.

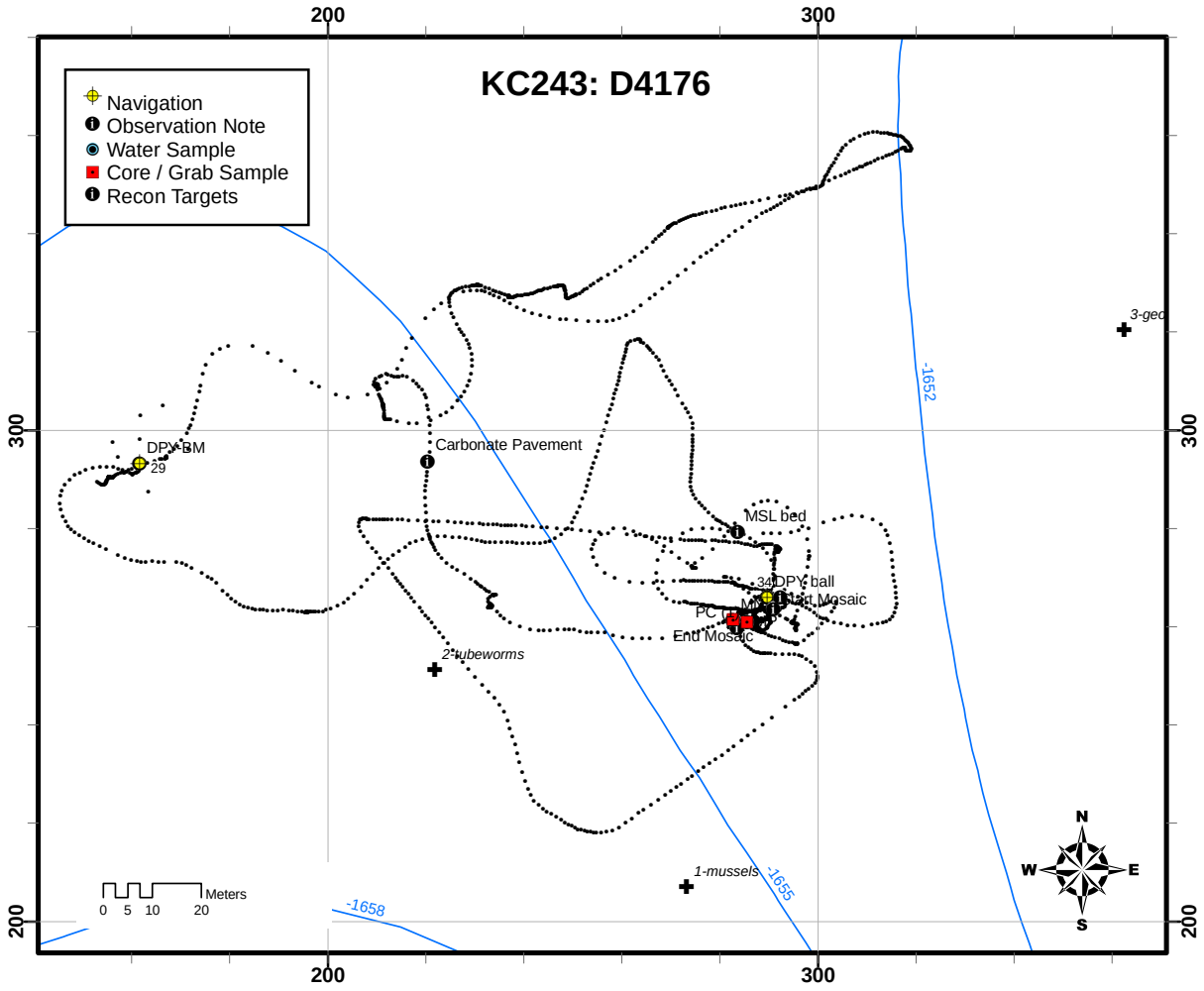

Figure 24. Dive 4176 on 5/12/2006 at an average depth of 1,610 m.

Green Canyon 852

Geologic Setting: GC852

The GC852 site is one of the most diverse on our dive schedule. The area of interest is a N-S oriented elongate mound that rises from the seafloor at the southeastern edge of a middle-to-lower slope suprasalt sedimentary basin. The top of this mounded region is at a water depth of approximately 1,435 m. The overall elongate-mounded area is approximately 2 km long, the highest elevation on this feature is at the southern end. This southern area is characterized by a localized mound that rises more than 20 m above the northern crest of the overall feature. The

3D seismic surface reflectivity data indicate that the entire crest of this feature exhibits a high amplitude response, suggesting the presence of hard bottom conditions. Scattered highly reflective targets are also present around the upper flanks of the ridge-like feature. Profiles of the subsurface configuration of this feature indicate acoustically turbid migration pathways to the modern seafloor. These vertically oriented acoustic “wipeout zones” are migration routes for fluids and gases to the modern seafloor. The structural and stratigraphic framework of the subsurfaces focuses these products (including hydrocarbons) to the GC852 mounded area.

Photo reconnaissance work in March 2006, as well as direct observations made with the aid of ALVIN, indicates the presence of numerous chemosynthetic communities around the mounded area in the southern half of the study area. Tubeworms, mussel beds, and carbonate outcrops are common around the flanks of the southern mound. Although the ALVIN did not travel to the northern end of the N-S trending overall feature, the photo reconnaissance indicated brine seeps and carbonates, but no chemosynthetic communities. At the apex of the southern mound, carbonate blocks and hardgrounds are common, and soft corals are taking advantage of the hard substrates as a place to attach and grow. Bacterial mats seem to be few and far between.

Site Description - Green Canyon 852

This site lies on the southern extent of a steep-sided N-S trending elongated mound rising from over 1500 to 1395 m depth. This feature occurs at the SE edge of a well-defined sedimentary basin. The overall mounded area is approximately 2 km long with the highest elevation at the southern end. This area of primary interest is characterized by a localized mound that rises more than 20 m above the rest of this overall feature. The 3D seismic surface reflectivity data from this area indicate that the entire crest of the elongated feature exhibits a high amplitude response relative to surrounding seafloor, suggesting the presence of hard bottom conditions. Scattered highly reflective targets are concentrated in the vicinity of the southern mound. Profiles of the southern end of the elongated mound indicate acoustically turbid migration pathways to the modern seafloor. These “wipeout zones” are interpreted as routes for upward transport of fluids and gases from the deep subsurface. Submersible operations confirmed the indicators of hydrocarbon seepage in this area. These operations were conducted on the crest of this feature in an area approximately 650 m N-S and 300 m E-W. The crest of the feature has extensive carbonate that appears to have been scoured by currents removing sediment from between 2-3 m high carbonate pillars. At the tops of the pillars are numerous types of corals: gorgonians, antipatharians, bamboo coral, and scleractinians (**Figure 25**), as well as numerous individuals of a globose soft-ball sized hexactinilid sponge, a few anemones, and a yellow *zoanthid* sp encrusting dead bamboo corals.

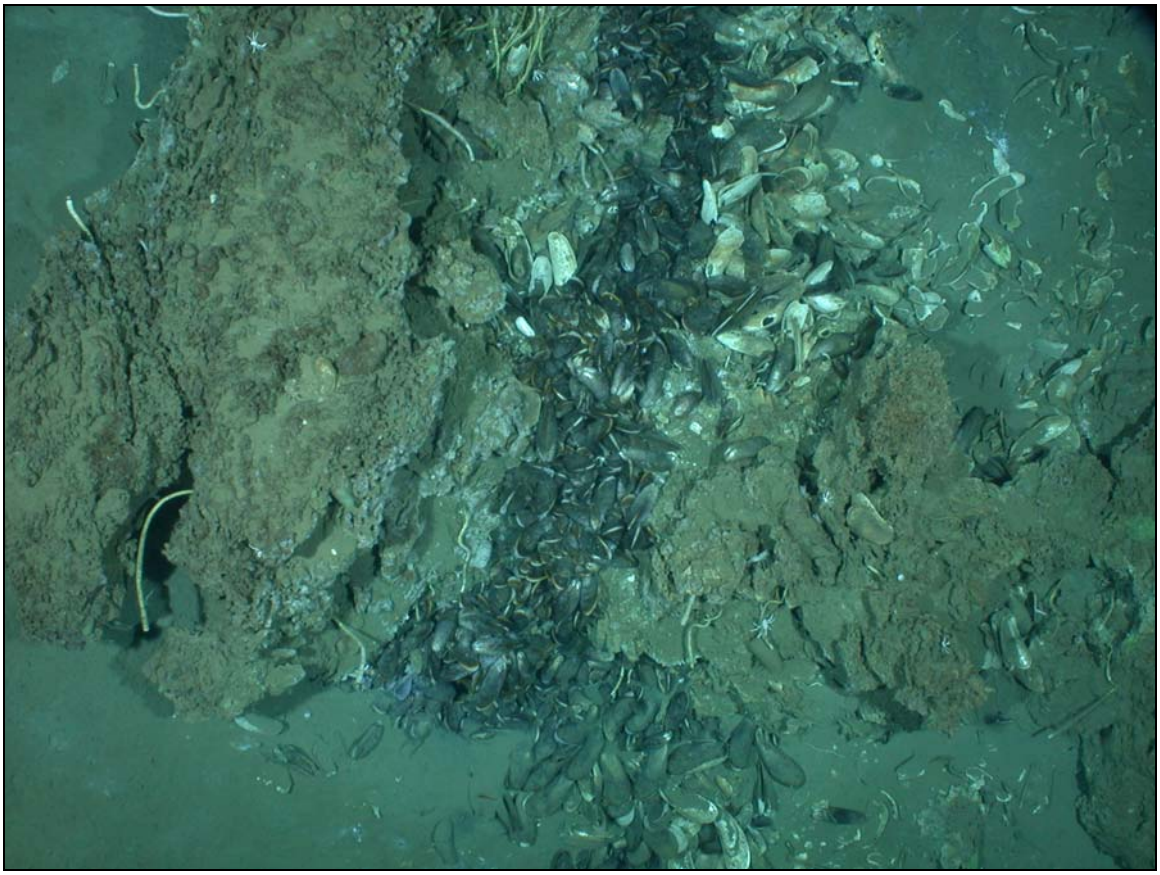

Figure 25. Chemosynthetic communities at the GC852 site comprised a series of features situated along a 1.5 km ridge line. The southern-most area was characterized by large carbonates with mussels and tubeworms.

Numerous plumate polychates and hydroids were visible in macrophotos of the carbonates. The hard coral *Solenosmilia variablis* was collected and *Madrepora oculata* was observed. A potential identification of *Lophelia pertusa* was also made from the photographic record, but this could not be confirmed since there were no specimens of this species collected. There was an unidentified species of chirostylid crab commonly associated with the soft corals and a species of ophionerid brittle star on the gorgonians (**Figures 26** and **27**).

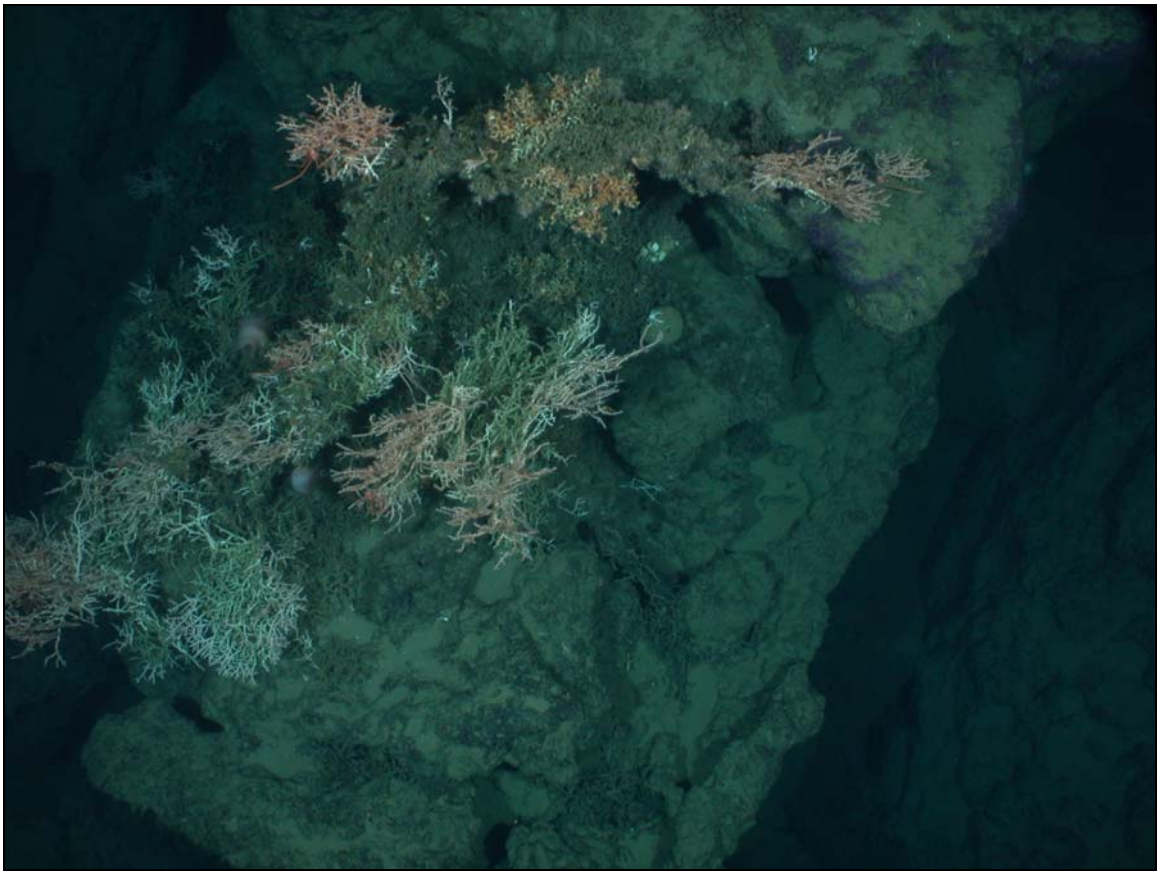

Figure 26. The northern portion of the site contained an area where massive carbonates were colonized by scleractinian corals.

Figure 27. Soft corals included living octocoral polyps and dead skeletons colonized by zooanthids.

Also on top of the mound are some scattered tubeworms and smaller carbonates and an area of active oil seepage. On the flanks of the mound were two areas of active seepage and authigentic carbonate. One feature is about 80 m to the NE of the corals and consisted of low-lying cracked carbonate blocks, occasional methane bubble streams, and oily sediments. Aggregations of both species of tubeworms, *Escarpia laminata* and *Lamellibrachia* sp., were collected here. Small mussel beds nested in carbonate (**Figure 28**) comprised *Bathymodiolus brooksi* and *B. childressi*.

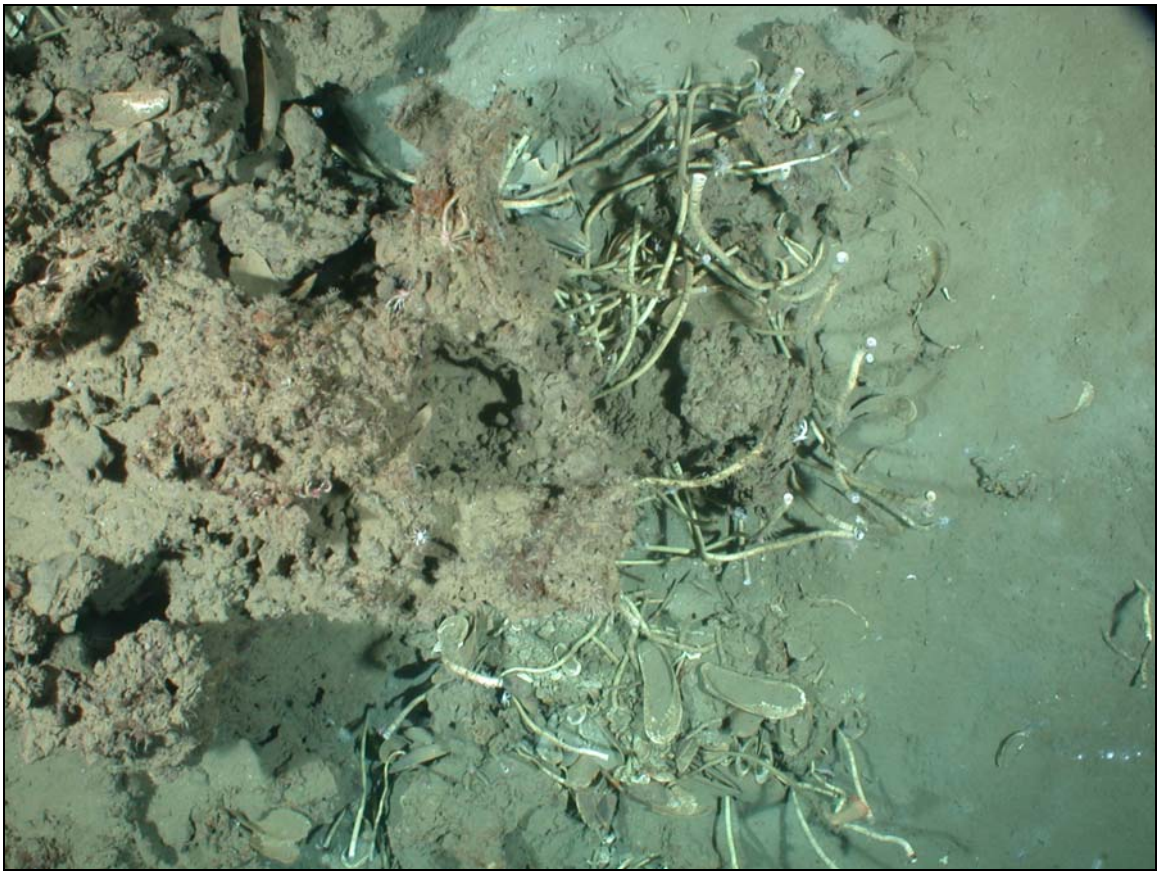

Figure 28. Tubeworm colonies at GC852 were generally sparse assemblages attached to carbonate and cemented shells.

The most common associated fauna were *A. muricola* and *O. acies*. Many of the *E. laminata* collected contained a species of phyllodocid polychaete, which is an apparent blood-sucking parasite. Dead tubeworm tubes often contained this species and another polychaete filling their tubes. A second area of active seepage was found approximately 400 m to the south of the corals near the top of a ridge extending down from the other sites. The substrate in this area consisted of numerous small to medium sized carbonate slabs and boulders and areas of carbonate rubble. Numerous transits between the two areas found only mud between the sites.

The same species noted above were present in the second area. The tubeworms were present as scattered individuals as well as small aggregations associated with the carbonates and mussels were present in beds among the carbonates as well as in small groups apparently nestled in the sediment. Vesicomyid clams were also present in this area, although none were collected. These collections extend the depth range of the common upper slope gastropod *Cataegis meroglypta*, the mussel *Tamu fisheri*, and the methane ice-worm *Hesiocaeca methanicola* to 1400 m, and extends the geographic range of *S. variables* to the NE from previous Gulf records in the Straits of Florida.

Oil slicks were visible on the sea surface during much of the time ATLANTIS occupied this site. Streams of bubbles, probably lined with oil, were observed escaping through beds of mussels at several positions on the bottom. Gas hydrate was inferred from hard layers encountered while collecting push cores and was photographed in an exposed patch with the macro camera.

Six dives were completed at site GC852. **Figures 29** through **34** show the dive track of ALVIN and activities performed during the dives.

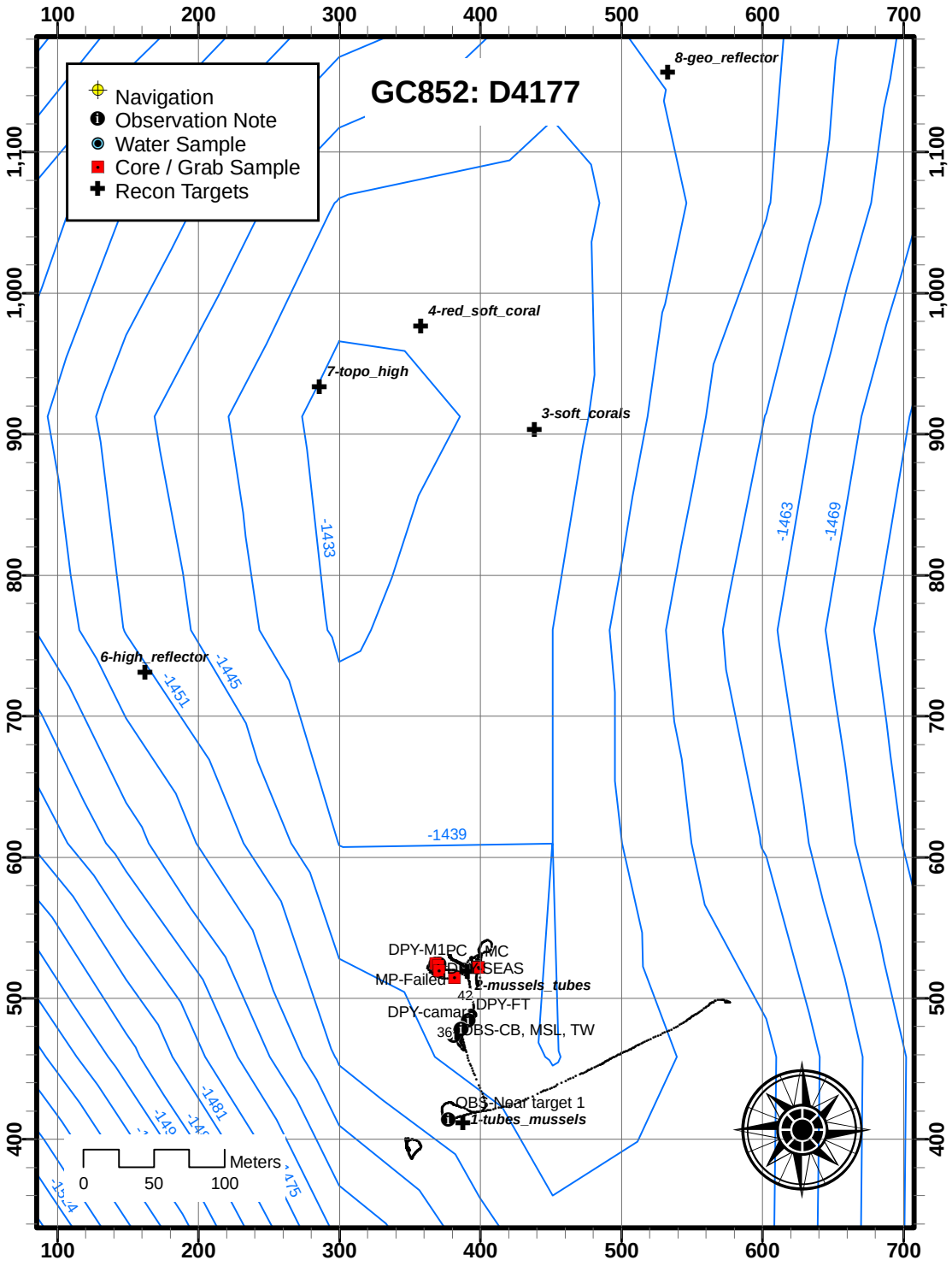

Figure 29. Dive 4177 on 5/13/2006 at an average depth of 1,450 m.

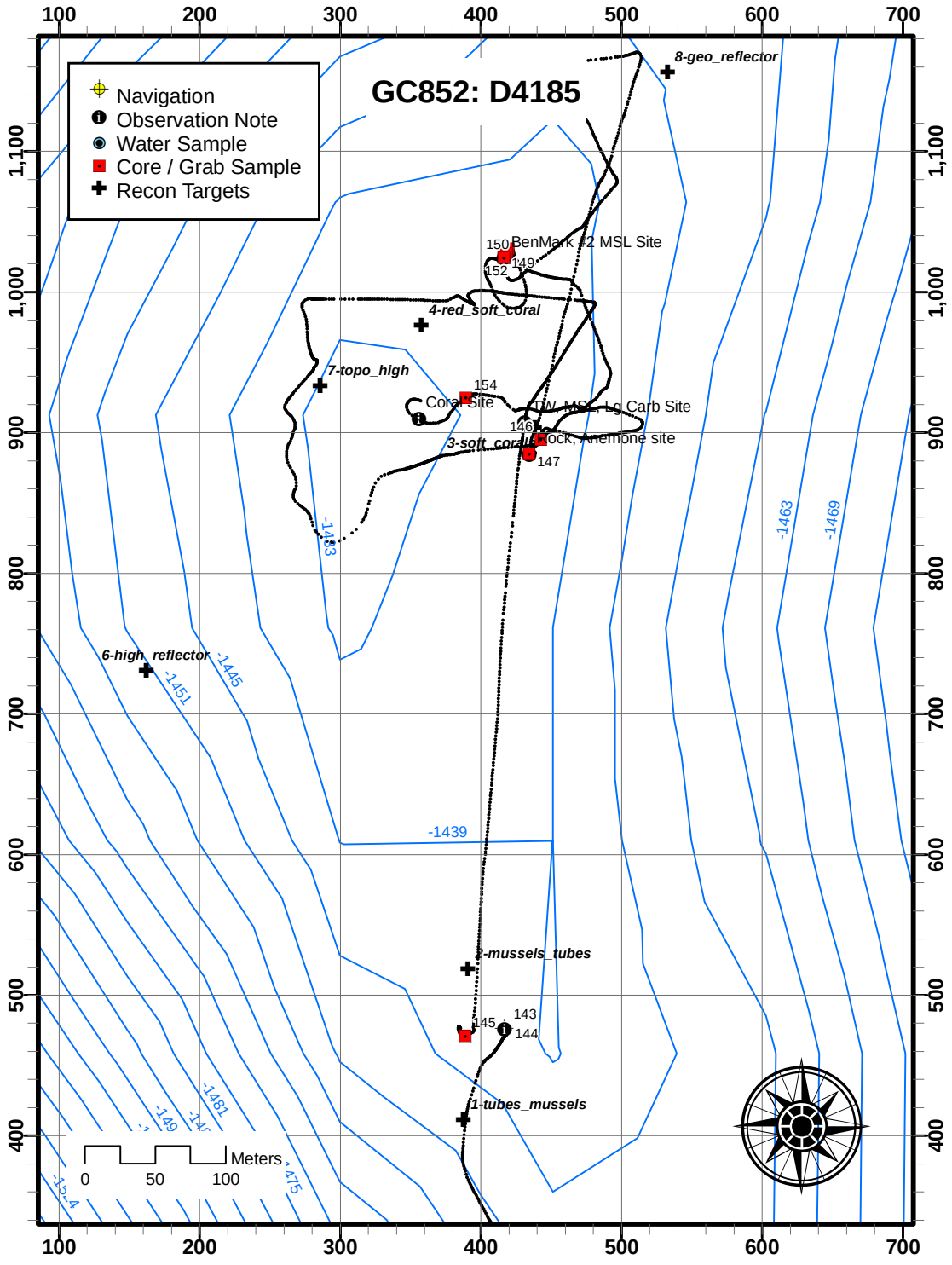

Figure 30. Dive 4185 on 5/21/2006 at an average depth of 1,410 m.

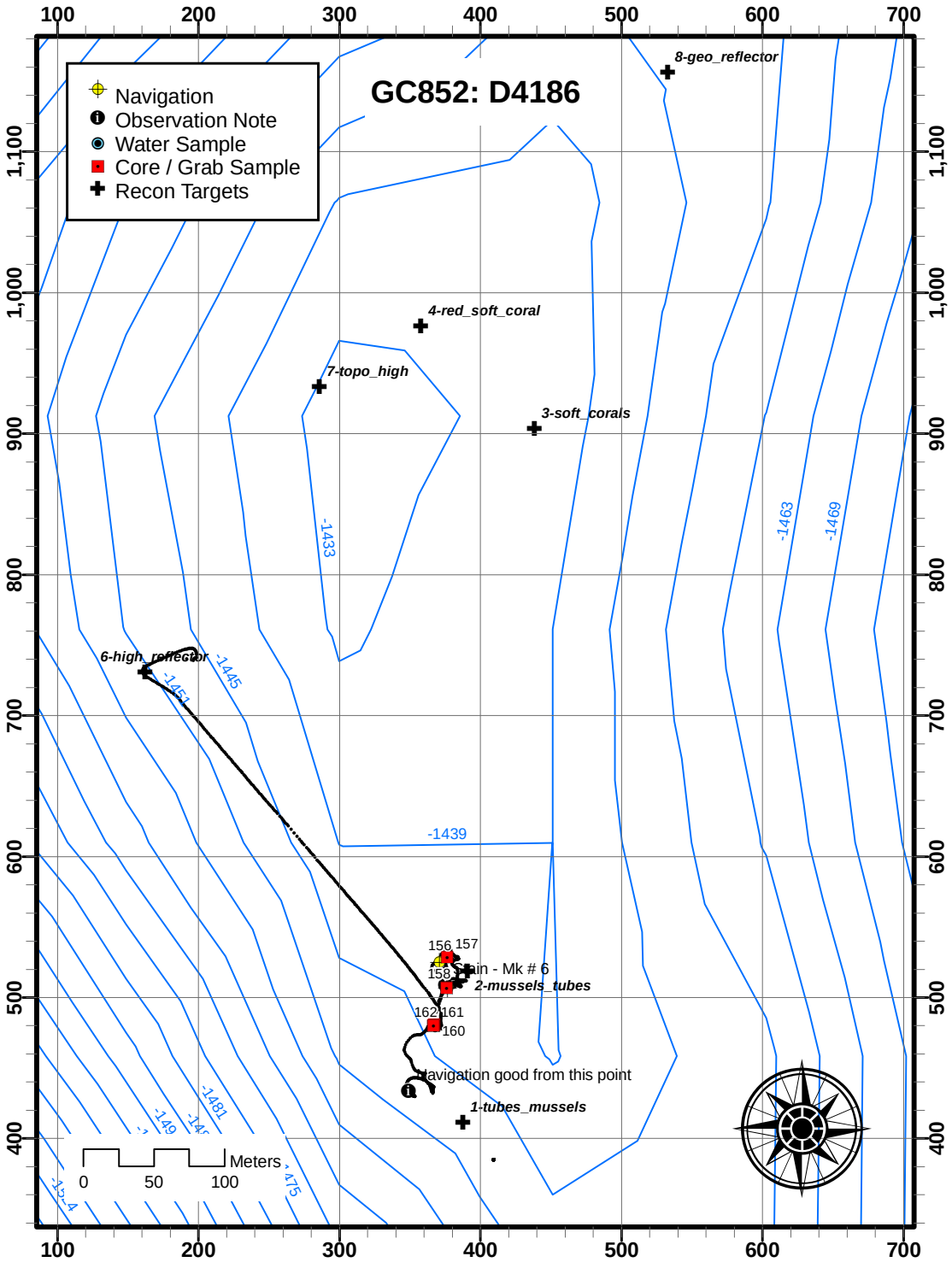

Figure 31. Dive 4186 on 5/22/2006 at an average depth of 1,410 m.

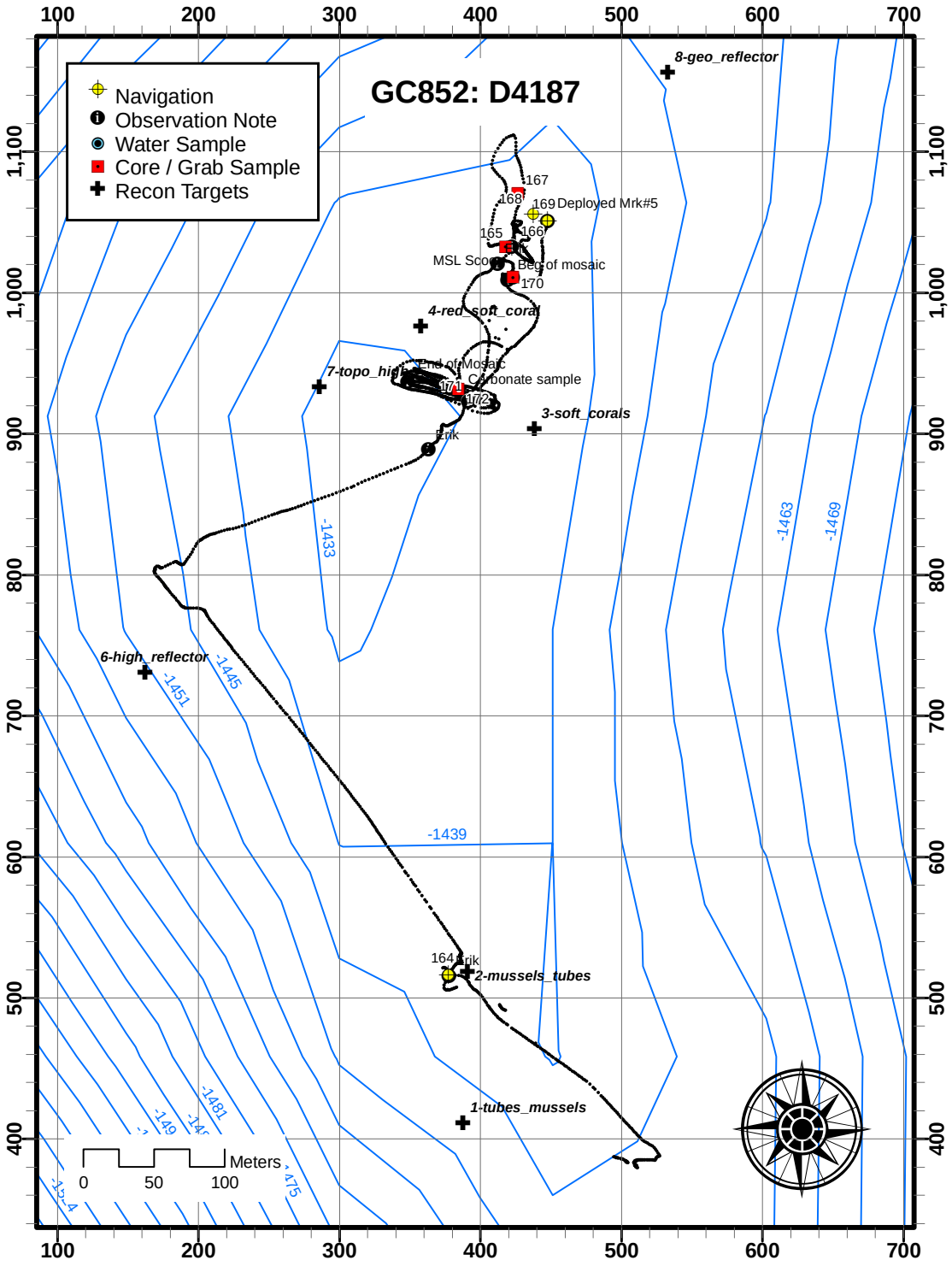

Figure 32. Dive 4187 on 5/23/2006 at an average depth of 1,410 m.

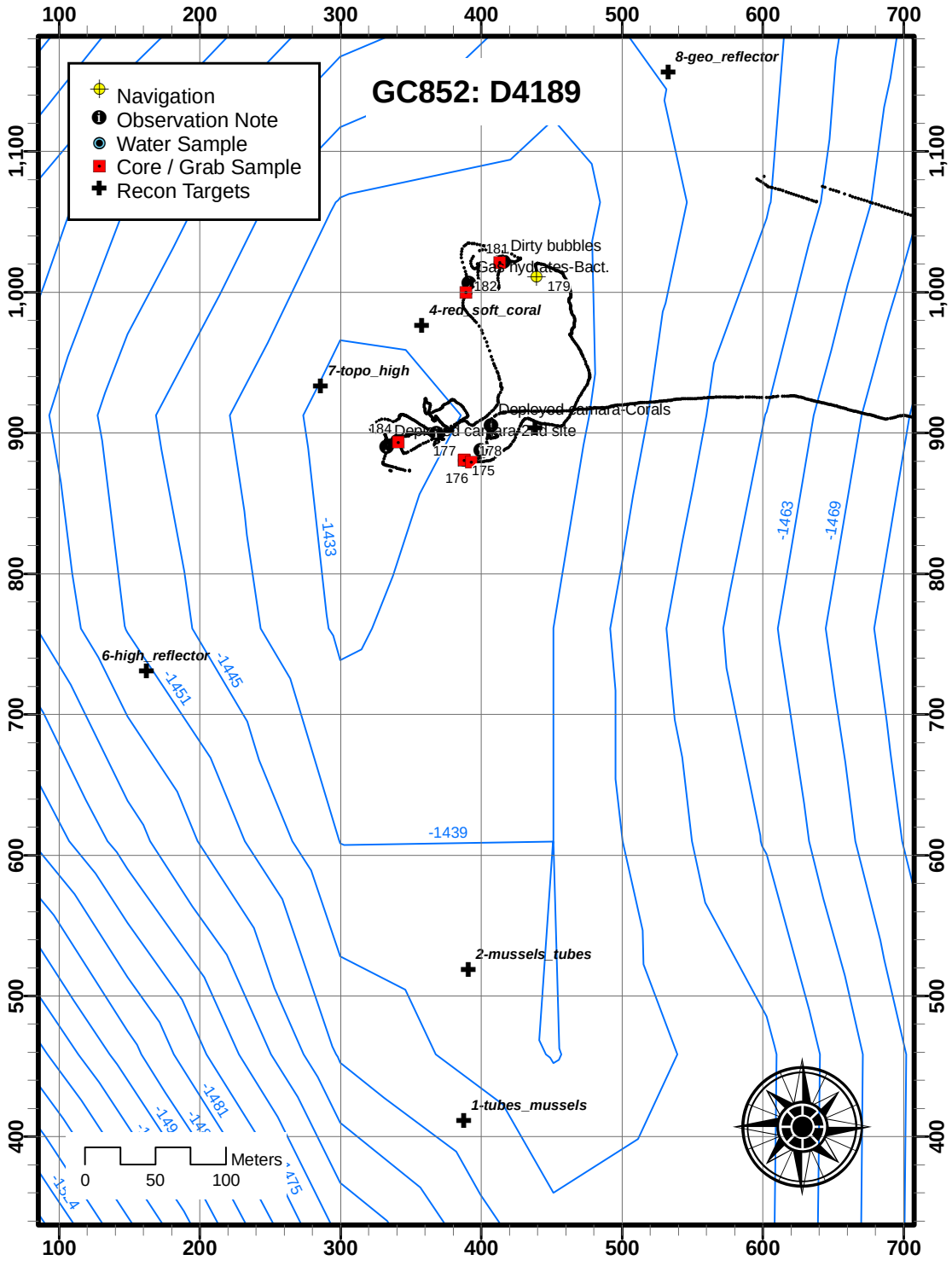

Figure 33. Dive 4189 on 5/24/2006 at an average depth of 1,410 m.

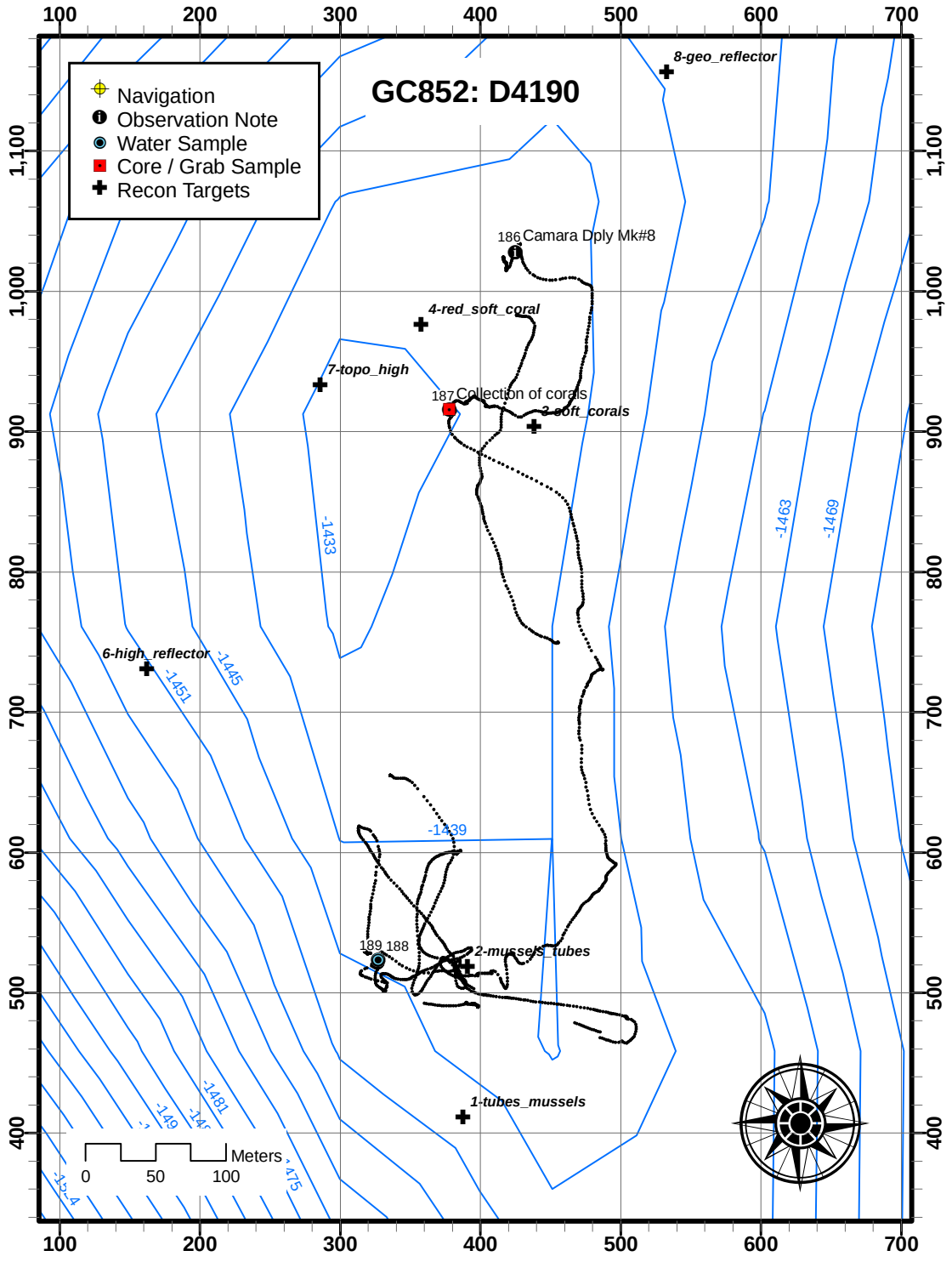

Figure 34. Dive 4190 on 5/25/2006 at an average depth of 1,410 m.

Mississippi Canyon 853

Geologic Summary of MC853

The MC853 site consists of an oblong NW-SE trending mound that rises over 100 m above the surrounding seafloor. It is located along the eastern margin of the Mississippi Canyon and the mound rises above the levee deposits that are a part of this regional geologic feature. The top of the mound has a water depth of approximately 1065 m. The 3D seismic surface reflectivity data over the mound area describe a pattern of highly reflective seafloor in the middle of the mound and scattered high reflectivity targets around the NW and SE parts of the mound top and upper flanks. Seismic profiles across the mound indicate a subsurface stratigraphic and structural configuration highly influenced by the presence of a large salt mass in the shallow subsurface. When viewed in the optimal perspective, it is apparent that the high amplitude surface reflectivity zone in the middle of the mound is salt at or extremely close to the seafloor. Even though the salt blocks fluid and gas migration to the central part of the mound, there are numerous leak points along the edges of the salt mass. This geologic interpretation of the MC853 mound was verified by both drift camera reconnaissance pictures and direct observations, plus sampling from ALVIN.

A previous ALVIN dive and photo reconnaissance confirmed the existence of chemosynthetic communities at the MC853 site. As suggested by the geophysical data, the occurrence of mussels, bacterial mats, clams, carbonates, and a few gorgonians on the hard substrates clustered away from the center of the mound along the upper flanks of the feature. The center of the mound was characterized by hummocky bottom topography with brine seeps and associated gullies. Small slumps of mussels and areas of hard bottom with scattered bacterial mats are common to this region of the mound. Tubeworms were generally absent from this area, although a few isolated tubes were spotted.

Site Summary - MC853

Depth: 1070 m, Latitude, Longitude: 28° 07.643 N, 89° 08.470 W. Explored during ALVIN Dive 4178. Surveyed during the survey cruise. Visited previously by Ian MacDonald in 2000.

Summary of Dive Observations

This is the shallowest of the study sites. During the dive, we transited from the N end to the S end, across a topographic high (a carbonate mound). Abundant microbial mats, live clams and giant mussels were observed consistently along the dive path. Numerous pockmarks and carbonate pavements were evident. Exposed gas hydrate was observed in the crater where clams were collected towards the end of the dive (S end of the site).

- Bench Marker (X367, Y1167) near target #1.
- Marker #2 (X342, Y1171) in epic mat area.
- Marker #3 (X548, Y706) near mussel collection area

Biology

The dominant fauna at this site were mussels, clams, microbial mats and various fish. A few gorgonians (several of which were quite large) were also observed. One of the most interesting

creatures we observed during the dive was a large, colorful siphonophore (1525 in dive log), which was slurped up by Pat. Live clam tracks were present along most of the dive track although (dead) clam shells were just as common. Microbial mats of the sulfide-oxidizing bacteria *Beggiatoa* were observed on sediments characterized by intense seepage-derived staining (sediments beneath were black and reducing). Mainly, white mats were observed, but small patches of cantaloupe orange *Beggiatoa* was also observed (these were photo-documented during the dive). The light (cantaloupe) orange color of these *Beggiatoa* is interestingly different from the bright orange color that typifies *Beggiatoa* of the shallow slope. *Beggiatoa* mats occupied areas varying in size between 10s of cm to m in diameter and mat localities were often co-inhabited by mussels. Numerous small fish were observed in the mat areas as well. Many of these fish were sitting in the sediment surface directly on top of *Beggiatoa.* In the laboratory, the *Beggiatoa* filaments were observed to be quite small (about 5-10 µm in diameter) compared to the giant *Beggiatoa* (>100 µm in diameter) commonly observed at shallow slope sites.

During the dive, black streams from topographic highs were assumed to be brine flows, but geochemical examination of sediment cores back in the lab showed no evidence of brine (the pore water salinity at all sites was ~35). Based on video watched from other sites, the microbial mats at this site are the most extensive and prolific of all the sites. Obviously, some factor or factors is limiting the development of *Beggiatoa* populations at sites along the deep slope.

Numerous dense accumulations of mussels and clams were observed all along the dive track. Two mussel pots were attempted during the dive, but only one was successful. Additional mussel collections were made with the manipulator arm. Several enormous specimens of *B. brooksi* were recovered using this approach. The scoop sampler was used to recover several live clams of various sizes (including some live small (<5 cm long) ones) from two sites. Clams (and mussels) were particularly abundant at the topographic highs. These huge pockmarks and carbonate banks seems to be areas of intense seepage, which supports dense accumulations of chemosynthetic fauna.

No tubeworms were observed during this dive though tubeworms have been noted previously at the site. A more extensive survey of the site with the ROV JASON would aid in determining tubeworm abundance at this site.

One dive was completed at site MC853. **Figure 35** shows the dive track of ALVIN and activities performed during the dive.

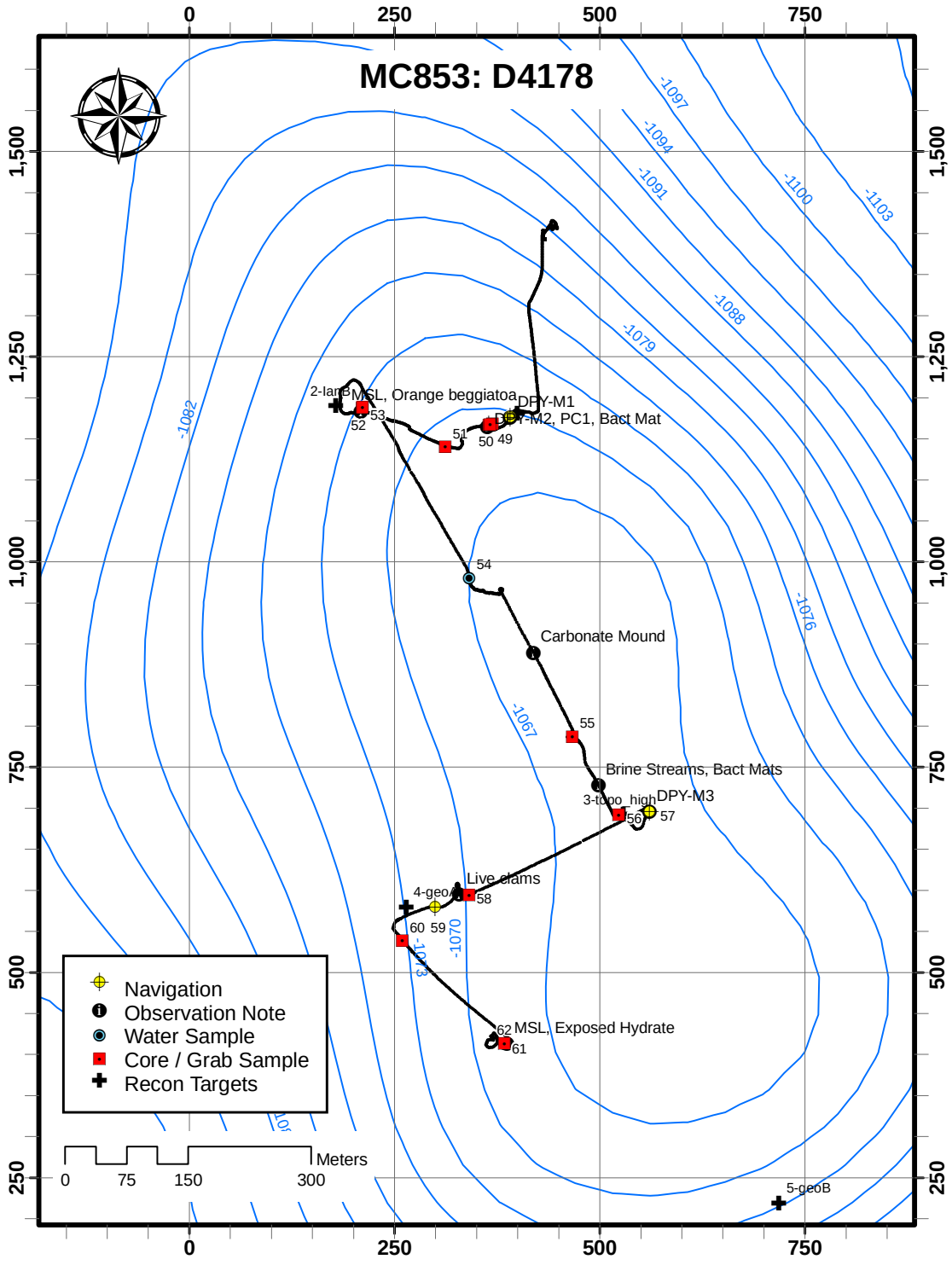

Figure 35. Dive 4178 on 5/14/2006 at an average depth of 1,070 m.

Mississippi Canyon 640

Geologic Setting: MC640

The Mississippi Canyon 640 (MC640) dive site is located on the upper Continental Slope, east of Mississippi Canyon and south of the modern Mississippi “birdfoot” delta. The overall feature is roughly circular in plan-view outline. At the top of this larger feature is a mound that rises roughly 15 m above the surrounding seafloor, which is at a water depth of 1420 m. The 3D seismic surface reflectivity data indicate variable patches of high and low amplitude responses over the area of the mound. This pattern suggests that the bottom will be covered with soft mud alternating with areas of seafloor hardgrounds, pavements, and other hydrocarbon seep-related carbonate blocks. Additional patterns of moderate seabed reflectivity describe linear patterns that originate from the mound and radiate from that point to deeper water areas surrounding the mound. These features are interpreted as fluidized sediment flows that originate from highly productive vents at the top of the circular mound-like feature. This type of geologic feature is usually indicative of rapid and episodic expulsion of fluids and gases. These rapid flux systems frequently are the sites of oil slicks on the sea surface. These slicks are usually visible in calm seas and from radarsat satellite images. Inspection of the seismic profiles across this feature reveal a highly focused migration pathway from the deep subsurface. This subsurface configuration generally leads to rapid venting and the construction of mud mounds on the seafloor.

Drift camera reconnaissance tracks and direct observations from ALVIN confirm the variability of seafloor types at this site, reflecting the variations in patterns observed on the surface reflectivity maps. The surface of the mound displays scattered pockmarks and craters of varying sizes. These features indicate gas seepage. Some were as much as 10 m in diameter and 2 m deep. Frequently, mussels and carbonates are found in the bottoms of these localized vents. Scattered exposures of authigenic carbonate account for the very high localized reflectivity patterns on our maps made from 3D seismic data. Bacterial mats and clumps of tubeworms (**Figure 36**) are scattered throughout the mound area.

Figure 36. Sediments away from the brine pools were carpeted with pogonphora.

Irregular patches and small streams of brine occur at the mound top and along the upper flanks of the feature (**Figure 37**).

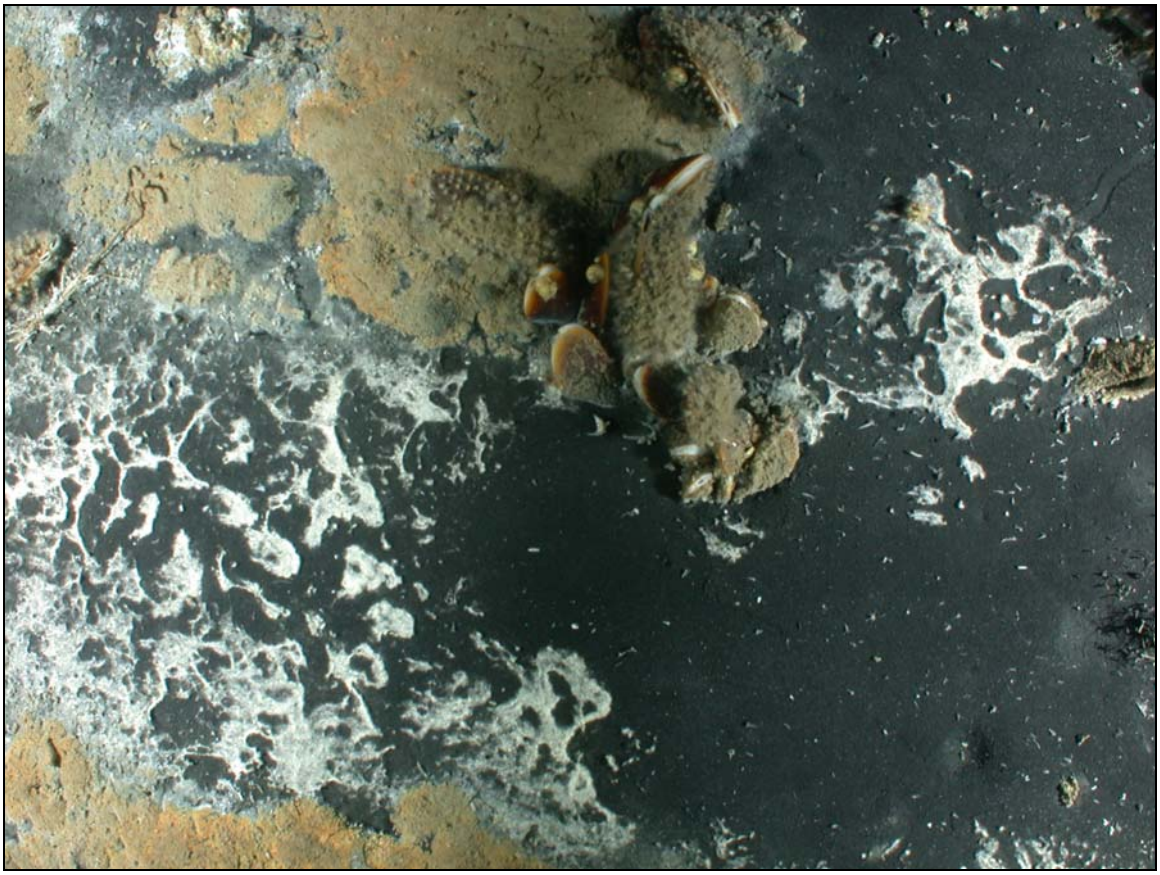

Figure 37. Extensive brine pools and flow channels supported bacterial mats and mussel colonies at the MC460 site.

One dive was completed at site MC640. **Figure 38** shows the dive track of ALVIN and activities performed during the dive.

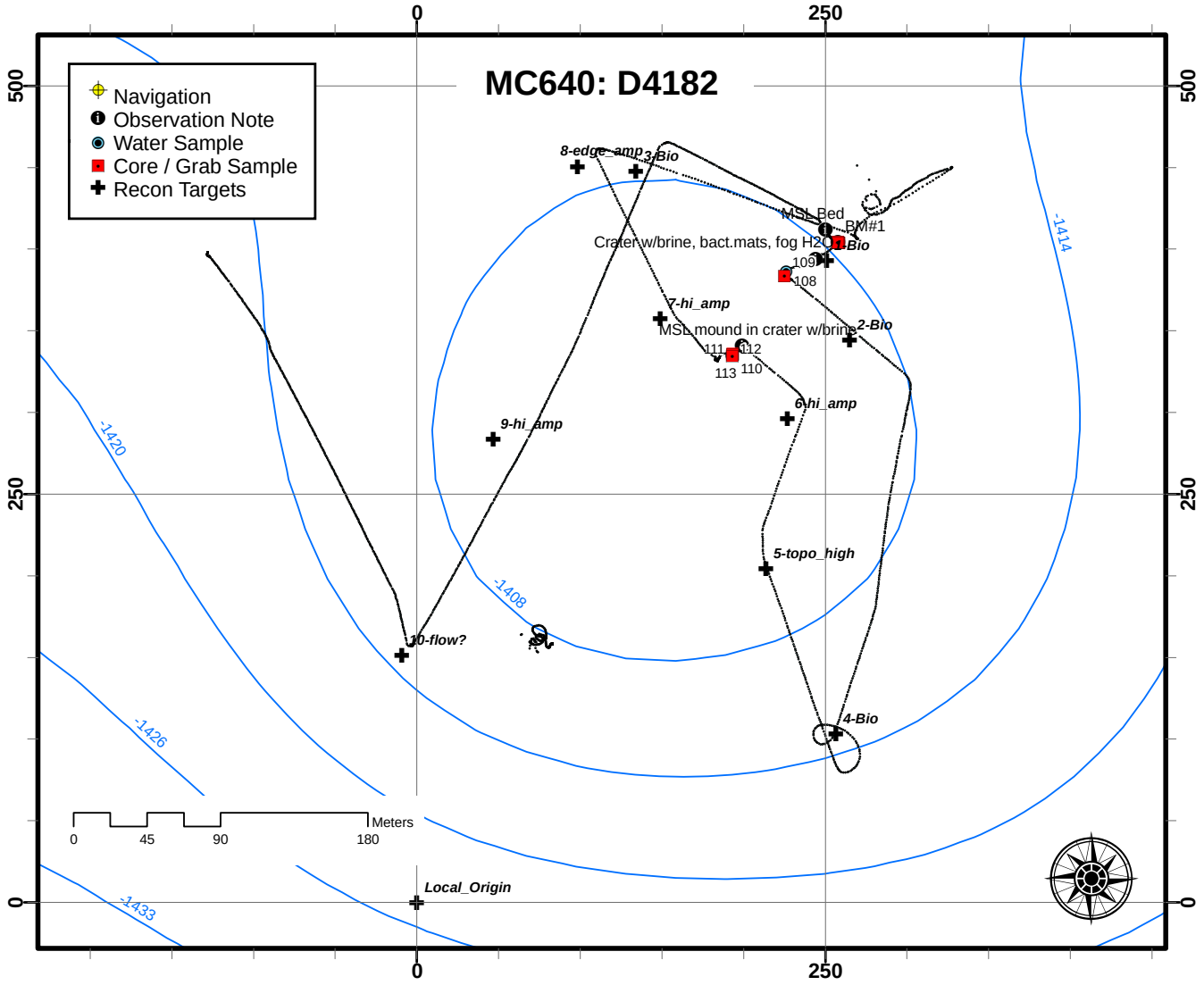

Figure 38. Dive 4182 on 5/18/2006 at an average depth of 1,410 m.

Alaminos Canyon 818

Geologic Summary of AC818

The AC818 site is located seaward of the Sigsbee Escarpment and slightly to the west of Alaminos Canyon. The site is associated with the ChevronTexaco Tiger Prospect in a water depth of approximately 2750 m. A wellhead is present in the vicinity of a well-developed chemosynthetic community discovered on an ROV survey of the immediate wellhead area. The regional geology of this region is that of a rather flat area of relatively low reflectivity on 3D seismic surface reflectivity data. Immediately to the southwest is a highly reflective area of seafloor that corresponds to a submarine fan extending seaward and to the southeast from Perdido Canyon. This fan has very high surface reflectivity on 3D seismic reflectivity data and is interpreted to be composed largely of sand. The chemosynthetic community site is located on a regional fault that trends north-northeast to south-southwest. This fault is clearly defined in seismic profile data, but the location of the known chemosynthetic community and perhaps others along the fault are not well defined on surface reflectivity data. However, there are small and very localized reflective anomalies along the fault like beads on a necklace. The lack of seismic response is probably due to the small sizes of the chemosynthetic community sites.

Direct observation from our first ALVIN dive at the AC818 community site near the wellhead confirmed the localized nature of this assemblage of chemosynthetic organisms. The seismic data suggest that there should be a number of these small communities distributed along the fault.

Site Description - AC818

Depth 2740-2750 m, Explored during ALVIN Dives 4192 and 4195.
Previous data: This site is about 50 m north of an exploratory drill site (wellhead left in place X555, Y 892). During clean-up surveys with an ROV, a small community was discovered.

Summary of dive observations:

Along a N-S fault, there is an area of diffuse seepage, as evidence by sediment stains, pogonophorans, sea urchins, and a relatively small area with tubeworms and mussels. It starts about 50 m north of the wellhead and stretches for about 50 m. After a short break, there is a second, smaller area north with two small mussel beds and one tubeworm patch. Dive 4195 explored about 350 m north of the area covered during Dive 4192 and south of the wellhead.

Bench Marker 1 (X534, Y958) in the tubeworm area. A survey at the bench marker during Dive 4195 gave X 535, Y 1013.

This area follows a fault on a north-south axis. Sediment stain and some oil bubbling out were observed. Thi site has the most active seepage colonized by tubeworms and mussels and is close to exposed carbonate. Carbonate sometimes forms overhangs and pits, with obvious bacterial stain.

Biology

Sea urchins were very common in the area where the sediment was stained (**Figure 39**). The snail *Phymorhynchus* were abundant on the stained areas. Beds of dead clam shells were also common. No live clams were observed, but five small live individuals were found in a mussel

scoop sample collected during Dive 4195. The clams that were collected were a different species from *Calyptogena ponderosa* and appear to be the same as observed in the clam beds on the sea-floor. Tubeworms (*Escarpia laminata*) are common in the central area (**Figure 40**), found close to mussels (mainly *Bathymodiolus brooksi* and a few *B. heckerae*) and spatangoid sea urchins. No *Lamellibrachia* sp. were observed on either dive. The sea-cucumber *Chiridota* sp. is very abundant in mussel beds. The shrimp collected were *Alvinocaris muricola* and a single specimen of a possibly new *Alvinocaris* species. Two species of brittle star were collected (*Ophioctenella acies* and *Ophienigma spinilimbata*).

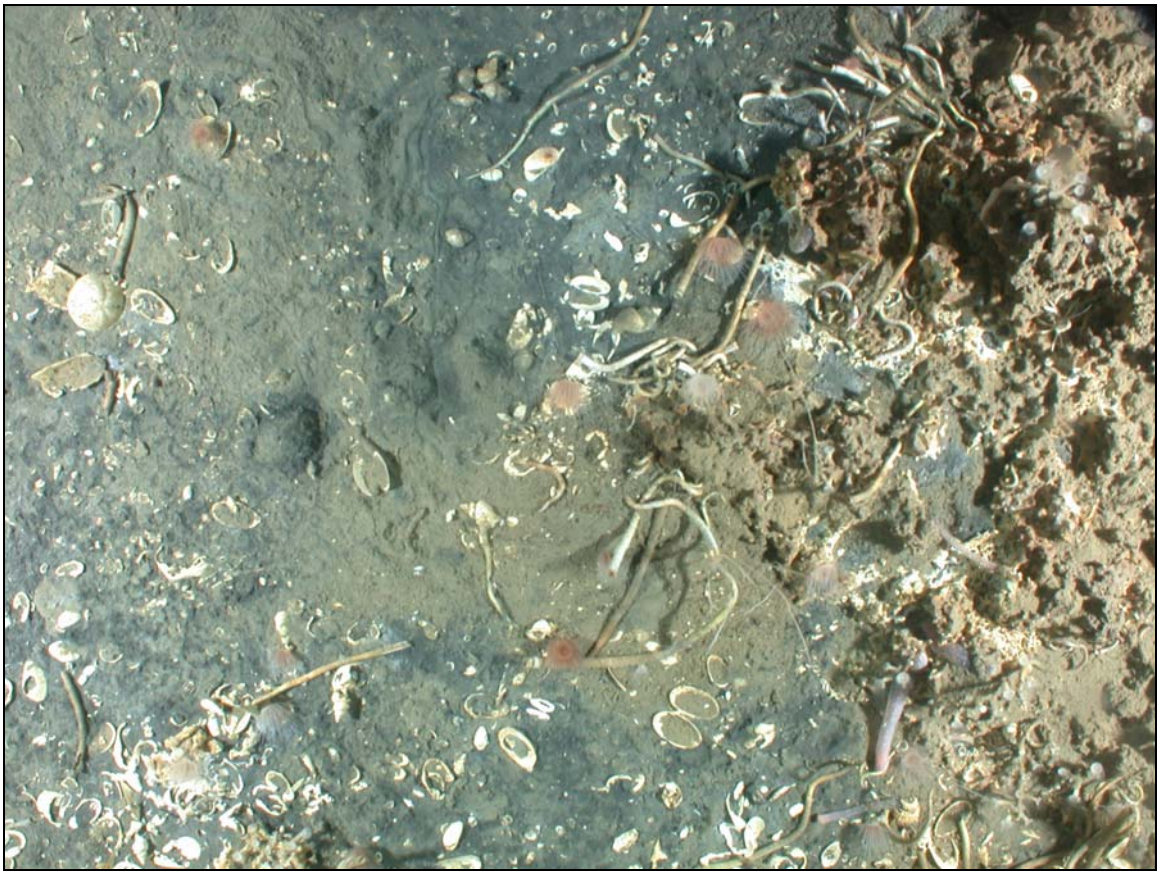

Figure 39. The AC818 site featured extensive bacterial mats and hard urchin aggregations, but relatively few and isolated tubeworm clusters. Extensive shell pavements indicate reduced flux in recent times.

Figure 40. Tubeworms at the AC818 site were stained to study their growth rate. This aggregation will be collected in 2007 to determine growth over the coming year.

Mosaic

No mosaic was done on this site, but a series of photos taken during a fly-by covers most of the area and served as a base map for the site during the second dive.

Two dives were completed at site AC818. **Figures 41-42** show the dive track of ALVIN and activities performed during the dives.

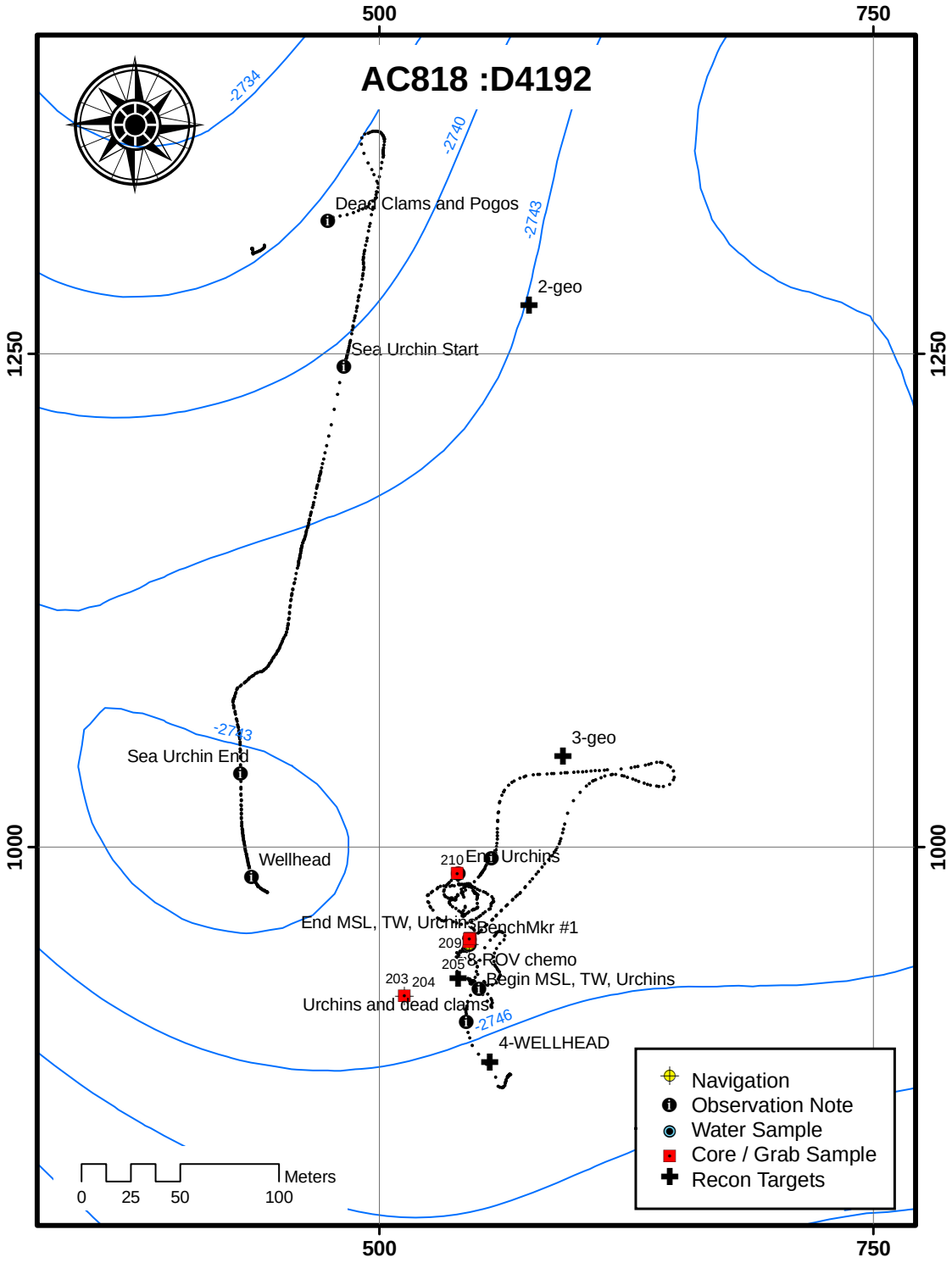

Figure 41. Dive 4192 on 5/27/2006 at an average depth of 2,740 m.

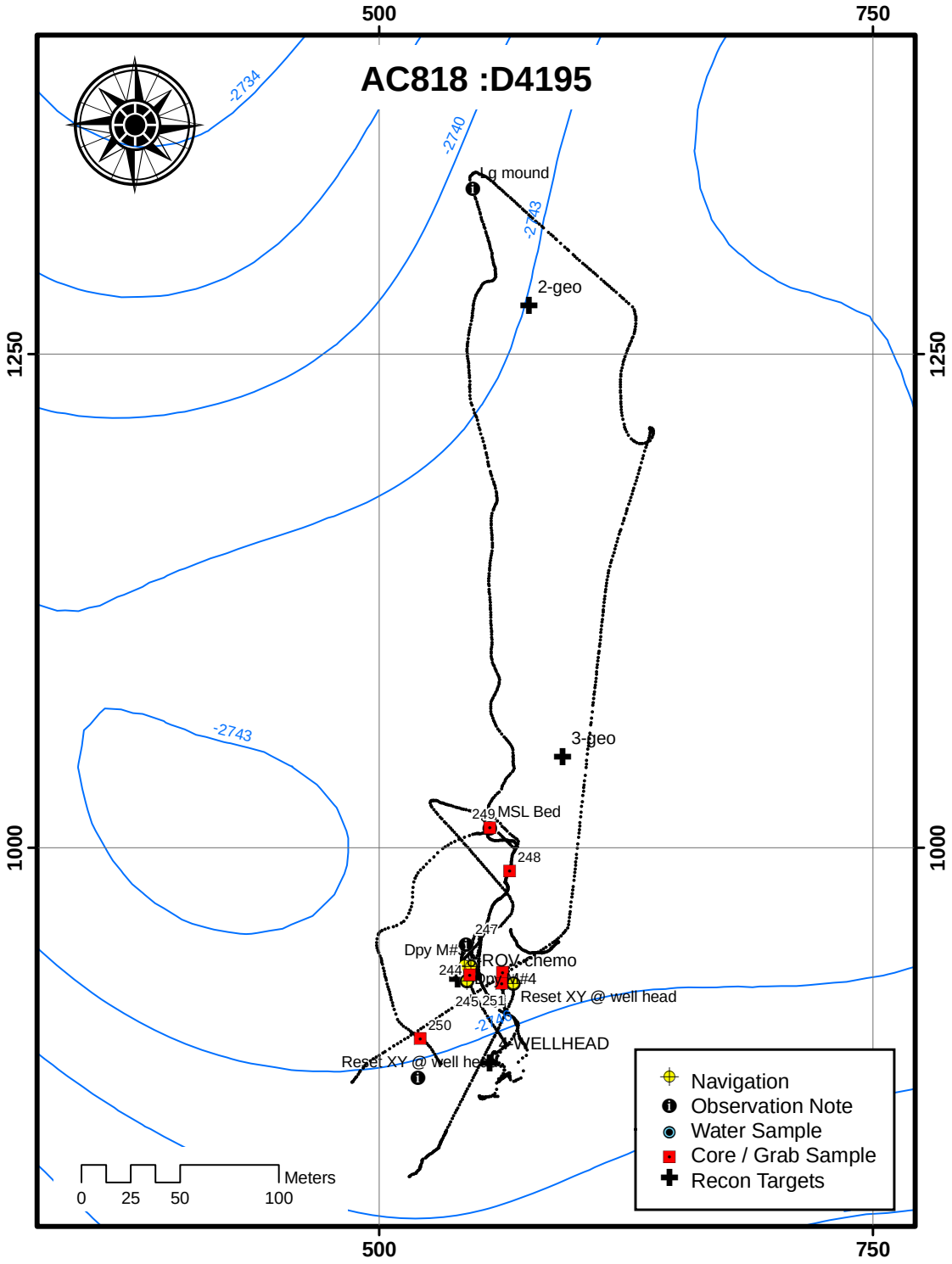

Figure 42. Dive 4195 on 5/30/2006 at an average depth of 2,740 m.

Alaminos Canyon 601

Geologic Setting: AC601

Alaminos Canyon is a reentrant into the Sigsbee Escarpment at the base of the Continental Slope off western Louisiana-eastern Texas, slightly west of the longitude of the Sabine River. From the edge of the Sigsbee Escarpment, the Alaminos Canyon extends landward a distance equivalent to 6-7 lease blocks. Our dive sites in AC601 are located in approximately the middle of the canyon and toward the eastern side. Geologically, the sites are located on the top of a breached anticline that generally trends E-W. The base of the Continental Slope is a compressional environment forced by the sedimentary loading upslope. Compressional folding characterizes the strata underlying the Louann salt sheet that is being thrust out over the basin floor. The AC601 area of interest is stratigraphically above one of these compressional features that has been fractured and faulted. The fractures and faults that breach the crestal area of the anticlinal structure provide the migration pathways for transporting fluids and gases to the modern seafloor. The AC601 block is situated directly over the breached anticline crest and consequently, there are a number of well-defined expulsion features in this block. The locations of these features are easily identified on 3D seismic surface reflectivity maps. On subsurface profiles, clear migration pathways to the seafloor can be identified. There are four major reflectivity targets and a number of smaller targets in AC601. The anomaly of interest for this project is in the NW corner of the block. It was mapped with deep tow side-scan sonar and subbottom data in the 1990s. It became clear from analysis of these data that the feature in the NW quadrant of the block was a mounded fluid and gas expulsion feature with some evidence of mudflow activity radiating from the crestal area of the mound. More recent analysis with 3D seismic data indicates high reflectivity targets associated with the mound top and a low amplitude zone to the north of the mound. The high amplitude targets at the crest and on the upper flanks of the mound suggest lithification of the seafloor which usually indicates inactivity of fluidized sediment venting, an old feature. In 2005, a MMS-sponsored ROV survey confirmed the presence of chemosynthetic communities at this site. This survey also found that the low amplitude zone to the north of the mound represented a sizeable brine lake.

Site Summary - Alaminos Canyon 601

There were several mpressions on the biology of the brine lake and environs. The first thing noticed after crossing the shoreline and moving over the lake, was an abundance of pelagic sea cucumbers. However many of these were swimming very slowly (even for a sea cucumber) and many others were not swimming at all. After poking a few it was confirmed that many were simply drifting through the “fog.” Occasional fish were seen in a similar state.

The first impression of the brine lake was that there was a clear interface and shoreline of brine, with flock aggregations of various sizes floating at this interface. Over that is a more amorphous layer that was refered to as fog. It looks almost smokey. In places, it is thick, in others, especially near some shorelines, it is almost non-existent. The brine below the visible interface is quite clear in some areas, and very cloudy in others. We possibly stirred it up a bit and it will take time to settle. We stay light and move slowly as our “bow wave” is clearly disturbing the interface. After stopping to sample, ALVIN gets just heavy enough to settle on the interface, where it floats nicely. From here the smokey layer can reach the level of the camera bar, but is sometimes below it (about 1.5 m thick). Looking out the port view-port the interface normally can be seen, but is sometimes in the murk. There are no signs of sea monkeys in the brine or in the smoke.

The shoreline, intertidal, and beach are shown in **Figure 43**. It is very similar in appearance to a beach, with areas of shell deposition, areas of what looks like sand and rocks, and areas of relatively clean beach. The fact that it is littered with trash also brings up images of beaches. There are even carbonates in the shallows that are only partially submerged in the brine. The brine on the shorelines is so clear that it is sometime hard to see. The bathymetry of the shoreline is quite variable on different areas of the lake. On the E. edge a "sand spit" was observed and the shallows extended for quite a distance. On the NW edge, it was a relatively steep dropoff. In areas where we moved along the shoreline 10 m away from the pool (the N-NE edges), an old shoreline (resembling a high tide mark) was clearly visible. Urchins could be seen and, what appeared to be pogonophorans, occasionally small mussel clumps, and very occasionally a few tubeworms on the shoreline 5-10 m from the pool.

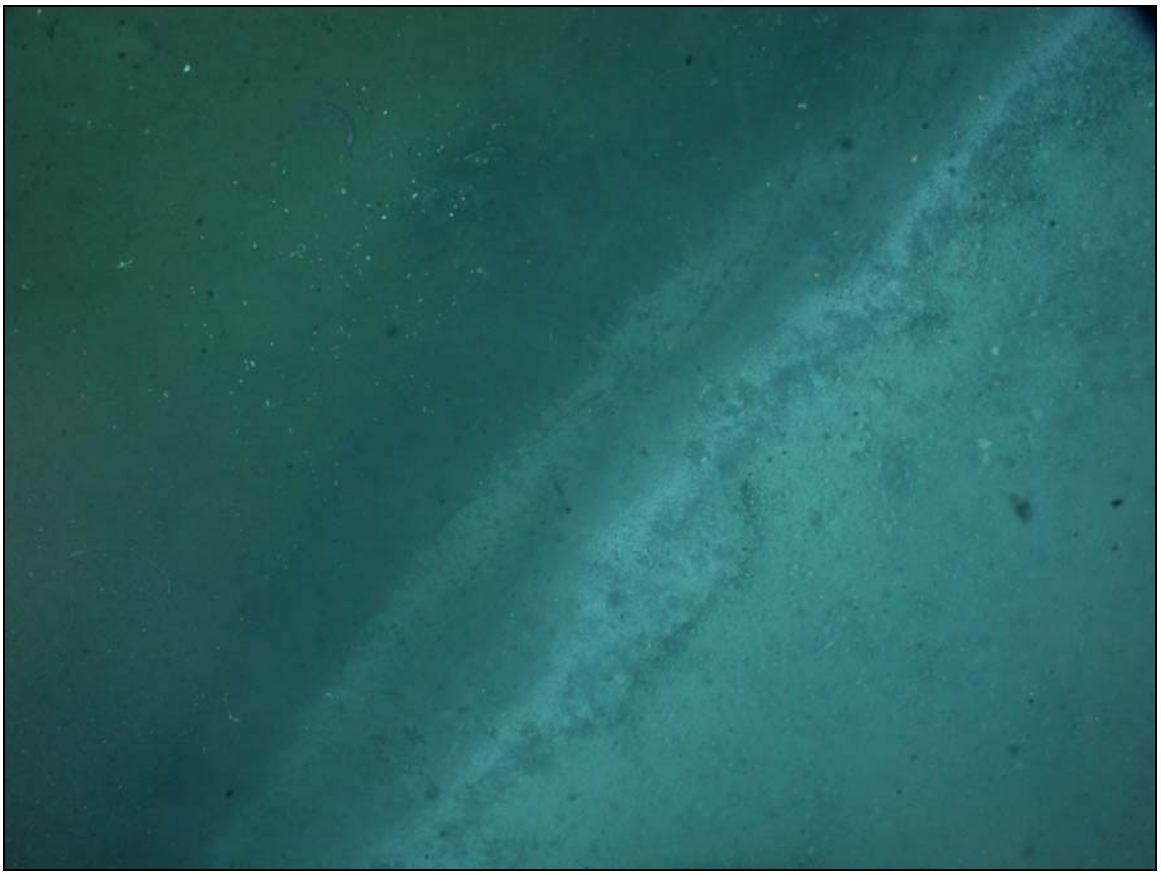

Figure 43. This image shows the shoreline of a brine pool at AC601 that was approximately 150 m in diameter. ALVIN divers were able to trace most of the edge and to collect samples of the brine with Niskin bottles operated by the submarine.

Up slope to the south, mud prevailed. The common pelagic sea cucumber was very abundant, feeding on the mud. 8-10 were often in view. Near the top of the ridge, the bigger species was moderately abundant with scattered smaller ones (3-4 in the field of view at a time). Near the tops of the ridges, usually on the flanks, scattered exposed carbonates and tubeworm clumps were observed. Many were isolated clumps without visible carbonates (one of these was collected, along with pieces of the buried carbonate it was attached to.) Many of the clumps were heavily colonized with attached fauna. They generally appeared quite old, but occasional

smaller, non-encrusted aggregations were seen. No live mussels were seen on any carbonates outcrops or anywhere except near the pool. The small area of “ridge” to the south did not seem to circle the pool, but it is a minor feature and the “ridge” was not very distinct. The sub went up when it could and detoured a bit when sonar hits were noticed. Quite a few scattered areas with a few nice tubeworm clumps and associated communities and moderate sized carbonate outcroppings were observed (**Figures 44** and **45**).

Figure 44. Two species of shrimp and epifaunal octocorals on an Escarpia tube worm at AC601.

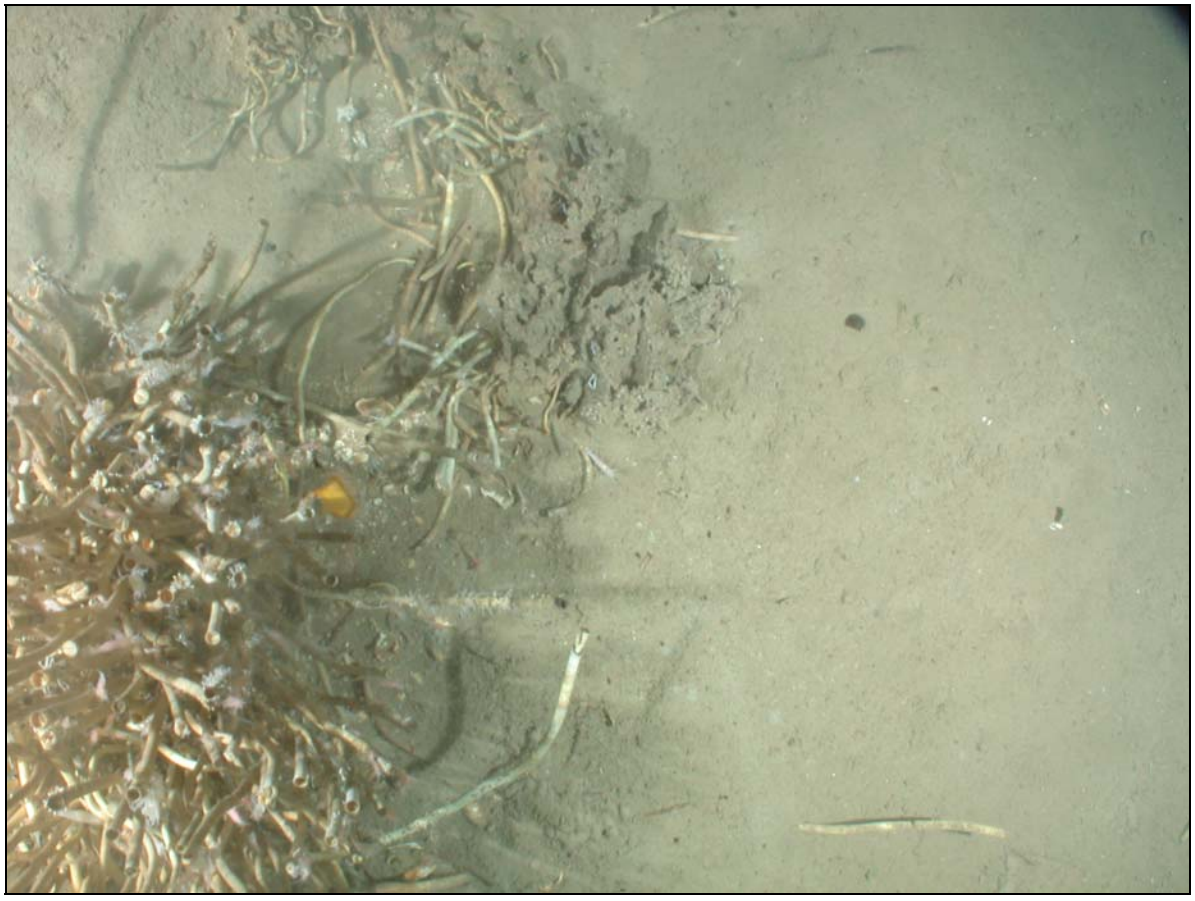

Figure 45. Chemosynthetic fauna at AC601 was restricted to isolated aggregations of tubeworms and mussels.

Two dives were completed at site AC601. **Figures 46 and 47** show the dive track of ALVIN and activities performed during the dives.

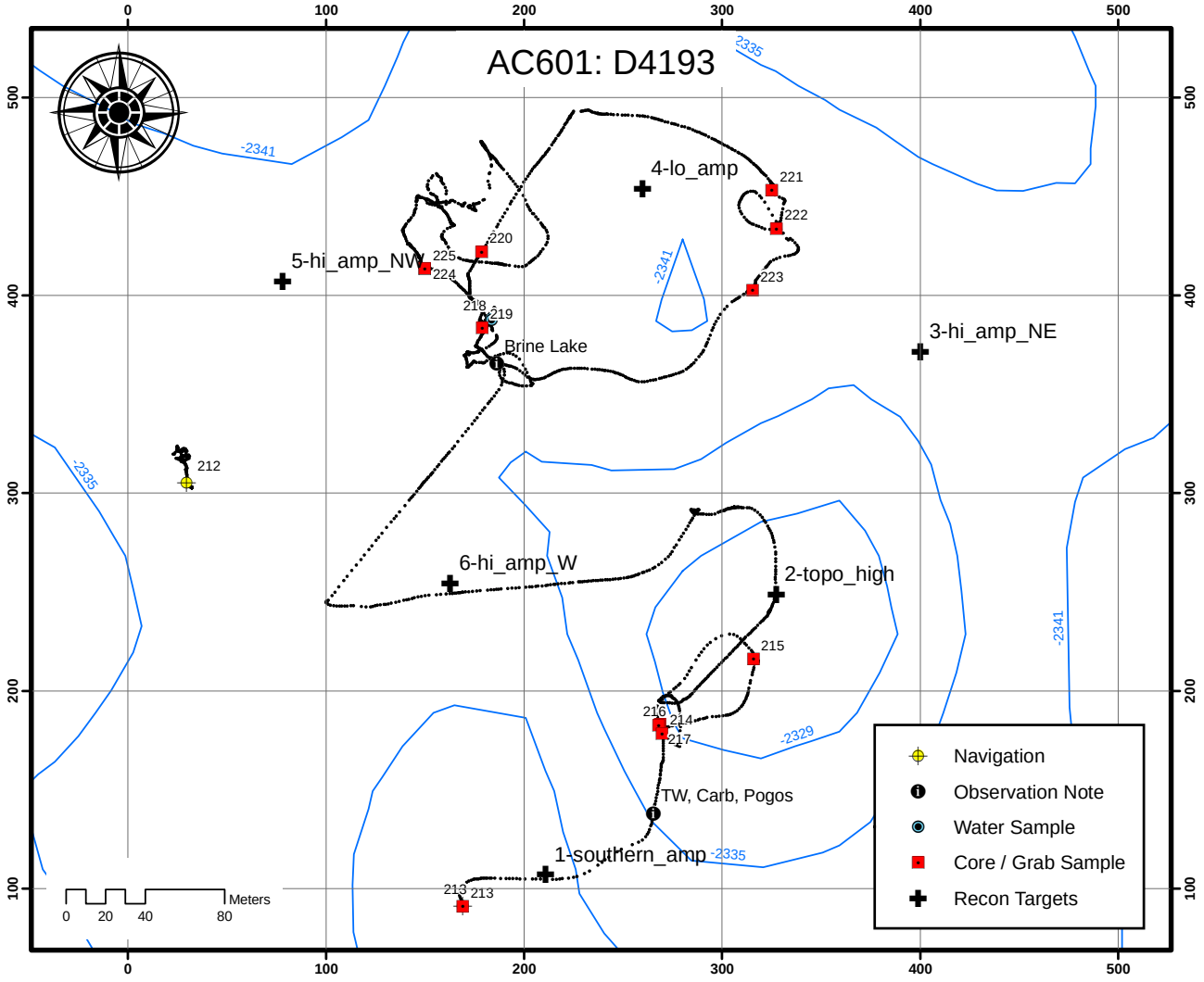

Figure 46. Dive 4193 on 5/28/2006 at an average depth of 2,330 m.

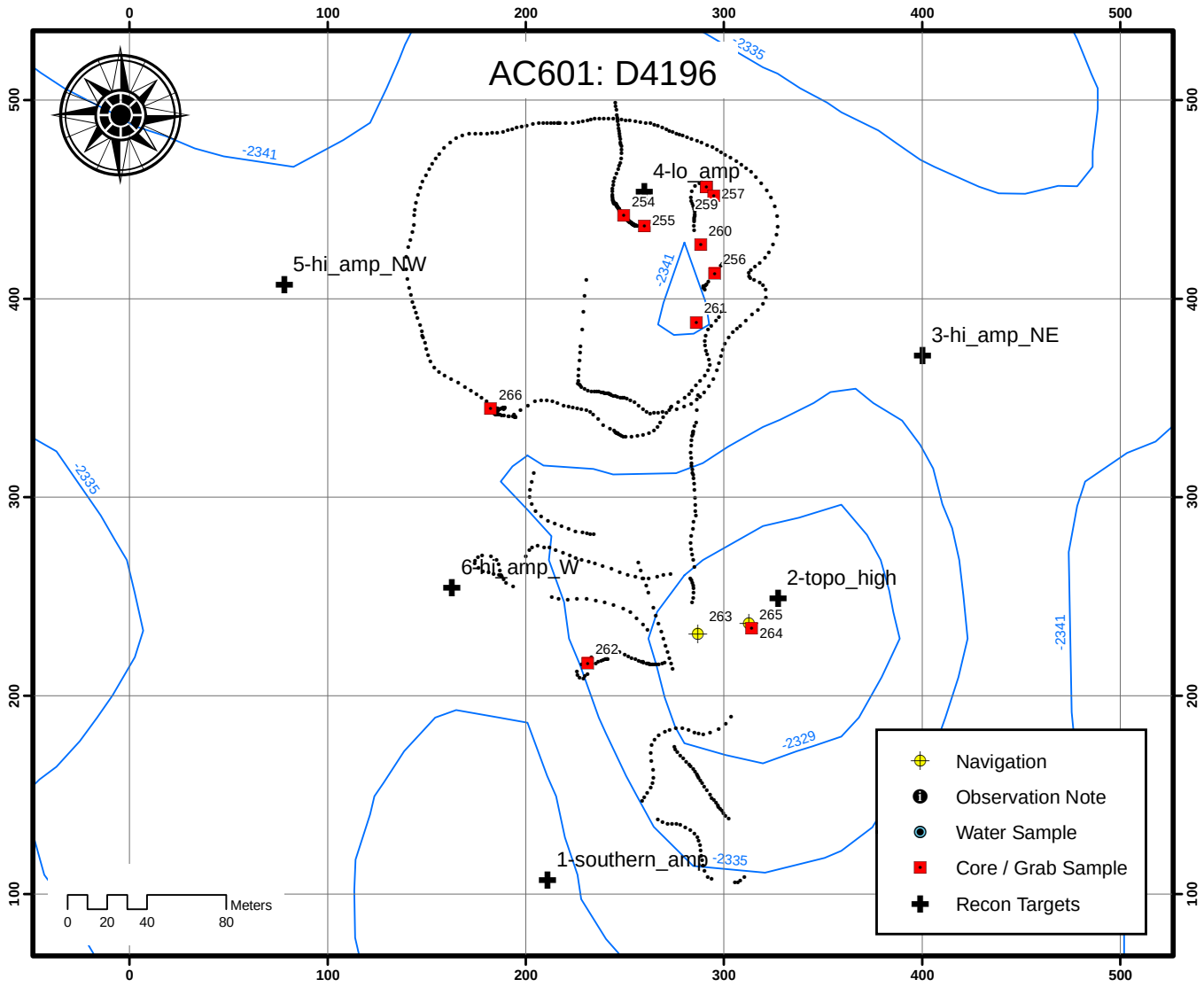

Figure 47. Dive 4196 on 5/31/2006 at an average depth of 2,330 m.

Alaminos Canyon 645

Site Description - AC645

Port Observer: Robert Carney, Dive 4194, May 29, 2006, Stbd Observer: Cindy Peterson, Pilot: Mark Speer.

The site has been surveyed as a low 1 km long E-W ridge with topographic highs at the eastern and western end. Previous ALVIN dives found abundant tubeworms (**Figure 48**) and some mussel beds associated with fractured carbonate pavement at the eastern high. The purpose of the dive was to explore for seeps at the western high and then proceed to the eastern high for sampling if sufficient material was not found.

The larger area is typical deep-sea floor covered with light brown oxidized hemipelagic sediments. Conspicuous megafauna included four holothurians (*Benthodytes typical*, *Benthodytes lingua*, *Euphronites* sp., and *Benthothurian* sp.) and a whip-like cnidarian. This non-seep fauna was found at targets four and three with no indication of seepage. Transiting to target five, a western-facing slope was encountered with fractured carbonate pavement. Tubeworms were abundant either as clusters among boulders or as a large field. Mussel beds (**Figure 49**) were also present among and adjacent to the carbonates.

Figure 48. A study site with marked tubeworms from 1993 was re-sampled during the final dive (4197). This specimen is dead, but a second individual was still alive and will provide a 13 year data point for growth rates.

Figure 49. Mussels at AC645 were coated with a white precipitate not seen at other sites.

Sediments were chemically stained. Although west and south of target five coordinates, this area of lush growth may represent that location. Progressing up slope to NE additional carbonate fields and seep fauna were encountered. Markers left in 1982 were encountered (**Figures 48** and **50**). Soft corals were scattered along the carbonates (**Figure 51**).

Figure 50. The community at AC645 was sampled by ALVIN divers in 1993. At that time, they deployed numerous markers that are still present.

Figure 51. Soft coral colonies were observed on the rocky slope to the north of the main sampling station and marker field at AC645.

Progressing NW and downslope towards target two, seep fauna and carbonates became less common and large expanses of bottom were again holothuroid and whip seapen dominated. In the vicinity of target two, an area of carbonate, tubeworms, dead clams, and mixed live/dead mussels was encountered. Following seep fauna sampling, exploration began westward, southward, eastward, and northward to determine the extent of the seep area. No new seeps were encountered. Only typical non-seep habitats exist surrounding the previously found communities.

Two dives were completed at site A645. **Figures 52** and **53** show the dive track of ALVIN and activities performed during the dives.

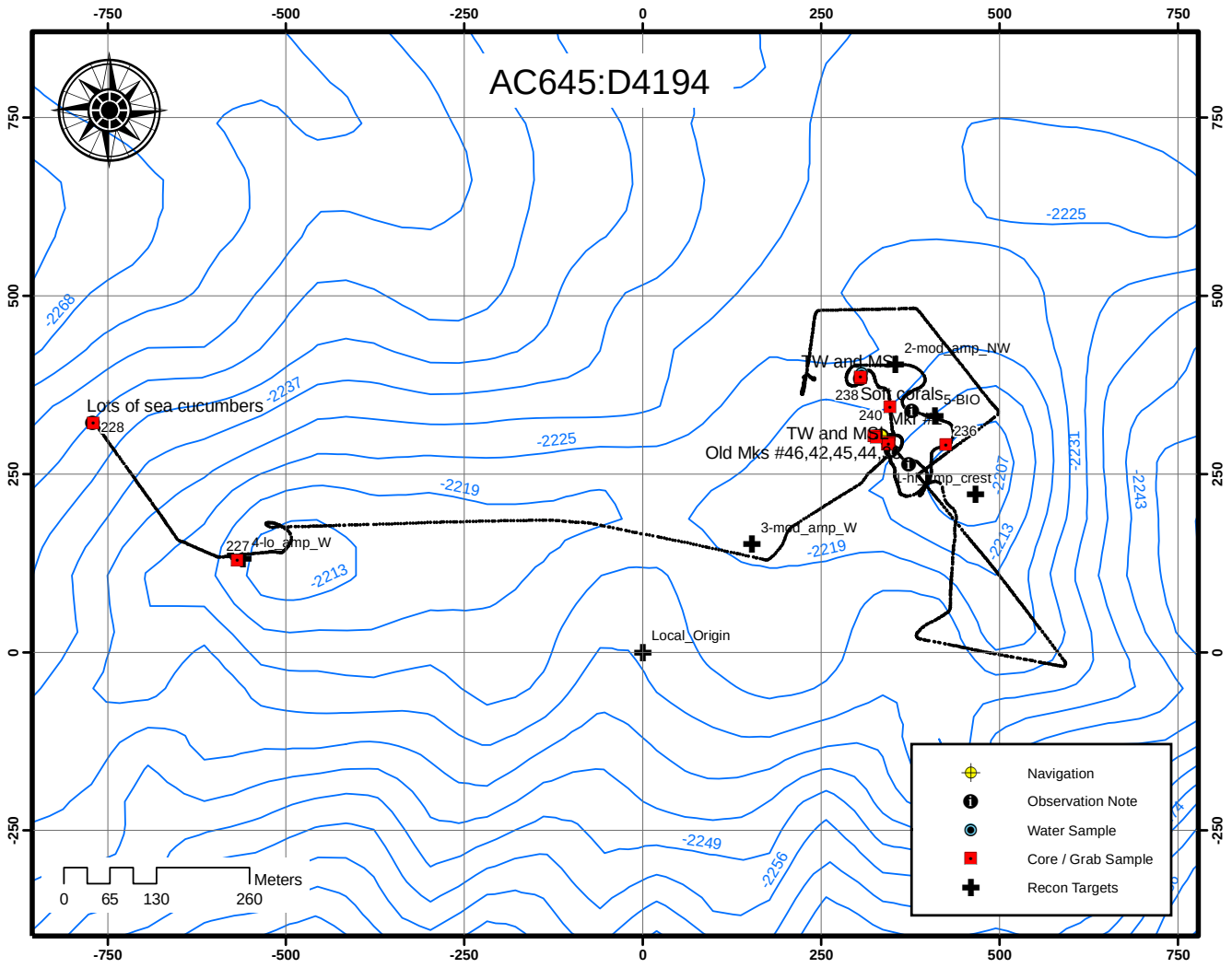

Figure 52. Dive 4194 on 5/29/2006 at an average depth of 2,240 m.

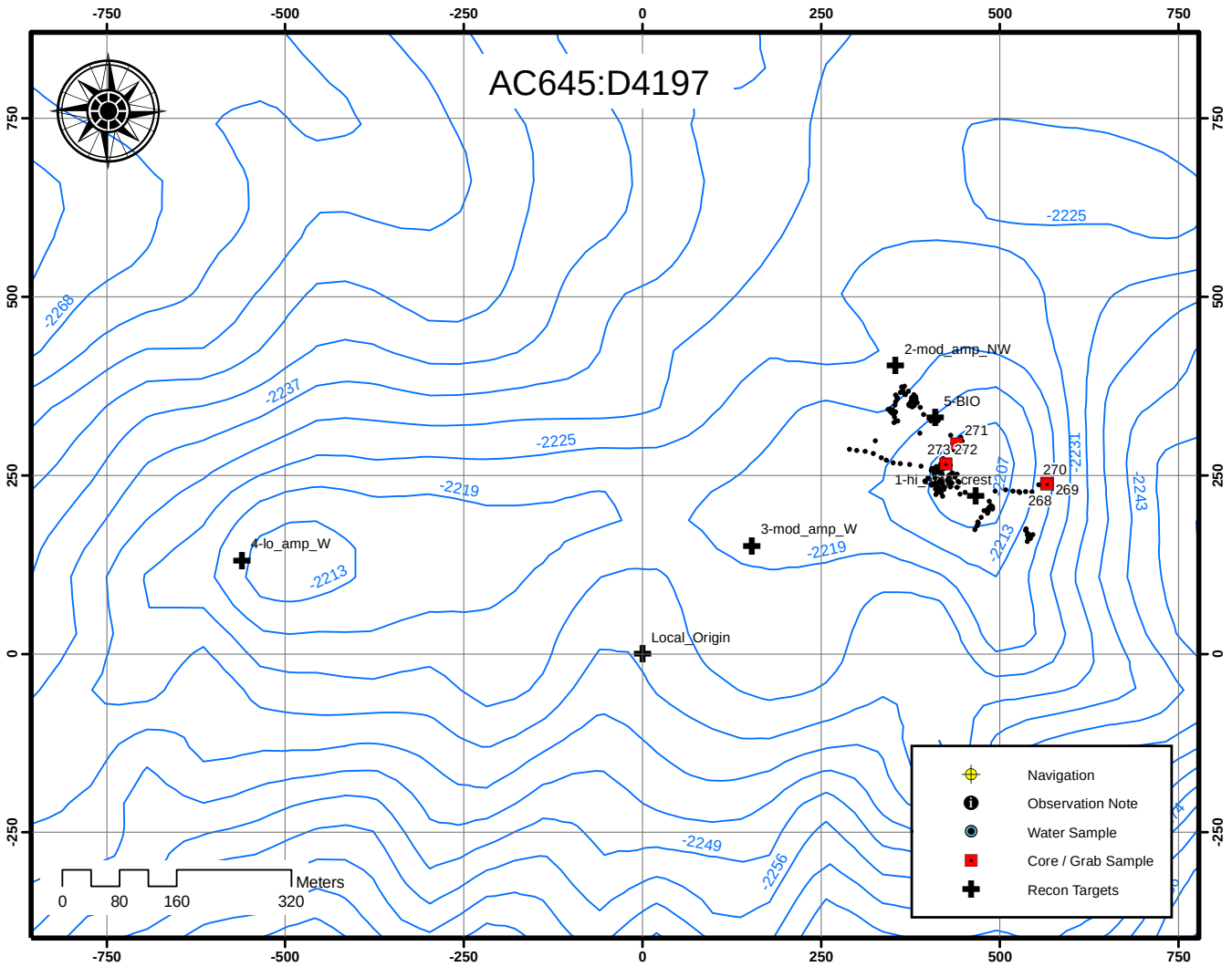

Figure 53. Dive 4197 on 6/01/2006 at an average depth of 2,200 m.

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APPENDICES

Appendix 1. Navigation Target Positions.

AT340

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N27 38.50000	W088 22.20000	0	0	
1-Launch BM	N27 38.67600	W088 21.90200	494	320	2,182
2-Mussels-BeerCan	N27 38.84577	W088 21.72023	796	630	2,216
3-Lo_Amp	N27 38.91826	W088 21.77264	711	765	2,213
4-Hi_Amp_Rim	N27 38.95293	W088 21.84751	589	830	2,218
5-Lo_Amp	N27 38.91962	W088 21.98060	369	771	2,207
6-Mussels-Mats	N27 38.82016	W088 21.99486	344	587	2,207
7-Topo_High	N27 38.63063	W088 21.90074	495	236	2,192
8-Hi_Amp	N27 38.68041	W088 21.81164	642	326	2,204
9-Geo_Focal_Point	N27 38.84309	W088 22.17553	47	633	2,213
10-Hi_Amp	N27 38.66138	W088 22.11501	143	296	2,192
11-West_Topo_Hi	N27 38.84205	W088 22.41383	-345	635	2,182
12-Tubies-Mussels	N27 38.67360	W088 21.89610	503	315	2,195
13-Orange_Mat	N27 38.74590	W088 22.02100	299	451	2,201
14-Heart_Urchins	N27 38.84020	W088 22.11320	150	627	2,200
WGS84 UTM16					
Central Meridian		W087 00.0000			
Latitude of Origin	N00 00.0000				
Scale Factor	0.999600				
False Northing				-3,058,258.71	
False Easting			135,152.20		
Local Origin					
N3058258.71m					
E364847.80m					

GC600

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N27 21.9	W090 34.7	0	0	
1	N27 22.38960	W090 34.52590	270	910	
2	N27 22.35650	W090 34.50360	307	849	
3	N27 22.16180	W090 34.28370	677	497	
4	N27 22.13070	W090 34.06731	1,035	446	
5	N27 22.29970	W090 34.33556	587	750	
6	N27 22.15775	W090 33.92080	1,276	501	
7	N27 22.12116	W090 33.94481	1,237	433	
8	N27 22.38280	W090 34.43158	425	900	
9	N27 22.46869	W090 34.51759	280	1,056	
10	N27 22.44819	W090 34.36051	540	1,023	
11	N27 22.01970	W090 33.84760	1,401	249	
12	N27 21.98000	W090 33.81300	1,460	176	
WGS84 UTM15					
Central Meridian		W093 00.0000			
Latitude of Origin	N00 00.0000				
Scale Factor	0.999600				
False Northing				-3,029,191.05	
False Easting			-239,526.99		
Local Origin					
N3029191.05m					
E739526.99m					

WR269

Target	Latitude	Longitude	X (m)	Y (m)	Depth (m)
Local_Origin	N26 40.50000	W091 40.50000	0	0	
1	N26 41.14132	W091 39.56046	1,546	1,200	
2	N26 41.14446	W091 39.74229	1,244	1,203	
3	N26 41.21387	W091 39.96005	882	1,327	
4	N26 40.99515	W091 40.17158	535	920	
5	N26 41.01827	W091 40.34520	247	960	
6	N26 40.72553	W091 40.30552	318	420	
WGS84 UTM15					
Central Meridian		W093 00.0000			
Latitude of Origin	N00 00.0000				
Scale Factor	0.999600				
False Northing				-2,951,123.79	
False Easting			-131,843.00		
Local Origin					
N2951123.79m					
E631843.00m					

KC243

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local Origin	N26 43.7	W092 50.0	0	0	1,672
1-mussels	N26 43.81200	W092 49.83500	273	207	1,656
2-tubeworms	N26 43.83600	W092 49.86600	222	251	1,656
3-geo	N26 43.87339	W092 49.78109	362	321	1,650
WGS84 UTM15					
Central Meridian		W093 00.0000			
Latitude of Origin	N00 00.0000				
Scale Factor	0.999600				
False Northing				-2,956,357.08	
False Easting			-16,575.43		
Local Origin					
N2956357.08m					
E516575.43m					

GC852

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N27 06.1	W091 10.2	0	0	
1-tubes_mussels	N27 06.320	W091 09.962	387	412	
2-mussels_tubes	N27 06.378	W091 09.959	391	519	
3-soft_corals	N27 06.586	W091 09.927	438	904	
4-red_soft_coral	N27 06.626	W091 09.975	358	977	
5-soft_reflector	N27 06.20083	W091 09.93492	435	193	
6-high_reflector	N27 06.49466	W091 10.09557	162	731	
7-topo_high	N27 06.60334	W091 10.01904	286	934	
8-geo_reflector	N27 06.72200	W091 09.86759	533	1,157	
9-topo_high_reflector	N27 06.87347	W091 09.79281	652	1,438	
10-Jason_geoA	N27 07.09276	W091 09.95591	377	1,839	
11-Jason_geoB	N27 07.21342	W091 09.95762	371	2,062	
12-Jason_geoC	N27 07.14364	W091 09.82149	597	1,936	
WGS84 UTM15					
Central Meridian		W093 00.0000			
Latitude of Origin	N00 00.0000				
Scale Factor	0.999600				
False Northing				-2,999,016.02	
False Easting			-181,418.40		
Local Origin					
N2999016.02m					
E681418.40m					

MC853

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N28 07.0000	W089 08.7000	0	0	
1-IanA	N28 07.64310	W089 08.46960	398	1,181	
2-IanB	N28 07.64610	W089 08.60440	178	1,191	
3-topo_high	N28 07.38005	W089 08.38549	527	693	
4-geoA	N28 07.31668	W089 08.54517	264	580	
5-geoB	N28 07.12567	W089 08.26496	716	220	
6-geoC	N28 07.23794	W089 08.15560	899	424	
new_mussel_bed	N28 07.61990	W089 08.47970	381	1,139	
Previous_Marker_C 3	N28 07.60411	W089 08.53554	289	1,111	
WGS84 UTM16					
Central Meridian		W087 00.0000			
Latitude of Origin	N00 00.0000				
Scale Factor	0.999600				
False Northing				-3,111,985.51	
False Easting			210,701.78		
Local Origin					
N3111985.51m					
E289298.22m					

MC640

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N28 21.2	W088 47.7	0	0	
1-Bio	N28 21.4147	W088 47.5508	250	393	
2-Bio	N28 21.3885	W088 47.5411	265	344	
3-Bio	N28 21.4436	W088 47.6221	134	448	
4-Bio	N28 21.2580	W088 47.5443	256	103	
4-hi_amp	N28 21.25792	W088 47.57867	200	104	
5-topo_high	N28 21.31234	W088 47.57106	214	204	
6-hi_amp	N28 21.36221	W088 47.56422	226	296	
7-hi_amp	N28 21.39477	W088 47.61252	148	358	
8-edge_amp	N28 21.44488	W088 47.64491	97	451	
9-hi_amp	N28 21.35398	W088 47.67408	47	284	
10-flow?	N28 21.28187	W088 47.70783	-11	151	
WGS84 UTM16					
Central Meridian		W087 00.0000			
Latitude of Origin	N00 00.0000				
Scale Factor	0.999600				
False Northing				-3,137,652.93	
False Easting			175,925.82		
Local Origin					
N3137652.93m					
E324074.18m					

AC818

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N26 10.3	W094 37.7	0	0	
3-geo	N26 10.87071	W094 37.35272	592	1,046	
7-geo	N26 10.39953	W094 37.61391	146	182	
2-geo	N26 10.99434	W094 37.36435	575	1,275	
1-geo	N26 11.10067	W094 37.32450	644	1,470	
5-geo	N26 10.73630	W094 37.37069	559	799	
WELLHEAD	N26 10.78663	W094 37.37362	555	892	
6-geo	N26 10.60057	W094 37.50598	330	551	
ROV chemo	N26 10.80933	W094 37.38367	539	934	
WGS84 UTM15					
Central Meridian		W093 00.0000			
Latitude of Origin	N00 00.0000				
Scale Factor	0.999600				
False Northing				-2,895,715.18	
False Easting			162,735.70		
Local Origin					
N2895715.18m					
E337264.30m					

AC601

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N26 23.3	W094 31.0	0	0	
2-topo_high	N26 23.43701	W094 30.80559	326	249	
1-southern_amp	N26 23.35948	W094 30.87494	209	107	
3-hi_amp_NE	N26 23.50382	W094 30.76258	399	372	
4-lo_amp	N26 23.54766	W094 30.84760	259	454	
5-hi_amp_NW	N26 23.52115	W094 30.95653	77	407	
6-hi_amp_W	N26 23.43895	W094 30.90413	162	255	
WGS84 UTM15					
Central Meridian		W093 00.0000			
Latitude of Origin	N00 00.0000				
Scale Factor	0.999600				
False Northing				-2,919,580.57	
False Easting			151,292.71		
Local Origin					
N2919580.57m					
E348707.29m					

AC645

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N26 21.1	W094 30.1	0	0	
1-hi_amp_crest	N26 21.22265	W094 29.82120	466	221	
2-mod_amp_NW	N26 21.32091	W094 29.89063	353	404	
3-mod_amp_W	N26 21.18310	W094 30.00991	152	152	
4-lo_amp_W	N26 21.16761	W094 30.43800	-561	131	
WGS84 UTM15					
Central Meridian		W093 00.0000			
Latitude of Origin	N00 00.0000				
Scale Factor	0.999600				
False Northing				-2,915,501.39	
False Easting			149,843.49		
Local Origin					
N2915501.39m					
E350156.51m					

Appendix 2. Niskin Log.

Site	Dive #	Niskin #	Collection Date	Collection Time	Used for	By	Processed
MC853	4178	1	5/14/2006	not fired	--	--	--
MC853	4178	2	5/14/2006	19:01	gas analysis	Joye	5/14/2006
MC853	4178	3	5/14/2006	19:01	gas analysis	Joye	5/14/2006
MC853	4178	4	5/14/2006	16:45	gas analysis	Joye	5/14/2006
MC853	4178	5	5/14/2006	16:45	gas analysis	Joye	5/14/2006
AT340	4179	1	5/15/2006	not fired	--	--	--
AT340	4179	2	5/15/2006	not fired	--	--	--
AT340	4179	3	5/15/2006	not fired	--	--	--
AT340	4179	4	5/15/2006	not fired	--	--	--
AT340	4179	5	5/15/2006	16:27	gas analysis	Joye	5/15/2006
AT340	4180	1	5/16/2006	not fired	--	--	--
AT340	4180	2	5/16/2006	18:56	gas analysis	Joye	5/16/2006
AT340	4180	3	5/16/2006	18:32	gas analysis	Joye	5/16/2006
AT340	4180	4	5/16/2006	17:42	gas analysis	Joye	5/16/2006
AT340	4180	5	5/16/2006	17:17	gas analysis	Joye	5/16/2006
AT340	4181	1	5/17/2006	16:22	gas analysis	Joye	5/17/2006
AT340	4181	2	5/17/2006	not fired	--	--	--
AT340	4181	3	5/17/2006	19:39	gas analysis	Joye	5/17/2006
AT340	4181	4	5/17/2006	not fired	--	--	--
AT340	4181	5	5/17/2006	not fired	--	--	--
GC 600	4182	1	5/18/2006	15:37	gas analysis	Joye	5/18/2006
GC 600	4182	2	5/18/2006	15:37	gas analysis	Joye	5/18/2006
GC 600	4182	3	5/18/2006	16:25	gas analysis	Joye	5/18/2006
GC 600	4182	4	5/18/2006	16:25	gas analysis	Joye	5/18/2006
GC 600	4182	5	5/18/2006	17:42	gas analysis	Joye	5/18/2006

Site	Dive #	Niskin #	Collection Date	Collection Time	Used for	By	Processed
GC 852	4189	1	5/24/2006	17:09	gas analysis	Joye	5/24/2006
GC 852	4189	2	5/24/2006	17:09	gas analysis	Joye	5/24/2006
GC 852	4189	3	5/24/2006	17:09	gas analysis	Joye	5/24/2006
GC 852	4189	4	5/24/2006	18:03	gas analysis	Joye	5/24/2006
GC 852	4189	5	5/24/2006	18:03	gas analysis	Joye	5/24/2006
WR 269	4190	1	5/25/2006	18:13	gas analysis	Joye	5/25/2006
WR 269	4190	2	5/25/2006	18:13	gas analysis	Joye	5/25/2006
WR 269	4190	3	5/25/2006	18:13	gas analysis	Joye	5/25/2006
WR 269	4190	4	5/25/2006	18:13	gas analysis	Joye	5/25/2006
WR 269	4190	5	5/25/2006	18:13	gas analysis	Joye	5/25/2006
AC 818	4191	1	5/26/2006	16:13	gas analysis	Joye	5/26/2006
AC 818	4191	2	5/26/2006	17:13	gas analysis	Joye	5/26/2006
AC 818	4191	3	5/26/2006	18:02	gas analysis	Joye	5/26/2006
AC 818	4191	4	5/26/2006	18:02	gas analysis	Joye	5/26/2006
AC 818	4191	5	5/26/2006	18:41	gas analysis	Joye	5/26/2006
AC 601	4193	1	5/28/2006	17:08	gas analysis	Joye	5/28/2006
AC 601	4193	2	5/28/2006	17:08	gas analysis	Joye	5/28/2006
AC 601	4193	3	5/28/2006	17:08	gas analysis	Joye	5/28/2006
AC 601	4193	4	5/28/2006	17:08	gas analysis	Joye	5/28/2006
AC 601	4193	5	5/28/2006	17:08	gas analysis	Joye	5/28/2006
AC 645	4194	1	5/29/2006	17:07	gas analysis	Joye	5/29/2006
AC 645	4194	2	5/29/2006	17:07	gas analysis	Joye	5/29/2006
AC 645	4194	3	5/29/2006	17:07	gas analysis	Joye	5/29/2006
AC 645	4194	4	5/29/2006	18:41	gas analysis	Joye	5/29/2006
AC 645	4194	5	5/29/2006	18:41	gas analysis	Joye	5/29/2006

Appendix 3. CTD Log.

Date	Site	CTD Cast #	# bottles tripped
5/15/2006	AT 340	1	23
5/17/2006	AT 340	2	20
5/20/2006	GC 852	3	18
5/22/2006	GC 852	4	20
5/22/2006	GC 852	5	21
5/29/2006	AC 601	6	23
5/31/2006	AC 601	7	23

Appendix 4. Hard Corals.

Dive Number	Date	Sample Description
4190	25-May-2006	One hard coral sample, tentative identification, *Solenosmilia variabilis*

Appendix 5. Hydrocarbon Analysis Samples

Site	Crude Oil Samples (Jars)		Site	Gas Samples (Cans)
AT340	4173-Y2			Blank
	4173-R3		AT340	4173-Y6
GC600	4174-Pot		GC600	4174-Y5
	4174-Y2			4174-Y6
	4174-Y4		KC243	4176-R1
	4174-R1		GC852	4177-R4
WR269	4175-Y5			4177-R3
KC243	4176-Rk/Sed		MC853	4178-Y1
	4176-R1			4178-R5
GC852	4177-R4			4178-Y6
MC853	4178-Y2			4178-R3
	4178-R4		MC640	4182-R6
MC640	4182-R2		AT340	4183-R4
	4182-R6			4183-Y3
AT340	4183-R5		GC600	4184-Y3
	4183-R4			4184-Y6
	4183-R5		GC852	4189-R6
GC600	4184-Y4		WR269	4191-R6
	4184-R5		AC818	4192-Y1
GC852	4189-R6		AC601	4193-R2
WR269	4191-R6		AC601	4196-Y4
AC818	4192-Y1			
AC601	4193-Y2			
AC818	4195-Y2 (small sample)			
AC601	4196-Y4			

Appendix 6. Authigenic Carbonate Samples

Dive Number	Dive Site	Date	Comments
4173	AT 340	5/9/2006	4 samples (3 mussel grab, 1 tube worms)
4174	GC 600	5/10/2006	3 samples
4175	WR 269	5/11/2006	No sample
4176	KC 243	5/12/2006	2 samples (mussel scoop)
4177	GC 852	5/13/2006	2 samples (mussel scoop)
4178	MC 853	5/14/2006	2 samples (carb. slab, barite)
4179	AT 340	5/15/2006	1 sample
4180	AT 340	5/16/2006	1 sample (large block)
4181	AT 340	5/17/2006	1 sample (small sample-mussel pot #2)
4182	MC 640	5/18/2006	2 samples (large slab, frags mussel scoop,aft)
4183	AT 340	5/19/2006	2 small samples (bushmaster, baby tubies)
4184	GC 600	5/20/2006	4 samples (2 slabs clam site#1, 2 bags frags clam site #2)
4185	GC 852	5/21/2006	3 rock samples (near benchmark)
4186	GC 852	5/22/2006	2 samples (TW site/bushmaster bag)
Trawl AT-6	GC 852	5/22/2006	3 samples (scale and carbonates)
4187	GC 852	5/23/2006	2 samples (top mound/mussel pot)
4188	GC 852	5/24/2006	Lost dive-sub power problems
4190	GC 852	5/25/2006	Hard coral sample
4191	WR 269	5/26/2006	1 rock sample
4192	AC 818	5/27/2006	1 small bag rocks (mussel pot), 1 small rock from biobox
4193	AC 601	5/28/2006	1 large rock sample (ridge crest), 1 small rock sample (scoop net)
4194	AC 645	5/29/2006	2 large rock samples(bottom and top of mound)
4195	AC 818	5/30/2006	2 large rock samples, 1 bag of small rocks-mussel scoop, 1 bag of small rocks-bushmaster
4196	AC 601	5/31/2006	2 rock samples, 1 group of rock samples, bushmaster
4197	AC 645	6/1/2006	2 large samples (top mound), 1 sample (base of mound)

Appendix 7. Core Log.

Site	Dive #	Core #	Collected	Used for	By	Processed
AT340	4173	Y1	5/9/2006	porewater	Joye	5/9/2006
AT340	4173	Y2	5/9/2006	microbiol	Joye/Bright	5/9/2006
AT340	4173	Y3	5/9/2006	animals	Bright	5/10/2006
AT340	4173	Y4	5/9/2006	rates	Joye	5/10/2006
AT340	4173	Y5	5/9/2006	animals	Bright	5/10/2006
AT340	4173	Y6	5/9/2006	hydrocarb	Bernard	5/10/2006
AT340	4173	R1	5/9/2006	porewater	Joye	5/9/2006
AT340	4173	R2	5/9/2006	??	??	??
AT340	4173	R3	5/9/2006	hydrocarb	Bernard	5/10/2006
AT340	4173	R4	5/9/2006	rates	Joye	5/10/2006
AT340	4173	R5	5/9/2006	microbiol	Joye/Bright	5/10/2006
AT340	4173	R6	5/9/2006	microbiol	Joye/Bright	5/10/2006
GC600	4174	Y1	5/10/2006	animals	Bright	5/11/2006
GC600	4174	Y2	5/10/2006	porewater	Joye	5/10/2006
GC600	4174	Y3	5/10/2006	NO CORE	--	--
GC600	4174	Y4	5/10/2006	microbiol	Joye/Bright	5/11/2006
GC600	4174	Y5	5/10/2006	hydrocarb	Bernard	5/11/2006
GC600	4174	Y6	5/10/2006	NO CORE	--	--
GC600	4174	R1	5/10/2006	rates	Joye	5/11/2006
GC600	4174	R2	5/10/2006	animals	Bright	5/11/2006
GC600	4174	R3	5/10/2006	animals	Bright	5/11/2006
GC600	4174	R4	5/10/2006	rates	Joye	5/11/2006
GC600	4174	R5	5/10/2006	microbiol	Joye/Bright	5/11/2006
GC600	4174	R6	5/10/2006	porewater	Joye	5/10/2006
GC852	4177	R1	5/13/2006	porewater	Joye	5/13/2006
GC852	4177	R2	5/13/2006	microbiol	Joye/Bright	5/14/2006
GC852	4177	R3	5/13/2006	??	??	??
GC852	4177	R4	5/13/2006	??	??	??
GC852	4177	R5	5/13/2006	rates	Joye	5/14/2006
GC852	4177	R6	5/13/2006	rates	Joye	5/14/2006
MC853	4178	Y1	5/14/2006	animals	Bright	5/15/2006
MC853	4178	Y2	5/14/2006	porewater	Joye	5/14/2006
MC853	4178	Y3	5/14/2006	microbiol	Joye/Bright	5/15/2006
MC853	4178	Y4	5/14/2006	rates	Joye	5/15/2006

Site	Dive #	Core #	Collected	Used for	By	Processed
MC853	4178	Y5	5/14/2006	rates	Joye	5/15/2006
MC853	4178	Y6	5/14/2006	anim/hyd	Bright/Bernard	5/15/2006
MC853	4178	R1	5/14/2006	rates	Joye	5/15/2006
MC853	4178	R2	5/14/2006	microbiol	Joye/Bright	5/15/2006
MC853	4178	R3	5/14/2006	animals	Bright	5/15/2006
MC853	4178	R4	5/14/2006	porewater	Joye	5/14/2006
MC853	4178	R5	5/14/2006	anim/hyd	Bright/Bernard	5/15/2006
MC853	4178	R6	5/14/2006	rates	Joye	5/15/2006
AT340	4181	R3	5/17/2006	Rates	Niemann	5/17/2006
AT340	4181	R4	5/17/2006	Rates	Niemann	5/17/2006
AT340	4181	R5	5/17/2006	Squeeze	Joye	5/17/2006
MC640	4182	Y1	5/18/2006	NO CORE	--	--
MC640	4182	Y2	5/18/2006	NO CORE	--	--
MC640	4182	Y3	5/18/2006	Squeeze	Joye	5/18/2006
MC640	4182	Y4	5/18/2006	Squeeze	Joye	5/18/2006
MC640	4182	Y5	5/18/2006	rates	Joye	5/19/2006
MC640	4182	Y6	5/18/2006	microbiol	Joye	5/19/2006
MC640	4182	R1	5/18/2006	NO CORE	--	--
MC640	4182	R2	5/18/2006	Squeeze	Joye	5/18/2006
MC640	4182	R3	5/18/2006	rates	Joye	5/19/2006
MC640	4182	R4	5/18/2006	rates	Joye	5/19/2006
MC640	4182	R5	5/18/2006	micro/hydro	Joye/Bernard	5/19/2006
MC640	4182	R6	5/18/2006	microbiol	Joye/Bernard	5/19/2006
AT340	4183	Y1	5/19/2006	rates	Niemann	5/19/2006
AT340	4183	Y2	5/19/2006	Squeeze	Joye	5/19/2006
AT340	4183	Y3	5/19/2006	Squeeze	Joye	5/19/2006
AT340	4183	Y4	5/19/2006	macrofau	Cordez	5/18/2006
AT340	4183	Y5	5/19/2006	overfull	--	--
AT340	4183	Y6	5/19/2006	macrofau	Cordez	5/19/2006
AT340	4183	R1	5/19/2006	macrofau	Cordez	5/19/2006
AT340	4183	R2	5/19/2006	Squeeze	Joye	5/19/2006
AT340	4183	R3	5/19/2006	Trode	Joye	5/20/2006
AT340	4183	R4	5/19/2006	rates	Joye	5/20/2006
AT340	4183	R5	5/19/2006	rates	Joye	5/20/2006
AT340	4183	R6	5/19/2006	overfull	--	--
GC 600	4184	R1	5/20/2006	macrofau	Bright	5/20/2006

Site	Dive #	Core #	Collected	Used for	By	Processed
GC 600	4184	R2	5/20/2006	macrofau	Bright	5/20/2006
GC 600	4184	R3	5/20/2006	macrofau	Bright	5/20/2006
GC 600	4184	R4	5/20/2006	rocks	--	--
GC 600	4184	R5	5/20/2006	rocks	--	--
GC 600	4184	R6	5/20/2006	rocky	Bernard?	--
GC 600	4184	Y1	5/20/2006	rates	Joye	5/20/2006
GC 600	4184	Y2	5/20/2006	trode/micro	Joye	5/20/2006
GC 600	4184	Y3	5/20/2006	rates	Joye	5/20/2006
GC 600	4184	Y4	5/20/2006	take home	Joye	5/20/2006
GC 600	4184	Y5	5/20/2006	rates	Joye	5/20/2006
GC 600	4184	Y6	5/20/2006	squeeze	Joye	5/20/2006
GC 852	4189	R1	5/24/2006	Trode	Joye	5/24/2006
GC 852	4189	R2	5/24/2006	rates	Joye	5/24/2006
GC 852	4189	R3	5/24/2006	Squeeze	Joye	5/24/2006
GC 852	4189	R4	5/24/2006	trode/micro	Joye	5/24/2006
GC 852	4189	R5	5/24/2006	take home	Joye	5/24/2006
GC 852	4189	R6	5/24/2006	hydrocarb	Bernard	5/24/2006
GC 852	4189	Y1	5/24/2006	trode/sque	Joye	5/24/2006
GC 852	4189	Y2	5/24/2006	lost	--	--
GC 852	4189	Y3	5/24/2006	lost	--	--
GC 852	4189	Y4	5/24/2006	NO CORE	--	--
GC 852	4189	Y5	5/24/2006	tubeworm	Niemann	5/24/2006
GC 852	4189	Y6	5/24/2006	tubeworm	Niemann	5/24/2006
WR 269	4191	R1	5/26/2006	macrofau	Bright	5/26/2006
WR 269	4191	R2	5/26/2006	rates	Joye	5/26/2006
WR 269	4191	R3	5/26/2006	rates	Joye	5/26/2006
WR 269	4191	R4	5/26/2006	macrofau	Bright	5/26/2006
WR 269	4191	R5	5/26/2006	macrofau	Bright	5/26/2006
WR 269	4191	R6	5/26/2006	hydrocarb	Bernard	5/26/2006
WR 269	4191	Y1	5/26/2006	trode/faun	Joye/Bright	5/26/2006
WR 269	4191	Y2	5/26/2006	rates (MOG)	Joye	5/26/2006
WR 269	4191	Y3	5/26/2006	take home	Joye	5/26/2006
WR 269	4191	Y4	5/26/2006	trode/micro	Joye	5/26/2006
WR 269	4191	Y5	5/26/2006	squeeze	Joye	5/26/2006
WR 269	4191	Y6	5/26/2006	NO CORE	--	--
AC 818	4192	R1	5/27/2006	??	??	

Site	Dive #	Core #	Collected	Used for	By	Processed
AC 818	4192	R2	5/27/2006	??	??	
AC 818	4192	R3	5/27/2006	??	??	
AC 818	4192	R4	5/27/2006	??	??	
AC 818	4192	R5	5/27/2006	??	??	
AC 818	4192	R6	5/27/2006	rates	Joye	5/27/2006
AC 818	4192	Y1	5/27/2006	hydrocarb	Bern	5/27/2006
AC 818	4192	Y2	5/27/2006	trodes	Joye	5/27/2006
AC 818	4192	Y3	5/27/2006	microbiol	Joye	5/27/2006
AC 818	4192	Y4	5/27/2006	molecular	Joye	5/27/2006
AC 818	4192	Y5	5/27/2006	rates	Joye	5/27/2006
AC 818	4192	Y6	5/27/2006	rates (MOG)	Joye	5/27/2006
AC 601	4193	R1	5/28/2006	??	??	5/29/2006
AC 601	4193	R2	5/28/2006	squeeze	Joye	5/29/2006
AC 601	4193	R3	5/28/2006	geol	Roberts	5/28/2006
AC 601	4193	R4	5/28/2006	geol	Roberts	5/28/2006
AC 601	4193	R5	5/28/2006	trode/micro	Joye	5/29/2006
AC 601	4193	R6	5/28/2006	rates	Joye	5/23/2006
AC 601	4193	Y1	5/28/2006	squeeze	Joye	5/28/2006
AC 601	4193	Y2	5/28/2006	rates	Joye	5/29/2006
AC 601	4193	Y3	5/28/2006	tubeworm	Niemann	5/28/2006
AC 601	4193	Y4	5/28/2006	tubeworm	Niemann	5/28/2006
AC 601	4193	Y5	5/28/2006	rates	Joye	5/29/2006
AC 601	4193	Y6	5/28/2006	squeeze	Joye	5/29/2006
AC 645	4194	R1	5/29/2006	Girguis	Cordes	5/29/2006
AC 645	4194	R2	5/29/2006	microbiol	Joye	5/29/2006
AC 645	4194	R3	5/29/2006	hydrocarb	Roberts	5/30/2006
AC 645	4194	R4	5/29/2006	geol	Roberts	5/30/2006
AC 645	4194	R5	5/29/2006	take home	Joye	5/29/2006
AC 645	4194	R6	5/29/2006	take home	Joye	5/29/2006
AC 645	4194	Y1	5/29/2006	microbiol	Joye	5/29/2006
AC 645	4194	Y2	5/29/2006	rates	Joye	5/29/2006
AC 645	4194	Y3	5/29/2006	molecular	Joye	5/29/2006
AC 645	4194	Y4	5/29/2006	NO CORE	--	--
AC 645	4194	Y5	5/29/2006	rates (MOG)	Joye/Bernard	5/30/2006
AC 645	4194	Y6	5/29/2006	squeeze	Joye	5/29/2006

Site	Dive #	Core #	Collected	Used for	By	Processed
AC 601	4196	R1	5/31/2006	rates	Joye	5/31/2006
AC 601	4196	R2	5/31/2006	rates (MOG)	Joye	5/31/2006
AC 601	4196	R3	5/31/2006	microbiol	Joye	5/31/2006
AC 601	4196	R4	5/31/2006	rates	Joye	5/31/2006
AC 601	4196	R5	5/31/2006	Squeeze	Joye	5/31/2006
AC 601	4196	R6	5/31/2006	Geochem	Roberts	5/31/2006
AC 601	4196	Y1	5/31/2006	rates	Joye	5/31/2006
AC 601	4196	Y2	5/31/2006	rates	Joye	5/31/2006
AC 601	4196	Y3	5/31/2006	rate	Joye	5/31/2006
AC 601	4196	Y4	5/31/2006	Geochem	Roberts	5/31/2006
AC 601	4196	Y5	5/31/2006	microbiol	Joye	5/31/2006
AC 601	4196	Y6	5/31/2006	Squeeze	Joye	5/31/2006

Appendix 8. Trawl Log.

Trawl # 1	**Inventory ID AT-1**						
Site		Atwater Valley 340	2276m depth				
Pos:		27 30.00N 88 22.00W		to	27 42.00N	88 26.00W	
Date:		9 May, 2006					
Time:		Start - 11:45pm	On Bottom- 13:50	Off Bottom 15:25			
Notes: Trawl hung on bottom at 14:40, ship's position 27 39.9375. Pulled free at 7000lbs tension. Wood, iron scale, clinkers, and coal suggest remote possibility of shipwreck.Trawl with ~ 20L mud. Good catch, see inventory. Typical holothuroid/sponge collection for this depth.							
Trawl # 2	**Inventory ID AT-2**						
Site:		Walker Ridge 269	2000m depth				
Date:		11 May, 2006					
Pos:		26 40.00N 91 34.00W to 26 44.00N 91 38.00W					
Time:		Start - 15:37		On Bottom - 16:58	Off Bottom 18:00		
Notes: Trawl with ~ 10L mud							
Trawl # 3	**Inventory ID AT-3**						
Site:		Atwater Valley 340		2200m depth			
Date:		14 May, 2006					
Pos:		27 37.00N 88 24.00W to 27 37.00N 88 18.00W					
Time:		Start - 23:15		On Bottom - 00:55	Off Bottom 02:05		
Notes: Good sample with minimal mud and numerous holothuroids							
Trawl # 4	**Inventory ID AT-4**						
Site:		Atwater Valley 340	2372m depth				
Date:		16 May, 2006					
Pos:		27 37.00N	88 17.00W	to	27 41.00N	88 21.00W	

Time:		Start - 18:15	On Bottom - 19:50	Off Bottom -20:50			
Notes: Small sample similar in content to other AT 340 trawls. Minimal mud.							
Trawl #5	**Inventory ID AT-5**						
Site:	Green Canyon 852						
Date:	21 May, 2006						
Pos:	27 0.45N 91 08.5W	to	27 08.0N	91 08.5W			
Time:	Start - 16:10	On Bottom - 17:15	Off Bottom -	18:15			
Notes: Apparently near-bottom water tow with ~ 6 shrimp. Strong surface current made speed during lowering greater than 3 knots.							
Trawl #6	**Inventory ID AT-6**						
Site:	Green Canyon 852						
Date:	23-May-10						
Pos:	27 08.0N	91 11.5W	to	27 04.0N	91 11.5W		
Time:	Start - 16:30	On Bottom - 17:33	Off Bottom - 18:35				
Notes: Small sample size.							
Trawl #7	**Inventory ID AT-7**						
Site:	Green Canyon 852						
Date:	23 May, 2006						
Pos:	27 09.9N	91 11.5W	to	27 04.0	91 11.5W		
Time:	Start - 17:15	On Bottom - 18:35	Off Bottom 13:35				
Notes: Net inverted. Few speciemens.							
Trawl #8	**Inventory ID AT-8**						
Site:		Green Canyon 852					

Date:	25 May, 2006						
Pos:	26 09.00N	91 11.5W	to	27 04.00	91 11.5W		
Time:	Start -16:45	On Bottom - 18:30	Off Bottom - 19:30				
Notes: Strong and opposing surface versus bottom currents make trawling difficult. Added 5lb weight to cod end. Small catch, Umbellula, holothuroids, etc							
Trawl #9	**Inventory ID AT-9**						
Site:		Alaminos Canyon 818					
Date:		27 May, 2006					
Pos:		08.0N	94 36.6W	to	26 12.0N	94 36.6W	
Time:	Start - 18:20	On Bottom - 20:30	Off Bottom - 21:30				
Notes: Modest catch Holothurians, sponges, ophiuroids.							
Trawl #10	**Inventory ID AT-10**						
Site:		Alaminos Canyon 818					
Date:		31-May-10					
Pos:		26 05.0N	94 36.5W	to	26 11.0N	94 36.5W	
Time:	Start - 17:35	On Bottom - 19:20	Off Bottom - 20:55				
Notes: Slow recovery due to washing of cable and frequent adjustment of level wind. Modest catch with good variety, octopus, squid, fish, ophiuroids, holothuroids, and many sponges.							

Appendix 9. Pre-dive plans.

AT340
Dive #4173

Date 5/09/2006 Cruise AT 15-03 Site AT340
Pilot: Mark Port: Erik Cordes Starboard: Bernie Bernard

Launch Target
N27 38.84577 W088 21.72023
X 5397, Y 7102 Depth 2216 m

Equipment:
Push Core Rack, Medium Biobox, 2 mussel pots,
Milk crate for rocks, Suction pump sampler, collection net
Markers: one site bench marker, 1 ball, one ball plus float, two Ian markers

Tasks:
i) watch for opportunities to collect softball sized pieces of carbonates. Three total over the dive is good: document setting, location, and rock with a pic
ii) watch for opportunities to collect random fauna (crabs, big snails, starfish, Sea cukes…). use either nets or suction

1) Sit down facing North. and navigate in the sub (30 minutes, do it right).
If this is a nice spot, deploy the Bench Marker
If not a nice spot, then move to one and deploy the bench marker
2) turn on the Fornari digital camera. Head to Target 1 (original launch target) Take a look around. Head to target 8 on the way to target 11. Look around here and adjacent target 6(60-90 minutes)
Note locations of tubeworm clumps, mussel beds, mats, carbonates etc.
3) Pick a nice mussel bed and set down to take two mussel pots. (30 – 60 min)
Take 2 mussel pots from within the same bed.
Make sure you image the ring before picking it up
Leave Liz and Cindys experiment in a ”ring scar”
Stick low T probe into the mud and read (have camera on it and the t will display in the video.
Leave an Ian marker
4) Find a nice bacterial mat and take 6 push cores. (20 – 30 min)
If you havn’t seen one, head to target 12 and then 5
5) Find some tubeworms. (60 min)
Sit down and take 2 Niskins if not too stirred up.
Take 6 pushcores close to tubies.
Leave a marker here.
If good for BM or growth, then do not collect
If NOA good for either , then collect some into biobox
Mark this spot with Ian marker if it is a good one
6) Find another mussel bed to mosaick. Deploy 2 markers (with balls) within area. Collect

images for mosaick (60 min)

6.5) head up towards Target 3 while you are looking for rocks and animals. Then go towards Target 2

7) still no rocks collected. Find and collect 2 or three from different locations

8) How about mobile fauna? go suck and net some up.

9) If time remains call topside for targets.

Planned Collections: 12 pushcores, 2 mussel pots, 10 – 20 tubeworms, water, 3 carbonates, assorted fauna.

Targets (Origin = 27°35N, 88°25W)

Target	Latitude	Longitude	X	Y	Depth
1	N27 38.84577	W088 21.72023	5397	7102	2216
Launch, mussel bed and isolated tubies					
2	N27 38.91826	W088 21.77264	5311	7236	2213
3	N27 38.96198	W088 21.83758	5204	7317	2218
4	N27 38.91962	W088 21.98060	4969	7239	2207
5	N27 38.82016	W088 21.99486	4945	7055	2207
Scattered mussels and mats					
6	N27 38.63063	W088 21.90074	5100	6705	2192
7	N27 38.68041	W088 21.81164	5247	6797	2204
8	N27 38.77387	W088 21.78625	5289	6970	2213
9	N27 38.66138	W088 22.11501	4748	6799	2192
10	N27 38.84205	W088 22.41383	4256	7095	2182
11	N27 38.67360	W088 21.89610	5108	6784	2195
Tubeworm clumps and mussel bed					
12	N27 38.74590	W088 22.02100	4902	6918	2201
Bacterial mats (orange and white)					
13	N27 38.84020	W088 22.11320	4751	7092	2200
Heart urchins					

AT340
Dive #4179

Date 5/15/2006 Cruise AT 15-03 Site AT340
Pilot: Bruce Port: Chuck Starboard: Stephanie

Launch Target
Launch BM_(LatLon) N27 38.67600 W088 21.90200
Depth 2200 m

Equipment:
Bushmaster, stainer, biobox, Suction pump sampler, niskins, fishtrap
Markers: 1 ball, one ball plus float, two new markers

Plan:
Head to launch target and find the Bench marker. Set down at a heading of 60°, get a fix, then set XY appropriately.
Deploy the fish trap in this area.
Find some tubies to stain (here or towards target 11).
Fire a niskin
stain ‘em
Deploy a marker
Find another to stain and do it again
Find one to collect
Fire a niskin
Collect it
Move to target 11 and find the most excellent mussel bed. Get xy
Move to target 01 and find the beer mussel bed confirm xy
Deploy 2 scale markers here
fire remaining niskins
do a mosaick
Collect a net of mussels nearby
Fire a niskin after setting down
Move to target 02 and look around
Move to target 03 and look around

Planned Collections: bushmaster, water, carbonates, mussels and assorted fauna.

Targets

New_Origin N27 38.50000 W088 22.20000

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
New_Origin	N27 38.50000	W088 22.20000	0	0	
Launch BM_(LatLon)	N27 38.67600	W088 21.90200	494	320	2,182
1-Mussels-BeerCan	N27 38.84577	W088 21.72023	796	630	2,216
2-Lo_Amp	N27 38.91826	W088 21.77264	711	765	2,213
3-Hi_Amp_Rim	N27 38.95293	W088 21.84751	589	830	2,218
4-Lo_Amp	N27 38.91962	W088 21.98060	369	771	2,207
5-Mussels-Mats	N27 38.82016	W088 21.99486	344	587	2,207
6-Topo_High	N27 38.63063	W088 21.90074	495	236	2,192
7-Hi_Amp	N27 38.68041	W088 21.81164	642	326	2,204
8-Geo_Focal_Point	N27 38.84309	W088 22.17553	47	633	2,213
9-Hi_Amp	N27 38.66138	W088 22.11501	143	296	2,192
10-West_Topo_Hi	N27 38.84205	W088 22.41383	-345	635	2,182
11-Tubies-Mussels	N27 38.67360	W088 21.89610	503	315	2,195
12-Orange_Mat	N27 38.74590	W088 22.02100	299	451	2,201
13-Heart_Urchins	N27 38.84020	W088 22.11320	150	627	2,200
BM_XY	N27 38.70738	W088 21.94736	420	378	2,182
Old_Origin	N27 35.0000	W088 25.0000	-4,678	-6,411	

AT340
Dive #4180

Date 5/16/2006 Cruise AT 15-03
Pilot: Gavin Port: Erik Starboard: Jill

Launch Target
Launch BM_(LatLon) N27 38.67600 W088 21.90200
Depth 2200 m

Equipment:
Bushmaster, stainer, biobox, net, niskins
Markers: Three new markers

Plan:
Head to launch target and find the Bench marker. Set down at a heading near 60°, get a fix, then set XY to X 494, Y 320 and use DVL Nav
Check out fish trap in this area (just look, don't touch)
Find some tubies to stain or collect (I found them to be somewhat abundant about 50 m NE of here at x 542, y 369: there should also be some around target 11). I stained medium to medium-small worms. You should stain some bigger ones, and perhaps some smaller ones. If you see some lamellibrachia, those would be good, to collect or stain…
To stain:
Fire a niskin
stain 'em (fill to overflowing around the base and leave it for 7 minutes with a 10 – 15 second bump of stain every 2 – 3 minutes, then pump back. Watch the overflow on the return and do it gently)
Stow the stainer
Deploy a marker
Take a picture
Find another to stain and do it again
And do it again.
Find one to collect.
Fire a niskin
Collect it
Now you are looking for a good mussel bed for the scoop and also exploring to better know this site. I suggest that you move towards target 12 then towards 7 and then towards 8 (in this area). These are all geo targets so take notes. Also note that #7 is supposed to be on a topo high that is fairly focused. Try and find the top of this mound to ground truth our bathymetry. As you check out a target, do not be afraid to check out a 50 m area around it as our nav is not perfect…
Move to target 03 and look around
Move to target 04 and look around

Planned Collections: bushmaster, water, carbonates, mussels and assorted fauna.

Targets

New_Origin N27 38.50000 W088 22.20000

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
New_Origin	N27 38.50000	W088 22.20000	0	0	
1-Launch BM_(LatLon)	N27 38.67600	W088 21.90200	494	320	2,182
2-Mussels-BeerCan	N27 38.84577	W088 21.72023	796	630	2,216
3-Lo_Amp	N27 38.91826	W088 21.77264	711	765	2,213
4-Hi_Amp_Rim	N27 38.95293	W088 21.84751	589	830	2,218
5-Lo_Amp	N27 38.91962	W088 21.98060	369	771	2,207
6-Mussels-Mats	N27 38.82016	W088 21.99486	344	587	2,207
7-Topo_High	N27 38.63063	W088 21.90074	495	236	2,192
8-Hi_Amp	N27 38.68041	W088 21.81164	642	326	2,204
9-Geo_Focal_Point	N27 38.84309	W088 22.17553	47	633	2,213
10-Hi_Amp	N27 38.66138	W088 22.11501	143	296	2,192
11-West_Topo_Hi	N27 38.84205	W088 22.41383	-345	635	2,182
12-Tubies-Mussels	N27 38.67360	W088 21.89610	503	315	2,195
13-Orange_Mat	N27 38.74590	W088 22.02100	299	451	2,201
14-Heart_Urchins	N27 38.84020	W088 22.11320	150	627	2,200
Old_Origin	*N27 35.0000*	*W088 25.0000*	*-4,678*	*-6,411*	

Site AT340
Dive #4181

Date 5/17/2006 Cruise AT 15-03
Pilot: Mark Port: Harry Starboard: Guy

Launch Target
West_Topo_Hi N27 38.84205 W088 22.41383
Depth 2180 m

Equipment:
Push Core Rack, Medium Biobox, 1 mussel pots, 1 small bio box, chem. Profiler, Niskin rack, Suction pump sampler, lined collection net, smaller net
Markers: two Ian markers

General notes: This dive has 6 general objectives
1) to boldly go where no one has gone before (and take notes)
2) to test the chem. profiler
3) to collect pushcores and urchins to characterize this community
4) to make a paired mussel pot and mussel bag collection
5) collect some push cores near tubeworms
6) to bring up the fish trap and Liz's experiments. Leave one hour at the end to make sure you get this done

Tasks:
1)Dive on target 11, the Western most geo target. Look around as needed.
a) If at any time during the dive you see some tubeworms in sediment:
i) stop, sniff them with the chemical profiler (around their plumes and around their bases,
ii) fire a niskin,
iii) take 3 push cores as close to the tubes as possible.
b) If at any time during the dive you see a nice bed of live mussels:
i) stop, sniff them with the chemical profiler (at several points right over the mussels)
ii) fire a nisken
iii) make a mussel pot collection
iv) make a net collection of mussels in to larger biobox
v) deploy a marker
2) go to target 9 "geo focal point" and look around. Hey, what the heck, grab a rock.
3) If you have not already seen a good urchin community, head to target 14 and find some urchins plowing trails through the seep stained sediments
- a) fire a niskin
- b) use the chem. Profiler
- c) take 9 pushcores
- d) Use the net in the small biobox to collect a 3-6 urchins
- e) deploy a marker

4) Evaluate time and power. If you are doing well with dive objectives and have extra time, head to target 5 and look around
5) Still no mussels? Head by target 6 where we saw some on the survey cruise and follow directions for 1b.
6) Go to target 1. find the bench marker (#1).
Still not tubeworm root cores for Helge? This is a good place.
Pick up Liz's experiments into one of the bioboxes
Pick up the fish trap
7) Time left, head to target 10 and look around.

Planned Collections: 12 pushcores, 1 mussel pot, one mussel net, 1 urchin net, carbonates, water, fish trap, E&O experiment

Targets

New_Origin N27 35.00000 W088 25.00000

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
New_Origin	N27 38.50000	W088 22.20000	0	0	
1-Launch BM_(LatLon)	N27 38.67600	W088 21.90200	494	320	2,182
2-Mussels-BeerCan	N27 38.84577	W088 21.72023	796	630	2,216
3-Lo_Amp	N27 38.91826	W088 21.77264	711	765	2,213
4-Hi_Amp_Rim	N27 38.95293	W088 21.84751	589	830	2,218
5-Lo_Amp	N27 38.91962	W088 21.98060	369	771	2,207
6-Mussels-Mats	N27 38.82016	W088 21.99486	344	587	2,207
7-Topo_High	N27 38.63063	W088 21.90074	495	236	2,192
8-Hi_Amp	N27 38.68041	W088 21.81164	642	326	2,204
9-Geo_Focal_Point	N27 38.84309	W088 22.17553	47	633	2,213
10-Hi_Amp	N27 38.66138	W088 22.11501	143	296	2,192
11-West_Topo_Hi	N27 38.84205	W088 22.41383	-345	635	2,182
12-Tubies-Mussels	N27 38.67360	W088 21.89610	503	315	2,195
13-Orange_Mat	N27 38.74590	W088 22.02100	299	451	2,201
14-Heart_Urchins	N27 38.84020	W088 22.11320	150	627	2,200

AT340
Dive #4183

Date 5/19/2006 Cruise AT 15-03
Pilot: Bruce Port: Chuck Starboard: Adriana

Launch Target
West_Topo_Hi N27 38.84205 W088 22.41383
Depth 2180 m

Equipment:
Bushmaster, stainer, pushcores, Suction pump sampler, net, niskins
Markers: 3 balls, one ball plus float, three new markers

Plan:
Dive on launch target. Set down and get navigated in. Take 2 push cores. Fire a niskin
Head to launch target/topo high if you are not there
Find some tubies to stain.
stain ‘em and fire a niskin
Deploy a marker
Find another to stain and do it again
Do it again
Find one to collect
Collect it
Move to X375, Y375 and find the most excellent Urchin field (alternate Urchin field at X 640, Y 200).
Fire a niskin
Take 10 pushcores
Net a few urchins
Move to the mussel brick road (X680, Y310 to X 685, Y 370)
Cruise up the road dropping markers every 15 meters (4 total).
Run three mosaick lines.
Head north to targets 3, 4, and 5: and look around.

Planned Collections: bushmaster, carbonates, push cores, urchins and pictures.

Targets

New_Origin N27 38.50000 W088 22.20000

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
New_Origin	N27 38.50000	W088 22.20000	0	0	
1-Launch BM_(LatLon)	N27 38.67600	W088 21.90200	494	320	2,182
2-Mussels-BeerCan	N27 38.84577	W088 21.72023	796	630	2,216
3-Lo_Amp	N27 38.91826	W088 21.77264	711	765	2,213
4-Hi_Amp_Rim	N27 38.95293	W088 21.84751	589	830	2,218
5-Lo_Amp	N27 38.91962	W088 21.98060	369	771	2,207
6-Mussels-Mats	N27 38.82016	W088 21.99486	344	587	2,207
7-Topo_High	N27 38.63063	W088 21.90074	495	236	2,192
8-Hi_Amp	N27 38.68041	W088 21.81164	642	326	2,204
9-Geo_Focal_Point	N27 38.84309	W088 22.17553	47	633	2,213
10-Hi_Amp	N27 38.66138	W088 22.11501	143	296	2,192
11-West_Topo_Hi	N27 38.84205	W088 22.41383	-345	635	2,182
12-Tubies-Mussels	N27 38.67360	W088 21.89610	503	315	2,195
13-Orange_Mat	N27 38.74590	W088 22.02100	299	451	2,201
14-Heart_Urchins	N27 38.84020	W088 22.11320	150	627	2,200

GC600
Dive #4184

Date 5/20/2006 Cruise AT 15-03
Pilot: Gavin Port: Stephane Starboard: Marshall

Launch: Target
1: N27° 22.390, W90° 34.526
Depth 1250m

Equipment:
Bushmaster, Push Core Rack, 1 Bioboxs, Mussel Pot, Niskin rack(?), Suction pump sampler, 1 lined collection net, one unlined square net
Markers:
one bench marker, 1 ian marker

Plan:
1) Dive on Target 1. Land, and get navigated in. Go to target 1
2) Land heading N and deploy the Bench Marker (#2) Turn on Dan Cam and put strobes out.
3) Find a tubeworm bush to collect. Bob saw stuff round here. If you find nothing here then head N to Target 9 and then E to Target 10
4) Give up on tubeworms, or done, head to target 3, and keep your eyes open for live clams or mussels
5) If you don't see them then pass on by to target 11.
6) When you find some mussels:
Set down and fire two niskins
Take a mussel pot
Collect some into a net
Take 6 push cores as close to the mussel as possible
Deploy a marker
7) When you find some clams (try target 12 if you haven't found any yet):
Set down and fire two niskins
Take six push cores around the live clams
Collect a few (3-4) into a net: put net in milk crate
Deploy a marker
8) If you are having a bad day, or running out of time before finding mussels and/or clams, take 6 push cores in a mat, or at least in the mud.
9) if you see something cool running around, suck it up
10) if you find a good carbonate, pick it up

Planned Collections: 12 pushcores, 1 mussel scoop, clams, carbonates, assorted fauna, bushmaster

Targets (Origin 27°N 21.90, 90°W 34.70)

Target	Latitude	Longitude	Local X (m)	Local Y (m)
Local_Origin	N27 21.9	W090 34.7	0	0
1 TWs	N27 22.38960	W090 34.52590	270	910
2 Mats	N27 22.35650	W090 34.50360	307	849
3 clams	N27 22.16180	W090 34.28370	677	497
4 Geo	N27 22.13070	W090 34.06731	1,035	446
5 Geo	N27 22.29970	W090 34.33556	587	750
6 Geo	N27 22.15775	W090 33.92080	1,276	501
7 Geo	N27 22.12116	W090 33.94481	1,237	433
8 Geo	N27 22.38280	W090 34.43158	425	900
9 Geo	N27 22.46869	W090 34.51759	280	1,056
10 Geo	N27 22.44819	W090 34.36051	540	1,023
11 Mussels	N27 22.01970	W090 33.84760	1,401	249
12 Clams	N27 21.98000	W090 33.81300	1,460	176

GC 600
Dive #4174

Date 5/10/2006 Cruise AT 15-03
Pilot: Pat Port: Bob Carney Starboard: Helge Neimann

Launch Target
N 27 22.390 W 090 34.526
X 2431, Y 2567 Depth ˜1250 m

Equipment:
Push Core Rack, Medium Biobox, 2 mussel pots, Chem. Profiler,
Milk crate for rocks, Suction pump sampler, collection net
Markers: one site bench marker, 1 ball, one ball plus float, two Ian markers

Tasks:
i) watch for opportunities to collect softball sized pieces of carbonates. Three total over the dive is good: document setting, location, and rock with a pic
ii) watch for opportunities to collect random fauna (crabs, big snails, starfish, Sea cukes…). use either nets or suction
iii) Lots of notes on X,Y, new targets, and all depths…

1) Sit down facing North. and navigate in the sub (30 minutes, do it right).
If this is a nice spot, deploy the Bench Marker
If not a nice spot, then move to Target 1 (launch target) and deploy the bench marker
2) Take a good look around here and at Target 2 (about 75 m to the SE)
3) These are the two targets with mussels and tubeworms confirmed and even those are scarce. After a quick survey of this area:
If you see an area to mussel pot, set down.
Try out the Chem Profiler at multiple locations in mussel bed
Make mussel pot collections (see mussel pot directions) Stick the low t probe in mussel bed
Try and collect a few tubeworms, even if they are solitary (here or nearby). Chem profiler first (at plumes and bases)
if any of the places you set down here look seepy and there is enough sediment, then take a series of 6 push cores.
If any of the areas look like an interesting area for a 10 by 10 m mosaick, do it (check out mosaick directions). If you are time rich, do some Chem surveys in the area mosaicked with careful doc of probe position.
4) Move to target 8 and look around : move to target 5 and look around
5) Head to target 4. it's a long run (about a km), but stay in site of bottom and keep your eyes peeled
6) Look around target 4 and head to 7 and look around.
7) move towards target 12 (you will pass through target 11 which had some live mussels) Target 12 is an area with live vesicomyid clams and lots of dead shells.
Find live clams (or at least clams in live position) Survey sediment surface with Chem

profiler. Collect some clam(s) (4-6), take a set of 6 push cores here, stick the low T probe in the mud, and deploy an Ian marker
8) still no rocks collected. Find and collect 2 or three from different locations
9) How about mobile fauna? go suck and net some up.
10) If time remains look around hear then head to target 3.

Planned Collections: 12 pushcores, 2 mussel pots, 10 – 20 tubeworms, clams, 3 carbonates, assorted fauna.

Targets (origin 27°21 N, 90°36 W)

Target	Lat	Long	X	Y	
1	N27 22.390	W090 34.526	2431	2567	
Isolated tubeworms					
2	N27 22.356	W090 34.504	2467	2504	
Bacterial mats					
3	N27 22.162	W090 34.284	2839	2144	
Live clams					
4	N27 22.130	W090 34.067	3188	2087	
5	N27 22.30	W090 34.335	2746	2504	
6	N27 22.158	W090 33.921	3428	2138	
7	N27 22.121	W090 33.945	3389	2070	
8	N27 22.383	W090 34.431	2587	2554	
9	N27 22.469	W090 34.518	2444	2713	
10	N27 22.448	W090 34.360	2705	2674	
11	N27 22.020	W090 33.848	3549	1884	
Few live mussels					
12	N27 21.980	W090 33.813	3606	1809	
Group of live vesicomyid clams					

WR269/270
Dive # 4191

Date 5/26/2006 Cruise AT 15-03
Pilot: Pat Port: Harry Roberts Starboard: Matt

Launch Target Lat 26 41.15 Long 91 39.57
Dive target: X = 1540 , Y = 1201 Depth = 1953

Equipment:
Push Core Rack, niskins, Biobox, 1 mussel pot, Ian cool pix,
Milk crate for rocks, Suction pump sampler, collection net (unlined)
Markers: One marker; #2

Tasks:
i) Thorough job on Pogo community
ii) Explore and document
iii) Nice photos and voucher collections of chemos as found
iv) Deploy Marker #2 at a lush site away from Target #1 (if found)

Plan:
1) Sit down and navigate in the sub.
2) Go to Bench marker. The pogo's should be here. Before stirring it up, take a collection of Dan Cam shots looking down at the pogos.
3) Land at the BM, facing north and
Record XY
Reset DVL XY to X=1540 , Y =1201
4) If not already among the Pogos, land among them and:
Use cool pix to take a bunch of photos
Take all 12 push cores in the pogos, with pogos
Slurp up a bunch of 'em (then nothing else in the slurp) Take 2 niskin bottle samples
5) AT mussels:
Take some cool pix
Take a mussel pot
Take 1 niskins over mussels
6) At clams
Take some cool pix
Net a few (3 is enough to id, 5-6 is plenty)
Take 1 niskin over clams
7) At tubeworms
Take cool pix
Grab some into biobox
Take 1 niskin over tubeworms

This site does not have camera ground truthing over the areas considered prime targets from the geophysical records. Therefore there is a strong reconnaissance element to this dive. We will

start at the east end of the area with strong surface reflectivity on the 3D seismic data.
A) Target 1 constitutes a highly reflective area that is to the southeast of a low amplitude feature considered to be a likely mud vent site. This is the pogos site. This is the marker and pogo site.
B) Target 2 is a circular low reflectiviy feature unterpreted as a mud vent from the geophysical records. This is the area where tube worms and mussels were found on the first dive to this site that was cut short by rough seas. This is the mussel site.
C) Target 3 is a highly reflective area to the NW of the apparent vent site. Transit to this area and if it turns out to be a chemosynthetic use the same sampling suggested for Target 2. D) Target 4 is a very highly reflective area to the SW of the interpreted vent sit at Target 2. If this site is a chemosynthetic community site, use the sampling protocols used at other sites as sampling gear permits. Take pictures.
E) Target 5 is to the west of Target 4. The same sampling will be used at this site as Target 4.
F) Target 6 is directly south of Target 5. This site is another highly reflective area of the If this is a chemosynthetic community site take pictures and use any remaining sampling gear.

Collections planned : 12 pushcores, 1 mussel pot, tubeworms, clams, at least 2 carbonate substrate samples

Target	Latitude	Longitude	X (m)	Y (m)	Depth (m)
Local_Origin	N26 40.50000	W091 40.50000	0	0	
1 launch/pogo	N26 41.15132	W091 39.57046	1,540	1,201	1953
2 mussel site	N26 41.17146	W091 39.74929	1,246	1,239	1908
3 Geo target	N26 41.21387	W091 39.96005	882	1,327	1945
4 Geo target	N26 40.99515	W091 40.17158	535	920	1951
5 Geo target	N26 41.01827	W091 40.34520	247	960	1957
6 Geo target	N26 40.72553	W091 40.30552	318	420	1960

WR 269/270
Dive #4175

Date 5/11/2006 Cruise AT 15-03
Pilot: Bruce Port: Harry Roberts Starboard: Valdimir Samarkin

Launch Target
Lat 26 41.14132 Long 91 39.56046
X 2388.21 , Y 1184.24 Depth m

Equipment:
Push Core Rack, Medium Biobox, 1 mussel pot, Chem. Profiler,
Milk crate for rocks, Suction pump sampler, collection net
Markers: one site bench marker, 1 ball, one ball plus float, two Ian markers

Tasks:
i) watch for opportunities to collect softball sized pieces of carbonates. Three total over the dive is good: document setting, location, and rock with a pic
ii) watch for opportunities to collect random chemo and other fauna (Tubeworms, mussels, crabs, big snails, starfish, Sea cukes…). use either nets or suction
iii) Lots of notes on X,Y, new targets, and all depths…

1) Sit down facing North. and navigate in the sub (30 minutes, do it right).
   If this is a nice spot, deploy the Bench Marker
   If not a nice spot, then move to Target 1 (launch target) and deploy the bench marker
2) Take a good look around here and

Planned Collections: 12 pushcores, 2 mussel pots, 10 – 20 tubeworms, water, 3 carbonates, assorted fauna.
This site does not have camera ground truthing over the areas considered prime targets from the geophysical records. Therefore there is a strong reconnaissance element to this dive. We will start at the east end of the area with strong surface reflectivity on the 3D seismic data.

3) Target 1 constitutes a highly reflective area that is to the east of a low amplitude feature considered to be a likely mud vent site. If Target 1 represents a chemosynthetic community, the usual sampling protocols will be used including mussel pot if mussels are present, tube worm sampling, and samples of lithified seafloor. Coring of bacterial mats or areas new tube worms should be done. Turn on vertical camera for entire dive.
4) Target 2 is a circular low reflectiviy feature unterpreted as a mud vent from the geophysical records. If this is a mud vent, use the chemical profiler and the low temp thermistor. Survey the edge of the vent to see if there are any associated chemosynthetic communities. Photograph the vent and move on. Use the suction sampler on organisms of opportunity.
5) Target 3 is a highly reflective area to the NW of the apparent vent site. Transit to this area and if it turns out to be a chemosynthetic use the same sampling suggested for Target 1. If Target 1 is a chemosynthetic community site and it is sampled, Target 3 will be the last site for taking our suite of 6 cores. Photograph the area.

6) Target 4 is a very highly reflective area to the SW of the interpreted vent sit at Target 2. If this site is a chemosynthetic community site, use the sampling protocols used at other sites. If Targets 1 and 3 are chemosynthetic community sites, no cores will be available for this site. If available, we will take cores. Continue to photographically log the area.
7) Target 5 is to the west of Target 4. The same sampling will be used at this site as Target 4.
8) Target 6 is directly south of Target 5. This site is another highly reflective area of the If this is a chemosynthetic community site the same sampling scheme is to be used.

Collections planned : 12 pushcores, 1 mussel pot, tubeworms, clams, at lease 2 carbonate substrate samples, and organisms of opportunity.

Targets (origin 26 40.5 N: 91 40.5 W)

Target	Latitude	Longitude	X (m)	Y (m)	Depth (m)
Local_Origin	N26 40.50000	W091 40.50000	0	0	
1	N26 41.14132	W091 39.56046	1,546	1,200	
2	N26 41.14446	W091 39.74229	1,244	1,203	
3	N26 41.21387	W091 39.96005	882	1,327	
4	N26 40.99515	W091 40.17158	535	920	
5	N26 41.01827	W091 40.34520	247	960	
6	N26 40.72553	W091 40.30552	318	420	

KC243
Dive #4176

Date 5/12/2006 Cruise AT 15-03
Pilot: Gavin Port: Stephane Starboard: PIT

Launch Target
26N 43.812 92W 49.835
X 273, Y 207 Depth ~1610m

Equipment:
Push Core Rack, Medium Biobox, 2 mussel pots, Ian cool pix camera,
Milk crate for rocks, Suction pump sampler, collection net
Markers: one site bench marker, 1 ball, one ball plus float, two Ian markers

Remember:
i) watch for opportunities to collect softball sized pieces of carbonates. Three total over the dive is good: document setting, location, and rock with a pic
ii) watch for opportunities to collect random fauna: use either nets or suction

iii) keep your eyes open for bushmasterable tubies and record XYs if found

iv) Take lots of notes on X,Y, new targets, and all depths…
v) Leave time (20 minutes at this site) to return to the bench marker to check nav drift (get X,Y, do not resurvey).
vi) Try out ian's camera

Tasks:
1) Sit down facing North. and navigate in the sub (30 minutes, do it right).
If this is within 100m of targets 1 or 2, deploy the Bench Marker.
If not, then move to Target 1 (launch target) and deploy the bench marker. Note X,Y
2) Take a good look around here for mussels
3) Choose a nice area of live mussels to work
3.1) Mosaick first:
Deploy the two markers with balls within the 10 x 10 m mosaick area. Run the image collection pattern at about 3 m altitude (see mosaicing notes)
3.2) Use the mussel pots to get some mussels. If you don't get a good pot, use the net to get a few more. Leave an Ian marker here
4) Take 6 push cores near here
5) move to target 2 and look around.
6) find a nice tubeworm group, that is not good for bushmaster
6.1) Take some macro shots with Ian's camera
6.2) Suction the tubie clump
6.3) Collect a nice handful (up to 20)
6.4) Take 6 push cores here (near tubeworms)
7) move to target 3. look around and take notes. Run a search pattern over this target. If you find something different, make a collection, take some pics

8) still no rocks collected. Find and collect 2 or three from different locations
9) How about mobile fauna? go suck and net some up if room remains.
9.5) did you try the camera yet? Now is a good time.
10) At the end of the dive circle back to the Bench marker and note XY when at the marker (facing N) to check drift on doppler nav.

Planned Collections: 12 pushcores, 2 mussel pots, 10 – 20 tubeworms, 3 carbonates, assorted fauna.

Targets (origin 26°43.7 N, 92°50.0 W) NOTE, this is the correct origin

Targets	Latitude	Longitude	X	Y
1-mussels	N26 43.81200	W092 49.83500	273	207
2-tubeworms	N26 43.83600	W092 49.86600	222	251
3-geo anomoly	N26 43.87339	W092 49.78109	362	321

GC852
Dive #4190

Date 5/25/2006 Cruise AT 15-03
Pilot: Melbert Port: Bob Starboard: Meg

Launch:
N 27 06.6, W091 09.93 (for a bottom target of X 431, Y 1018)
Depth ˜1410m

Equipment:
Ian cool Pix camera, push core rack, niskins, two bio box, net (unlined)
Markers: Mosaic #4 and 2 balls

Tasks:
i) deploy camera
ii) Collect corals
iii) pushcore
iv) Mosaic
v) image and collect mussels and clams
vi) let Dan cam run, with strobes out, whenever in transit.
vii) recover SEAS experiments and fish trap

Plan:
1) Dive on Bench Marker #2 (Target 14: X 431, Y 1018)
2) Land and evaluate nav. If you are sure LBL is good, proceed to BM#2
Record XY
Reset DVL XY to X 431, Y 1018
3) Deploy Ians camera near marker 5 and stained tubeworms X 443 Y1064 find a flat spot
4) Go find some hard corals and make a collection. If in a good spot, take some cool pix first: X 370 Y 934
5) Transit to BM #1 (Target 13; X 379, Y 516).
Pick up SEAS experiment into biobox
6) At a small mussel patch:
Collect 6 push cores and 3 niskins
7) At an area with clams:
Shoot some cool pix
Collect 6 push cores near clams and 2 niskins
Collect a few clams into the net
8) Find An area with mixed chemo's (small mussel patches, clams, some tubies etc) and low relief (perhaps this is it)
Place the markers in the area, 3-5 meters apart (without landing)
Follow the mosaic directions. If you stir things up, go get the fish trap
and come back
9) Leave at least 30 min: return to BM #1:, pick up fish trap.

10a) Either: finish up mosaic if it is ready to go and needs some more lines (the mud should be clear by now)
or
10b) if power/time remains cruise around the edges of the site (drive the perimeter to delineate it's extent)

Planned collections: Mussel pot, fauna, push cores, fish trap, SEAS expt.

Targets (origin= 27N 06.1, 91W 10.2)

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N27 06.1000	W091 10.2000	0	0	
1-tubes_mussels	N27 06.320	W091 09.962	387	412	
2-mussels_tubes	N27 06.378	W091 09.959	391	519	
3-soft_corals	N27 06.586	W091 09.927	438	904	
4-red_soft_coral	N27 06.626	W091 09.975	358	977	
5-soft_reflector	N27 06.20083	W091 09.93492	435	193	
6-high_reflector	N27 06.49466	W091 10.09557	162	731	
7-topo_high	N27 06.60334	W091 10.01904	286	934	
8-geo_reflector	N27 06.72200	W091 09.86759	533	1,157	
9-topo_high_reflector	N27 06.87347	W091 09.79281	652	1,438	
10-Jason_geoA	N27 07.09276	W091 09.95591	377	1,839	
11-Jason_geoB	N27 07.21342	W091 09.95762	371	2,062	
12-Jason_geoC	N27 07.14364	W091 09.82149	597	1,936	
13 Bench Marker #1			379	516	
14 Bench Marker #2			431	1018	
15 Monika Coral			402	919	

GC 852
Dive #4177

Date 5/13/2006 Cruise AT 15-03
Pilot: Mark Port: Ian Starboard: Monika

Launch Target
27°06.320 N, 91°09.962W
X 387, Y 412 Depth ~ 1450m

Equipment:
Push Core Rack, Small Biobox, 2 mussel pots, Ian handheld camera, Ian rotary camera on spikes for deployment
Milk crate for rocks, Suction pump sampler, collection net, Liz experiments
Markers: one site bench marker, 1 ball, one ball plus float, two Ian markers

Tasks:
i) watch for opportunities to collect softball sized pieces of carbonates. Three total over the dive is good: document setting, location, and rock with a pic
ii) watch for opportunities to collect random fauna (crabs, big snails, starfish, Sea cukes…). use either nets or suction

iii) keep your eyes open for bushmasterable tubies and record XYs if found

iv) Take lots of notes on X,Y, new targets, and all depths…
v) leave enough time at the end to return to the bench marker to check nav drift.

1) Sit down and navigate in the sub (30 minutes, do it right).
2) move to Target 1 (launch target) and deploy the rotary camera
3) find a good spot to deploy the bench marker. Land heading north and deploy the bench marker. Note XY
4) Find a nice area for a mosaick
    Deploy the two markers with balls within the 10 x 10 m mosaick area.
    Run the image collection pattern at about 3.5 - 4 m altitude
5) Go to target 2 and find a nice live mussel bed (unless you have already found one). Set down and take 2 mussel pots
    5.1 Deploy Liz's experiments
        Deploy one in a mussel pot scar
        Deploy the other next to the mussel bed
    5.2) Leave an Ian marker here
    5.3) Take 6 push cores here
6) go to target 3 and survey the corals here with the cameras Don't collect any yet. Set down for some close ups and take 6 push cores here.
    6.5) perhaps slurp up some associated fauna
7) still no rocks collected. Find and collect 2 or three from different locations
8) How about mobile fauna? go suck and net some up.

9) Evaluate your time.

If less than 30 minutes left then go to target 7 and then to 6. leave downlooking camera running and take notes of fauna and terrain. If more time head back to bench mark and get xy (check drift).

If more then 1 hr left head to target 8 and then 9 with camera on and looking around. Then head East and look for Corals on the slope..

Planned Collections: 12 pushcores, 2 mussel pots, 3 carbonates, assorted fauna, lots of pictures and a mosaick

Targets (origin= 27N 06.1, 91W 10.2)

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N27 06.1000	W091 10.2000	0	0	
1-tubes_mussels	N27 06.320	W091 09.962	387	412	
2-mussels_tubes	N27 06.378	W091 09.959	391	519	
3-soft_corals	N27 06.586	W091 09.927	438	904	
4-red_soft_coral	N27 06.626	W091 09.975	358	977	
5-soft_reflector	N27 06.20083	W091 09.93492	435	193	
6-high_reflector	N27 06.49466	W091 10.09557	162	731	
7-topo_high	N27 06.60334	W091 10.01904	286	934	
8-geo_reflector	N27 06.72200	W091 09.86759	533	1,157	
9-topo_high_reflector	N27 06.87347	W091 09.79281	652	1,438	
10-Jason_geoA	N27 07.09276	W091 09.95591	377	1,839	
11-Jason_geoB	N27 07.21342	W091 09.95762	371	2,062	
12-Jason_geoC	N27 07.14364	W091 09.82149	597	1,936	

GC 852
Dive #4185

Date 5/21/2006 Cruise AT 15-03
Pilot: Mark Port: Monika Starboard: Cheryl

Launch Target
Ian's camera: N27 06.359, W91 09.961
Depth ˜1410m

Equipment:
Ian cool Pix camera, 3 bioboxes, suction sampler, one net (no lining), niskins
Markers: Second Bench marker: #2

Tasks:
i) watch for opportunities to collect softball sized pieces of carbonates. Three total over the dive is good: document setting, location, and rock with a pic. Can go in a biobox, or if large on top
ii) watch for opportunities to collect random fauna (crabs, big snails, starfish, Sea cukes…). use either nets or suction

iii) keep your eyes open for bushmasterable tubies and record XYs if found

iv) Take lots of notes on X,Y, new targets, and all depths…
v) let Dan cam run, with strobes out, whenever in transit.
Note: your map's bathymetry is off.

1) Dive on Ian's camera (X 391, Y 472), Depth 1408.
Get XY and reset you DVL Nav to X 391, Y 472
Send it up
Pick up the crab trap and put it in a bio box
Turn on the Dam cam with strobes out.
2) head for Target 3. This is the coral site. Look around. Tend W towards the topographic high (target 7). Deploy the Bench Marker #2 here when you set down to work some corals. Also fire two niskins when you set down to work corals the first two times, and the last the third tijme. Check out the edges of this high point. Corals are likely on the "windward shore" (which ever that is). At this point you are mostly on your own. When you see cool corals, set down, get fixes, take pics, and collect at will. I suggest you temper your collections with explorations as this is the first dive to this area and the very best area may be just around the corner. Since there is likely to be a good bit of transit in this dive, a good estimate is that you will be heading up by 2:30 local time. When you are ready to move on:
3) head N-NE to target 8. This is a 3D seismic reflector and should be a good spot. do not be afraid to deviate to check out ridges. You may also want to use the side scan sonar to look for hard returns (carbonates).
4) keep heading N-NE towards target 9 (another geo-reflector).
Don't forget to pick up some rocks when opportunity presents and use the suction sampler

Planned Collections: corals, pictures, fishtrap, and a rotary camera

Targets (origin= 27N 06.1, 91W 10.2)

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N27 06.1000	W091 10.2000	0	0	
1-tubes_mussels	N27 06.320	W091 09.962	387	412	
2-mussels_tubes	N27 06.378	W091 09.959	391	519	
3-soft_corals	N27 06.586	W091 09.927	438	904	
4-red_soft_coral	N27 06.626	W091 09.975	358	977	
5-soft_reflector	N27 06.20083	W091 09.93492	435	193	
6-high_reflector	N27 06.49466	W091 10.09557	162	731	
7-topo_high	N27 06.60334	W091 10.01904	286	934	
8-geo_reflector	N27 06.72200	W091 09.86759	533	1,157	
9-topo_high_reflector	N27 06.87347	W091 09.79281	652	1,438	
10-Jason_geoA	N27 07.09276	W091 09.95591	377	1,839	
11-Jason_geoB	N27 07.21342	W091 09.95762	371	2,062	
12-Jason_geoC	N27 07.14364	W091 09.82149	597	1,936	
Bench Marker			379	516	
Ian Camera	N27 06.359	91 09.961	391	472	

GC 852
Dive #4186

Date 5/22/2006 Cruise AT 15-03
Pilot: Pat Port: Chuck Starboard: Erin

Launch
N 27 05.7, W 91 09.96
(for a bottom target of N27 06.36, W 91 09.96)
Depth ˜1410m

Equipment:
Ian cool Pix camera, Bushmaster, stainer, mussel pot, suction sampler, milk crate, fish Trap down
Markers: Three markers for Stainer (numbers 5,6, and 7 or any old ones), two sets of markers for mosaicks (number 3 and 4 and 4 balls)

Tasks:
i) watch for opportunities to collect softball sized pieces of carbonates: document setting, location, and rock with a pic. Can go in a biobox, or if large on top
ii) watch for opportunities to collect random fauna (crabs, big snails, starfish, Sea cukes…).
use suction

iii) let Dan cam run, with strobes out, whenever in transit.

Note: map's bathymetry is off bio targets may be 25 m E and 50m N of where shown on map.

Plan:
1) Dive on Bench Marker #1: X 379, Y 516, deploy fish trap
2) Set down heading N at BM and log LBL XY, then enter DVL XY (above)
3) Find Tubeworms to stain and collect. Take some cool pix . If nothing at this site, then head to target 6 (geo marker) then to bench marker #2. (X 431, Y 1018 DEPTH 1404)
4) Find area(s) to mosaick (BM #1??) See if this is good for rotary camera
5) Find mussels to pot. Take some cool pix
6) Slurp coral associates. (X 402, Y 919) Take some cool pix
7) grab a few rocks
8) explore ridges for corals. Try W edges.

Planned collections: Bushmaster, Mussel pot, carbonates, slurpetes, pictures

Targets (origin= 27N 06.1, 91W 10.2)

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N27 06.1000	W091 10.2000	0	0	
1-tubes_mussels	N27 06.320	W091 09.962	387	412	
2-mussels_tubes	N27 06.378	W091 09.959	391	519	
3-soft_corals	N27 06.586	W091 09.927	438	904	
4-red_soft_coral	N27 06.626	W091 09.975	358	977	
5-soft_reflector	N27 06.20083	W091 09.93492	435	193	
6-high_reflector	N27 06.49466	W091 10.09557	162	731	
7-topo_high	N27 06.60334	W091 10.01904	286	934	
8-geo_reflector	N27 06.72200	W091 09.86759	533	1,157	
9-topo_high_reflector	N27 06.87347	W091 09.79281	652	1,438	
10-Jason_geoA	N27 07.09276	W091 09.95591	377	1,839	
11-Jason_geoB	N27 07.21342	W091 09.95762	371	2,062	
12-Jason_geoC	N27 07.14364	W091 09.82149	597	1,936	
Bench Marker #1			379	516	
Bench Marker #2			431	1018	
Monika Coral			402	919	
If land S, (a guess)			375	409	

GC 852
Dive #4187

Date 5/23/2006 Cruise AT 15-03
Pilot: Bruce Port: Erik Starboard: PIT Sean

Launch
N 27 06.3, W091 10.10
(south of a bottom target of X 175, Y800)
Depth ˜1410m

Equipment:
Ian cool Pix camera, Bushmaster, stainer, mussel pot, suction sampler, biobox, net
Markers: Two markers for Stainer (5,7), One sets of markers for mosaicks (number 3 and 2 balls)

Tasks:
i) watch for opportunities to collect softball sized pieces of carbonates: document setting, location, and rock with a pic. Can go in a biobox, or if large on top
ii) watch for opportunities to collect random fauna (crabs, big snails, starfish, Sea cukes…). use suction

iii) let Dan cam run, with strobes out, whenever in transit.

Note: map's bathymetry is off set

Plan:
1) Dive on X175, Y800 New Target: lucky # 13
2) Land and get surveyed in. Proceed to lucky #13: There is likely nothing here, so drive up and over the top from here heading towards X 402, Y 919 Monika's coral site. Keep your eyes open for the lush chemo site. When you see it, work it. If not, pass over the corals for now and proceed on to Bench Marker #2 X 431, Y 1018. Sit down heading north and reset the nav if necessary.
3) Find Tubeworms to stain and collect. Take some cool pix
4) Find area(s) to mosaick
5) Find mussels to pot. Take some cool pix
6) Slurp coral associates. Take some cool pix
7) grab a few rocks
8) explore ridges for corals

Planned collections: Bushmaster, Mussel pot, carbonates, slurpetes, pictures

Targets (origin= 27N 06.1, 91W 10.2)

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N27 06.1000	W091 10.2000	0	0	
1-tubes_mussels	N27 06.320	W091 09.962	387	412	
2-mussels_tubes	N27 06.378	W091 09.959	391	519	
3-soft_corals	N27 06.586	W091 09.927	438	904	
4-red_soft_coral	N27 06.626	W091 09.975	358	977	
5-soft_reflector	N27 06.20083	W091 09.93492	435	193	
6-high_reflector	N27 06.49466	W091 10.09557	162	731	
7-topo_high	N27 06.60334	W091 10.01904	286	934	
8-geo_reflector	N27 06.72200	W091 09.86759	533	1,157	
9-topo_high_reflector	N27 06.87347	W091 09.79281	652	1,438	
10-Jason_geoA	N27 07.09276	W091 09.95591	377	1,839	
11-Jason_geoB	N27 07.21342	W091 09.95762	371	2,062	
12-Jason_geoC	N27 07.14364	W091 09.82149	597	1,936	
13 launch target 4187			175	800	
Bench Marker #1			379	516	
Bench Marker #2			431	1018	
Monika Coral			402	919	

GC852
Dive #4188

Date 5/24/2006 Cruise AT 15-03
Pilot: Gavin Port: Ian Starboard: Cheryl

Launch
N 27 06.6, W091 09.95 (for a bottom target of X 431, Y 1018)
Depth ˜1410m

Equipment:
Ian cool Pix camera, push core rack, niskins, rotary camera, room to carry up the rotary camera, bio-boxes as space allows, no nets, no suction sampler
Markers: NONE

Tasks:
i) deploy camera
ii)pushcore
iii)image and collect corals
iv)watch for opportunities to collect softball sized pieces of carbonates: document setting, location, and rock with a pic. Can go in a biobox, or if large on top
v) let Dan cam run, with strobes out, whenever in transit.

Note: the world is crooked: Maps generally good, but non-confirmed targets are offset …

Plan:
1) Dive on Bench Marker #2 X 431, Y 1018
2) Land and evaluate nav. If you are sure LBL is good, proceed to BM#2 to set DVL navigation. If not get surveyed in.

3) Go to BM #2 (X 431, Y 1018). Land heading N with BM in front of basket a

Record XY

Reset DVL XY to X 431, Y1018

While you are here, watch for good sized mat for 12 push cores: drop a (digital) target if you see one.

4) Go to Monika's coral site X 402, Y919. Deploy the camera.

5) leave (for now) and go get 12 push cores in a bacterial mat

Fire 2 niskins before coring

6) Return to the coral area and image/collect corals (and carbonates) as directed by Cheryl.

Fire 3 niskins together here

7) Pick up the camera and head home

Planned collections: Corals, push cores, carbonates, pictures of corals and Alvin.

Targets (origin= 27N 06.1, 91W 10.2)

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N27 06.1000	W091 10.2000	0	0	
1-tubes_mussels	N27 06.320	W091 09.962	387	412	
2-mussels_tubes	N27 06.378	W091 09.959	391	519	
3-soft_corals	N27 06.586	W091 09.927	438	904	
4-red_soft_coral	N27 06.626	W091 09.975	358	977	
5-soft_reflector	N27 06.20083	W091 09.93492	435	193	
6-high_reflector	N27 06.49466	W091 10.09557	162	731	
7-topo_high	N27 06.60334	W091 10.01904	286	934	
8-geo_reflector	N27 06.72200	W091 09.86759	533	1,157	
9-topo_high_reflector	N27 06.87347	W091 09.79281	652	1,438	
10-Jason_geoA	N27 07.09276	W091 09.95591	377	1,839	
11-Jason_geoB	N27 07.21342	W091 09.95762	371	2,062	
12-Jason_geoC	N27 07.14364	W091 09.82149	597	1,936	
16 launch target 4187			175	800	
13 Bench Marker #1			379	516	
14 Bench Marker #2			431	1018	
15 Monika Coral			402	919	

MC853
Dive #4178

Date 5/14/2006 Cruise AT 15-03
Pilot: Pat Port: Mandy Starboard: Bill Shedd

Launch Target
28° 07.643 N, 89° 08.470W
X 398, Y 1,181 Depth ˜1070m

Equipment:
Push Core Rack, Medium Biobox, 2 mussel pots, chem. profiler
Niskin rack, Suction pump sampler, collection net/collection scoop
Markers: one site bench marker, two Ian markers

General notes:
Mussel beds, bacterial mats, clams, and an isolated tubeworm have been reported from this site. It is the shallowest of our deep sites and very important for the depth related biogeographic questions. Faunal occurrence is NOT well constrained by the information at our disposal. The first 2 targets are our "best guess" of the general area of the previous reports of macrofauna and mats. It seems that mats are widely distributed from previous Alvin topside logs. If you don't find everything near the first 2 targets, then transiting through the rest of the targets will have you pass over our estimates (from the geophysical and bathymetric data) of where seepage will be localized. Leave the down looking camera on for all transits and stay low enough (4-5 m or so) to survey as you transit.

Tasks:
i) Find mussel bed and some tubeworms, and bacterial mats.
ii) pick up carbonates when you get a chance: softball sized pieces
iii) keep your eyes open for bushmasterable tubies and record XYs if found

iv) Take lots of notes on X,Y, new targets, and all depths…
v) take two sets of 6 push cores

Plan:
1) Sit down and navigate in the sub (30 minutes, do it right).
2) move to Target 1 (launch target). Land heading north and deploy the bench marker. Note XY

3) Look around here and then in vicinity of target 2: for tubeworms, mussel beds, mats and clams. Note XYs as you see them. If you find a nice live mussel bed Set down and:
- 3.1) fire off 2 niskins
- 3.2) take 2 mussel pots
- 3.3) Leave an Ian marker here
- 3.4) Take 6 push cores near here

4) If you see only scattered mussels, and not enough for a pot, then net some into the bio box. Fire off 2 niskins (any carbonates here?)
5) If you see any tubeworms, make a collection of them. If it is a clump, then suction it first. Fire a

niskin (any carbonates here?)
6) If you see live clams, take a set of push cores here and then scoop up some clams. Fire a niskin
7) If you see a mat that gives you goose bumps, set down, fire a niskin, core it
8) If no luck in the vicinity of targets 1 and 2, head for target 3
9) Then to target 4, then 5, then 6. These tracks and areas were chosen to maximize your exposure to seeping areas…
10) If you have been striking out consistently, head up hill and transit over the top and 100 m past the topo high on the other side. Repeat this a few times in a search pattern using the topo high as the center of radiating lines.

11) When you are down to about 30 minutes head back to the bench marker to check drift on the Doppler nav (just note X and Y when in the same position as the deployment of the bench mark). This is a lower priority than the collections, but if you've had a good dive then it is very worthwhile.

Planned Collections: 12 pushcores, 2 mussel pots, 3 carbonates, assorted fauna, lots of pictures and a mosaick

Targets (Origin 28°N 07.00, 89°W 08.70)

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N28 07.0000	W089 08.7000	0	0	
1-IanA	N28 07.64310	W089 08.46960	398	1,181	
2-IanB	N28 07.64610	W089 08.60440	178	1,191	
3-topo_high	N28 07.38005	W089 08.38549	527	693	
4-geoA	N28 07.31668	W089 08.54517	264	580	
5-geoB	N28 07.12567	W089 08.26496	717	220	
6-geoC	N28 07.23794	W089 08.15560	899	424	

MC640
Dive # 4182

Date 5/18/2006 Cruise AT 15-03
Pilot: Pat Port: Bob Carney Starboard: PIT

Launch: Target
10; N28 21.282, W088 47.708 Depth 1410m

Equipment:

Push Core Rack, 2 Medium Bioboxs, 1 mussel pot, Niskin rack, Suction pump sampler, 2 lined collection nets
Markers: one bench marker, 2 Ian markers

General notes: This dive has 6 general objectives
1) to boldly go where no one has gone before (and take notes)
2) to make a paired mussel pot and mussel bag collection
3) Collect some tubeworms if they exist (both species)
4) collect some push cores near tubeworms
5) Collect some push cores through mats
6) Slurp some cool stuff
7) grab some cool rocks

Plan:
1) Sit down and navigate in the sub (30 minutes, do it right). Turn on Dan Cam with strobes out every time you cruise
2) move to Target 10 (launch target). Look around. If there is any "action" here, Land heading north and deploy the bench marker (if not wait you see some action). Note XY
3) Head up to Target 3. Look around
4) head to Target 1 then 2 and look around
5) head to Target 4 and look around
6) head to back toward Target 7 (while looking around). If you have seen good stuff, then make some decisions. If not circle through Targets 6, 5, and 9.
7) Go back to the best mussel bed you found:
    7.1) fire off 2 niskins
    7.2) take the mussel pot
    7.3) use one of the nets to get a sample of mussels and associates
    7.3.5) IF you have NOT seen any tubeworms on this dive, then take 6 push cores here
    7.4) Leave an Ian marker here
    7.5) any carbonates here? Grab one
    7.6) pick up, strobes out, Dan cam on
8) Go back to the best tubeworm bush you found in sediment
    8.1) fire off 2 niskins
    8.2) Take 6 push cores
    8.3) Grab a bunch of tubeworms, look for two species.

8.4) decide if you want to slurp the tubeworm bush. If it is "rich" with little critters, please do so and keep track of what else you add to it.

8.5) pick up, strobes out, dan cam on

9) Head for the best mat area you found

9.1) fire a niskin

9.2) take 6 push cores in the mat

10) IF you have not seen tubeworms, nor used the other biobox, then go back to a different mussel bed (or different area of the same big one) and do another mussel bed net collection with niskins and leave a marker

11) Explore more. Try transiting the mound and down the sides a bit in different directions

11) When you are down to about 30 minutes head back to the bench marker to check drift on the Doppler nav (just note X and Y when in the same position as the deployment of the bench mark). This is a lower priority than the collections, but if you've had a good dive then it is very worthwhile.

Planned Collections: 12 pushcores, 1 mussel pot, 3 carbonates, assorted fauna, lots of pictures and a mosaick

Targets (Origin 28°N 21.20, 88°W 47.70)

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N28 21.2	W088 47.7	0	0	
1-Bio	N28 21.4147	W088 47.5508	250	393	
2-Bio	N28 21.3885	W088 47.5411	265	344	
3-Bio	N28 21.4436	W088 47.6221	134	448	
4-Bio	N28 21.2580	W088 47.5443	256	103	
5-topo_high	N28 21.31234	W088 47.57106	214	204	
6-hi_amp	N28 21.36221	W088 47.56422	226	296	
7-hi_amp	N28 21.39477	W088 47.61252	148	358	
8-edge_amp	N28 21.44488	W088 47.64491	97	451	
9-hi_amp	N28 21.35398	W088 47.67408	47	284	
10-flow?	N28 21.28187	W088 47.70783	-11	151	

AC818
Dive # 4195

Date 5/30/2006 Cruise AT 15-03
Pilot: Pat Port: Erik Starboard: Liz

Launch Target:
N26°10.74, W 94°37.4

Dive target: Target 5: X = 559 , Y = 799, 100m south of the wellhead
Depth = 2,750m

Equipment:
Bushmaster, stainer, Biobox, Ian cool pix,
Suction pump sampler, milk crate with 3 push cores, collection net (lined) in biobox
Markers: Benchmarker #2 and three staining markers (#3,4, and 5)

Tasks:
i) Explore and document
ii) stain and bushmaster

Plan:
1) Move towards Target 4 (Well head). X=555, Y=892
Use the side scan. Its 2 m high, and gives a good signal
If you find chemos, look around…
2) You need to set you DVL nav at either the wellhead (to X 555, Y 892) or at the bench marker (to X534, Y 958), when you are pulled up to the target heading North
3) After setting the DVL nav, head in a northerly direction following the seep action and staining. You may want to use sonar as well, but the expectation (and evidence so far) is that the feature is linear and trends almost due north (perhaps a smidge W of due N). Go past the bench marker site for at least 200m, and more if the signs of seepage persist. When you find the mother load of tubeworms, mussels and trilobites, it's time to get to work. If you have moved substantially, deploy the Benchmarker #2 at some point while working.

4) When you set up to stain a large clump of tubeworms (multiple stains), ask topside to nav you in. This is to calibrate the Alvin nav with the wellhead based xy's we are using. DO NOT reset your DVL.

5) If the clump is nice, use the cool pix first.

6) Stain a bunch of clumps, but leave us each one to BM IF you are going to recommend I come back the next dive (stain BM sized bushes last…)

7) When you do the bushmaster, follow it up with the three push cores taken from under where the bush came from.

8) Grab a carbonate or two

9) cool pix and net some mussels or clams

10) FYI, the hose on the starboard with the T-handle is the inlet for the suction sampler…

Collections planned : Bushmaster, carbonates, mussels or clams, slurpets

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N26 10.3	W094 37.7	0	0	
1-geo	N26 11.10067	W094 37.32450	644	1,470	
2-geo	N26 10.99434	W094 37.36435	575	1,275	
3-geo	N26 10.87071	W094 37.35272	592	1,046	
4- WELLHEAD	N26 10.78663	W094 37.37362	555	892	
5-geo	N26 10.73630	W094 37.37069	559	799	
6-geo	N26 10.60057	W094 37.50598	330	551	
7-geo	N26 10.39953	W094 37.61391	146	182	
8- ROV chemo	N26 10.80933	W094 37.38367	539	934	
Bench Marker 1			534	958	2744

AC818
Dive # 4192

Date 5/27/2006 Cruise AT 15-03
Pilot: Bruce Port: Stephane Starboard: Mike the PIT

Launch Target:
N26°11.0, W 94°37.4
Dive target: Geo Target 3: X = 575 , Y = 1275
Depth = 2,800m

Equipment:
Push Core Rack, niskins, Biobox, 1 mussel pot, Ian cool pix,
Milk crate for rocks, Suction pump sampler, collection net (unlined)
Markers: Bench marker #1, Homer Probe on a spike

Tasks:
i) Explore and document
ii) Nice photos and voucher collections of chemos as found

Plan:
1) Sit down and navigate in the sub.
2) Move towards Target 4 (Well head). X=555, Y=892
Use the side scan. Its only 2 m high, but should be a good signal
If you find chemos, look around, drop a digital target and move on.
3) Pull up to the well head and land heading north
note your XY
Change the XY in the DVL nav to X 555, Y 892
Note your offset if you need it to get back to targets later…
4) head to the ROV chemo site: X 539, Y934

When you find it look around a little then run its perimeter to get an idea of its size. Harry thinks that we will find that this site is small and basically a linear feature, perhaps will small sites strung out in a line like "pearls on a string". So, after looking around here you are going to visit a set of potential pearls heading north. You should follow communities and side scan targets for the most part, but can also go through Geo 3, Geo 2 and Geo 1 as you head North. When you have found extensive areas of tubeworms, mussels and trilobites, it's time to get to deploy the Benchmarker and the Homer probe on a spike, then get to work

5) AT mussels:

Take 2 niskins, some cool pix, and 6 cores

Take a mussel pot , and grab a carbonate

6) At clams

Take a niskin and some cool pix

Net a few (5-6 is plenty)

7) At tubeworms

Take cool pix, 2 niskins, and 6 cores

Grab a few into biobox (but not from good stain or bm possibilities)

Grab a carbonate

8) If not successful finding tubeworms or mussels, take the remaining cores in bacterial mats

Grab a carbonate

9) if time left then run the perimeter of the site(s) and/or go check out the geo targets S of the wellhead

Collections planned : 12 pushcores, 1 mussel pot, tubeworms, clams, at least 2 carbonate substrate samples

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N26 10.3	W094 37.7	0	0	
1-geo	N26 11.10067	W094 37.32450	644	1,470	
2-geo	N26 10.99434	W094 37.36435	575	1,275	
3-geo	N26 10.87071	W094 37.35272	592	1,046	
4- WELLHEAD	N26 10.78663	W094 37.37362	555	892	
5-geo	N26 10.73630	W094 37.37069	559	799	
6-geo	N26 10.60057	W094 37.50598	330	551	
7-geo	N26 10.39953	W094 37.61391	146	182	
8- ROV chemo	N26 10.80933	W094 37.38367	539	934	

AC601
Dive #4196

Date 5/30/2006 Cruise AT 15-03
Pilot: Bruce Port: Chuck Starboard: Jeremy

Launch Target: N26° 23.55, W94° 30.85
Dive target is Target 4: X 259, Y 454
Depth: 2330 m

Equipment:
Push Core Rack, niskin(s) for brine sampling, Biobox, Ian cool pix, Bushmaster
Milk crate for rocks, Suction pump for sea monkeys, collection net (lined)
Markers: Bench marker #1

Tasks:
i) Brine pool brine sample
ii) push cores from the fluff zone on the edge of the pool
iii) push cores from the subtidal zone, taken from the edge
iv) suction sample of brine critters

v) bushmaster

vi) assorted cool pix

vii) scoop of mussels

Plan:
1) Sit down and navigate in the sub.
2) Move towards Target 4: X 259, Y 454.
3) Move to the center of the brine pool

    Collect the niskin sample (s)

    Slurp brine to collect sea monkeys

4) Move to the edge and run the perimeter cleanly

5) Set down to Push core

    Take cool pix

    PC In fluff

    PC in Sediment below brine

6) Back to the crater rim

    Deploy the Bench Marker

    Run the rim.

7) Bushmaster

8) Scoop net of mussels on carbonates

9) Cool pix

Collections planned : Brine, seamonkeys, pushcores, bushmaster, carbonate substrate samples, net of mussels or clams

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N26 23.3	W094 31.0	0	0	
1-southern_amp	N26 23.35948	W094 30.87494	209	107	
2-topo_high	N26 23.43701	W094 30.80559	326	249	
3-hi_amp_NE	N26 23.50382	W094 30.76258	399	372	
4-lo_amp	N26 23.54766	W094 30.84760	259	454	
5-hi_amp_NW	N26 23.52115	W094 30.95653	77	407	
6-hi_amp_W	N26 23.43895	W094 30.90413	162	255	
Tubeworms			265	130	

AC 601
Dive # 4193

Date 5/28/2006 Cruise AT 15-03
Pilot: Gavin Port: Harry Starboard: Mandy

Launch Target:
N26° 23.36, W94° 30.87
Dive target: X 209, Y 107
Depth: 2330 m

Equipment:
Push Core Rack, niskins, Biobox, 1 mussel pot, Ian cool pix,
Milk crate for rocks, Suction pump sampler, collection net (unlined)
Markers: Bench marker #2

This is an exploratory dive. Take push cores and collect carbonates as desired. Spend a good bit of time looking around before committing to animal collections. If you see a place you may want to come back to, drop a digital target. a guide of activities for each type of faunal community you may encounter are listed under "tasks". This may be our only dive at this site, so voucher collections are important. If you don't see clams, net some extra mussels from a second area please.

Tasks:
i) Explore and document (with Dan Cam running and strobes out)
ii) Nice photos and voucher collections of chemos as found
iii) At mussels: Take a mussel pot, and grab a carbonate

iv) At clams; Take some cool pix, Net a few (5-6 is plenty)

v) At tubeworms: Take cool pix, Grab a few into biobox

Plan:
1) Sit down and navigate in the sub.
2) Move towards Target 1:X209, Y107 (check and see if strobes for Dan Cam are out)

3) From there head uphill and explore the topo high (Target 2) and take push cores for Mandy, then work your way through the targets:3, 4, 5, and 6. when you see good stuff, drop a digital target.
4) After exploring, go back to the best area and land and deploy the bench marker, with a sub heading of due N (or close)

5) make appropriate Macrofaunal collections

6) If you have time and it is appropriate after what you have learned, you can run the perimeter of an area to get an (exact) plot of it's size and shape (keep mud out one porthole and chemo's out the other.

Collections planned : 12 pushcores, 1 mussel pot, tubeworms, clams, at least 2 carbonate substrate samples

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N26 23.3	W094 31.0	0	0	
1-southern_amp	N26 23.35948	W094 30.87494	209	107	
2-topo_high	N26 23.43701	W094 30.80559	326	249	
3-hi_amp_NE	N26 23.50382	W094 30.76258	399	372	
4-lo_amp	N26 23.54766	W094 30.84760	259	454	
5-hi_amp_NW	N26 23.52115	W094 30.95653	77	407	
6-hi_amp_W	N26 23.43895	W094 30.90413	162	255	

AC645
Dive # 4194

Date 5/29/2006 Cruise AT 15-03
Pilot: Mark lar Port: Bob Starboard: Cindy

Launch Target:
N26 21.168, W94 30.438
Dive target: X –561 (negative 561), Y 131
2210 m depth

Equipment:
Push Core Rack, niskins, Biobox, 2 mussel pots,
Milk crate for rocks, Suction pump sampler, collection net (unlined)
Markers: Bench marker #1

The biotarget was dived on in 2003. We know there are other sites nearby. There was also a single glass ball deployed 50m off the bottom in the area in 1990 as a passive sonar target (exact location is unknown, but it should be between 100 and 200 m away from the bio target if it is still there, we did not see it in 2003). Be aware of the fact that there are negative Xs when to the west of the biotarget area.

Tasks (generally prioritized):
i) Explore and document unknown areas(with Dan Cam running and strobes out) If you find good stuff before you get to the known bio target, look around and work in this area. Perhaps run it's perimeter which will provide an exact map of its size. If you find nothing, move to the biotarget.
ii) Two push cores in background and 10 in active seep area (mats or near mussels etc)
iii) make some mussel collections and clams if you see them. If the clams are in a thick bed of live animals, make both mussel pots in the clam bed. (if not use the net)
iv) take the mussel pots in different locations (diff. Mussel beds)
v) Watch for soft corals (last seen in area of bio target) and collect.
vi) don't forget about the suction sampler
vii) grab a hand full or two of tubeworms into the biobox.

Plan:
1) Sit down and navigate in the sub. If not in a seep area, take two push cores.
2) Go to Target 4 (Low amp W) X –561 (negative 561), Y 131 (check and see if strobes for Dan Cam are out)
3) When you are close head up the slope and look around, this target is supposed to be near the local topo high
4) If you don't find anything here proceed to Target 3 (mod amp W) X 152, Y 152 and look around
5) Still nothing, head to Target 5 (biotarget) X 409 Y 332

Collections planned : 2 mussel pot, tubeworms, clams, at least 2 carbonate substrate samples

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N26 21.1	W094 30.1	0	0	
1-hi_amp_crest	N26 21.22265	W094 29.82120	466	221	2210
2-mod_amp_NW	N26 21.32091	W094 29.89063	353	404	
3-mod_amp_W	N26 21.18310	W094 30.00991	152	152	2215
4-lo_amp_W	N26 21.16761	W094 30.43800	-561	131	2220
5 biotarget	N26 21.282	W94 29.856	409	332	2210

AC 645
Dive #4197

Date 6/1/2006 Cruise AT 15-03
Pilot: Gavin Port: Ian Starboard: Kazumi Shibata (ssssc)

Launch Target:
N26 21.282, W94 29.856
Dive target: X 375, Y 270
2210 m depth

Equipment:
2 mussel pots, Ian's Aquapix, Milk crate for rocks, net for octopus
Markers: none

Tasks:
1) Take 2 mussel pots in different beds
2) take cool pix of your choice
3) catch an octopus

Plan:
1) Sit down and navigate in the sub.
2) head towards the old markers: X 375, Y 270
3) Mussel pot and pix at first opportunity
4) If you find the old markers, and are in the right place, search around for banded tubies. Image them, do not collect.
5) DFU

Collections planned : 2 mussel pot, cool pix

Target	Latitude	Longitude	Local X (m)	Local Y (m)	Depth (m)
Local_Origin	N26 21.1	W094 30.1	0	0	
1-hi_amp_crest	N26 21.22265	W094 29.82120	466	221	2210
2-mod_amp_NW	N26 21.32091	W094 29.89063	353	404	
3-mod_amp_W	N26 21.18310	W094 30.00991	152	152	2215
4-lo_amp_W	N26 21.16761	W094 30.43800	-561	131	2220
5 biotarget	N26 21.282	W94 29.856	409	332	2210
Old markers			375	270	

Appendix 10. Samples Collected ATLANTIS / ALVIN.

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4173	AT 340	PSU	tubeworm genetics	x																		
4173	AT 340	PSU	tubeworm stable isotopes	x																		
4173	AT 340	PSU	tubeworm morphology	x																		
4173	AT 340	U. Austria	tubeworm symbionts	x																		
4173	AT 340	PSU	mussel genetics		x																	
4173	AT 340	PSU	mussel stable isotopes		x																	
4173	AT 340	PSU	mussel morphology		x																	
4173	AT 340	MPI Bremen	mussel symbionts		x																	
4173	AT 340	PSU	clam genetics																			
4173	AT 340	PSU	clam stable isotopes																			
4173	AT 340	PSU	clam morphology																			
4173	AT 340	MPI Bremen	clam symbionts																			
4173	AT 340	PSU	macrofauna genetics																			

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4173	AT 340	PSU	macrofauna stable isotopes																			
4173	AT 340	PSU	macrofauna preserved				x															
4173	AT 340	U. Austria	meiofauna																			
4174	GC 600	PSU	tubeworm genetics	x																		
4174	GC 600	PSU	tubeworm stable isotopes	x																		
4174	GC 600	PSU	tubeworm morphology	x																		
4174	GC 600	U. Austria	tubeworm symbionts	x																		
4174	GC 600	PSU	mussel genetics					x														
4174	GC 600	PSU	mussel stable isotopes					x														
4174	GC 600	PSU	mussel morphology					x														
4174	GC 600	MPI Bremen	mussel symbionts																			
4174	GC 600	PSU	clam genetics																			
4174	GC 600	PSU	clam stable isotopes																			
4174	GC 600	PSU	clam morphology																			
4174	GC 600	MPI Bremen	clam symbionts																			

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4174	GC 600	PSU	macrofauna genetics																			
4174	GC 600	PSU	macrofauna stable isotopes																			
4174	GC 600	PSU	macrofauna preserved					x														
4174	GC 600	U. Austria	meiofauna				x															
4175	WR 269	PSU	tubeworm genetics						x													
4175	WR 269	PSU	tubeworm stable isotopes						x													
4175	WR 269	PSU	tubeworm morphology						x													
4175	WR 269	U. Austria	tubeworm symbionts						x													
4175	WR 269	PSU	mussel genetics																			
4175	WR 269	PSU	mussel stable isotopes																			
4175	WR 269	PSU	mussel morphology																			
4175	WR 269	MPI Bremen	mussel symbionts																			
4175	WR 269	PSU	clam genetics																			
4175	WR 269	PSU	clam stable isotopes																			
4175	WR 269	PSU	clam morphology																			

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4175	WR 269	MPI Bremen	clam symbionts																			
4175	WR 269	PSU	macrofauna genetics																			
4175	WR 269	PSU	macrofauna stable isotopes						x													
4175	WR 269	PSU	macrofauna preserved						x													
4175	WR 269	U. Austria	meiofauna																			
4176	KC 243	PSU	tubeworm genetics																			
4176	KC 243	PSU	tubeworm stable isotopes																			
4176	KC 243	PSU	tubeworm morphology																			
4176	KC 243	U. Austria	tubeworm symbionts																			
4176	KC 243	PSU	mussel genetics							x												
4176	KC 243	PSU	mussel stable isotopes							x												
4176	KC 243	PSU	mussel morphology							x												
4176	KC 243	MPI Bremen	mussel symbionts							x												
4176	KC 243	PSU	clam genetics																			

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4176	KC 243	PSU	clam stable isotopes																			
4176	KC 243	PSU	clam morphology																			
4176	KC 243	MPI Bremen	clam symbionts																			
4176	KC 243	PSU	macrofauna genetics							x												
4176	KC 243	PSU	macrofauna stable isotopes							x												
4176	KC 243	PSU	macrofauna preserved		x					x												
4176	KC 243	U. Austria	meiofauna							x												
4178	MC 853	PSU	tubeworm genetics																			
4178	MC 853	PSU	tubeworm stable isotopes																			
4178	MC 853	PSU	tubeworm morphology																			
4178	MC 853	U. Austria	tubeworm symbionts																			
4178	MC 853	PSU	mussel genetics							x												
4178	MC 853	PSU	mussel stable isotopes							x												
4178	MC 853	PSU	mussel morphology							x												
4178	MC 853	MPI Bremen	mussel symbionts							x												

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4178	MC 853	PSU	clam genetics																			
4178	MC 853	PSU	clam stable isotopes		x																	
4178	MC 853	PSU	clam morphology		x																	
4178	MC 853	MPI Bremen	clam symbionts		x																	
4178	MC 853	PSU	macrofauna genetics		x			x	x	x												
4178	MC 853	PSU	macrofauna stable isotopes		x			x	x	x	x											
4178	MC 853	PSU	macrofauna preserved		x			x	x	x	x											
4178	MC 853	U. Austria	meiofauna							x												
4179	AT 340	PSU	tubeworm genetics									x										
4179	AT 340	PSU	tubeworm stable isotopes									x										
4179	AT 340	PSU	tubeworm morphology									x										
4179	AT 340	U. Austria	tubeworm symbionts																			
4179	AT 340	PSU	mussel genetics		x																	
4179	AT 340	PSU	mussel stable isotopes		x																	
4179	AT 340	PSU	mussel morphology		x																	

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4179	AT 340	MPI Bremen	mussel symbionts		x																	
4179	AT 340	PSU	clam genetics																			
4179	AT 340	PSU	clam stable isotopes																			
4179	AT 340	PSU	clam morphology																			
4179	AT 340	MPI Bremen	clam symbionts																			
4179	AT 340	PSU	macrofauna genetics		x				x			x										
4179	AT 340	PSU	macrofauna stable isotopes		x							x										
4179	AT 340	PSU	macrofauna preserved		x				x			x										
4179	AT 340	U. Austria	meiofauna		x							x										
4180	AT 340	PSU	tubeworm genetics									x										
4180	AT 340	PSU	tubeworm stable isotopes									x										
4180	AT 340	PSU	tubeworm morphology									x										
4180	AT 340	U. Austria	tubeworm symbionts																			
4180	AT 340	PSU	mussel genetics		x																	
4180	AT 340	PSU	mussel stable isotopes		x																	

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4180	AT 340	PSU	mussel morphology		x																	
4180	AT 340	MPI Bremen	mussel symbionts		x																	
4180	AT 340	PSU	clam genetics																			
4180	AT 340	PSU	clam stable isotopes																			
4180	AT 340	PSU	clam morphology																			
4180	AT 340	MPI Bremen	clam symbionts																			
4180	AT 340	PSU	macrofauna genetics		x							x										
4180	AT 340	PSU	macrofauna stable isotopes		x							x										
4180	AT 340	PSU	macrofauna preserved		x							x										
4180	AT 340	U. Austria	meiofauna		x							x										
4181	AT 340	PSU	tubeworm genetics																			
4181	AT 340	PSU	tubeworm stable isotopes																			
4181	AT 340	PSU	tubeworm morphology																			
4181	AT 340	U. Austria	tubeworm symbionts																			
4181	AT 340	PSU	mussel genetics		x	x				x												

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4181	AT 340	PSU	mussel stable isotopes		x	x				x												
4181	AT 340	PSU	mussel morphology		x	x				x												
4181	AT 340	MPI Bremen	mussel symbionts			x																
4181	AT 340	PSU	clam genetics																			
4181	AT 340	PSU	clam stable isotopes																			
4181	AT 340	PSU	clam morphology																			
4181	AT 340	MPI Bremen	clam symbionts																			
4181	AT 340	PSU	macrofauna genetics		x	x				x												
4181	AT 340	PSU	macrofauna stable isotopes		x	x				x												
4181	AT 340	PSU	macrofauna preserved		x	x				x												
4181	AT 340	U. Austria	meiofauna		x	x				x												
4182	MC 640	PSU	tubeworm genetics																			
4182	MC 640	PSU	tubeworm stable isotopes																			
4182	MC 640	PSU	tubeworm morphology																			
4182	MC 640	U. Austria	tubeworm symbionts																			

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4182	MC 640	PSU	mussel genetics		x	x				x												
4182	MC 640	PSU	mussel stable isotopes		x	x				x												
4182	MC 640	PSU	mussel morphology		x	x				x												
4182	MC 640	MPI Bremen	mussel symbionts			x																
4182	MC 640	PSU	clam genetics																			
4182	MC 640	PSU	clam stable isotopes																			
4182	MC 640	PSU	clam morphology																			
4182	MC 640	MPI Bremen	clam symbionts																			
4182	MC 640	PSU	macrofauna genetics		x	x				x												
4182	MC 640	PSU	macrofauna stable isotopes		x	x				x												
4182	MC 640	PSU	macrofauna preserved		x	x		x		x			x									
4182	MC 640	U. Austria	meiofauna		x	x				x												
4183	AT 340	PSU	tubeworm genetics									x										
4183	AT 340	PSU	tubeworm stable isotopes									x										
4183	AT 340	PSU	tubeworm morphology									x										

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4183	AT 340	U. Austria	tubeworm symbionts																			
4183	AT 340	PSU	mussel genetics																			
4183	AT 340	PSU	mussel stable isotopes																			
4183	AT 340	PSU	mussel morphology																			
4183	AT 340	MPI Bremen	mussel symbionts																			
4183	AT 340	PSU	clam genetics																			
4183	AT 340	PSU	clam stable isotopes																			
4183	AT 340	PSU	clam morphology																			
4183	AT 340	MPI Bremen	clam symbionts																			
4183	AT 340	PSU	macrofauna genetics						x			x										
4183	AT 340	PSU	macrofauna stable isotopes			x			x			x										
4183	AT 340	PSU	macrofauna preserved			x			x			x		x	x							
4183	AT 340	U. Austria	meiofauna									x		x	x							
4184	GC600	PSU	tubeworm genetics																			
4184	GC600	PSU	tubeworm stable isotopes																			

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4184	GC600	PSU	tubeworm morphology																			
4184	GC600	U. Austria	tubeworm symbionts																			
4184	GC600	PSU	mussel genetics																			
4184	GC600	PSU	mussel stable isotopes																			
4184	GC600	PSU	mussel morphology																			
4184	GC600	MPI Bremen	mussel symbionts																			
4184	GC600	PSU	clam genetics													x						
4184	GC600	PSU	clam stable isotopes													x						
4184	GC600	PSU	clam morphology													x						
4184	GC600	MPI Bremen	clam symbionts																			
4184	GC600	PSU	macrofauna genetics					x	x													
4184	GC600	PSU	macrofauna stable isotopes					x	x							x						
4184	GC600	PSU	macrofauna preserved					x	x							x						
4184	GC600	U. Austria	meiofauna													x						
4185	GC 852	PSU	tubeworm genetics																			

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4185	GC 852	PSU	tubeworm stable isotopes																			
4185	GC 852	PSU	tubeworm morphology																			
4185	GC 852	U. Austria	tubeworm symbionts																			
4185	GC 852	PSU	mussel genetics																			
4185	GC 852	PSU	mussel stable isotopes																			
4185	GC 852	PSU	mussel morphology																			
4185	GC 852	MPI Bremen	mussel symbionts																			
4185	GC 852	PSU	clam genetics																			
4185	GC 852	PSU	clam stable isotopes																			
4185	GC 852	PSU	clam morphology																			
4185	GC 852	MPI Bremen	clam symbionts																			
4185	GC 852	PSU	coral preserved															x				
4185	GC 852	PSU	coral stable isotope															x				
4185	GC 852	USGS	coral genetics															x				
4185	GC 852	PSU	macrofauna genetics					x														

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4185	GC 852	PSU	macrofauna stable isotopes					x									x	x				
4185	GC 852	PSU	macrofauna preserved					x									x	x				
4185	GC 852	U. Austria	meiofauna																			
4186	GC 852	PSU	tubeworm genetics									x										
4186	GC 852	PSU	tubeworm stable isotopes									x										
4186	GC 852	PSU	tubeworm morphology									x										
4186	GC 852	U. Austria	tubeworm symbionts																			
4186	GC 852	PSU	mussel genetics							x												
4186	GC 852	PSU	mussel stable isotopes							x												
4186	GC 852	PSU	mussel morphology							x												
4186	GC 852	MPI Bremen	mussel symbionts																			
4186	GC 852	PSU	clam genetics																			
4186	GC 852	PSU	clam stable isotopes																			
4186	GC 852	PSU	clam morphology																			
4186	GC 852	MPI Bremen	clam symbionts																			

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4186	GC 852	PSU	coral preserved																			
4186	GC 852	PSU	coral stable isotope																			
4186	GC 852	USGS	coral genetics																			
4186	GC 852	PSU	macrofauna genetics						x	x		x										
4186	GC 852	PSU	macrofauna stable isotopes							x		x										
4186	GC 852	PSU	macrofauna preserved						x	x		x										
4186	GC 852	U. Austria	meiofauna							x		x										
4187	GC 852	PSU	tubeworm genetics									x										
4187	GC 852	PSU	tubeworm stable isotopes									x										
4187	GC 852	PSU	tubeworm morphology									x										
4187	GC 852	U. Austria	tubeworm symbionts																			
4187	GC 852	PSU	mussel genetics							x												
4187	GC 852	PSU	mussel stable isotopes							x												
4187	GC 852	PSU	mussel morphology		x					x												
4187	GC 852	MPI Bremen	mussel symbionts		x																	

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4187	GC 852	PSU	clam genetics																			
4187	GC 852	PSU	clam stable isotopes																			
4187	GC 852	PSU	clam morphology																			
4187	GC 852	MPI Bremen	clam symbionts																			
4187	GC 852	PSU	coral preserved																			
4187	GC 852	PSU	coral stable isotope																			
4187	GC 852	USGS	coral genetics																			
4187	GC 852	PSU	macrofauna genetics		x			x		x		x										
4187	GC 852	PSU	macrofauna stable isotopes		x					x		x										
4187	GC 852	PSU	macrofauna preserved		x			x		x		x										
4187	GC 852	U. Austria	meiofauna							x		x										
4188																						
4189	GC 852	PSU	tubeworm genetics																			
4189	GC 852	PSU	tubeworm stable isotopes																			
4189	GC 852	PSU	tubeworm morphology																			
4189	GC 852	U. Austria	tubeworm symbionts																			

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4189	GC 852	PSU	mussel genetics																			
4189	GC 852	PSU	mussel stable isotopes																			
4189	GC 852	PSU	mussel morphology																			
4189	GC 852	MPI Bremen	mussel symbionts																			
4189	GC 852	PSU	clam genetics																			
4189	GC 852	PSU	clam stable isotopes																			
4189	GC 852	PSU	clam morphology																			
4189	GC 852	MPI Bremen	clam symbionts																			
4189	GC 852	PSU	coral preserved															x				
4189	GC 852	PSU	coral stable isotope															x				
4189	GC 852	USGS	coral genetics															x				
4189	GC 852	PSU	macrofauna genetics															x				
4189	GC 852	PSU	macrofauna stable isotopes															x				
4189	GC 852	PSU	macrofauna preserved															x				
4189	GC 852	U. Austria	meiofauna															x				
4190	GC 852	PSU	tubeworm genetics																			

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4190	GC 852	PSU	tubeworm stable isotopes																			
4190	GC 852	PSU	tubeworm morphology																			
4190	GC 852	U. Austria	tubeworm symbionts																			
4190	GC 852	PSU	mussel genetics																			
4190	GC 852	PSU	mussel stable isotopes																			
4190	GC 852	PSU	mussel morphology																			
4190	GC 852	MPI Bremen	mussel symbionts																			
4190	GC 852	PSU	clam genetics																			
4190	GC 852	PSU	clam stable isotopes																			
4190	GC 852	PSU	clam morphology																			
4190	GC 852	MPI Bremen	clam symbionts																			
4190	GC 852	PSU	coral preserved															x				
4190	GC 852	PSU	coral stable isotope															x				
4190	GC 852	USGS	coral genetics															x				
4190	GC 852	PSU	macrofauna genetics															x				

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4190	GC 852	PSU	macrofauna stable isotopes															x				
4190	GC 852	PSU	macrofauna preserved															x				
4190	GC 852	U. Austria	meiofauna															x				
4191	WR 269	PSU	tubeworm genetics	x															x			
4191	WR 269	PSU	tubeworm stable isotopes	x															x			
4191	WR 269	PSU	tubeworm morphology	x															x			
4191	WR 269	U. Austria	tubeworm symbionts																x			
4191	WR 269	PSU	mussel genetics		x					x												
4191	WR 269	PSU	mussel stable isotopes							x												
4191	WR 269	PSU	mussel morphology							x												
4191	WR 269	MPI Bremen	mussel symbionts		x																	
4191	WR 269	PSU	clam genetics																			
4191	WR 269	PSU	clam stable isotopes																			
4191	WR 269	PSU	clam morphology																			
4191	WR 269	MPI Bremen	clam symbionts																			

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4191	WR 269	PSU	coral preserved																			
4191	WR 269	PSU	coral stable isotope																			
4191	WR 269	USGS	coral genetics																			
4191	WR 269	PSU	macrofauna genetics	x	x					x									x			
4191	WR 269	PSU	macrofauna stable isotopes	x	x					x									x			
4191	WR 269	PSU	macrofauna preserved	x	x					x									x			
4191	WR 269	U. Austria	meiofauna							x									x			
4192	AC 818	PSU	tubeworm genetics	x																		
4192	AC 818	PSU	tubeworm stable isotopes	x																		
4192	AC 818	PSU	tubeworm morphology	x																		
4192	AC 818	U. Austria	tubeworm symbionts	x																		
4192	AC 818	PSU	mussel genetics							x												
4192	AC 818	PSU	mussel stable isotopes							x												
4192	AC 818	PSU	mussel morphology							x												
4192	AC 818	MPI Bremen	mussel symbionts		x																	

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4192	AC 818	PSU	clam genetics																			
4192	AC 818	PSU	clam stable isotopes																			
4192	AC 818	PSU	clam morphology																			
4192	AC 818	MPI Bremen	clam symbionts																			
4192	AC 818	PSU	coral preserved																			
4192	AC 818	PSU	coral stable isotope																			
4192	AC 818	USGS	coral genetics																			
4192	AC 818	PSU	macrofauna genetics	x	x					x												
4192	AC 818	PSU	macrofauna stable isotopes	x	x					x												
4192	AC 818	PSU	macrofauna preserved	x	x					x												
4192	AC 818	U. Austria	meiofauna							x												
4193	AC601	PSU	tubeworm genetics	x																		
4193	AC601	PSU	tubeworm stable isotopes	x																		
4193	AC601	PSU	tubeworm morphology	x																		
4193	AC601	U. Austria	tubeworm symbionts																			

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4193	AC601	PSU	mussel genetics		x																	
4193	AC601	PSU	mussel stable isotopes		x																	
4193	AC601	PSU	mussel morphology		x																	
4193	AC601	MPI Bremen	mussel symbionts		x																	
4193	AC601	PSU	clam genetics																			
4193	AC601	PSU	clam stable isotopes																			
4193	AC601	PSU	clam morphology																			
4193	AC601	MPI Bremen	clam symbionts																			
4193	AC601	PSU	coral preserved																			
4193	AC601	PSU	coral stable isotope																			
4193	AC601	USGS	coral genetics																			
4193	AC601	PSU	macrofauna genetics		x			x														
4193	AC601	PSU	macrofauna stable isotopes		x																	
4193	AC601	PSU	macrofauna preserved	x	x			x														
4193	AC601	U. Austria	meiofauna																			
4194	AC 645	PSU	tubeworm genetics	x																		

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4194	AC 645	PSU	tubeworm stable isotopes	x																		
4194	AC 645	PSU	tubeworm morphology	x																		
4194	AC 645	U. Austria	tubeworm symbionts																			
4194	AC 645	PSU	mussel genetics																		x	
4194	AC 645	PSU	mussel stable isotopes																		x	
4194	AC 645	PSU	mussel morphology																		x	
4194	AC 645	MPI Bremen	mussel symbionts																			
4194	AC 645	PSU	clam genetics																			
4194	AC 645	PSU	clam stable isotopes																			
4194	AC 645	PSU	clam morphology																			
4194	AC 645	MPI Bremen	clam symbionts																			
4194	AC 645	PSU	coral preserved																			
4194	AC 645	PSU	coral stable isotope																			
4194	AC 645	USGS	coral genetics																			
4194	AC 645	PSU	macrofauna genetics	x				x												x	x	

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4194	AC 645	PSU	macrofauna stable isotopes	x				x												x	x	
4194	AC 645	PSU	macrofauna preserved	x				x												x	x	
4194	AC 645	U. Austria	meiofauna																	x	x	
4195	AC 818	PSU	tubeworm genetics									x										
4195	AC 818	PSU	tubeworm stable isotopes									x										
4195	AC 818	PSU	tubeworm morphology									x										
4195	AC 818	U. Austria	tubeworm symbionts																			
4195	AC 818	PSU	mussel genetics			x																
4195	AC 818	PSU	mussel stable isotopes			x																
4195	AC 818	PSU	mussel morphology			x																
4195	AC 818	MPI Bremen	mussel symbionts			x																
4195	AC 818	PSU	clam genetics																			
4195	AC 818	PSU	clam stable isotopes																			
4195	AC 818	PSU	clam morphology																			
4195	AC 818	MPI Bremen	clam symbionts																			

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4195	AC 818	PSU	coral preserved																			
4195	AC 818	PSU	coral stable isotope																			
4195	AC 818	USGS	coral genetics																			
4195	AC 818	PSU	macrofauna genetics			x		x				x										
4195	AC 818	PSU	macrofauna stable isotopes			x		x				x										
4195	AC 818	PSU	macrofauna preserved			x		x				x										
4195	AC 818	U. Austria	meiofauna									x										
4196	AC 601	PSU	tubeworm genetics									x										
4196	AC 601	PSU	tubeworm stable isotopes									x										
4196	AC 601	PSU	tubeworm morphology									x										
4196	AC 601	U. Austria	tubeworm symbionts																			
4196	AC 601	PSU	mussel genetics		x																	
4196	AC 601	PSU	mussel stable isotopes		x																	
4196	AC 601	PSU	mussel morphology																			
4196	AC 601	MPI Bremen	mussel symbionts																			

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4196	AC 601	PSU	clam genetics																			
4196	AC 601	PSU	clam stable isotopes																			
4196	AC 601	PSU	clam morphology																			
4196	AC 601	MPI Bremen	clam symbionts																			
4196	AC 601	PSU	coral preserved																			
4196	AC 601	PSU	coral stable isotope																			
4196	AC 601	USGS	coral genetics																			
4196	AC 601	PSU	macrofauna genetics		x			x				x										
4196	AC 601	PSU	macrofauna stable isotopes		x							x										
4196	AC 601	PSU	macrofauna preserved		x			x				x										
4196	AC 601	U. Austria	meiofauna									x										
4197	AC 645	PSU	tubeworm genetics		x																	
4197	AC 645	PSU	tubeworm stable isotopes		x																	
4197	AC 645	PSU	tubeworm morphology		x																	
4197	AC 645	U. Austria	tubeworm symbionts																			

Dive	Site	Lab	Sample Type	tubeworm grab	mussel scoop	mussel scoop 2	biobox	rock grab	slurp	mussel pot 1	mussel pot 2	bushmaster	core R4	core Y4	core R1	clam scoop	crab grab	coral grab	push cores	mussel pot A	mussel pot D	mussel pot B
4197	AC 645	PSU	mussel genetics		x															x		x
4197	AC 645	PSU	mussel stable isotopes		x															x		x
4197	AC 645	PSU	mussel morphology		x															x		x
4197	AC 645	MPI Bremen	mussel symbionts		x																	x
4197	AC 645	PSU	clam genetics																			
4197	AC 645	PSU	clam stable isotopes																			
4197	AC 645	PSU	clam morphology																			
4197	AC 645	MPI Bremen	clam symbionts																			
4197	AC 645	PSU	coral preserved																			
4197	AC 645	PSU	coral stable isotope																			
4197	AC 645	USGS	coral genetics																			
4197	AC 645	PSU	macrofauna genetics		x															x		x
4197	AC 645	PSU	macrofauna stable isotopes		x															x		x
4197	AC 645	PSU	macrofauna preserved		x			x												x		x
4197	AC 645	U. Austria	meiofauna																	x		x

Appendix 11. Record of Dive Activities.

DIVE NUM	Site	Depth (m)	Date	Time	Lat Mean	Lon Mean	Pilot	Port Observer	STB Observer	Activity
4173	AT340	2216	5/9/2006	14:59	27.64780486	-88.36231220	Mark Spear	Erik Cordes	Bernie Bernard	Nav set 5462 7065
4173	AT340	2216	5/9/2006	16:08	27.64552701	-88.36329334	Mark Spear	Erik Cordes	Bernie Bernard	1 rock sample
4173	AT340	2216	5/9/2006	16:20	27.64550965	-88.36328493	Mark Spear	Erik Cordes	Bernie Bernard	Yellow cores near mussels and tubeworms
4173	AT340	2216	5/9/2006	16:31	27.64551074	-88.36328422	Mark Spear	Erik Cordes	Bernie Bernard	Mussel scoop
4173	AT340	2216	5/9/2006	16:37	27.64552198	-88.36328749	Mark Spear	Erik Cordes	Bernie Bernard	3 rock samples
4173	AT340	2216	5/9/2006	16:37	27.64552198	-88.36328749	Mark Spear	Erik Cordes	Bernie Bernard	Grab of mussels
4173	AT340	2216	5/9/2006	18:39	27.64463321	-88.36499541	Mark Spear	Erik Cordes	Bernie Bernard	Red cores near tubeworms
4173	AT340	2216	5/9/2006	18:55	27.64463424	-88.36499630	Mark Spear	Erik Cordes	Bernie Bernard	Deployed SEAS experiments
4173	AT340	2216	5/9/2006	18:59	27.64463549	-88.36499424	Mark Spear	Erik Cordes	Bernie Bernard	Collected 1 rock sample
4173	AT340	2216	5/9/2006	18:59	27.64463549	-88.36499424	Mark Spear	Erik Cordes	Bernie Bernard	Collected small clump of tubeworms
4173	AT340	2216	5/9/2006	19:20	27.64460149	-88.36503358	Mark Spear	Erik Cordes	Bernie Bernard	Deployed Marker 1
4174	GC600	1250	5/10/2006	14:04	27.37334615	-90.57041377	Pat Hickey	Bob Carney	Helge Neimann	Surveyed in
4174	GC600	1250	5/10/2006	15:01	27.37323726	-90.57566860	Pat Hickey	Bob Carney	Helge Neimann	Chem sensor deployed, malfunctions
4174	GC600	1250	5/10/2006	15:05	27.37324361	-90.57566171	Pat Hickey	Bob Carney	Helge Neimann	Tubeworm collection
4174	GC600	1250	5/10/2006	15:40	27.37307240	-90.57463477	Pat Hickey	Bob Carney	Helge Neimann	Red pushcores of white bacterial mat
4174	GC600	1250	5/10/2006	17:55	27.36870709	-90.56634925	Pat Hickey	Bob Carney	Helge Neimann	Yellow pushcores of white bacterial mat
4174	GC600	1250	5/10/2006	18:13	27.36869295	-90.56632326	Pat Hickey	Bob Carney	Helge Neimann	Mussel pot collection-failed

DIVE NUM	Site	Depth (m)	Date	Time	Lat Mean	Lon Mean	Pilot	Port Observer	STB Observer	Activity
4174	GC600	1250	5/10/2006	18:18	27.36869140	-90.56632375	Pat Hickey	Bob Carney	Helge Neimann	Marker yellow #3 deployed
4174	GC600	1250	5/10/2006	18:20	27.36870575	-90.56633456	Pat Hickey	Bob Carney	Helge Neimann	Large grey carbonate collection- 3 samples
4174	GC600	1250	5/10/2006	18:24	27.36871251	-90.56636470	Pat Hickey	Bob Carney	Helge Neimann	Slurp sample- shrimp and galatheids
4174	GC600	1250	5/10/2006	18:39	27.36797549	-90.56670115	Pat Hickey	Bob Carney	Helge Neimann	Anemone collection
4175	WR269	1950	5/11/2006	16:20	26.68583938	-91.65952070	Bruce Strickrott	Harry Roberts	Vladimir Samarkin	Deployed benchmark #1
4175	WR269	1950	5/11/2006	16:20	26.68583938	-91.65952070	Bruce Strickrott	Harry Roberts	Vladimir Samarkin	Suction sample of tube-like hairy growth and holothurians
4175	WR269	1950	5/11/2006	16:51	26.68626982	-91.66259904	Bruce Strickrott	Harry Roberts	Vladimir Samarkin	Mussel pot collection-failed
4176	KC243	1610	5/12/2006	14:29	26.73097869	-92.83170483	Gavin Eppard	Stephane Hourdez	Mike McCarthy	Deployed benchmarker
4176	KC243	1610	5/12/2006	15:18	26.73073188	-92.83041777	Gavin Eppard	Stephane Hourdez	Mike McCarthy	Deployed ball marker
4176	KC243	1610	5/12/2006	15:29	26.73068558	-92.83045916	Gavin Eppard	Stephane Hourdez	Mike McCarthy	Mussel pot collection
4176	KC243	1610	5/12/2006	16:07	26.73069054	-92.83048721	Gavin Eppard	Stephane Hourdez	Mike McCarthy	2 small rock samples
4176	KC243	1610	5/12/2006	16:07	26.73069054	-92.83048721	Gavin Eppard	Stephane Hourdez	Mike McCarthy	Scooping mussels
4176	KC243	1610	5/12/2006	17:11	26.73073259	-92.83039082	Gavin Eppard	Stephane Hourdez	Mike McCarthy	Mosaic
4177	GC852	1450	5/13/2006	15:27	27.10593737	-91.16603396	Mark Spear	Ian MacDonald	Monika Bright	Deploy rotary camera
4177	GC852	1450	5/13/2006	16:07	27.10635324	-91.16620915	Mark Spear	Ian MacDonald	Monika Bright	Mussel pot collection-failed
4177	GC852	1450	5/13/2006	16:33	27.10635092	-91.16618529	Mark Spear	Ian MacDonald	Monika Bright	SEAS RUST #4 and #5 experiment deployed
4177	GC852	1450	5/13/2006	16:50	27.10633883	-91.16619351	Mark Spear	Ian MacDonald	Monika Bright	Deployed benchmarker #1
4177	GC852	1450	5/13/2006	16:56	27.10633774	-91.16619309	Mark Spear	Ian MacDonald	Monika Bright	Red pushcores

DIVE NUM	Site	Depth (m)	Date	Time	Lat Mean	Lon Mean	Pilot	Port Observer	STB Observer	Activity
4177	GC852	1450	5/13/2006	17:10	27.10630550	-91.16618850	Mark Spear	Ian MacDonald	Monika Bright	Rock collection
4177	GC852	1450	5/13/2006	17:40	27.10625979	-91.16607717	Mark Spear	Ian MacDonald	Monika Bright	Tubeworm collection
4177	GC852	1450	5/13/2006	18:29	27.10632465	-91.16590704	Mark Spear	Ian MacDonald	Monika Bright	2 small rock samples
4177	GC852	1450	5/13/2006	18:29	27.10632465	-91.16590704	Mark Spear	Ian MacDonald	Monika Bright	Mussel Scoop
4178	MC853	1070	5/14/2006	14:35	28.12734069	-89.14123695	Pat Hickey	Mandy Joye	Bill Shedd	Deployed marker #1
4178	MC853	1070	5/14/2006	14:55	28.12725063	-89.14149671	Pat Hickey	Mandy Joye	Bill Shedd	Deployed marker #2
4178	MC853	1070	5/14/2006	14:55	28.12725063	-89.14149671	Pat Hickey	Mandy Joye	Bill Shedd	Red cores near bacterial mat
4178	MC853	1070	5/14/2006	15:00	28.12725391	-89.14148473	Pat Hickey	Mandy Joye	Bill Shedd	Slurp surface fauna
4178	MC853	1070	5/14/2006	15:12	28.12726679	-89.14145702	Pat Hickey	Mandy Joye	Bill Shedd	Slurp animals from carbonate
4178	MC853	1070	5/14/2006	15:27	28.12699717	-89.14203478	Pat Hickey	Mandy Joye	Bill Shedd	Slurp large siphonophore
4178	MC853	1070	5/14/2006	15:44	28.12741575	-89.14307532	Pat Hickey	Mandy Joye	Bill Shedd	Mussel pot #1
4178	MC853	1070	5/14/2006	16:11	28.12742335	-89.14307010	Pat Hickey	Mandy Joye	Bill Shedd	Net of mussels
4178	MC853	1070	5/14/2006	16:45	28.12556342	-89.14171007	Pat Hickey	Mandy Joye	Bill Shedd	Fired niskins #4 and 5
4178	MC853	1070	5/14/2006	17:12	28.12383968	-89.14039497	Pat Hickey	Mandy Joye	Bill Shedd	Net of mussels
4178	MC853	1070	5/14/2006	17:29	28.12299006	-89.13980296	Pat Hickey	Mandy Joye	Bill Shedd	Yellow pushcores
4178	MC853	1070	5/14/2006	17:59	28.12303414	-89.13942237	Pat Hickey	Mandy Joye	Bill Shedd	Deployed marker #3
4178	MC853	1070	5/14/2006	18:13	28.12208425	-89.14164213	Pat Hickey	Mandy Joye	Bill Shedd	Clam and mussel scoop
4178	MC853	1070	5/14/2006	18:31	28.12194479	-89.14206153	Pat Hickey	Mandy Joye	Bill Shedd	Marker deployed

DIVE NUM	Site	Depth (m)	Date	Time	Lat Mean	Lon Mean	Pilot	Port Observer	STB Observer	Activity
4178	MC853	1070	5/14/2006	18:41	28.12156428	-89.14246169	Pat Hickey	Mandy Joye	Bill Shedd	1 carbonate sample and 1 barite sample
4178	MC853	1070	5/14/2006	19:01	28.12045830	-89.14117104	Pat Hickey	Mandy Joye	Bill Shedd	Niskins 2 and 3
4178	MC853	1070	5/14/2006	19:02	28.12045892	-89.14117084	Pat Hickey	Mandy Joye	Bill Shedd	Mussel pot #2
4179	AT340	2200	5/15/2006	14:47	27.64468997	-88.36498100	Bruce Strickrott	Chuck Fisher	Stephanie Lessard-Pilon	On bench marker #1
4179	AT340	2200	5/15/2006	14:52	27.64455472	-88.36499410	Bruce Strickrott	Chuck Fisher	Stephanie Lessard-Pilon	Deployed fish trap, reset nav
4179	AT340	2200	5/15/2006	15:17	27.64496778	-88.36451021	Bruce Strickrott	Chuck Fisher	Stephanie Lessard-Pilon	Marker 2 deployed in mussel bed, ball marker deployed
4179	AT340	2200	5/15/2006	15:39	27.64497002	-88.36446480	Bruce Strickrott	Chuck Fisher	Stephanie Lessard-Pilon	Mosaic in progress
4179	AT340	2200	5/15/2006	16:27	27.64494116	-88.36459931	Bruce Strickrott	Chuck Fisher	Stephanie Lessard-Pilon	Niskin #5 deployed
4179	AT340	2200	5/15/2006	16:27	27.64494116	-88.36459931	Bruce Strickrott	Chuck Fisher	Stephanie Lessard-Pilon	Staining tubeworms, marker #3 deployed
4179	AT340	2200	5/15/2006	17:20	27.64496206	-88.36454942	Bruce Strickrott	Chuck Fisher	Stephanie Lessard-Pilon	Shrimp slurped
4179	AT340	2200	5/15/2006	17:31	27.64491791	-88.36481012	Bruce Strickrott	Chuck Fisher	Stephanie Lessard-Pilon	Grab of holothurian
4179	AT340	2200	5/15/2006	18:05	27.64461380	-88.36464289	Bruce Strickrott	Chuck Fisher	Stephanie Lessard-Pilon	Bushmaster sample
4179	AT340	2200	5/15/2006	18:56	27.64493215	-88.36440101	Bruce Strickrott	Chuck Fisher	Stephanie Lessard-Pilon	1 carbonate sample

DIVE NUM	Site	Depth (m)	Date	Time	Lat Mean	Lon Mean	Pilot	Port Observer	STB Observer	Activity
4179	AT340	2200	5/15/2006	18:56	27.64493215	-88.36440101	Bruce Strickrott	Chuck Fisher	Stephanie Lessard-Pilon	Staining tubeworms, marker #15 deployed
4179	AT340	2200	5/15/2006	19:20	27.64491725	-88.36442337	Bruce Strickrott	Chuck Fisher	Stephanie Lessard-Pilon	More tubeworm staining, deployed marker 6
4179	AT340	2200	5/15/2006	###	27.64757016	-88.36181058	Bruce Strickrott	Chuck Fisher	Stephanie Lessard-Pilon	Net of mussels
4180	AT340	2200	5/16/2006	16:45	27.64460498	-88.36502738	Gavin Eppard	Erik Cordes	Jill Petersen	Reset nav, at benchmark
4180	AT340	2200	5/16/2006	17:03	27.64485193	-88.36464174	Gavin Eppard	Erik Cordes	Jill Petersen	Tubies stained, marker deployed- failed, marker recovered
4180	AT340	2200	5/16/2006	17:17	27.64485272	-88.36464627	Gavin Eppard	Erik Cordes	Jill Petersen	Niskin #5 fired
4180	AT340	2200	5/16/2006	17:23	27.64485243	-88.36464715	Gavin Eppard	Erik Cordes	Jill Petersen	1 large carbonate collection
4180	AT340	2200	5/16/2006	17:42	27.64463373	-88.36475435	Gavin Eppard	Erik Cordes	Jill Petersen	Niskin #4 fired
4180	AT340	2200	5/16/2006	18:32	27.64463456	-88.36470480	Gavin Eppard	Erik Cordes	Jill Petersen	Niskin #3 fired
4180	AT340	2200	5/16/2006	18:43	27.64463854	-88.36470252	Gavin Eppard	Erik Cordes	Jill Petersen	Bushmaster collection, deployed marker 10
4180	AT340	2200	5/16/2006	18:55	27.64487636	-88.36479546	Gavin Eppard	Erik Cordes	Jill Petersen	Deployed marker 11
4180	AT340	2200	5/16/2006	18:56	27.64487591	-88.36479545	Gavin Eppard	Erik Cordes	Jill Petersen	Fired niskin #2
4180	AT340	2200	5/16/2006	19:09	27.64487344	-88.36480341	Gavin Eppard	Erik Cordes	Jill Petersen	Mussel scoop
4180	AT340	2200	5/16/2006	19:09	27.64487344	-88.36480341	Gavin Eppard	Erik Cordes	Jill Petersen	Tubeworm collection
4181	AT340	2200	5/17/2006	16:22	27.64769809	-88.37371885	Mark Spear	Harry Roberts	Guy Telesnicki	Niskin sample #1
4181	AT340	2200	5/17/2006	16:38	27.64771148	-88.37372086	Mark Spear	Harry Roberts	Guy Telesnicki	Mussel scoop sample #1

DIVE NUM	Site	Depth (m)	Date	Time	Lat Mean	Lon Mean	Pilot	Port Observer	STB Observer	Activity
4181	AT340	2200	5/17/2006	17:16	27.64724248	-88.37009942	Mark Spear	Harry Roberts	Guy Telesnicki	1 small carbonate sample from mussel pot #2
4181	AT340	2200	5/17/2006	17:16	27.64724248	-88.37009942	Mark Spear	Harry Roberts	Guy Telesnicki	Deployed marker #4 next to brine lake
4181	AT340	2200	5/17/2006	17:16	27.64724248	-88.37009942	Mark Spear	Harry Roberts	Guy Telesnicki	Mussel pot collection
4181	AT340	2200	5/17/2006	17:16	27.64724248	-88.37009942	Mark Spear	Harry Roberts	Guy Telesnicki	Mussel scoop sample #2
4181	AT340	2200	5/17/2006	17:20	27.64723154	-88.37009544	Mark Spear	Harry Roberts	Guy Telesnicki	Niskin #2
4181	AT340	2200	5/17/2006	18:57	27.64486525	-88.36546289	Mark Spear	Harry Roberts	Guy Telesnicki	Three red pushcores #1,2,3 near tubie bush
4181	AT340	2200	5/17/2006	19:36	27.64496980	-88.36487699	Mark Spear	Harry Roberts	Guy Telesnicki	Pick up SEAS experiment
4181	AT340	2200	5/17/2006	19:39	27.64497012	-88.36487623	Mark Spear	Harry Roberts	Guy Telesnicki	Niskin #3 sample
4181	AT340	2200	5/17/2006	19:43	27.64494568	-88.36492379	Mark Spear	Harry Roberts	Guy Telesnicki	Retrieve fish trap
4182	MC640	1410	5/18/2006	15:37	28.35701639	-88.79243328	Pat Hickey	Bob Carney	PIT	Niskins #1,2 fired
4182	MC640	1410	5/18/2006	15:41	28.35701663	-88.79243354	Pat Hickey	Bob Carney	PIT	Yellow marker #1 deployed
4182	MC640	1410	5/18/2006	15:45	28.35701595	-88.79243416	Pat Hickey	Bob Carney	PIT	Mussel pot
4182	MC640	1410	5/18/2006	15:56	28.35701214	-88.79242785	Pat Hickey	Bob Carney	PIT	Yellow pushcores # 1,2,3
4182	MC640	1410	5/18/2006	16:00	28.35701531	-88.79243203	Pat Hickey	Bob Carney	PIT	Slurp sample, single brachyuran crab
4182	MC640	1410	5/18/2006	16:08	28.35700960	-88.79242800	Pat Hickey	Bob Carney	PIT	Net scoop, 1 small sample carbonate
4182	MC640	1410	5/18/2006	16:25	28.35684735	-88.79275408	Pat Hickey	Bob Carney	PIT	Niskin 3 and 4
4182	MC640	1410	5/18/2006	16:33	28.35682499	-88.79276285	Pat Hickey	Bob Carney	PIT	Pushcores in bacterial mat Yellow # 4, 5, 6 and Red 1, 2, 3

DIVE NUM	Site	Depth (m)	Date	Time	Lat Mean	Lon Mean	Pilot	Port Observer	STB Observer	Activity
4182	MC640	1410	5/18/2006	17:37	28.35638800	-88.79307935	Pat Hickey	Bob Carney	PIT	1 large carbonate slab
4182	MC640	1410	5/18/2006	17:37	28.35638800	-88.79307935	Pat Hickey	Bob Carney	PIT	Mussel net
4182	MC640	1410	5/18/2006	17:42	28.35637943	-88.79308487	Pat Hickey	Bob Carney	PIT	Niskin #5
4182	MC640	1410	5/18/2006	17:43	28.35637711	-88.79308268	Pat Hickey	Bob Carney	PIT	Push cores red #4,5,6
4183	AT340	2175	5/19/2006	14:58	27.64716006	-88.37394226	Bruce Strickrott	Chuck Fisher	Adriana Leiva	Two control push cores
4183	AT340	2175	5/19/2006	16:07	27.64743598	-88.37392894	Bruce Strickrott	Chuck Fisher	Adriana Leiva	Marker #12 deployed, tubies stained
4183	AT340	2175	5/19/2006	16:36	27.64740908	-88.37394170	Bruce Strickrott	Chuck Fisher	Adriana Leiva	Marker #8 deployed, tubies stained
4183	AT340	2175	5/19/2006	16:49	27.64742126	-88.37395479	Bruce Strickrott	Chuck Fisher	Adriana Leiva	More tubies stained close to marker #8
4183	AT340	2175	5/19/2006	17:30	27.64747180	-88.37407465	Bruce Strickrott	Chuck Fisher	Adriana Leiva	1 small sample carbonate
4183	AT340	2175	5/19/2006	17:30	27.64747180	-88.37407465	Bruce Strickrott	Chuck Fisher	Adriana Leiva	Baby tubeworms grabbed
4183	AT340	2175	5/19/2006	17:47	27.64719816	-88.37395332	Bruce Strickrott	Chuck Fisher	Adriana Leiva	1 small sample carbonate
4183	AT340	2175	5/19/2006	17:47	27.64719816	-88.37395332	Bruce Strickrott	Chuck Fisher	Adriana Leiva	Bushmaster collection
4183	AT340	2175	5/19/2006	18:28	27.64566399	-88.37047091	Bruce Strickrott	Chuck Fisher	Adriana Leiva	Coring urchins (10 cores)
4183	AT340	2175	5/19/2006	18:44	27.64566905	-88.37046218	Bruce Strickrott	Chuck Fisher	Adriana Leiva	Collecting net of urchins
4183	AT340	2175	5/19/2006	19:00	27.64567445	-88.37041617	Bruce Strickrott	Chuck Fisher	Adriana Leiva	Slurp of hermit crabs and shrimp
4183	AT340	2175	5/19/2006	19:30	27.64463582	-88.36313513	Bruce Strickrott	Chuck Fisher	Adriana Leiva	Deployed marker 5
4183	AT340	2175	5/19/2006	19:39	27.64449399	-88.36310889	Bruce Strickrott	Chuck Fisher	Adriana Leiva	Mosaic of Mussel brick road
4183	AT340	2175	5/19/2006	19:45	27.64505625	-88.36310903	Bruce Strickrott	Chuck Fisher	Adriana Leiva	Ball marker dropped

DIVE NUM	Site	Depth (m)	Date	Time	Lat Mean	Lon Mean	Pilot	Port Observer	STB Observer	Activity
4183	AT340	2175	5/19/2006	19:48	27.64520603	-88.36308171	Bruce Strickrott	Chuck Fisher	Adriana Leiva	Ball marker dropped
4184	GC600	1250	5/20/2006	14:25	27.37323512	-90.57566438	Gavin Eppard	Stephane Hourdez	Marshall Bowles	Dropped benchmarker 2
4184	GC600	1250	5/20/2006	17:12	27.37198656	-90.57340318	Gavin Eppard	Stephane Hourdez	Marshall Bowles	Niskins #1, 2
4184	GC600	1250	5/20/2006	17:23	27.37199002	-90.57340311	Gavin Eppard	Stephane Hourdez	Marshall Bowles	2 small carbonate samples from clam site 1
4184	GC600	1250	5/20/2006	17:23	27.37199002	-90.57340311	Gavin Eppard	Stephane Hourdez	Marshall Bowles	Yellow pushcores by clams
4184	GC600	1250	5/20/2006	17:41	27.37199935	-90.57341006	Gavin Eppard	Stephane Hourdez	Marshall Bowles	Clam collection - 2 carbonate samples
4184	GC600	1250	5/20/2006	17:55	27.37200733	-90.57342351	Gavin Eppard	Stephane Hourdez	Marshall Bowles	Rock collection
4184	GC600	1250	5/20/2006	19:12	27.36650148	-90.56391870	Gavin Eppard	Stephane Hourdez	Marshall Bowles	Niskins #3, 4, 5
4184	GC600	1250	5/20/2006	19:16	27.36651657	-90.56392994	Gavin Eppard	Stephane Hourdez	Marshall Bowles	Dropped Ian marker #5, took red pushcores with rock underneath
4184	GC600	1250	5/20/2006	19:22	27.36650222	-90.56392320	Gavin Eppard	Stephane Hourdez	Marshall Bowles	2 small bags of carbonate from clam site 2
4184	GC600	1250	5/20/2006	19:22	27.36650222	-90.56392320	Gavin Eppard	Stephane Hourdez	Marshall Bowles	Clam scoop
4184	GC600	1250	5/20/2006	19:35	27.36651593	-90.56392333	Gavin Eppard	Stephane Hourdez	Marshall Bowles	Slurping galatheids, crabs and shrimp
4185	GC852	1410	5/21/2006	14:45	27.10590706	-91.16572768	Mark Spear	Monika Bright	Cheryl Morrison	Deploy camera
4185	GC852	1410	5/21/2006	14:52	27.10591292	-91.16572970	Mark Spear	Monika Bright	Cheryl Morrison	Set DVL nav
4185	GC852	1410	5/21/2006	15:05	27.10586444	-91.16601322	Mark Spear	Monika Bright	Cheryl Morrison	Recover crab trap
4185	GC852	1410	5/21/2006	16:23	27.10968413	-91.16540625	Mark Spear	Monika Bright	Cheryl Morrison	Collect anemones
4185	GC852	1410	5/21/2006	16:45	27.10959154	-91.16549012	Mark Spear	Monika Bright	Cheryl Morrison	Collect anemones

DIVE NUM	Site	Depth (m)	Date	Time	Lat Mean	Lon Mean	Pilot	Port Observer	STB Observer	Activity
4185	GC852	1410	5/21/2006	17:52	27.11085603	-91.16565289	Mark Spear	Monika Bright	Cheryl Morrison	Collection of 3 rock samples near benchmark
4185	GC852	1410	5/21/2006	17:52	27.11085603	-91.16565289	Mark Spear	Monika Bright	Cheryl Morrison	Deployed benchmarker #2
4185	GC852	1410	5/21/2006	17:52	27.11085603	-91.16565289	Mark Spear	Monika Bright	Cheryl Morrison	Sponge collection
4185	GC852	1410	5/21/2006	18:05	27.11087553	-91.16562954	Mark Spear	Monika Bright	Cheryl Morrison	Crab collection
4185	GC852	1410	5/21/2006	18:12	27.11088447	-91.16563330	Mark Spear	Monika Bright	Cheryl Morrison	Collect rock
4185	GC852	1410	5/21/2006	18:20	27.11091394	-91.16561953	Mark Spear	Monika Bright	Cheryl Morrison	Collect crab with manipulator
4185	GC852	1410	5/21/2006	18:48	27.10995915	-91.16593877	Mark Spear	Monika Bright	Cheryl Morrison	Collect bamboo coral
4186	GC852	1410	5/22/2006	15:56	27.10635657	-91.16618318	Pat Hickey	Chuck Fisher	Erin Becker	at benchmarker 1
4186	GC852	1410	5/22/2006	16:08	27.10638635	-91.16612887	Pat Hickey	Chuck Fisher	Erin Becker	Deploy fish trap
4186	GC852	1410	5/22/2006	16:24	27.10619126	-91.16613587	Pat Hickey	Chuck Fisher	Erin Becker	Mussel pot collection
4186	GC852	1410	5/22/2006	17:43	27.10619210	-91.16613065	Pat Hickey	Chuck Fisher	Erin Becker	Deployed Ian marker 6 about 2-3 meters from stained tubeworms
4186	GC852	1410	5/22/2006	18:05	27.10595746	-91.16622784	Pat Hickey	Chuck Fisher	Erin Becker	Bushmaster collection
4186	GC852	1410	5/22/2006	18:22	27.10595072	-91.16623594	Pat Hickey	Chuck Fisher	Erin Becker	Carbonate collection- 2 rocks
4186	GC852	1410	5/22/2006	18:22	27.10595072	-91.16623594	Pat Hickey	Chuck Fisher	Erin Becker	Slurp collection
4187	GC852	1410	5/23/2006	14:19	27.10627679	-91.16612168	Bruce Strickrott	Erik Cordes	PIT Sean	At benchmarker 1, reset nav
4187	GC852	1410	5/23/2006	16:15	27.11092930	-91.16563683	Bruce Strickrott	Erik Cordes	PIT Sean	Mussel pot- 1 small carbonate sample
4187	GC852	1410	5/23/2006	16:38	27.11093301	-91.16559239	Bruce Strickrott	Erik Cordes	PIT Sean	Deployed marker #8, staining tubeworms
4187	GC852	1410	5/23/2006	17:25	27.11126986	-91.16554374	Bruce Strickrott	Erik Cordes	PIT Sean	Bushmaster

DIVE NUM	Site	Depth (m)	Date	Time	Lat Mean	Lon Mean	Pilot	Port Observer	STB Observer	Activity
4187	GC852	1410	5/23/2006	17:55	27.11113716	-91.16543614	Bruce Strickrott	Erik Cordes	PIT Sean	Reset nav again
4187	GC852	1410	5/23/2006	18:13	27.11109414	-91.16533438	Bruce Strickrott	Erik Cordes	PIT Sean	Deployed marker #5, staining tubeworms
4187	GC852	1410	5/23/2006	18:38	27.11073273	-91.16558741	Bruce Strickrott	Erik Cordes	PIT Sean	Mussel scoop
4187	GC852	1410	5/23/2006	19:30	27.10994806	-91.16591835	Bruce Strickrott	Erik Cordes	PIT Sean	Mosaic
4187	GC852	1410	5/23/2006	20:19	27.11002441	-91.16599061	Bruce Strickrott	Erik Cordes	PIT Sean	Grabbed rock- 1 sample from mound top
4189	GC852	1410	5/24/2006	16:39	27.10962838	-91.16583993	Gavin Eppard	Ian MacDonald	Cheryl Morrison	Deployed camera
4189	GC852	1410	5/24/2006	16:56	27.10956311	-91.16596107	Gavin Eppard	Ian MacDonald	Cheryl Morrison	Coral collection
4189	GC852	1410	5/24/2006	17:09	27.10956207	-91.16596204	Gavin Eppard	Ian MacDonald	Cheryl Morrison	Three niskins # 1,2,3
4189	GC852	1410	5/24/2006	17:15	27.10956263	-91.16596135	Gavin Eppard	Ian MacDonald	Cheryl Morrison	Carbonate/anemone collection
4189	GC852	1410	5/24/2006	17:28	27.10954937	-91.16591027	Gavin Eppard	Ian MacDonald	Cheryl Morrison	Sampled corals with manipulator
4189	GC852	1410	5/24/2006	17:48	27.11073239	-91.16542413	Gavin Eppard	Ian MacDonald	Cheryl Morrison	Reset nav
4189	GC852	1410	5/24/2006	18:03	27.11082444	-91.16568254	Gavin Eppard	Ian MacDonald	Cheryl Morrison	Fired 2 niskin bottles- #4,5
4189	GC852	1410	5/24/2006	18:10	27.11082626	-91.16568493	Gavin Eppard	Ian MacDonald	Cheryl Morrison	Red pushcores
4189	GC852	1410	5/24/2006	18:50	27.11063536	-91.16593047	Gavin Eppard	Ian MacDonald	Cheryl Morrison	Yellow pushcores
4189	GC852	1410	5/24/2006	19:07	27.10974384	-91.16615795	Gavin Eppard	Ian MacDonald	Cheryl Morrison	Collected camera
4189	GC852	1410	5/24/2006	19:55	27.10968478	-91.16643060	Gavin Eppard	Ian MacDonald	Cheryl Morrison	Collecting corals
4190	GC852	1410	5/25/2006	14:33	27.11089199	-91.16556501	Mark Spear	Bob Carney	Meg Bernier	Camera deployed
4190	GC852	1410	5/25/2006	15:55	27.10988105	-91.16605704	Mark Spear	Bob Carney	Meg Bernier	Corals (hard and soft) collected

DIVE NUM	Site	Depth (m)	Date	Time	Lat Mean	Lon Mean	Pilot	Port Observer	STB Observer	Activity
4190	GC852	1410	5/25/2006	18:13	27.10634876	-91.16662567	Mark Spear	Bob Carney	Meg Bernier	Recover SEAS experiments and fish trap
4190	GC852	1410	5/25/2006	18:13	27.10634876	-91.16662567	Mark Spear	Bob Carney	Meg Bernier	Trip all 5 Niskins at BM 2
4191	WR269	1950	5/26/2006	15:25	26.68584842	-91.65950000	Pat Hickey	Harry Roberts	Matt Kupchik	Mosaic of pogonopheran field
4191	WR269	1950	5/26/2006	16:13	26.68585277	-91.65943294	Pat Hickey	Harry Roberts	Matt Kupchik	Niskins #1 and #2
4191	WR269	1950	5/26/2006	16:34	26.68585359	-91.65943805	Pat Hickey	Harry Roberts	Matt Kupchik	12 pushcores in pogonopheran field
4191	WR269	1950	5/26/2006	16:45	26.68584936	-91.65943976	Pat Hickey	Harry Roberts	Matt Kupchik	Slurp of pogos and friends
4191	WR269	1950	5/26/2006	17:45	26.68623861	-91.66249239	Pat Hickey	Harry Roberts	Matt Kupchik	Scoop of mussels for biobox with manipulator and scoop
4191	WR269	1950	5/26/2006	18:02	26.68623575	-91.66249352	Pat Hickey	Harry Roberts	Matt Kupchik	Niskins #3 and #4
4191	WR269	1950	5/26/2006	18:08	26.68621371	-91.66252919	Pat Hickey	Harry Roberts	Matt Kupchik	Tubeworm sampling and niskin #5
4191	WR269	1950	5/26/2006	18:25	26.68614540	-91.66273958	Pat Hickey	Harry Roberts	Matt Kupchik	Mussel pot sampling
4191	WR269	1950	5/26/2006	18:41	26.68614449	-91.66273524	Pat Hickey	Harry Roberts	Matt Kupchik	Niskin #5
4191	WR269	1950	5/26/2006	18:41	26.68614449	-91.66273524	Pat Hickey	Harry Roberts	Matt Kupchik	Tubeworm sampling
4191	WR269	1950	5/26/2006	18:43	26.68615072	-91.66268446	Pat Hickey	Harry Roberts	Matt Kupchik	Carbonate sample- 1 rock sample
4192	AC818	2740	5/27/2006	16:34	26.18007124	-94.62332043	Bruce Strickrott	Stephane Hourdez	Mike McCarthy	Mussel pot- 1 small carbonate sample from mussel pot
4192	AC818	2740	5/27/2006	16:34	26.18007124	-94.62332043	Bruce Strickrott	Stephane Hourdez	Mike McCarthy	Reset nav
4192	AC818	2740	5/27/2006	18:15	26.18031058	-94.62299540	Bruce Strickrott	Stephane Hourdez	Mike McCarthy	Deployed benchmarker #1
4192	AC818	2740	5/27/2006	18:25	26.18032212	-94.62299783	Bruce Strickrott	Stephane Hourdez	Mike McCarthy	Grab of tubeworms

DIVE NUM	Site	Depth (m)	Date	Time	Lat Mean	Lon Mean	Pilot	Port Observer	STB Observer	Activity
4192	AC818	2740	5/27/2006	18:38	26.18033419	-94.62299176	Bruce Strickrott	Stephane Hourdez	Mike McCarthy	Red pushcores
4192	AC818	2740	5/27/2006	19:22	26.18033930	-94.62299229	Bruce Strickrott	Stephane Hourdez	Mike McCarthy	Mussel scoop
4192	AC818	2740	5/27/2006	19:41	26.18033421	-94.62299557	Bruce Strickrott	Stephane Hourdez	Mike McCarthy	Rock collection- 1 small sample of carbonate
4192	AC818	2740	5/27/2006	20:10	26.18063365	-94.62306222	Bruce Strickrott	Stephane Hourdez	Mike McCarthy	Yellow pushcores in urchins
4193	AC601	2340	5/28/2006	14:27	26.39109301	-94.51640515	Gavin Eppard	Harry Roberts	Mandy Joye	Reset nav
4193	AC601	2340	5/28/2006	14:46	26.38917276	-94.51498331	Gavin Eppard	Harry Roberts	Mandy Joye	Two pushcores (Y5 and Y6) and drop marker #8
4193	AC601	2340	5/28/2006	15:06	26.38997174	-94.51398619	Gavin Eppard	Harry Roberts	Mandy Joye	Sample tubeworms
4193	AC601	2340	5/28/2006	15:34	26.39031791	-94.51352748	Gavin Eppard	Harry Roberts	Mandy Joye	Rock sample
4193	AC601	2340	5/28/2006	15:56	26.39001010	-94.51400350	Gavin Eppard	Harry Roberts	Mandy Joye	Slurp sample
4193	AC601	2340	5/28/2006	16:03	26.39001444	-94.51399530	Gavin Eppard	Harry Roberts	Mandy Joye	Pushcore Y3 and Y4 near tubeworm bush
4193	AC601	2340	5/28/2006	17:08	26.39185364	-94.51487329	Gavin Eppard	Harry Roberts	Mandy Joye	Niskins 1-5
4193	AC601	2340	5/28/2006	17:12	26.39181519	-94.51491989	Gavin Eppard	Harry Roberts	Mandy Joye	#1, #2 Yellow cores in brine pool bottom
4193	AC601	2340	5/28/2006	17:30	26.39216157	-94.51492716	Gavin Eppard	Harry Roberts	Mandy Joye	#5,6 Red cores in brine pool bottom
4193	AC601	2340	5/28/2006	17:49	26.39245723	-94.51346072	Gavin Eppard	Harry Roberts	Mandy Joye	#R3,4 edge of brine pool
4193	AC601	2340	5/28/2006	17:59	26.39228399	-94.51343532	Gavin Eppard	Harry Roberts	Mandy Joye	Attempted sample of crystals
4193	AC601	2340	5/28/2006	18:09	26.39200087	-94.51355430	Gavin Eppard	Harry Roberts	Mandy Joye	Carbonate sample- 1 large rock sample from ridge crest
4193	AC601	2340	5/28/2006	18:48	26.39208202	-94.51521337	Gavin Eppard	Harry Roberts	Mandy Joye	Pushcores R1 and R2 by mixed mussel/urchin field

DIVE NUM	Site	Depth (m)	Date	Time	Lat Mean	Lon Mean	Pilot	Port Observer	STB Observer	Activity
4193	AC601	2340	5/28/2006	18:51	26.39208131	-94.51521359	Gavin Eppard	Harry Roberts	Mandy Joye	Scoop of mussels/urchins- 1 small carbonate sample
4194	AC645	2240	5/29/2006	14:32	26.35276965	-94.50737606	Mark Spear	Bob Carney	Cindy Petersen	2 red pushcores #1,2
4194	AC645	2240	5/29/2006	14:40	26.35448739	-94.50942685	Mark Spear	Bob Carney	Cindy Petersen	Coral and holothurian collection
4194	AC645	2240	5/29/2006	16:12	26.35433470	-94.49826002	Mark Spear	Bob Carney	Cindy Petersen	Mussel pot A taken
4194	AC645	2240	5/29/2006	16:29	26.35434411	-94.49824978	Mark Spear	Bob Carney	Cindy Petersen	Rock collection- 2 large rock samples from bottom and top of mound
4194	AC645	2240	5/29/2006	16:45	26.35435148	-94.49823508	Mark Spear	Bob Carney	Cindy Petersen	Grab of tubeworm clump
4194	AC645	2240	5/29/2006	16:58	26.35442288	-94.49841938	Mark Spear	Bob Carney	Cindy Petersen	Pushcores #3,4,5
4194	AC645	2240	5/29/2006	17:04	26.35444044	-94.49845174	Mark Spear	Bob Carney	Cindy Petersen	Pushcore #6
4194	AC645	2240	5/29/2006	17:05	26.35444043	-94.49845173	Mark Spear	Bob Carney	Cindy Petersen	Niskins 1,2,3
4194	AC645	2240	5/29/2006	17:13	26.35444820	-94.49834450	Mark Spear	Bob Carney	Cindy Petersen	Marker #1 deployed
4194	AC645	2240	5/29/2006	17:39	26.35434091	-94.49744296	Mark Spear	Bob Carney	Cindy Petersen	Soft and hard coral collection, 1 rock sample from base of soft coral
4194	AC645	2240	5/29/2006	18:22	26.35516997	-94.49865260	Mark Spear	Bob Carney	Cindy Petersen	Second mussel pot B
4194	AC645	2240	5/29/2006	18:30	26.35518301	-94.49865207	Mark Spear	Bob Carney	Cindy Petersen	Pushcores Y1-6 taken in bacterial mat
4194	AC645	2240	5/29/2006	18:41	26.35523857	-94.49863592	Mark Spear	Bob Carney	Cindy Petersen	Niskins #4, 5 fired
4194	AC645	2240	5/29/2006	19:10	26.35480803	-94.49823122	Mark Spear	Bob Carney	Cindy Petersen	Net samples of 3 holothuroids
4195	AC818	2740	5/30/2006	14:42	26.18013755	-94.62276839	Pat Hickey	Erik Cordes	Liz Goehring	Reset nav

DIVE NUM	Site	Depth (m)	Date	Time	Lat Mean	Lon Mean	Pilot	Port Observer	STB Observer	Activity
4195	AC818	2740	5/30/2006	14:54	26.18021658	-94.62301668	Pat Hickey	Erik Cordes	Liz Goehring	At benchmark 9
4195	AC818	2740	5/30/2006	16:36	26.18017507	-94.62298908	Pat Hickey	Erik Cordes	Liz Goehring	Bushmaster- 1 bag small rocks from bushmaster
4195	AC818	2740	5/30/2006	17:05	26.18014656	-94.62300305	Pat Hickey	Erik Cordes	Liz Goehring	Deployed marker #4 by stained tubeworms
4195	AC818	2740	5/30/2006	17:21	26.18021399	-94.62298475	Pat Hickey	Erik Cordes	Liz Goehring	Deployed marker #3 by 2nd stained tubie bush
4195	AC818	2740	5/30/2006	17:29	26.18031411	-94.62301068	Pat Hickey	Erik Cordes	Liz Goehring	3rd bush stained near marker #1
4195	AC818	2740	5/30/2006	18:31	26.18065005	-94.62279433	Pat Hickey	Erik Cordes	Liz Goehring	Slurp of 3 starfish, 1 squid, sea cucumber, galatheid crab and pogonophorans
4195	AC818	2740	5/30/2006	18:45	26.18084772	-94.62289617	Pat Hickey	Erik Cordes	Liz Goehring	Mussel scoop- included 1 back small carbonate rocks
4195	AC818	2740	5/30/2006	18:57	26.17987855	-94.62323654	Pat Hickey	Erik Cordes	Liz Goehring	Slurp of holothurian
4195	AC818	2740	5/30/2006	19:06	26.18013517	-94.62282694	Pat Hickey	Erik Cordes	Liz Goehring	Pushcore #2 and 3 at bushmaster scar
4195	AC818	2740	5/30/2006	19:14	26.18018699	-94.62282498	Pat Hickey	Erik Cordes	Liz Goehring	2 large carbonate collection near marker #3
4196	AC601	2330	5/31/2006	15:11	26.39235023	-94.51421983	Bruce Strickrott	Chuck Fisher	Jeremy Potter	Pelagic pump- yellow chamber
4196	AC601	2330	5/31/2006	15:27	26.39230210	-94.51411562	Bruce Strickrott	Chuck Fisher	Jeremy Potter	Pelagic pump- red chamber
4196	AC601	2330	5/31/2006	17:09	26.39208968	-94.51375551	Bruce Strickrott	Chuck Fisher	Jeremy Potter	Slurp of sargassum
4196	AC601	2330	5/31/2006	17:20	26.39244268	-94.51376537	Bruce Strickrott	Chuck Fisher	Jeremy Potter	Red pushcores of fluff
4196	AC601	2330	5/31/2006	17:31	26.39248183	-94.51380398	Bruce Strickrott	Chuck Fisher	Jeremy Potter	Coconut collection
4196	AC601	2330	5/31/2006	17:37	26.39248196	-94.51380323	Bruce Strickrott	Chuck Fisher	Jeremy Potter	Octopus collection

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4196	AC601	2330	5/31/2006	17:45	26.39222156	-94.51382848	Bruce Strickrott	Chuck Fisher	Jeremy Potter	6 push cores in brine
4196	AC601	2330	5/31/2006	18:00	26.39186735	-94.51384672	Bruce Strickrott	Chuck Fisher	Jeremy Potter	Carbonate with sponges collection
4196	AC601	2330	5/31/2006	18:42	26.39031060	-94.51437619	Bruce Strickrott	Chuck Fisher	Jeremy Potter	Bushmaster
4196	AC601	2330	5/31/2006	19:32	26.39045026	-94.51382057	Bruce Strickrott	Chuck Fisher	Jeremy Potter	Reset nav
4196	AC601	2330	5/31/2006	19:34	26.39050095	-94.51356327	Bruce Strickrott	Chuck Fisher	Jeremy Potter	Deployed Benchmarker #1
4196	AC601	2330	5/31/2006	19:35	26.39047826	-94.51354937	Bruce Strickrott	Chuck Fisher	Jeremy Potter	Carbonate collection
4196	AC601	2330	5/31/2006	20:21	26.39146400	-94.51488008	Bruce Strickrott	Chuck Fisher	Jeremy Potter	Mussel scoop
4197	AC645	2200	6/1/2006	14:29	26.35388547	-94.49602851	Gavin Eppard	Ian MacDonald	Kazumi Shibata	Mussel pot A near marker 3
4197	AC645	2200	6/1/2006	14:57	26.35387337	-94.49601058	Gavin Eppard	Ian MacDonald	Kazumi Shibata	Mussel pot B near marker 4
4197	AC645	2200	6/1/2006	15:16	26.35387452	-94.49601434	Gavin Eppard	Ian MacDonald	Kazumi Shibata	Mussel scoop
4197	AC645	2200	6/1/2006	15:33	26.35436315	-94.49729308	Gavin Eppard	Ian MacDonald	Kazumi Shibata	Carbonate collection
4197	AC645	2200	6/1/2006	15:45	26.35411139	-94.49743801	Gavin Eppard	Ian MacDonald	Kazumi Shibata	Medium carbonate from top of hill
4197	AC645	2200	6/1/2006	15:45	26.35411139	-94.49743801	Gavin Eppard	Ian MacDonald	Kazumi Shibata	Small carbonate collection from top of hill