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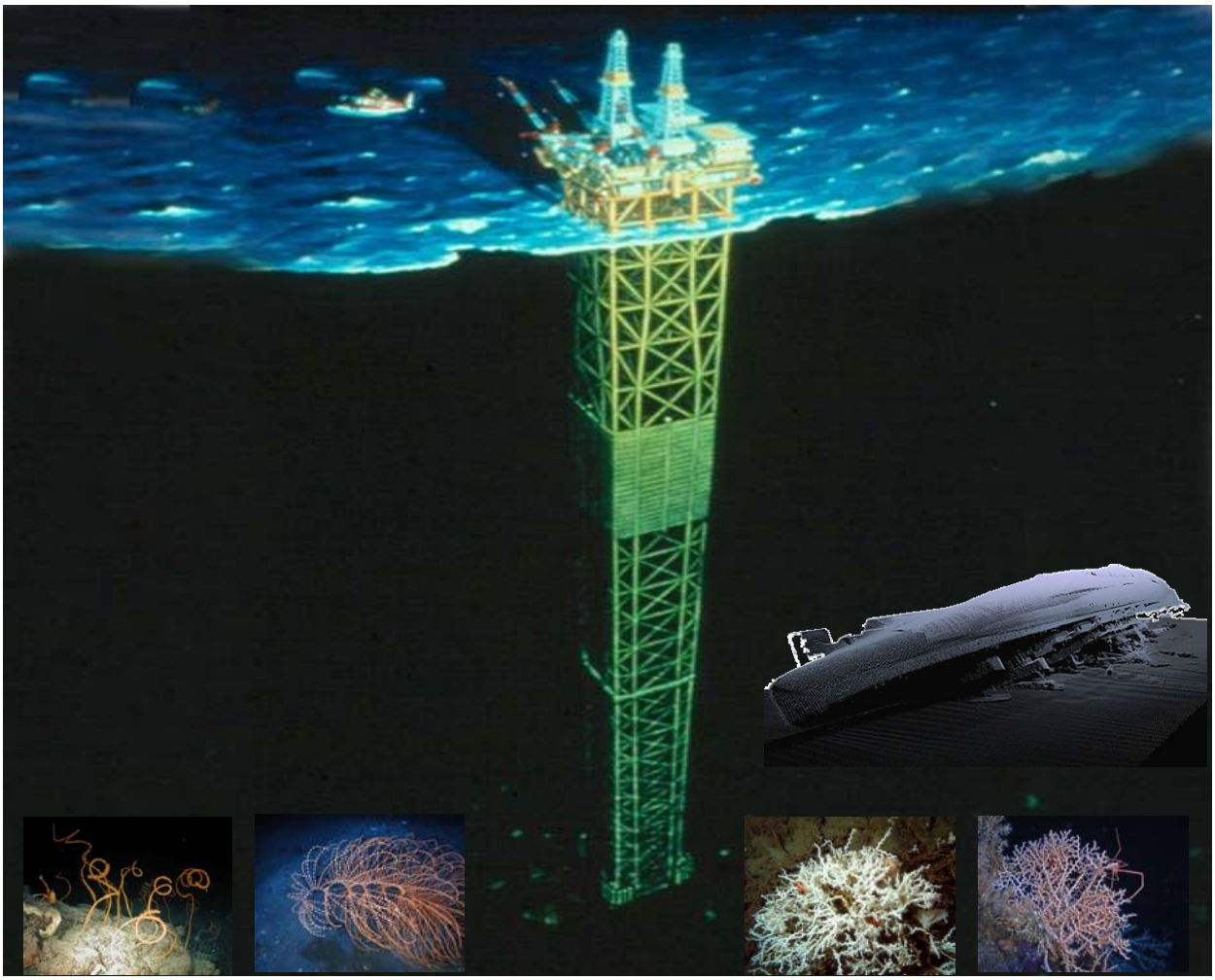
Deepwater Program: Exploration and Research of Northern Gulf of Mexico Deepwater Natural and Artificial Hard Bottom Habitats with Emphasis on Coral Communities: Reef, Rigs and Wrecks "Lophelia II"

Cruise 1 Report



November 2008

CRUISE 1 REPORT
2 September – 2 October 2008

for

Deepwater Program: Exploration and Research of Northern Gulf of Mexico Deepwater Natural and Artificial Hard Bottom Habitats with Emphasis on Coral Communities: Reef, Rigs and Wrecks

by

TDI-BROOKS INTERNATIONAL, INC.

Technical Report No. – 08-2175

November 2008

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INTRODUCTION

Overview

This document represents the TDI-Brooks International, Inc. Lophelia II Post-Cruise Report for contract number: **M08PC20038**, issued by the U.S.Department of the Interior, Minerals Management Service "**Deepwater Program: Exploration and Research of Northern Gulf of Mexico Deepwater Natural and Artificial Hard Bottom Habitats with Emphasis on Coral Communities: Reef, Rigs and Wrecks**. The Lophelia II Cruise was conducted on the NOAA Ship research vessel *Nancy Foster* from September 2, 2008 to October 2, 2008, and was the first cruise conducted for this contract. The cruise mobilized and embarked from Galveston, Texas and returned to Gulfport, Mississippi for the second leg. The second leg concluded on 2 October 2008 and demobilized in Pascagoula, Mississippi. This report provides 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

Over the last half century, offshore exploration for hydrocarbons in the northern Gulf of Mexico has advanced from the bay and inner shelf to the continental slope-to-continental rise transition. Geophysical and geotechnical data collected in support of both exploration and production has been largely responsible for the foundation of our present understanding of slope geology. This database emphasizes the extremely complex geological framework of the northern Gulf's continental slope and the surprisingly important role that the expulsion of subsurface fluids and gases has on shaping surficial geology and biology of the modern seafloor. Regional topography of the slope consists of basins, knolls, ridges, and mounds derived from the dynamic adjustments of salt to the introduction of large volumes of sediment over long time scales. Superimposed on this underlying topography is a smaller class of mounds, flows, and hard grounds that are the products of the transport of fluidized sediment, mineral-rich formation fluids, and hydrocarbons to the present sediment-water interface. The geologic response to the expulsion process is related both to the products being transported and the rate at which they arrive at the seafloor. Mud volcanoes and mudflows are typical or rapid flux settings where fluidized sediment is involved. Slow flux settings are mineral-prone. Authigenic carbonate mounds, hard grounds, crusts, and nodules are common to settings where hydrocarbons are involved.

Recent manned submersible and ROV dives to the middle and lower continental slope confirm the existence of these hard substrates to the deepest parts of the slope. Direct observation and sampling of expulsion sites started in the mid-1980s on the upper slope. We now know from analysis of 3D-seismic data and submersible-ROV dives that numerous expulsion sites with hard substrates provide habitat for deep water corals exist over the slope's full depth range.

In the context of this study, deep hardground communities of the Gulf of Mexico comprise all of the biological communities inhabiting natural or artificial hard substrates, excluding the chemosynthetic seep communities. These communities consist of foundation species, those species that form large complex habitats at these sites, and their associated fauna ranging in size from large mobile fishes to microscopic meiofauna. The most prominent foundation species in

these communities are the deep-water ("cold-water") corals. The terms "deep-water corals" or "cold-water corals" include relatives of the tropical reef-forming scleractinian corals, but also refer to a variety of other cnidarian taxa including antipatharians (black corals), gorgonians (including bamboo corals), alcyonaceans (soft corals), and stylasterine hydrocorals. Other taxa, including anemones and sponges are also significant contributors to the biogenic framework of these deep-water reef systems.

In the Gulf of Mexico, deep-water corals are commonly found on seep-related authigenic carbonates, but have also been observed on anthropogenic structures, ship wrecks and oil platforms in particular. The most common species of reef-forming deep-water coral in the Gulf of Mexico (GoM) is *Lophelia pertusa* (=*prolifera*). This species was first recovered in the late 1800s by the *U.S. Coast Survey Steamer Blake.*

Increasing industry activity in deepwater has resulted in the creation of numerous platforms in water depths exceeding 300 m. In areas where hard substrates are limiting, these platforms may significantly increase the potential range of corals and other hardground fauna. Growth of *Lophelia pertusa* has been noted on the Pompano platform in VK 989. In addition, the Joliet platform in GC 184 near Bush Hill and the Neptune platform near the large *L. pertusa* site in VK 826 are very likely to host coral populations. This study will focus on the exploration and characterization of these communities and examination of their potential connection to other coral populations and surrounding deep-water communities.

Objectives of the Project

A primary goal of this study is to obtain a robust predictive capability for the occurrence of rich cnidarian (primarily scleractinian coral) hard ground communities in the deep Gulf of Mexico. To achieve this long-term goal, this study will accomplish three interrelated and interdependent objectives:

1) Discover and describe new locations at greater than 300m depth in the GoM with extensive coral community development, particularly including *Lophelia pertusa*.

2) Gain a more comprehensive understanding of the fundamental processes that control the occurrence and distribution of *Lophelia* and other extensive coral communities at depths greater than 300 m in the GoM through both laboratory experiments and field data collection.

3) Document and understand the relations between coral communities on artificial and natural substrates with respect to community composition and function, phylogeographic and population genetics, and growth rates of the key cnidarian foundation fauna.

Upon meeting these three interrelated objectives we will have obtained an understanding of the biology and biogeography of Lophelia in the GoM that will result in a quantum increase on our ability to predict the occurrence of Lophelia at additional sites based on data such as bathymetry, current models, 3D seismic profiles, and known occurrence of source populations.

CRUISE OVERVIEW

Participating Organizations

- C & C Technologies, Inc. (C & C)
- TU Biology Department, Philadelphia, PA 19119
- PAST Foundation (PAST)
- Penn State University (PSU), Dept. of Biology, State College, PA 16802
- Texas A&M University at Corpus Christi (TAMUCC), Physical and Life Sciences Dept., Corpus Christi, TX 78412-5774
- METRO High School (METRO)
- US Geological Survey (USGS), Florida Integrated Science Center, St. Petersburg, FL 33701
- TDI BROOKS INTERNATIONAL (TDI-BROOKS)
- Minerals Management Service (MMS)
- NOAA Office of Ocean Exploration and Research (NOAA OER)
- SeaVision Marine Services LLC (SeaVision)

Personnel (Chief Scientist and participants)

Leg	NAME	AFFIL.	SEX	NAT.	POSITION
1	Robert Church	C & C	M	US	Chief scientist
1	Robert Westrick	C & C	M	US	Marine Archaeologist
1	Ann Corscadden	PAST	F	UK	Co-P.I., Marine Archaeologist
1	Keene Haywood	PAST	M	US	Archaeologist/Oceanographer
1	Stephanie Anne Lessard-Pilon	PSU	F	US	Biologist
1	Arunima Sen	PSU	F	India	Biologist
1	Kaitlin Kovacs	USGS	F	US	Scientist, Core Specialist
1	Andy Bruening	METRO	M	US	Geophysics teacher
1	Jack Irion	MMS	M	US	Marine Archaeologist
1	John Broadwater	NOAA OER	M	US	Observer
1,2	Jeffrey Snyder	SeaVision	M	US	ROV crew
1,2	Matthew Cook	SeaVision	M	US	ROV crew
1,2	Geoffrey Cook	SeaVision	M	Australia	ROV crew
1,2	Craig Bussel	SeaVision	M	US	ROV crew
2	Dr. Erik Cordes	TU	M	US	Chief scientist
2	Andrea Quattrini	USGS	F	US	scientist
2	Jay Lunden	TU	M	US	student
2	Leslie Wickes	TU	F	US	Scientist
2	Matt Porter	PSU	M	US	Student
2	Maria Pia Miglietta	PSU	F	Italy	Scientist
2	Morgan Kilgore	TAMUCC	F	US	Student
2	Doug Weaver	TAMUCC	M	US	Student
2	Mike Kullman	TDI	M	US	scientist
2	Bill Shedd	MMS	M	US	scientist
2	Emily Crum	NOAA OER	F	US	observer

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PSU	Dept. of Biology, State College, PA 16802
TAMUCC	Physical and Life Sciences Dept., Corpus Christi, TX 78412-5774
USGS	US Geological Survey, Florida Integrated Science Center, St. Petersburg, FL 33701
TDI-Brooks	College Station, TX 77845
MMS	Gulf of Mexico OCS Region and Atlantic Activities New Orleans, LA 70123-2394
NOAA OER	NOAA Office of Ocean Exploration and Research, Silver Spring, MD 20910
SeaVision	302 Maple Hill Road, Naugatuck, CT 06770

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FACILITIES

Equipment and capabilities provided by ship

- Seabeam or equivalent multibeam bathymetric mapping sonar
- XBT for speed of sound calibration
- Differential GPS navigation and serial data output
- Heading and water depth instruments with serial data output
- A-frame for launching ROV (see below)
- Power to the winch and vans (see below)
- Dynamic positioning system for vessel station-keeping
- INMARSAT satellite telephone service for voice and data (email)
- Networked computer printers
- Narrow band Acoustic Doppler Current Profiling (ADCP) system
- Laboratory and storage space
- PC based SCS workstations

- Zodiac, or equivalent, and motor for ROV contingencies, and video and still photo acquisition
- Crane support for all equipment during mobilization in Galveston and demobilization in Gulfport.
- Access to and use of the moon pool and transducer

Equipment and capabilities provided by science party

The scientific party provided the following items:

- All biological sampling equipment and supplies including backup still camera system, and sampling gear.
- Navigational transponders associated w/ ROV operations
- ROV winch system
- Control van

Communications

The NOAA Ship NANCY FOSTER communicates daily with the NOAA Marine Operations Center-Atlantic.

Communication Equipment *Nancy Foster*

- INMARSAT-B and C
- HF SSB/DSC Transceiver
- Cellular Telephone
- Land lines in port
- Iridium
- VHF Bridge to Bridge radio
- VHF Hand-held radios for ship-to-launch and deck communications
- E-mail address is: CO.Nancy.Foster@noaa.gov)

OPERATIONS

Data Collections

The primary data collected used the SeaVision ROV (**Appendix A**), high-resolution digital video and still photographic imagery, CTD data including conductivity, temperature, depth, dissolved oxygen concentration, pH, fluorometry, and turbidity, and physical samples of corals, sediment cores. Other data streams from the ROV, such as vehicle attitude, acoustic data, and sonar imagery were recorded. Navigational data for both the ship and ROV systems were also recorded. Observation Logs were recorded for all dives (**Appendix B**) While in transit to and from the site, and during times when the ROV is not deployed, Seabeam multibeam bathymetric data were collected.

Station Locations

The following (**Table 1**) is a list of sites that were visited during Legs 1 and 2 (**Figures 1, 2**).

Table 1. Sites occupied during Cruise 1.

Leg 1 Sites	Leg 2 Sites
EW1008, EW Wreck	AT47
MC497, Gulfpenn	EB478
MC796, Gulfoil	EW 1009
GC245, Green Lantern	GB201
	GB535
	GC140
	GC201
	GC234
	GC246
	MC539
	MC751
	MC885
	VK906

Table 2. Distance between selected sites and ports.

Straight Line Distance in Nautical Miles									
	Galveston, TX	Gulfport, MS	GC245	GC297	EW1008	MC796	MC497	MC539	MC588
Galveston, TX	0		Green Lantern	*Holly Ann*	EW Wreck	*Gulf Oil*	*Gulf Penn*	Oval Target	Steel Hull
Gulfport, MS	-	0							
GC245, Green Lantern	237.7	-	0						
GC297, Possible *Holly Ann*	257.7	-	20.9	0					
EW1008, EW Wreck	263.3	-	37.5	22.3	0				
MC796, Possible *Gulfoil*	276.5	-	57.3	42.3	20.4	0			
MC497, *Gulfpenn*	294.7	-	85.8	70.3	49.7	28.6	0		
MC539, Oval Target	290.2	-	80.8	65.5	44.2	23.4	5.4	0	
MC588, Steel Hull	303.4	-	90.8	74.2	53.7	33.3	8.7	13.2	0
VK786, VK Wreck	-	97.6	179.7	164.2	142.8	122.7	94.2	99.3	89.3

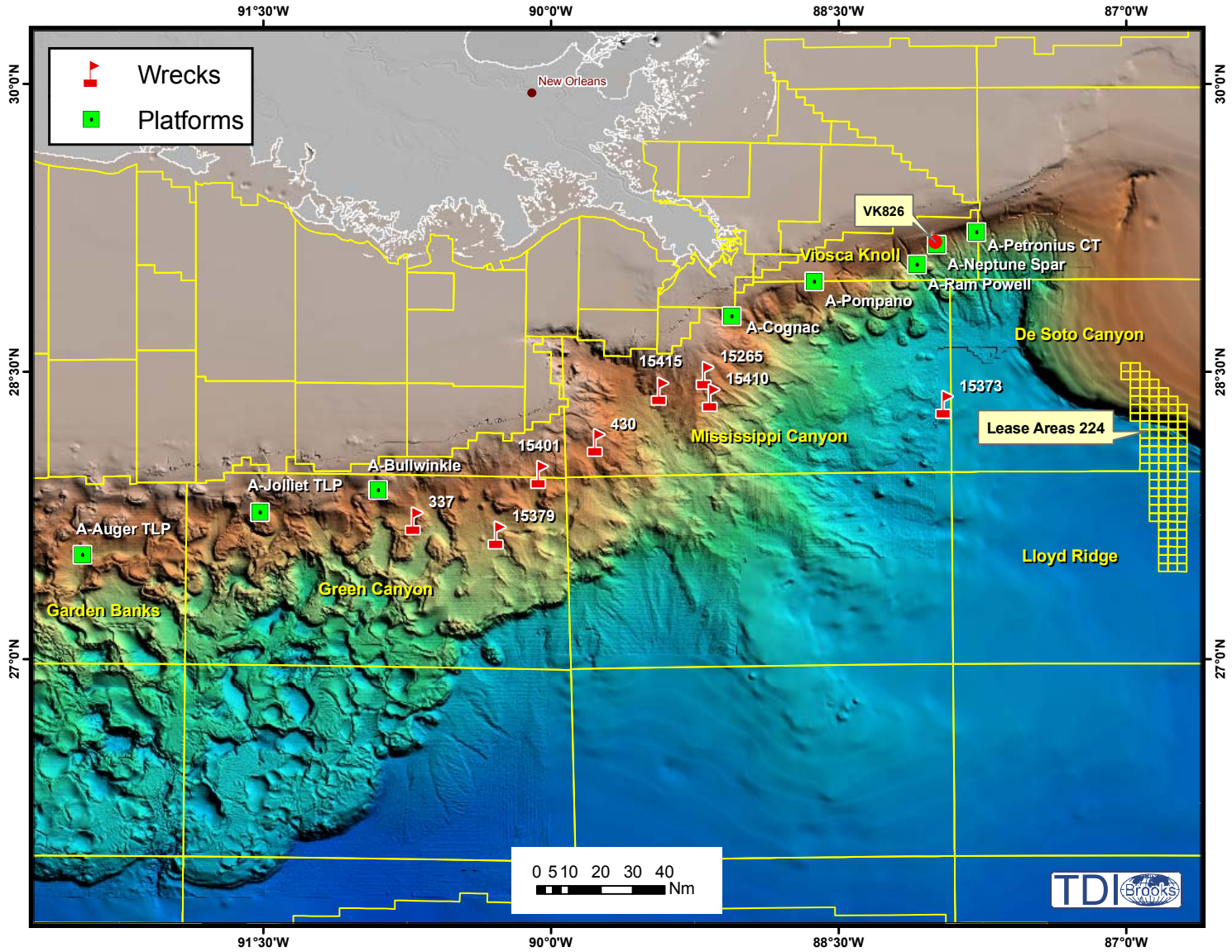

Figure 1. Sites of interest – Cruise 1.

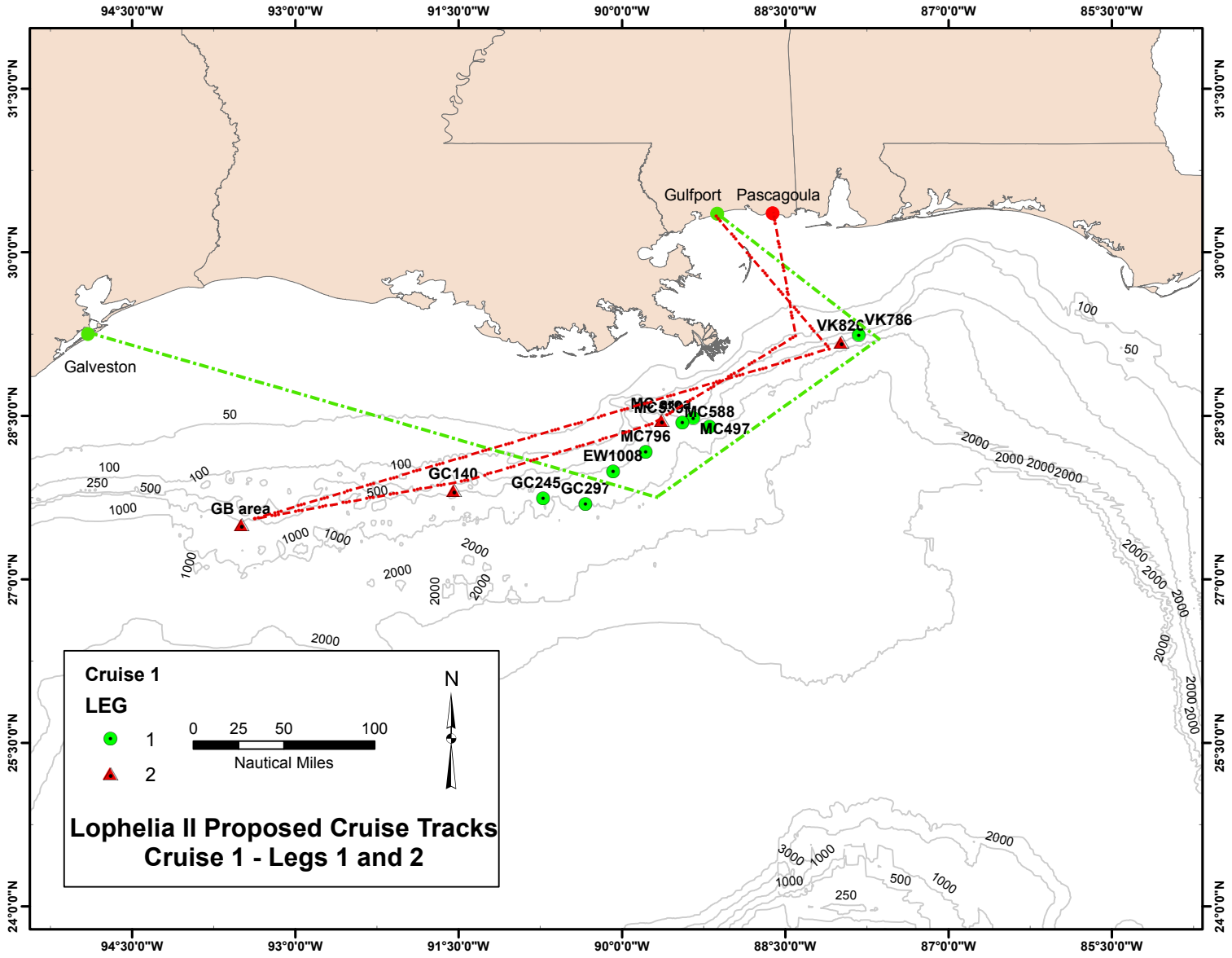

Figure 2. Cruise tracks for Leg 1 and Leg 2.

LEG 1 CRUISE DESCRIPTION – 5 SEPTEMBER – 17 SEPTEMBER 2008

Summary of the activities during leg one of the first cruise.

The main objective of the first shipwreck cruise was to conduct a reconnaissance of eight shipwreck sites and assess the archaeological and biological potential of the wrecks for inclusion in project. The planned site for the reconnaissance include the "Ewing Banks Wreck" site, the *Gulfpenn* site, the tentatively identified *Gulfoil* site, the "Green Lantern" site, the tentatively identified *Holly Ann Vieser* site, the "Oval Shape" site, the "Steel Hull" site, and the "Viosca Knoll Wreck" site. Several secondary objectives were planned pending the findings at each site. The secondary objectives were planned to accomplish as many tasks as possible toward meeting the overall project requirements of the four-year study. The secondary objectives included photo mosaics of each site, visual area survey around the sites to determine the extent of artifact scatter, detailed imaging of coral colonies at each site, collecting coral samples, collecting four sediment cores at each site, setting temperature loggers at select coral sites on the wrecks, reexamining a microbiology experiment placed at *Gulfpenn* in 2004, and setting microbiology experiments at two additional wreck sites.

Leg 1 Daily Reports

Day 1 - September 5, 2008

The voyage started out with a safety meeting aboard the R/V *Nancy Foster* at 1515. The vessel then departed Galveston, Texas at 1719. The science crew spent the rest of the day setting up the wet and dry labs and making preparations for the various experiments.

Day 2 - September 6, 2008

The R/V *Nancy Foster* continued cruising towards the first site throughout the day. At 0930 the general alarm bell rang indicating a fire drill. The science team mustered on the rear deck. At 1015, the general alarm rang once again; this time it was an abandon ship drill. The science team mustered on the second deck to don their Gumby survival suits.

From 1500 to 1600, we had a site briefing in the dry lab. Robert Church gave the team a brief history of what wreck site we were going to and went over our research objectives. The first wreck site, known as the "Ewing Banks" wreck, is thought to be a copper-hulled vessel, which likely dates to the nineteenth century. The *Nancy Foster* arrived at the site at 2018.

The ROV was in the water about thirty minutes later at 2050. A short dive was planned to check out the ROV systems and get a first look at the Ewing Banks wreck site to aid in planning the next day's dives. The ROV was on the seafloor at 2130. It took the ROV forty minutes to descend 621 meters to the bottom (the deep reading on the ROV was off about 5% and read 652 meters at the seafloor). The ROV searched for the wreck site for an hour and fifteen minutes. The ROV arrived at the wreck site at 2245 (**Figure 3**). The picture quality produced by the cameras was clear, but the 3-chip video camera (Kongsberg Simrad OE14-121) frequently switched from color to black and white during the dive and had to be reset multiple times.

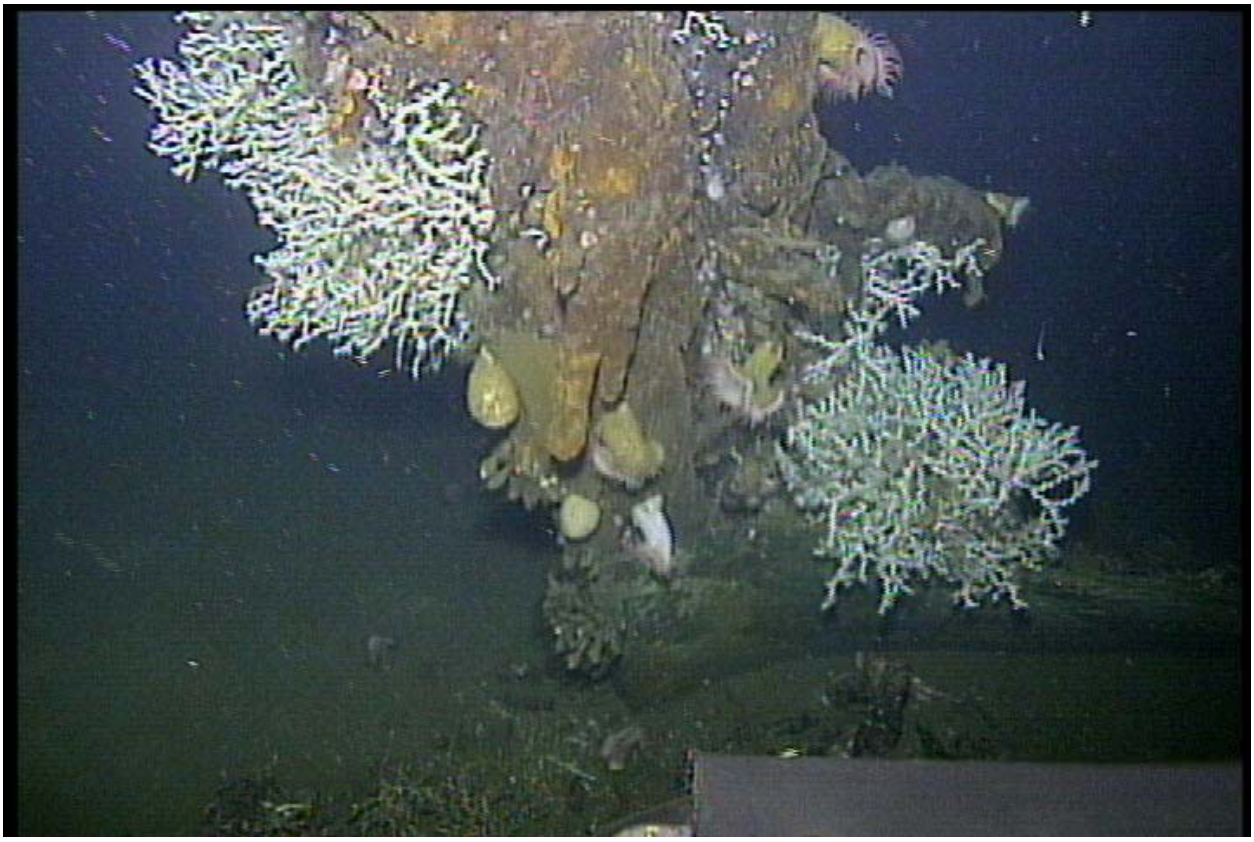

Figure 3. The deepwater coral *Lophelia* along with barnacles and sea anemones are seen growing on the stem post of the Ewing Banks Wreck.

The ROV spent the next forty-five minutes exploring the wreck site. The pilot brought the ROV back to the cage at 2245 and began the ascent stage to the surface. It reached the surface at 2305. The crew had some difficulty recovering the ROV from the water and it was nearly midnight (2350) before the ROV was back safely on the deck of *Nancy Foster*.

Day 3-September 7 , 2008

The day started with a safety meeting and site briefing at 0750. There was a delay with the ROV while the crew was busy making a few last minute adjustments. The start time for deploying the ROV was pushed back to 0930. The ROV descended to the bottom from 0930 to 1011. Once on the bottom, the ROV left the cage and nine minutes later was on the wreck site. From 1020 until 1216, the science team conducted a reconnaissance of the wreck site. The operation, however, had to be suspended when the ROV began having some additional problems with the 3-chip camera system (it began zooming in automatically and focus became problematic). The survey was suspended and from 1216 to 1306 the ROV ascended to the surface. The ROV was back on the deck of the *Nancy Foster* at 1307. Between 1308 and 1714, the ROV crew retooled the ROV camera system, replacing the 3-chip camera with the SeaEye low-light camera. During the retooling, the digital still camera (WesTech SDS3030) unfortunately was damaged and removed from the ROV system. We decided to make our next dive without a digital still camera, because it would take approximately six hours to prepare a whip for the back-up digital still camera (Ian MacDonald's Macro-camera).

At 1715, the ROV was back in the water and at 1755, it was on the bottom after a forty-minute descent. The ROV relocated the wreck and completed the reconnaissance of the site from 1815 to 1911.

From 1911 to 1930, the *Nancy Foster* was moved so that the ROV cage was in position for biological assessment and collection. At 1939, the cage was set down on the seafloor on the east side of the wreck and preparations were made to collect biological samples.

Coral colonies on the bow were imaged with scale (A ball on a T-handle was used for scale. The ROV was equipped with parallel lazars, but it is difficult to scale branching coral with lazars). The ROV returned to the cage and the scale (ball on a T-handle) was dropped and lost in mud. Then the operation moved to a small coral colony along the aft starboard side of the wreck for collection. It was discovered, the ROV could not reach the colony from the current location of the ROV cage (the tether was approximately 1 foot too short). The Cage was moved 20-feet closer to the wreck site and the collection attempt proceeded. An attempt was made to collect a small sample of the coral, but the entire colony fell to the seafloor upon contact. The colony was apparently not well anchored to the side of the hull (the colony was growing along the copper sheathing and was likely attached to a small fastener rather than the copper). The colony fell in a precarious location below the side of the hull. Numerous attempts were made to collect a sample of the coral, but resulted in a small wood sample being collected [it was not known until the ROV was recovered whether the sample was wood or coral]. The wood sample was sent to Droycon's lab for microbial analysis after the cruise. Coral collection was suspended and the team turned to sediment core collection.

The ROV also experienced problems collecting the core samples. From 1950 to 2220, several attempts were made to retrieve the core tubs from the core holsters, but due to a strong cross current, the ROV was only able to successfully retrieve one core tub and collect a sample. Operations were discontinued at 2220. The ROV entered the cage and began its ascent to the surface. The ROV was back on the surface at 2319 and successfully transferred onto the deck of the ship by 2320.

Day 4 - September 8, 2008

The morning began with a safety meeting and site briefing from 0750-0810. The briefing covered the history of the tanker *Gulfpenn*, which was sunk by a torpedo fired from a German U-Boat in 1942, and the scientific objectives we hoped to accomplish. The ROV deployment was originally scheduled for 0800, but was pushed back so that the crew could make some last minute adjustments to the vehicle. At 1041, the ROV was put in the water to check the trim after the camera changes (The macro-camera was added to the ROV to replace the WesTech SDS3030). Unfortunately, during the trim check the ROV was pulled under *Nancy Foster* and the tether fouled between the ship's rudder and port Z-drive. At 1105, the cage was launched in an effort to pull the ROV down and unfoul the tether, which was successful and at 1110, the tether cable was pulled free. The ROV was safely on the deck of *Nancy Foster* at 1220.

The ROV was back in the water at 1315. Between 1315 and 1358, the ROV descended to the *Gulfpenn* site. After a forty-three minute descent, the ROV was on the bottom. Progress across the seafloor was slow, because of strong current and poor visibility. The first section of debris the ROV came across was the stern section, which was slated for investigation. At 1439, the team began an investigation of the stern section. The archaeologists noted that a couple of the stanchions were missing. They also observed what appears to be the vessel's rear flagpole, still standing after more than a half century on the seafloor. At 1500, the ROV was moved to the cage for a brief inspection. At that time the crew discovered that only one of the core samplers for the biological retrieval was still in its proper place; one had fallen into the bio collection box and another was missing.

At 1505, the ROV headed to the main section of the wreck. The ROV was bought up to the bow where abundant coral was visible. Much coral was also seen lying on the seafloor, which had broken off and fallen from the hull above. The team inspected the wreck site from 1520 to 1804. The leeward side (port) of *Gulfpenn* offered more favorable working conditions for the ROV and we began our inspection of that side of the ship first. Near the stern, the pilot maneuvered the ROV up-close to a porthole, allowing the team a brief glimpse inside the hull.

At the forward edge of the aft deckhouse, a large *Lophelia* colony, which was imaged during the 2004 investigation, was found to have broken off the lifeboat davit where it once was attached and is now scattered in pieces across the ship's hull and seafloor. From here, the ROV was brought over to the starboard side to inspect a microbial platform placed during the 2004 expedition. The current on this side of the shipwreck was stronger making maneuverability difficult.

The ROV cage was set on the seafloor to begin biological collection and imaging near the bow. A temperature logger was placed near large *Lophelia* colonies at the bow. At 1805, the main LED light on the ROV malfunctioned and the vehicle had to be recovered before any biological collection could be conducted.

During the ROV recovery, the tether was fouled in the port Z-drive. The ROV was picked up with *Nancy Foster*'s A-frame on the back deck at 1930. The ROV crew tried to untangle the tether from 1931 to 2040. During this time a small boat was launched to assist with diver support at 2040. NOAA Divers from the ship entered the water to unfoul the tether. The divers were able to free the tether from the z-drive, but found that the tether had been cut in half (leaving a 75-foot section that could be reterminated). The divers came out of the water at 2120.

Day 5 - September 9, 2008

The morning began with a safety meeting at 0750. The primary concern was the approach of Hurricane Ike, which had entered the Gulf of Mexico a few days earlier. The ROV crew worked to reterminate the ROV tether in hopes we would have time for a short dive on the wreck site known as the "Steel Hull." At 0830, there was an announcement by the captain that a decision regarding the weather would be made at 1300. The ship was able to stay on location until 1515. The ship had been collecting multibeam through the night and continued to do so until the ship had to leave for the oncoming storm. The tether was not repaired in time for another dive. The

scientific team began securing equipment and personal gear for what was anticipated to be a bumpy ride to Pensacola, FL.

Day 6 - September 10, 2008

The *Nancy Foster* was en route to Pensacola from 0000-0925. At 0925 the research vessel arrived at the Pensacola Naval Air Station. The Navy's Blue Angels were practicing overhead as we pulled into port and docked. It was quite an experience to watch the F-18 Hornets flying directly over our ship performing their aerial acrobatics. The rest of the day was spent at the dock in Pensacola waiting on the weather. (Hurricane Ike)

Day 7 - September 11, 2008

Dockside, Pensacola Naval Air Station, 0000-2400. Waiting on the weather (Hurricane Ike)

Day 8 - September 12, 2008

Dockside, Pensacola Naval Air Station, 0000-2400. Waiting on the weather (Hurricane Ike)

Day 9 - September 13, 2008

Dockside, Pensacola Naval Air Station, 0000-2400. Waiting on the weather (Hurricane Ike) During the afternoon, graduate students from the underwater archaeology program at University of West Florida with Dr. Greg Cook toured *Nancy Foster*. That evening 1830 to 2030, the members of the science team held a meeting with Dr. Cook and colleagues (UWF) to discuss conservation, graduate research potential for later phases of the Deep Wrecks Project, and research possibilities for the Ewing Banks Wreck.

Day 10 - September 14, 2008

Dockside, Pensacola Naval Air Station, 0000-1300. Earlier that morning an announcement was made that the storm had passed and the ship would be able to leave port and return to the Gulf. At 1300 the *Nancy Foster* departed Pensacola. Throughout the rest of the day, the vessel was en route to the next site (the suspected wreck of *Gulfoil*.)

At 1430 there was a fire drill. The scientific team mustered on the aft main deck. The general alarm sounded again at 1445, this time indicating an abandon ship drill. The scientific team mustered on the second deck.

Day 11 - September 15, 2008

From 0000 to 0747, the *Nancy Foster* continued on to the suspected *Gulfoil* site. We arrived on the site at 0747. There was a brief safety meeting and site briefing between 0752-1809. The ROV, primary camera, LED lights, digital still camera, tracking, three core tubes, color video, manipulator arm, etc. were checked. ALL SYSTEMS tested A-OK. The ROV was launched and in the water at 0825. At 0910, the ROV was near the bottom.

Before the survey began, at 0940, one of *Nancy Foster's* generators broke down and the ship was adrift. At 0950, the vessel regained her propulsion, but the ship had drifted well away from the wreck site. Nancy Foster maneuvered back into position and by 1038, the ROV was back on location and out of its cage. At 1055, the ROV was on the bottom. The current was considerably stronger than before the hurricane and visibility was poor. The ROV was flown back to the cage at 1115 to check the equipment attached to the cage. The microbial experiment, which was to be placed at the wreck was missing and apparently lost during deployment.

The ROV reached the wreck at 1123 to begin a reconnaissance survey. From 1123 to 1230, the ROV successfully surveyed a portion of the starboard side of the wreck site. Conditions were very poor, low visibility and a strong current hampered the ROV survey. In spite of the difficult conditions, the wreck was found to be covered with Lophelia colonies (**Figure 4**) and positively identified as *Gulfoil* by finding the name at the bow. Although time constraints and the site conditions did not allow a detailed, systematic survey, the ROV could not have possibly dropped onto a better location. As the image of the wreck came across the video monitor, the scientists caught a glimpse of the ship's name, still legible after more than a half a century on the ocean floor. The wreck was indeed that of *Gulfoil*. The images thrilled the crowd in the viewing room. During the survey, several brass artillery shell casings were documented scattered on the starboard foredeck, which was consistent with the historical account that the ship carried a 4-inch deck gun. The deck gun was not seen during the survey. Approximately 150 feet of the starboard side of the hull was inspected (deck level from the bow to just past the superstructure).

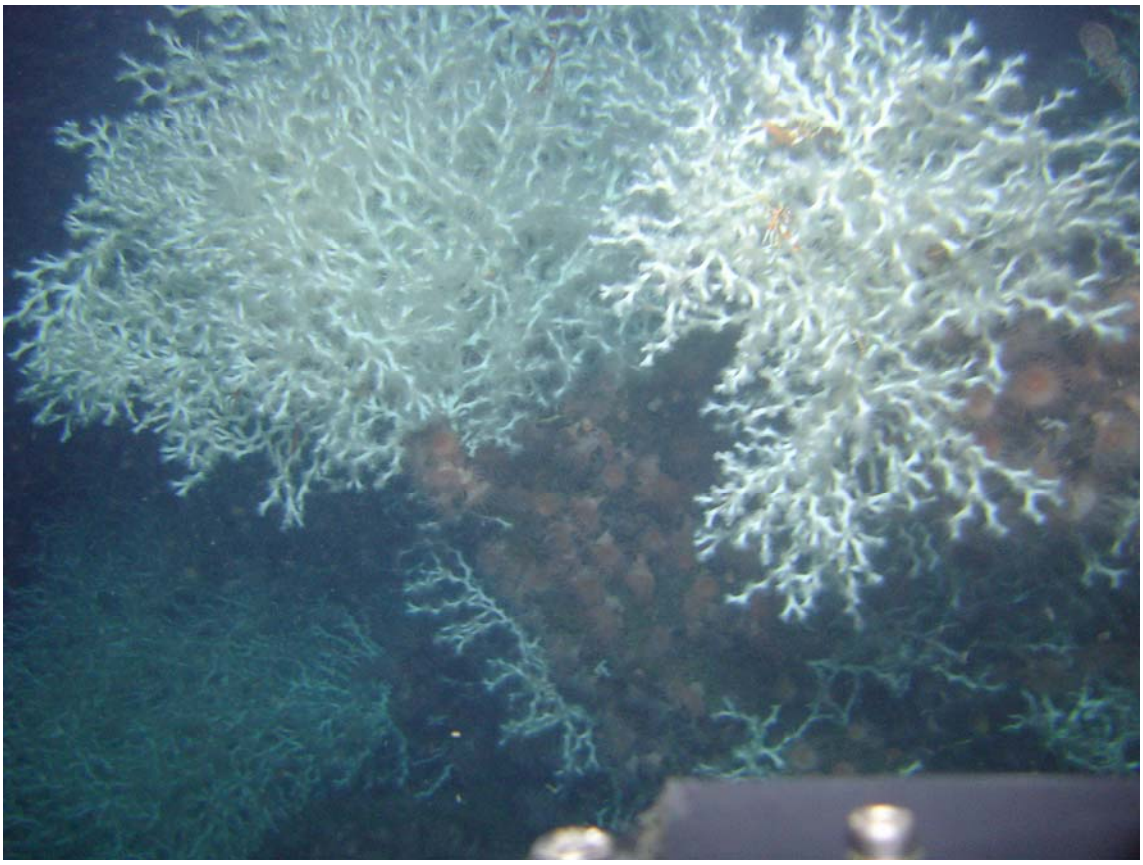

Figure 4. *Lophelia pertusa* thickets colonizing the starboard side of *Gulfoil*

At 1300, the ROV tried to return to the cage but was unable to find it. The cage was brought up to 160 meters so that contact could be reestablished between the ROV and cage. The ROV experienced total power failure and was recovered between 1340 and 1440.

Because of this delay, and our tight schedule, it became too late to do any additional reconnaissance on *Gulfoil*. R/V *Nancy Foster* left the site and was en route to "Green Lantern wreck."

Day 12 - September 16, 2008

En route to the "Green Lantern" wreck, 0000-0222.

The ROV crew continued to work on the ROV and at 0145 the ROV and its systems were reassembled, checked, and ready for deployment. *Nancy Foster* arrived on the site at 0222.

The ROV was in the water at 0315 and from 0319 to 0425 the ROV made the descent. At 0425 both the ROV and cage were near the bottom at a depth of 925 meters. The ROV was out of the cage and on bottom at 0502. Extremely poor visibility and strong current hampered the operations. It took nearly an hour to locate the wreck site.

At 0550, the wreck was imaged on the scanning sonar. The ROV was slowly maneuvered to the stern facing into the current. The pilot found the ROV extremely difficult to control in the current without setting the ROV down on the seafloor. Each time the ROV pilot attempted to fly up to the wreck, he lost control of the vehicle in the current. At 0640 the ROV pilot and the chief scientist decided it was unsafe for the site to continue and the dive was aborted. Once away from the wreck, an attempt was made to close the lid of one of the bio boxes on the cage to test the water temperature in the box after recovery. At 0646, the cage was on the bottom, but the visibility was too poor to attempt the operation. The crew then bought the cage up 40 meters off bottom for improved visibility. The ROV was at the cage at 0652, and tried to close the bio box, but could not because of the surge on the cage. At 0659, a decision was made to cease the operation and retrieve the ROV. The team decided to abort any additional work on the "Green Lantern" wreck and continue on with another target in the hopes that conditions would be move favorable at a different location. The daily safety meeting originally scheduled for 0750 was moved back until the ROV was back on deck. The ROV was on the deck of *Nancy Foster* at 0820.

Nancy Foster was en route to the "Steel-Hull" wreck between 0850 and 1750. We arrived at the site at 1750 after a nine-hour transit. At 1830 the ROV was ready for deployment. During the ROV launch the CTC cable, which was being used to aid in the launch broke. This was being filmed from the small boat. A review of the video later revealed that as the ROV touched the water, a wave hit the cage and swamped the open bio boxes, the ship rolled to starboard, and the cable snapped. This caused all the weight to immediately transfer to the ROV lifting umbilical and one of the chains holding the ROV winch also broke. The dive had to be aborted, but no

injuries occurred and all equipment was recovered safely. The ROV and cage were both back on deck at 2010. The *Nancy Foster* then left the site and headed for Gulfport, Mississippi.

Day 13 - September 17, 2008

Nancy Foster was en route to Gulfport, Mississippi from 0000 to 1036. We arrived at the dock at 1036. The rest of the day was spent demobilizing the research ship.

Summary

Five days were lost to weather and more than 28 additional hours were lost because of ROV and vessel down-time. Only thirteen hours of total bottom time were achieved on the wreck sites over the course of thirteen days (the ROV was in the water for a total of only 29.5 hours). Only four of the eight planned wreck sites were dove on during the cruise because of the considerable down-time and adverse conditions encountered on the seafloor. Useful data was collected at three of the four site investigated. The Ewing Banks Wreck site was confirmed to be a historic shipwreck site, which likely dates to the nineteenth century. More *Lophelia* was discovered growing on that site than any other nineteenth century wooden wreck known in the Gulf of Mexico. Many of the wreck's attributes, such as the lack of cargo, rigging, or machinery, make it an intriguing mystery. The identity of *Gulfoil* was confirmed on a brief dive at the site and substantial coral colonies were documented. The preliminary examination suggests the *Lophelia* coverage at *Gulfoil* may be more substantial than that documented at *Gulfpenn* in 2004. The dive on *Gulfpenn* allowed the identification of the stern section of the tanker, the microbial experiment placed on the site in 2004 was reexamined, and a temperature logger was placed on *Gulfpenn*'s bow.

LEG 2 CRUISE DESCRIPTION – 20 SEPTEMBER – 2 OCTOBER 2008

Leg 2 Daily Reports

Day 1: September 20, 2008

Prior to departing the Mississippi State Pier in Gulfport MS, the ROV was launched to test the re-termination of the tether and other repairs and configuration changes. The test was successful, including the ROV pulling against the tether while it was fixed to the deck. The ship then departed from Gulfport at 1000 hrs.

The first objective of the cruise was to run a multibeam survey over the main coral site at Viosca Knoll 826. Transit times were such that this could be completed while still allowing for an ROV lowering at Mississippi Canyon 539 on the first full day at sea. During the 10 hour transit to VK826, the science party completed a safety training session, held a science meeting discussing the general objectives of the cruise, and participated in fire and abandon ship drills.

We arrived on site at VK826 at approximately 2000 and made a CTD cast to derive sound velocity profiles for the multibeam survey. The multibeam survey began at approximately 2100. Five parallel lines were run with 100% overlap and an additional perpendicular line was run to complete the survey (**Figure 5**). Once the survey was complete at approximately 0100, we proceeded to the first site at MC539.

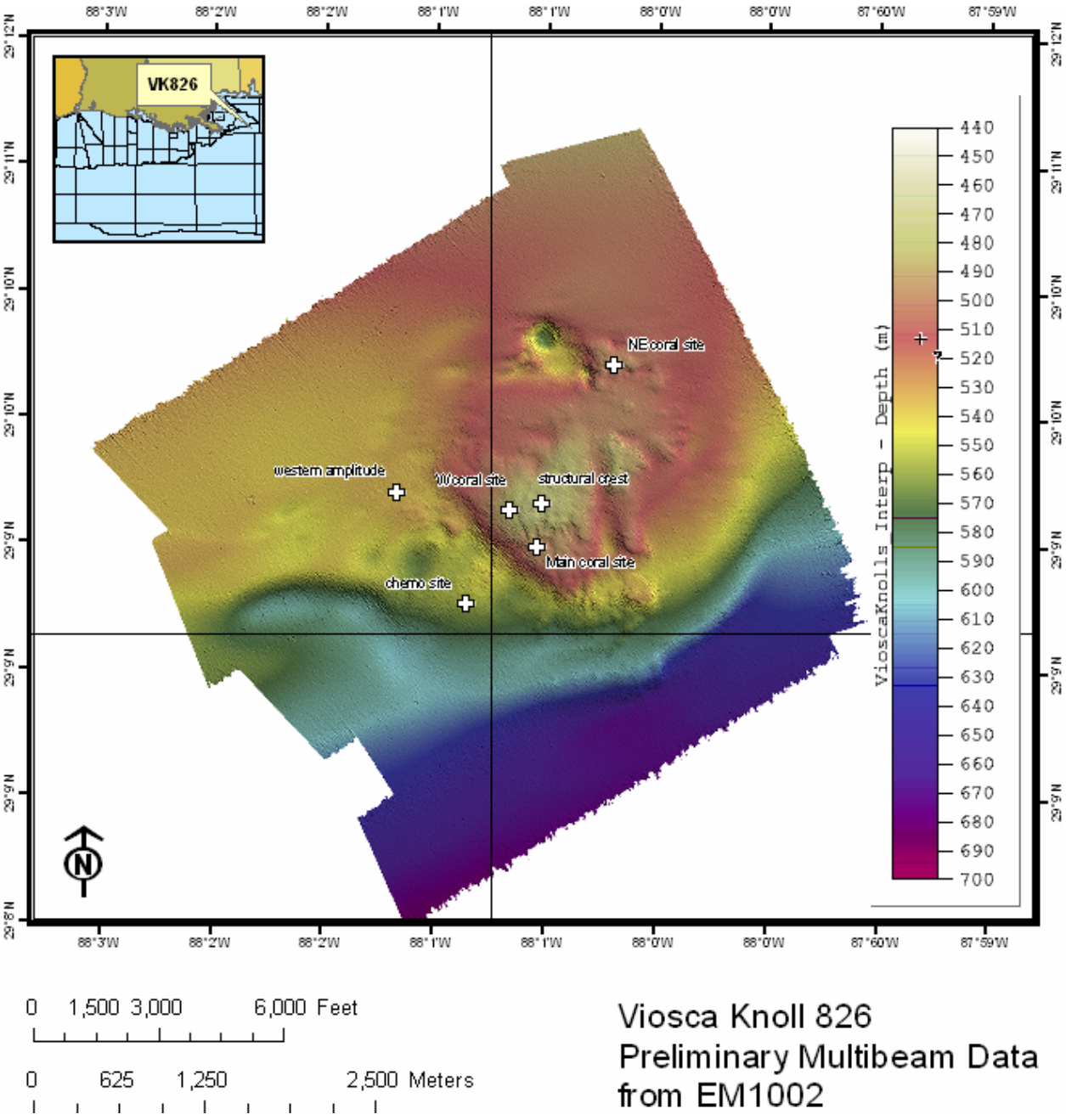

Figure 5. The completed multibeam survey with approximately 5m resolution at VK826. Coral sites are collection sites from the Lophelia I project. Chemo site is the location of a tubeworm community collection from 2003.

Day 2: September 21, 2008

MC539 Site Selection

The MC539 site is a small mound (~300 by 250 meters with ~20 meters vertical relief) that was identified using 3-D seismic. The amplitude extraction shows a strong positive response indicating a hard seafloor (authigenic carbonate). The seismic cross-sections across the mound show a vertical acoustic wipeout suggesting active gas migration to the seafloor, supporting the hypothesis that this is a natural seafloor hydrocarbon seep with authigenic carbonate on the seafloor that could support a coral community.

MC539, ROV dive SV1

We arrived on site at MC539 at 0915. At approximately 0930 we began a single line of multibeam to provide detailed bathymetry for the ROV underlay (**Figure 6**). At approximately 1030, the multibeam survey was complete and the ship maneuvered into position for ROV launch. The surface currents in the area were quite strong, so the ship spent some time trying to position itself to provide a shadow for the launch of the ROV with the J-frame on the port side. At 1145, the ROV was launched and the 1st dive commenced.

During the decent, at approximately 600 meters, the telemetry and video signal from the ROV became sporadic. The decent continued until the garage was on the bottom, to test for the effect of removing the tension on the tether. The seafloor at the center of the feature at MC539 appeared to be soft bottom with no apparent hard grounds or fauna. The video signal did not improve, so the ROV began its ascent and was recovered at 1300.

During the recovery, the tether between the ROV and garage was streaming behind the ship and became wrapped around the z-drive of the ship (which was not engaged at the time). However, they were still able to bring the ROV on deck and attempt a "short fix" of the umbilical connection. In the meantime, the small boat was put into the water and they tried to dislodge the tether from the propeller. This was unsuccessful, so when the ROV was repaired at approximately 1500 it was launched and eventually managed to remove the tether. It has been decided to alter the recovery of the vehicle, since it does not have a tether management system and this will continue to be an issue under the current operating procedures. On the way to the surface, at approximately 50m, the vehicle will exit the garage and ascend separately keeping the tether taught against the garage. This should prevent the extra bight of the tether from streaming under the ship and encountering the z-drive again.

At approximately 1730, we began our transit to GC140. This site was chosen because of the work that needed to be completed on the ROV and the fact that many of problems with the video that we experienced today began below 600m, while the top of GC140 is right at 300m. We should arrive at the site around 0400 and plan to complete a multibeam survey of the area prior to diving at 0800.

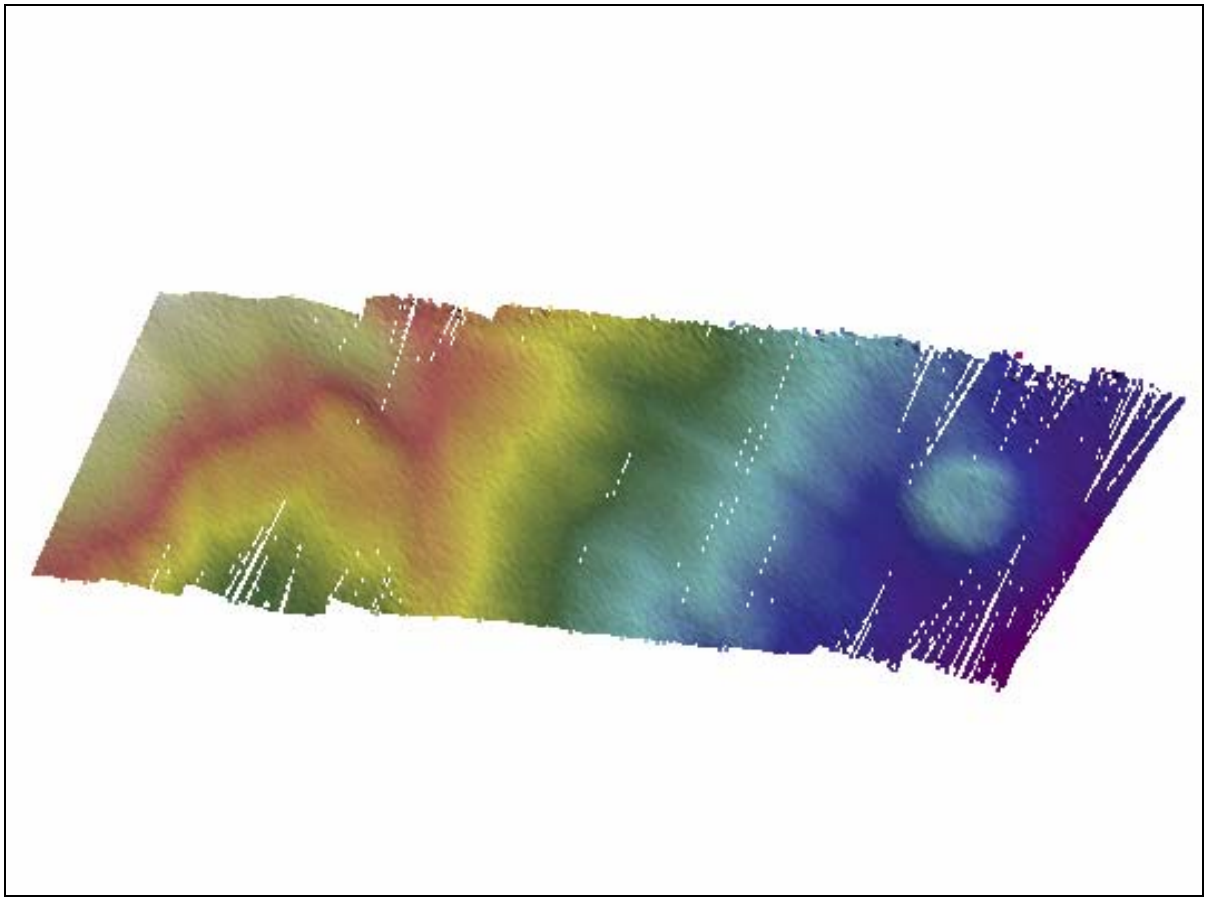

Figure 6. Multibeam bathymetry collected over MC539

Day 3: September 22, 2008

GC140 Site Selection

GC140 site is a large (3 by 4.5 km with 150 m vertical relief) salt-supported bathymetric high with several discrete, high positive amplitude anomalies apparent in the 3-D seismic indicating the presence of hardgrounds suitable for coral colonization. The north flank and crest display the best developed amplitude and were chosen as initial targets. This site is geologically related but older than the well-studied, deeper "Bush Hill" to the southeast. The subsurface seismic signature at GC140 shows less active migration to the seafloor than GC185, but more high positive amplitudes, suggesting thicker, older authigenic carbonate. The fault "feeding" hydrocarbon to GC 185 is antithetic to the larger, more deep-seated fault at GC140, supporting the hypothesis that GC140 is older. GC140 has been visited briefly by Dr. Harry Roberts in the late 1980's and he reported finding corals, but no chemosynthetic communities (aside from a lone tubeworm at 280 m), which flourish at GC185.

GC140: ROV dive SV2

We arrived on site at GC140 at approximately 0300. A CTD cast was made to derive the water column sound velocity profile. We then ran 3 lines of multibeam centered on the topographic high at GC140. These were processed and provided to the ROV crew as an underlay for their navigation (**Figure 7**).

At the scheduled launch time of 0800, the weather was on the edge of what was acceptable for ROV launch, so we sat on site and tested the capability of the dynamic positioning system of the ship to hold station. When the conditions were determined to be acceptable at 0830, the ROV was readied for launch. When power was delivered to the ROV, the still camera was not functional. Following an hour of repairs, the ROV was in the water at approximately 0930.

Bottom was reached at 270 m at approximately 1000 hrs. We began to head north to a local topographic high and ran into a field of mainly anemones with occasional gorgonians, antipatharians, and soft corals on what appeared to be a carbonate crust at 273 m and 1015 hrs. As we ran to the east, there was increased abundance of anemones and octocorals at the edge of the local topographic high to the north of the top of the mound. We continued to transect north along the eastern edge of the crest. When we discovered a discreet site with at least 4 different species of gorgonians, we stopped to make a collection at 1130. The garage was placed on the seafloor approximately 15 m to the south of the collection site. Four collections were made into one biobox on the garage and a marker (#16) was deployed. The collections included 3 different species of gorgonians, including 2 *Callogorgia* sp. colonies, an ophiuroid and a galatheoid on one of the colonies, a soft coral (likely *Anthomastus* sp.), a hydroid colony, and at least two carbonates.

When the collections were complete, at approximately 1300, we finished transiting the eastern flank of the northern mound. All of the communities in this area appeared similar. The ROV then moved to the cluster of local topographic highs to the east, going below 300 m in depth. In this trough, the sediment veneer appeared to be thicker, and there fewer suspension-feeding organisms. Once the ROV began to climb up the northeastern topographic high, the carbonate

was more apparent and the number of suspension feeders, largely dominated by crinoids and *Anthomastus* sp., began to increase.

On the northeastern high, the community appeared to be dominated by *Callogorgia* sp (probably *C. americana*). The ROV stopped to sample some of the *Callogorgia* sp. colonies, setting the garage down at 1400 hrs, 285m. While attempting to sample *Callogorgia* sp., a very large antipatharian was discovered. It measured approximately 2m high by 3m across. There were epizooic goose-neck barnacles and anemones, as well as galatheid crabs, a basket star, a spider crab, a scorpionfish and at least 3 brotulas closely associated with the colony. Numerous still photographs were taken of the coral and most of its associates. A sample of the antipatharian was taken and placed in a biobox, a fix taken and marker FV2 deployed next to the colony. While the garage was still on the bottom, a *Callogorgia* sp. specimen was collected and placed in the biobox at 1520.

The garage was picked up and the ROV began transit to the crest of the mound. Another large carbonate block was observed almost immediately at 1545 and the garage set down again to sample. Large white anemones, yellow crinoids, small white sponges, and numerous *Callogorgia* sp. colonies were observed. A yellow paramuriceid gorgonian and a *Callogorgia* sp. sample were taken, both along with an *Asteroschema* sp. ophiuroid. No marker was deployed at the collection site, but a target was dropped on the navigation.

The ROV transited south-southwest over a mostly mud bottom with scattered patches of carbonate rubble at depths of ~ 280 m. Attached fauna included yellow crinoids, stalked crinoids, *Anthomastus* sp., *Callogorgia* spp., ceranthids, and fields of white anemones. Also, orange, yellow, and red-purple gorgonians (the latter possibly a black coral) were observed. Mobile fauna in the area included numerous species of sea stars, ophiuroids, sea biscuits, hermit crabs, deepbody boarfish, and anthiines. During the transit over mainly mud bottom, a large crater was observed. This crater (or burrow) was ~ 1 m in diameter and at least 2-3 m deep. A large crab and an echinoid were the only species observed around the crater. The ROV panned the camera over the top of the crater to capture a vertical view of the crater/burrow. The ROV continued to transit up the slope to the top of the mound at depths of ~ 260-230 m. Large carbonate slabs and boulders were observed during this transit up slope. Attached fauna remained relatively sparse; however, mobile fauna were more abundant, including deepbody boarfish, *Gephroberyx darwini,* and anthiines,

At the top of the mound, at 1730 and approximately 230 m depth, there were numerous large carbonate boulders and slabs with overall a much higher abundance of high-relief hard substrata. They were covered in a different fauna from the lower local topographic highs, including large sponges, large urchins, lower abundance of *Florometra* sp. crinoids, and a higher abundance of fishes. There was also an attack on the ROV by a moray eel and some careful photography of a *Chaunax* sp. Much of the substrata appeared to be covered in fine sediments, which may be limiting the colonization of coral species, which are in very low abundance near the crest of the mound.

At approximately 1830 hrs the ROV began to transit at 090° off the top of the mound and down the steepest slope to the east of the mound. There was very isolated carbonate rubble and

pavement, but the bottom was largely soft and contained few attached fauna. During this transit, the tilt mechanism on the video camera became frozen in a down position. Efforts were made to dislodge it, but these were unsuccessful. The rest of the transit down into the bathymetric low on the east flank was made with the manipulator fully extended to be out of the field of view. When the ROV had reached over 300 m at 1915, and the entire transit had been over soft substrate, the dive was called. The ROV re-entered the garage at approximately 1930 and began its ascent.

note: depths are corrected from the ROV display, which is showing approximately 10-15m deeper depth than actual

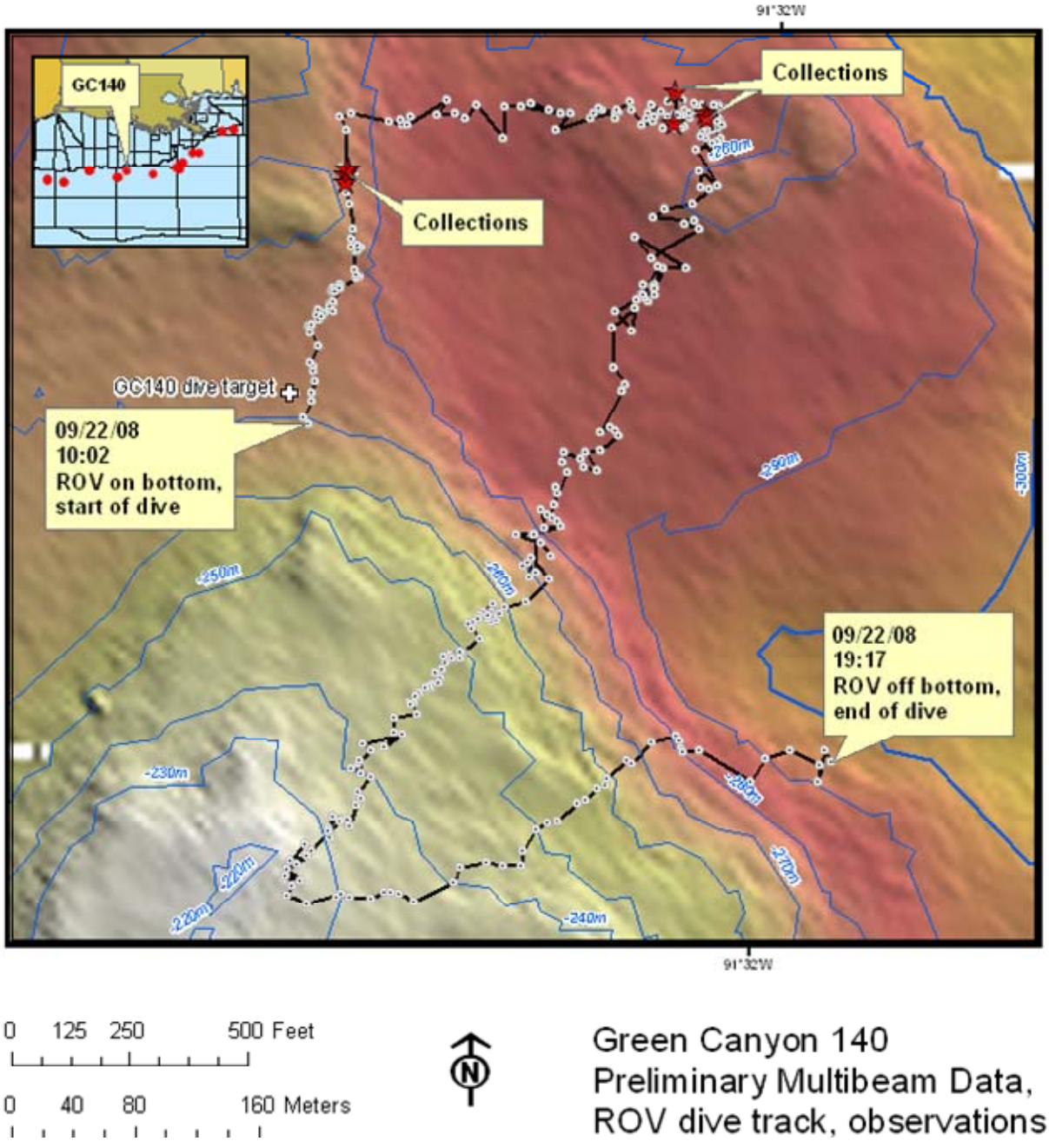

Figure 7. Multibeam bathymetry of GC140 showing dive track of the SeaView ROV.

Day 4: September 23, 2008

GB201 Site Selection

GB201 is a large (~6.5 km by 5.5 km, 250 m high) seafloor structure supported by a shallow salt diapir. 3-D seismic amplitude extraction of the seafloor reflector shows several areas with anomalously high positive amplitudes suggesting hardground development on the seafloor conducive to coral habitat. The northwestern flank and several discreet areas on and near the crest showed the most promise for coral habitat and were chosen for the dive (**Figure 8**). One characteristic of this feature is the abundance of "pockmarks", circular depressions on the seafloor that are hypothesized to be strong flows of gas without brine or sediment that excavated sediment from the area, as opposed to constructional mud volcanoes and flows that introduce new sediments to the area. The hypothesis was that areas near the pockmarks may inhibit the development of healthy communities of filter feeders such as corals by the spreading of sediment through the area and areas away from them may support corals.

A CTD cast was taken beginning at 0220 hrs. Following the processing of the CTD data, a multibeam survey was completed from approximately 0300 to 0700 hrs. Four lines of multibeam were processed and provided to the ROV crew for the underlay of their navigation.

GC201: ROV dive SV3

The ROV was launched at approximately 0830 hrs. The ROV reached the bottom at 520m at approximately 0845 hrs. We were in a trough between two local topographic highs. The ROV video feed appeared to function normally at this depth. The area consisted of soft bottom with occasional colonial soft coral or hydroid colonies. The ROV proceeded east towards the up-slope towards the primary geo target at 0930. At this time the ship lost one of its generators, and the ROV had to remain stationary. A series of photographs were taken of the small colonial cnidarians. The ROV continued on up-slope once this problem was resolved at approximately 1000 hrs. The entire transit was over soft bottom with partially consolidated sediments and thin carbonates. Occasional boulders were observed near the local topographic high at 420m at approximately 1030 hrs.

At 1045 hours the ROV encountered bacterial mats and methane bubbling from the seafloor. Immediately adjacent to this were some tubeworms and zoanthid anemones covering an unidentified structure. The ROV turned to a course of 180° at approximately 1100 hrs and ran over an area of friable carbonate pavement with a thin veneer of mud and occasional sponge and zoanthid aggregations. At approximately 1200 hrs, the ROV turned to 070° and ran up towards the northwest corner of the site in search of hard substrates.

While running up the side of the northwest corner, a large antipatharian was encountered. The ROV settled down, took some pictures, and got ready to sample. The garage was set on the bottom, and on the way to the garage, a number of other gorgonians (mostly *Callogorgia* sp.) were observed. The garage was located but it was on its side. The garage was righted, but in the process the hand of the manipulator became frozen, making sampling impossible for the remainder of the dive. The decision was made to continue on with photographic sampling and exploring additional areas of the site with the time that remained. At 1300 hrs, the ROV headed 135 towards the crest of the mound and surveyed the surrounding area.

During this entire transit, there were no side-scan sonar targets and very few epifaunal organisms found. There were occasional pock-marks of varying sizes. In the area of the lowest seismic return, at approximately 1415 hrs, there was a large field of pock-marks on the seafloor. This is near to the area of high large-scale pock-marks on the multibeam bathymetry at 315 m depth. It was hypothesized that the high frequency of blow-out events creating the pockmarks could generate additional sediment input to the entire area, potentially sufficient to prevent coral growth.

The ROV continued to climb, heading 090 to the top of the local high, reaching approximately 300 m depth at 1700 hrs. There were more pock-marks in this area, despite the bright reflectivity apparent from the seismic data. The only biological features at the top of the mound were seawhips, and one isolated gorgonian colony with two basket stars on the sediment next to them. There were no other apparent communities or exposed hardgrounds at the top of the mound so the ROV proceeded south down into one of the large pockmarks visible on the multibeam. The steep slope of the pockmark showed no exposed hardground (no strong positive amplitude was noted on the amplitude extraction) and few organisms other than fish and occasional sea whips. After this area was surveyed, at approximately 1815, the ROV rendezvoused with the garage and was brought to the surface.

note: depths are corrected from the ROV display, which is showing approximately 10-15m deeper depth than actual

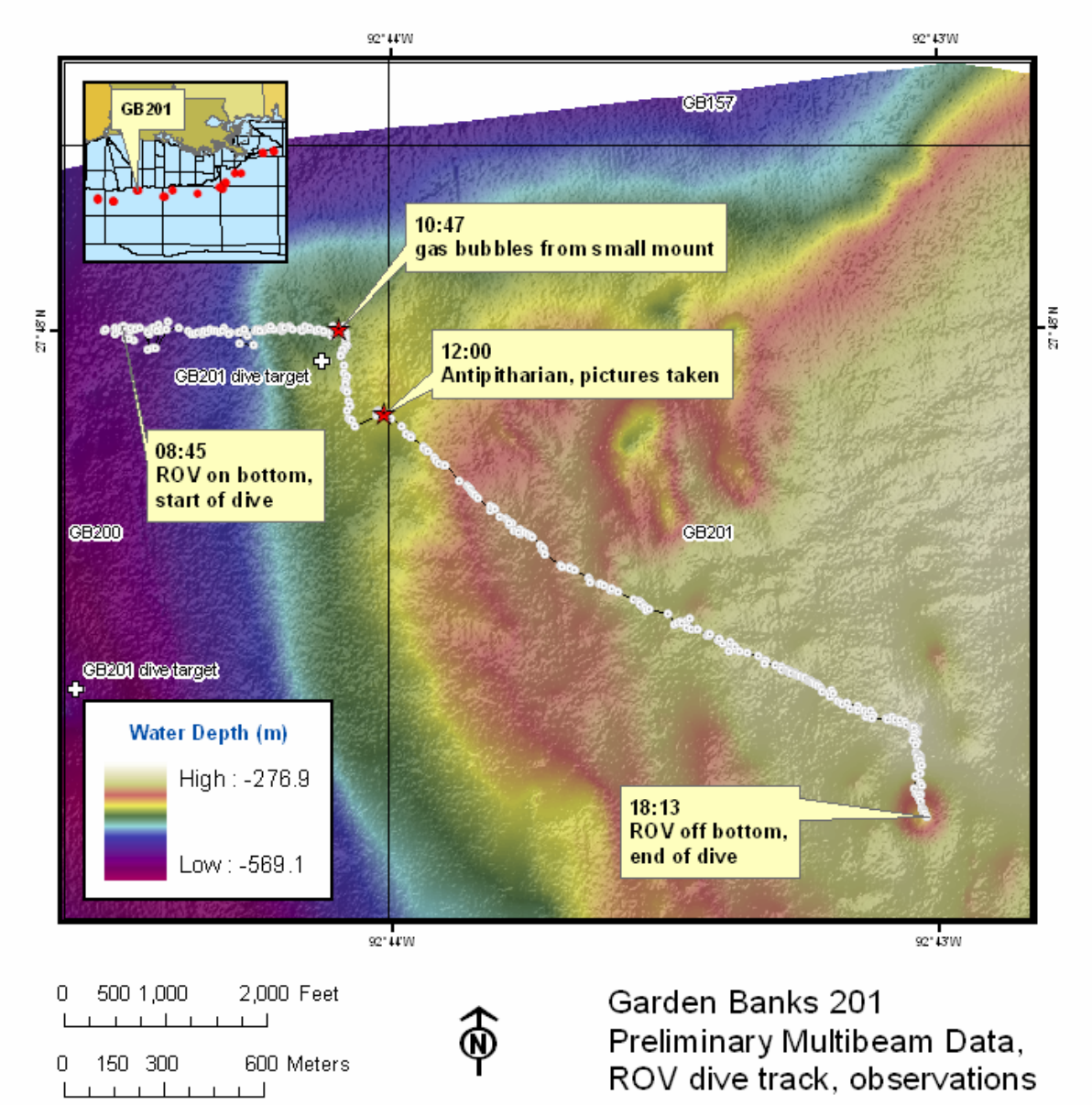

Figure 8. Multibeam bathymetry of GB201 with the SeaView ROV dive track.

Day 5: September 24, 2008

GB535 Site Selection

The GB535 site is divided into 3 distinct geologic areas. The site was created by a major NE-SW trending down-to-northwest fault with an antithetic fault creating a graben between them. The upthrown side of both faults show scattered subtle positive amplitude response, while the graben shows strong positive amplitude over a large area. The graben and the upthrown side of the main fault were investigated on one dive by the Johnson SeaLink previously and found chemosynthetic communities in the graben and one observation of *Lophelia pertusa* at the very of the dive on the main fault. It was decided this area needed more detailed study on the main fault and the graben.

A CTD cast was taken at 0100 hrs and the sound velocity profile derived. Five parallel lines of multibeam and 2 supplementary lines were run over the area. The multibeam showed the distinctive feature from the seismic surveys and the ridge on which previous coral sightings were made in 2002 (**Figure 9**).

The planned dive at this site was cancelled due to weather issues and the ship proceeded west to East Breaks 478 to complete another multibeam survey.

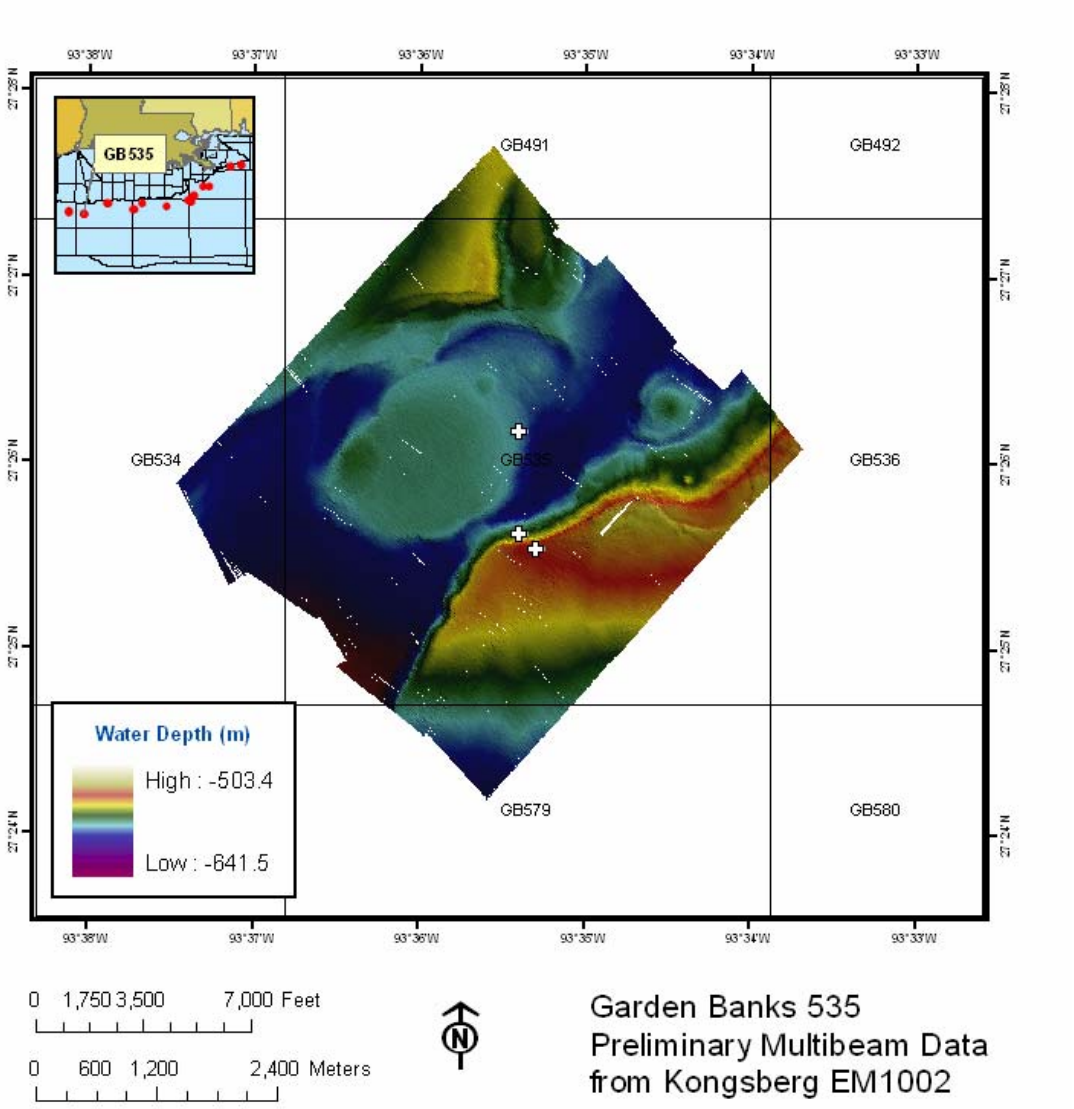

Figure 9. Multibeam bathymetry of GB535. The two southern points are the locations of previous tubeworm and coral sightings at this site.

EB478 Site Selection

The EB478 has several small mounds located at a break in slope, all with high positive amplitude response and good subsurface indications of migration to the seafloor. This site is the westernmost of all the sites and was chosen for its geographic position and geologic characteristics.

A multibeam survey was begun at this site, but during the second line the weather had worsened to the point where the multibeam data were full of errors. Following the second line the survey was cancelled (**Figure 10**).

There was no dive at this site due to weather. The ship began to transit back to the east to Green Canyon following the multibeam survey. The next planned multibeam site is centered around the *Lophelia* ridge at GC234. The next planned dive site is GC246.

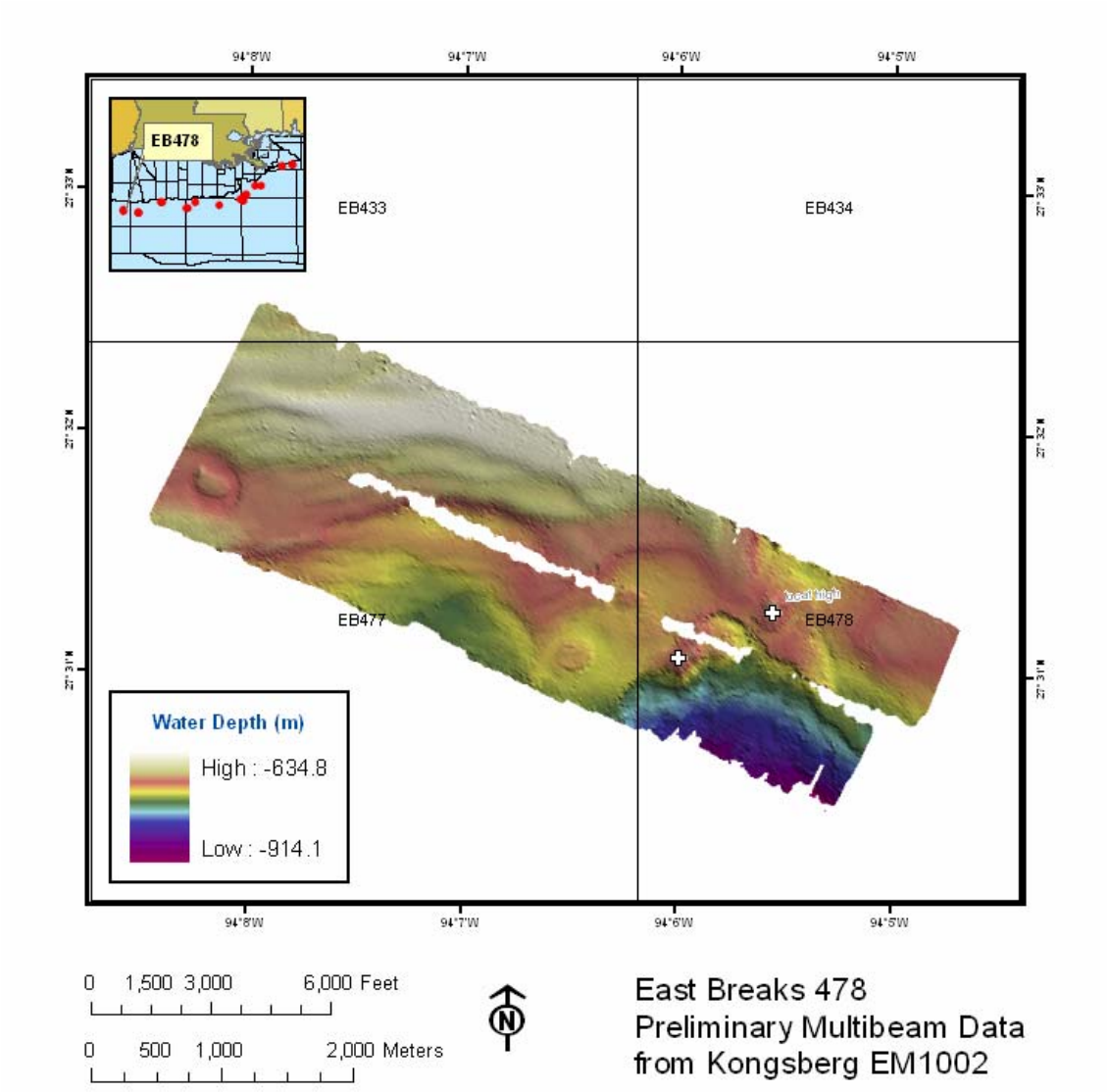

Figure 10. EB478 Multibeam bathymetry.

Day 6: September 25, 2008

There were no ROV operations today due to weather. The sea state also prevented multibeam operations for most of the day. We transited from East Breaks to GC234 overnight and through most of the day. The ship was only able to make approximately 6 kts since we were heading directly in to the wind, swell, and currents. During the down time, the ROV crew repaired the manipulator and completed maintenance on three thrusters and the lifting umbilical winch.

GC234 Site Selection

This is one of the best known seep sites in the Gulf of Mexico. During a dive just before the start of Lophelia I, an area of *Lophelia pertusa* abundance was discovered to the west-northwest of the main seep site. It was a roughly north-south ridge colonized by *Lophelia pertusa* most of which was dead standing coral. In between the seep site and the coral ridge is an area of small carbonate boulders colonized by the gorgonians *Callogorgia americana*. This was one of our primary sites during Lophelia I and may be a site of interest for Lophelia II. It is also a short transit from our next exploratory dive site at GC246, so it was selected for a multibeam survey while we wait for the seas and winds to calm down.

The multibeam survey revealed a linear ridge just north of the known site at GC234 (**Figure 11**). It appears to be a continuation of the known ridge colonized by *L. pertusa*. It was not explored during the first study since there is approximately 150m of soft bottom separating the two features.

Following the multibeam survey, the ship proceeded to GC246, approximately 30 nm away. A multibeam survey is planned once we arrive, followed by an ROV dive, weather permitting. This site is between 800-850 m depth. The ROV has had difficulty with telemetry at this depth due to signal loss at the termination of the tether on the vehicle. A solution has been attempted, but if signal is lost we will return to the newly discovered feature on GC234 (450-500 m depth) and complete a dive at that site.

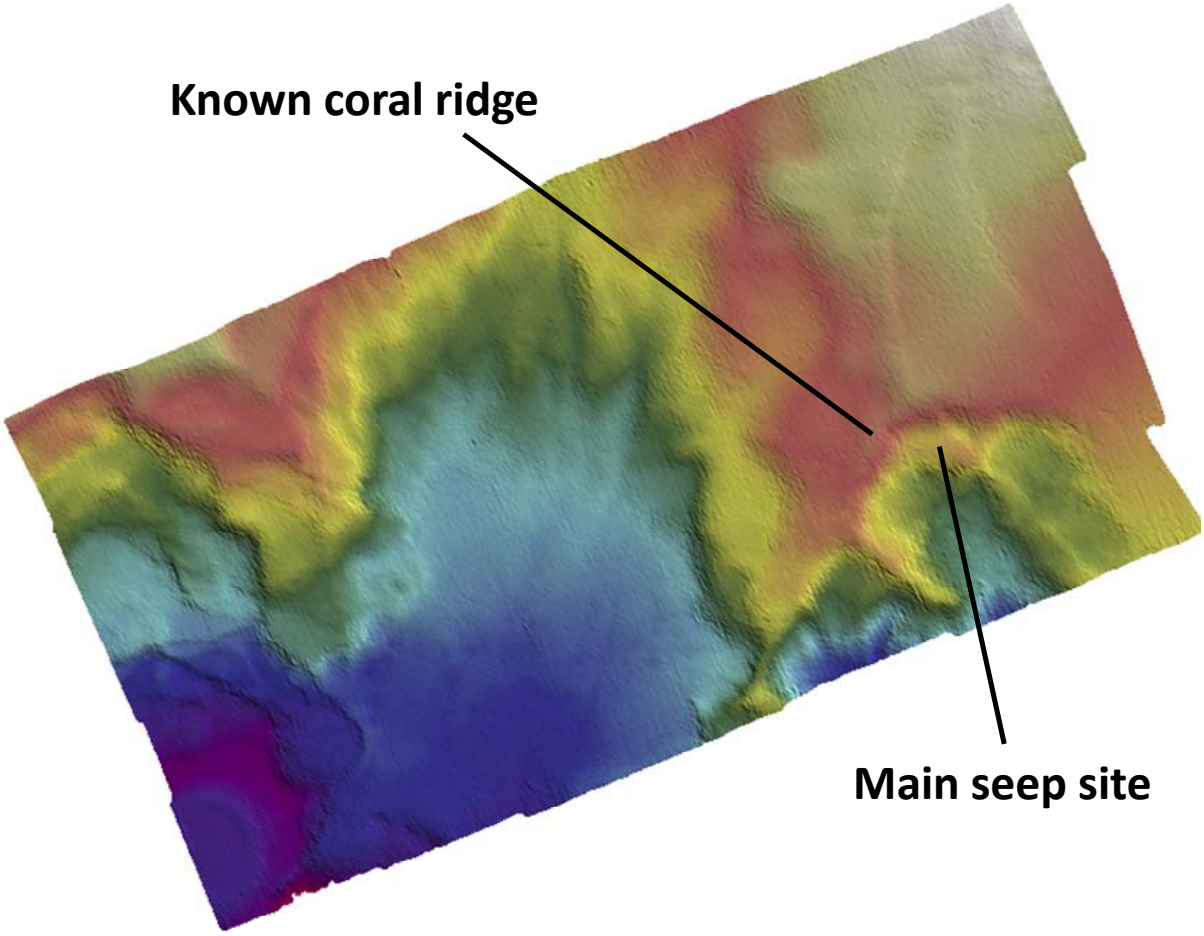

Figure 11. Multibeam bathymetry of Green Canyon 234. The center of the well-known seep site and the location of the coral ridge site from Lophelia I study are shown.

Day 7: September 26, 2008

GC246 Site Selection

The GC246 site is a large (5 km by 6km, 100 meter vertical relief) salt supported feature with a steep eastern flank and a gradual western flank. Five discreet bathymetric highs with positive amplitude responses are aligned roughly north-south along the eastern flank of the top of the feature, all with interpreted sediment flows present down the eastern flank (characterized by high amplitudes, due to coarse sediment flowing out of the active seep sites and/or lithification of hydrocarbon saturated sediment). The discreet highs were interpreted to have hardgrounds ideal for coral settlement on bathymetric highs exposed to currents for larval and food dispersion; the probable flows suggest the sediment coming up with hydrocarbon in the seeps is being carried down the slope by gravity and away from the hardgrounds and any filter feeders populating them.

A multibeam survey of GC246 was completed from 0300-0700 hrs. It was processed and provided to the ROV crew as an underlay for their navigation. A dive was attempted at this site (L2-08-SV4), but the ROV lost telemetry at approximately 700 m. The fix that was attempted increased the depth capability, but was not sufficient to reach 850 m. The ROV was recovered at 0930 and the ship transited to the new site at GC234.

GC234: ROV Dive SV5

The ROV was launched at approximately 1230. It reached bottom at 475 m according to the ROV tracking in the van. [NOTE: This depth is off. While we were sitting right next to the markers we placed in 2004 and 2005 at 505 m depth, the depth on the ROV read 525 m and the depth on the ROV tracking read 475. The true depth is somewhere in between, but the multibeam depth along the ROV track appears accurate (**Figure 13**). The remaining depths recorded here will be from the ROV reading, but should be corrected after the dive.] The ROV headed west towards the ridge visible on the multibeam survey. There were no sonar targets in the area, and the depth was too shallow, so we returned to the east at a heading of 070°. The bridge heard this as a heading of 270°, and continued to move the ship in that direction. Once this was corrected, we began to head east. The ROV found the known coral ridge at approximately 1400 hrs. The ROV began to follow the feature to the north, when the ship lost dynamic positioning. The garage was elevated higher off the bottom and the vehicle moved away from the coral ridge.

Once the ship had regained control, we returned to the feature. When we had run off of it to the north, there were two sonar targets next to each other at the edge of the sonar range. These were two outcropping carbonates colonized by *Lophelia pertusa* and *Callogorgia americana*. The two thickets were each approximately 3 m high and 3-4 m in diameter, consisting of mainly dead *Lophelia* and high abundances of fishes including *Hoplostethus* sp, *Urophycis* sp., Tinsel fish, and a conger eel.

The ROV continued north along the newly mapped section of the coral ridge. Off the ridge to the east there were soft sediments, but at the top of the ridge were occasional outcrops, low relief sheets of carbonates, and *Callogorgia* sp. At 1530, the ROV stopped to make a collection of *Callogorgia americana* at approximately 490 m depth. When the ROV had settled down, a closer inspection revealed that the substrate was dead *Lophelia*. It is possible that much of the relief on

this feature is in fact buried biogenic substrate. Collections at this site (marker 9) included *Callogorgia americana* with an *Asteroschema* sp. and another species of ophiuroid, an unidentified white gorgonian [upon recovery this was confirmed to be *Paragorgia* sp., the first reported occurrence of this genus in the Gulf of Mexico], and an isidiid bamboo coral. During the last collection, at approximately 1630, the fingers of the manipulator froze once again. The rest of the dive continued as a survey without the ability to collect. In addition to those collected, additional gorgonian genera observed include *Muricea, Scleracis, Thesea, Paramuricea*.

The ROV continued north along the center of the ridge line searching for sonar targets and hard substrata. At approximately 1700, the ROV encountered a small isolated seep site with the tubeworm *Lamellibrachia luymesi* and bacterial mats. At approximately 1720, a mound of cemented shell hash was found. It contained numerous species of gorgonians, large sponges, and a few isolated tubeworms. There were also two small colonies of live *L. pertusa*. North along the ridge from here was generally soft sediment with a occasional fishes and shrimp. After running almost one kilometer from the known site, the ROV left the bottom at approximately 1845 hrs.

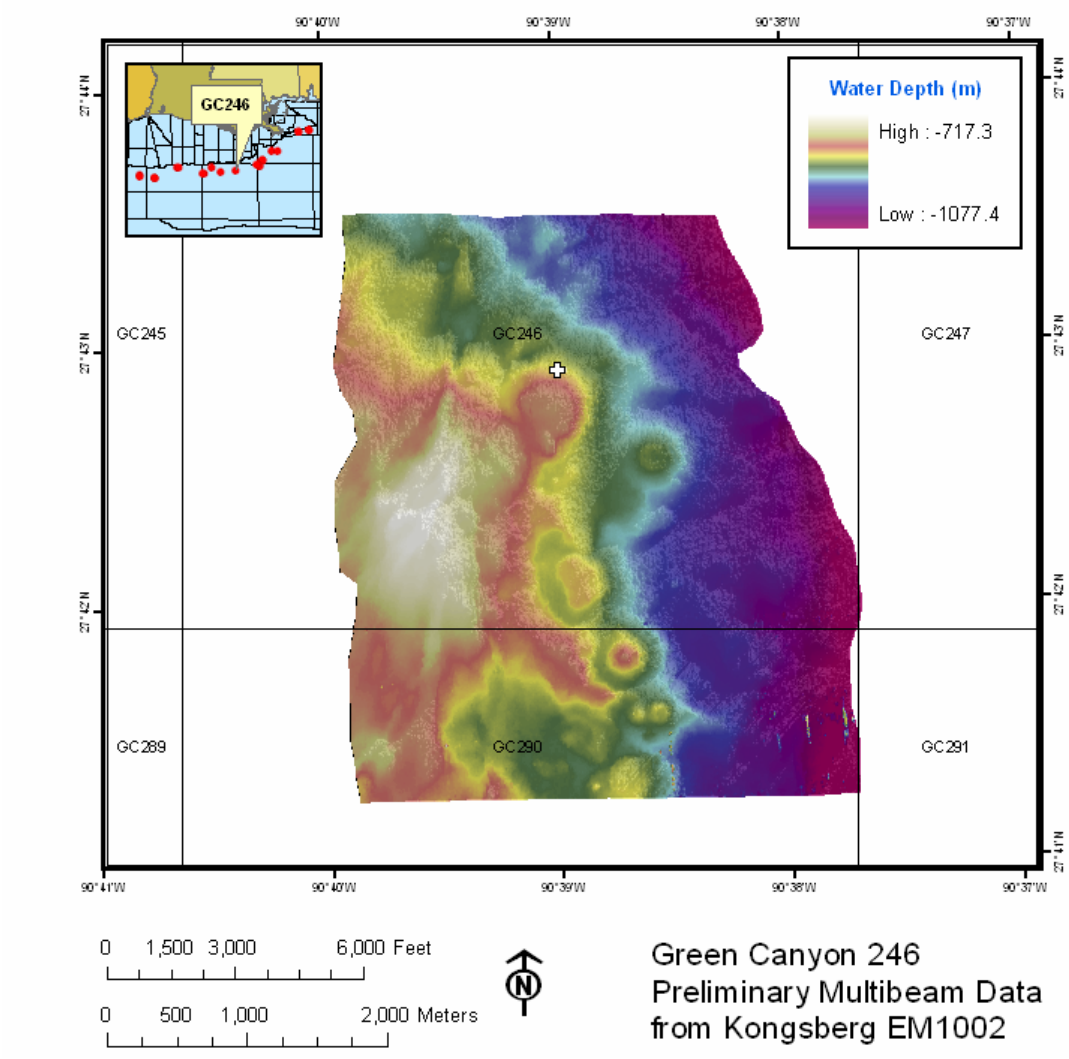

Figure 12. Multibeam bathymetry of GC246

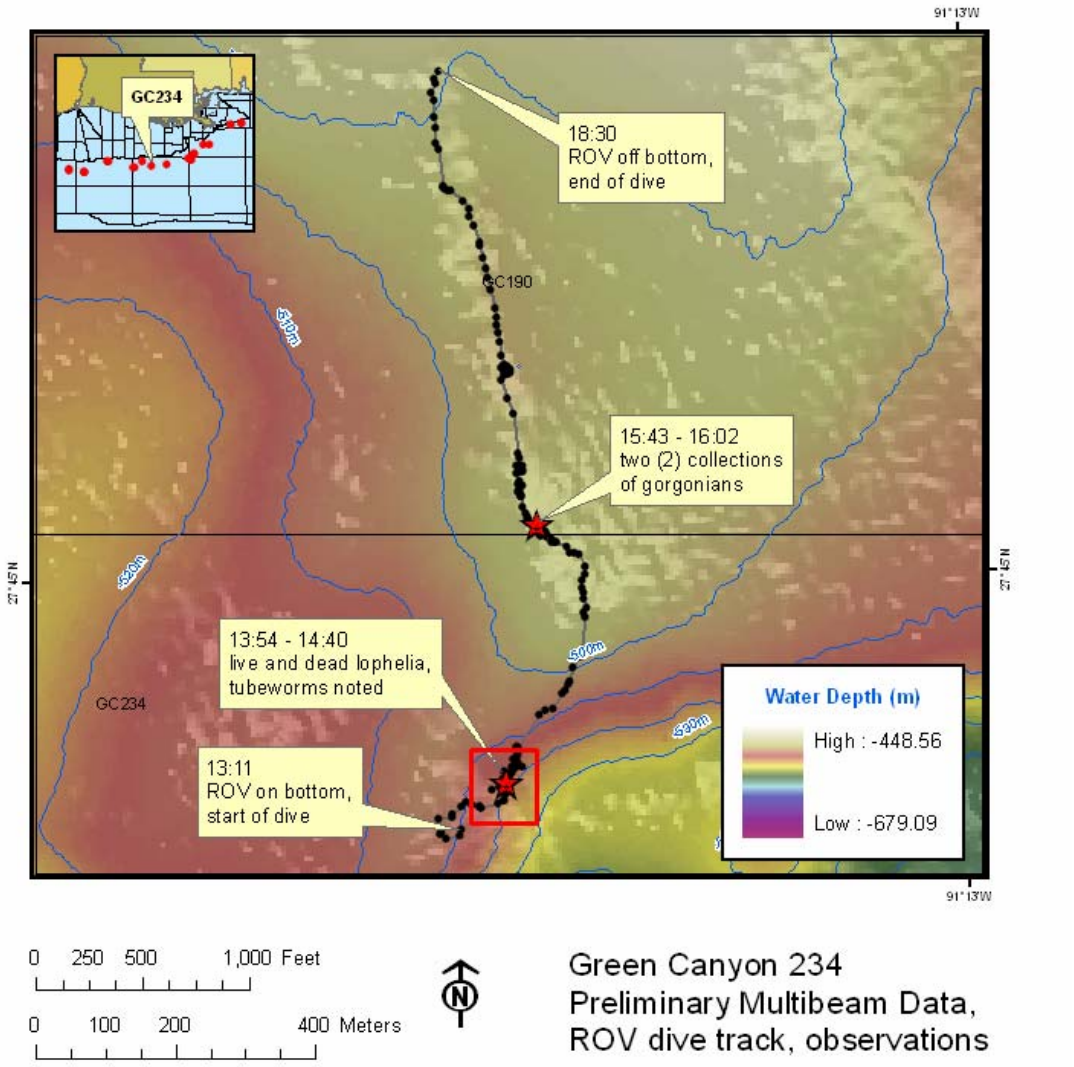

Figure 13. Multibeam bathymetry and dive track for GC234. The well-studied seep site is 100-200 m east of the coral site noted with a red box.

Day 8: September 27, 2008

Following the dive at GC234, the ship transited to GC354 and completed a multibeam survey of the area (**Figure 14**). This was one of the primary sites for the Lophelia I study and may be visited again in the future, although since it was a known site we did not include it in the list of sites targeted for this cruise. Following the multibeam survey, the ship transited to GC 140.

GC 140: ROV dive SV6

We returned to GC140 to complete the survey of the crest of the mound and the feature to the south of the crest that was revealed by the multibeam bathymetry. The first dive found high diversity of gorgonian and antipatharian corals, which left this site on the edge of our site selection criteria. The feature to the south appears to be a hummocky feature, but had low reflectivity on the 3D seismic (**Figure 15**). It is possible that this was due to scatter from the features on the surface, or instability of the substrate potentially from a series of mud volcanoes.

The ROV was launched at approximately 0815. The hand of the manipulator has been repaired, but spare parts for the manipulator are running low. The repaired servo for the manipulator was inserted in the elbow function and the working servo from the elbow placed in the gripping function. This will allow for functionality of the manipulator even if this servo fails in the elbow.

The ROV reached bottom at 230m at approximately 0830 hrs. The ROV headed to the southeast following sonar targets along the way. There were numerous long-spined urchins and a few fishes. At 0900 a large series of outcropping carbonates were observed, and were colonized by sponges, hydroids, and crinoids. There was a long cable on the bottom at this point as well. At 0925 a few gorgonians were observed on an outcrop and a large group of boarfish were also aggregating in the area. At 0930, the ROV passed over a field of large white anemones. At 0935 another series of carbonate outcrops were observed with basket stars and occasional seawhips. At 0950 another field of sea anemones with occasional pencil urchins was encountered.

These habitat types continued until we reached the southeast spur of the mound. At approximately 10:45, at the local topographic high on the southeast corner, a series of large boulders were found with numerous species of gorgonians and antipatharians. One large outcrop was selected for sampling and marker 2 deployed. Sampling of these colonies into biobox C continued until approximately 1230. At this point, the biobox was becoming full, so it was closed and the last sample placed into biobox B. When leaving the site, a bamboo coral that had been accidently knocked off of its perch was grabbed off the bottom and held in the manipulator until the next sampling opportunity.

The ROV then proceeded south off of the main site. It followed a series of small mounds trending just west of south. The depth dropped off as soon as the ROV left the main site. On the southern slope, there were scattered outcrops with bamboo corals and sea whips. As the ROV proceeded south-southeast, it encountered a series of large, steep-sided carbonates projecting up to 8m above the substrate. These appeared in the multibeam bathymetry, but possibly due to the steep angle of the slope, they did not appear in the 3D seismic data. They were colonized by various gorgonians and large *Leiopathes* sp. antipatharians. Another dense area of coral was located at 1345 and the garage was set down to sample. The manipulator lost function shortly after, and sampling was aborted. The ROV continued along this trail of mound features seen in

the multibeam data until reaching the southern hummocky area. At the southern area, we verified that there were a series of large carbonate mounds in this area. The majority of these carbonate outcrops were covered with a thin layer of sediment, potentially limiting coral colonization at this site. The ROV then left the bottom at approximately 1530.

As the garage began its ascent, it became hung up on an overhang approximately 6 m off the bottom. It was dislodged, but the bioboxes on one side became partially detached, hanging onto the garage only by the lines attached to the lids. The small boat was launched to retrieve the samples out of the bioboxes before the garage was lifted out of the water. Once the samples were safely on board, the garage was recovered followed by the ROV at approximately 1630.

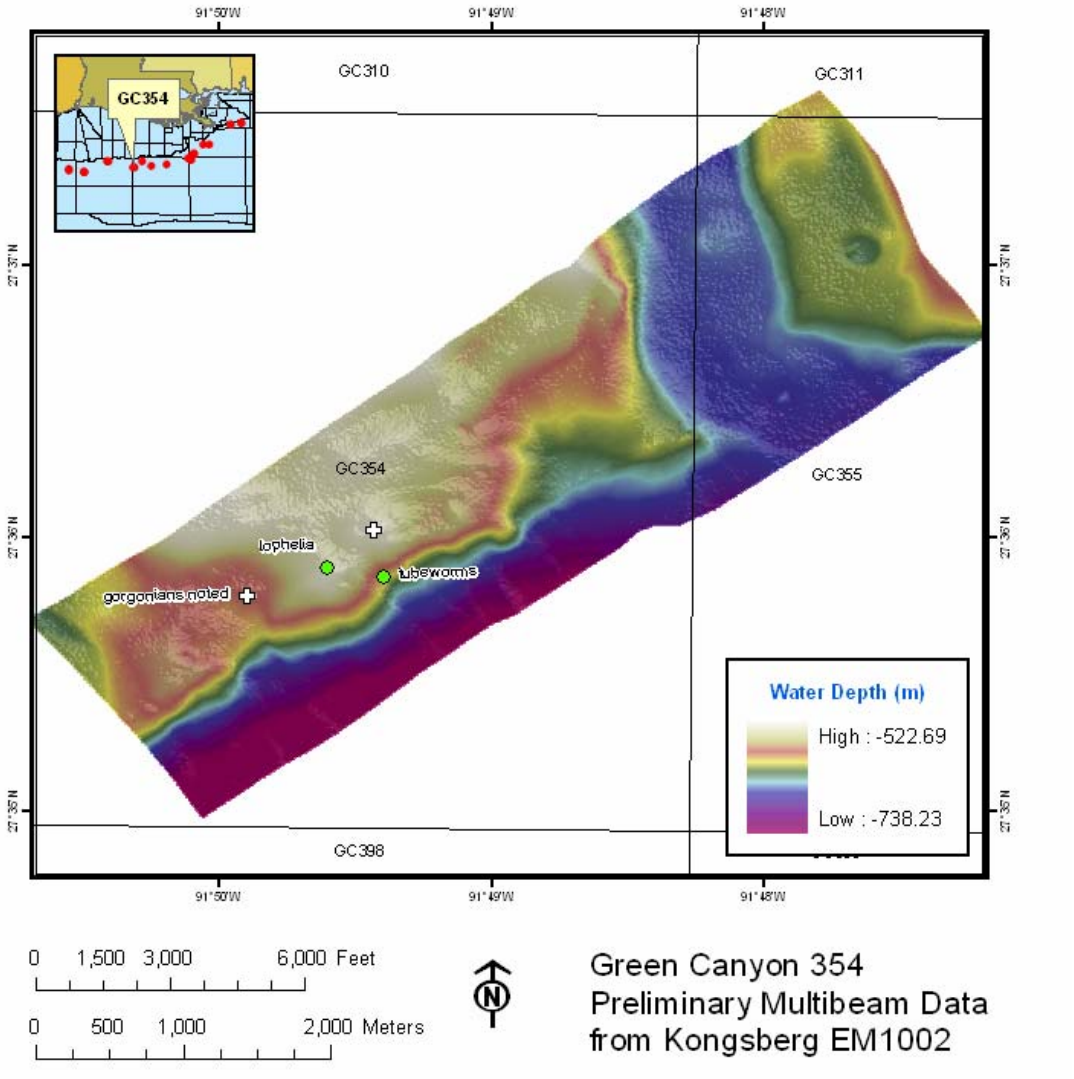

Figure 14. GC354 Multibeam Bathymetry including the known coral site and the location of a tubeworm bushmaster collection.

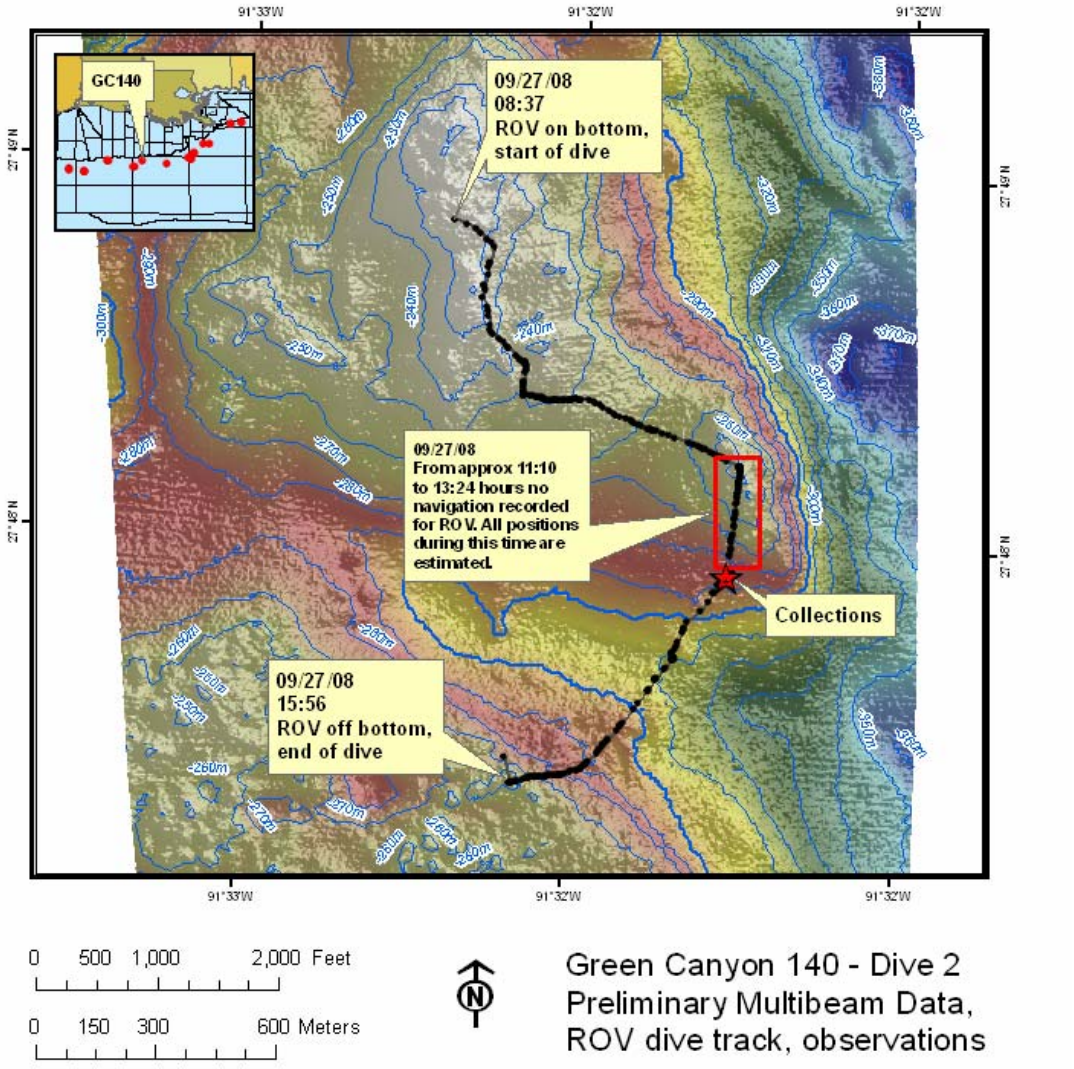

Figure 15. Dive track for ROV dive SV6 at GC140.

Day 9: September 28, 2008

EW 1009 Site Selection

The EW1009 seep site is ~9 km from the ship wreck in EW1008 targeted for investigation during Leg of 1 of this cruise. The area of interest is relatively small compared to most the sites targeted for the seep portion of the cruise (500 m by 2 km). The primary target at the northern end of the overall site is ~500 m by 600 m, with 20 m vertical relief, and shows moderately high positive amplitude response. The southern two-thirds of the site exhibits low relief and has a prominent pockmark on the eastern side (**Figure 16**). This may indicate active introduction of fine grained sediments expelled from the pockmark that may inhibit coral colonization, rendering the southern end of this feature less likely to have extensive coral development.

EW1009: ROV dive SV7

Overnight, the ROV manipulator was repaired and the hydraulic fluid changed to a lighter grade in the hope that this will prevent future issues. The ROV was launched at EW1008 at 0830 hrs. Upon entering the water, the ROV crew lost communication with the transponder and did not have a depth or heading display, and it was recovered. The ship transited to MC751 to conduct a multibeam survey while the ROV crew made repairs.

Two different issues were discovered when the ROV was inspected. First, the USBL transponder on the surface was flooded. This transponder had been attached to a pole on the port beam of the ship and had been functioning normally the entire first and second legs. The cause of this problem is unknown. This was replaced with the backup USBL system, but this system is only rated to 500m. The depth and heading problems were related to a circuit board that is now non-functional. There are no spares to replace this board. The ROV will be relying on its functioning altimeter to determine when it approaches the bottom, and the depth from its location on the multibeam survey. A dive compass has been rigged with an oil compensated bladder and placed in the view of the 3rd camera (previously looking backwards) to determine heading. Since these repairs required additional time, the ROV crew also re-terminated the tether to the ROV to address the loss of signal issues with the telemetry. It is hope that this will allow the ROV to maintain telemetry to the full 1000 m depth rating.

The dive to EW1009 in the afternoon was conducted without the USBL system or the compass. There were issues with the communication with the replacement USBL and it was not placed on the vehicle. The first attempt at the compass configuration failed. The ROV was launched at approximately 1730 hrs. There was a hard ground in the LED array, and it was secured. The ROV reached the bottom at 560 m at approximately 1800 hrs. The bottom appeared to be soft sediment, but the sediment may have been overlying a thin carbonate crust since there was very little disturbance of the bottom when the ROV landed. As the ROV exited the garage, it was apparent that the tether between the garage and the ROV had become wrapped around the umbilical leading the garage during the decent. Since the compass had not been functioning, there was no way to know that the ROV and garage had been spinning during the decent. By spinning the garage in the opposite direction, the ROV gained enough maneuverability to survey a small area of the seafloor. It looked similar to the landing site and no high-relief features were noted in the sonar as we completed a 360° trip around the garage. One sea cucumber and one chimera were observed, and these had not been previously seen during the cruise. The ROV

entered the garage and returned to the surface since the tether was fouled in the umbilical and it was preferred to have recovery before sunset. The ROV was recovered at approximately 1900.

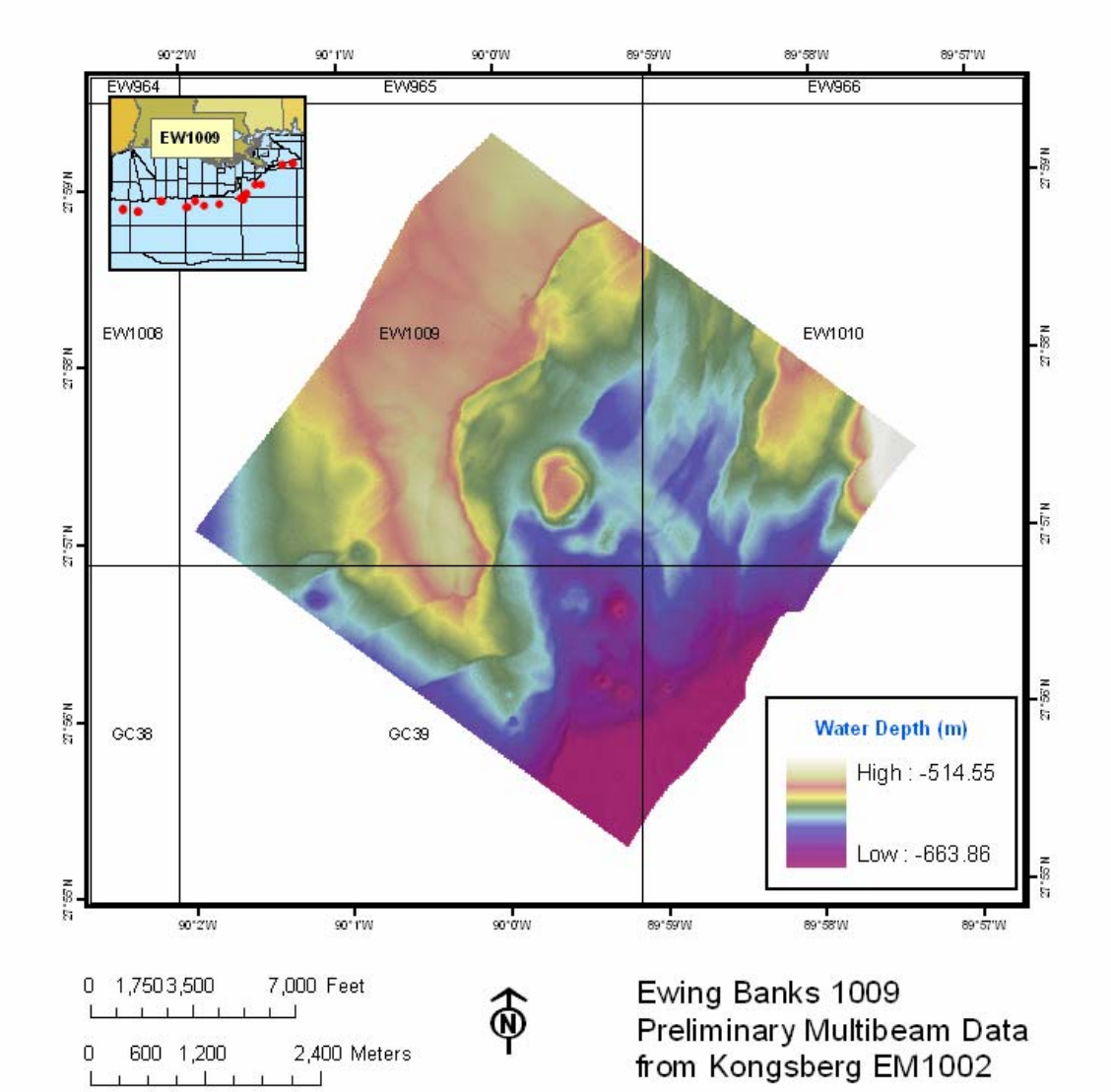

Figure 16. EW 1009 multibeam bathymetry. The dive target was the center of the high-reflectivity knoll in the southeast corner of block 1009.

Day 10: September 29, 2008

Following the short dive on EW1009 on the 28th, the ship transited to AT47 and conducted a multibeam survey (**Figure 17**). We then transited to MC751 where a multibeam survey was conducted followed by an ROV dive on the morning of the 29th.

AT47 Site Selection

The AT47 site comprises a series of small, discrete, low relief (100 by 200 meters, 10 to 20 meters vertical relief), moderate to high positive and negative seafloor amplitude anomalies situated on the east side of a graben system above salt. The vertical seismic profiles show clear vertical gas migration to the seafloor. The presence of the negative amplitude anomalies suggest the probability of high flux gas expulsion, but the lack of constructional mounds, mud volcanoes, or flows suggest the lack of sediment influx to the area that would inhibit coral development.

MC751 Site Selection

The MC751 site is a small (.8 to 1.4 km, 20 m relief) feature with moderate to high seafloor amplitude response (**Figure 18**). It is located at the southernmost end of a south dipping nose at the intersection with a southeast plunging trough created by a down-to-the southwest fault. The fault ends at the proposed seep site. We hypothesized that the trough would provide an avenue for any introduced fine sediments to be carried to deeper waters by current flow, leaving the probable hard-grounds clean and adequate as a substrate for coral.

MC751: ROV dive SV8

Once the replacement USBL system was online and the ground fault in the LED array was repaired, the ROV was launched at approximately 1000 hrs. The ROV reached bottom at approximately 500 m round 1030 hrs. Shortly after reaching bottom, the ROV came across a mound of mostly dead *Lophelia* coral. There were multiple species of gorgonians in the area, and a few living tips of *L. pertusa*. Blackbelly rosefish, ophirouids, anemones, and *Eumunida picta* were observed. At 1115, the ROV began to search for a good place to set the garage down on the bottom and begin sampling. One sample of live *Lophelia* was obtained, but as it was being placed in the biobox, the claw of the manipulator froze at 1215. The piece of *Lophelia* was broken off into the box. [Despite not being able to close the lid on the box, this small piece of *Lophelia*, our only sample of this species so far on this cruise, remained inside the biobox and was subsampled after the ROV was on deck.]

The garage was left on the bottom and the ROV surveyed the area accessible from the tether length. Multiple still photos were taken of the *Lophelia* mound and surrounding small pieces of carbonate. At approximately 1245 the garage was picked up off the bottom and the ROV moved northeast to a ridge structure seen on the multibeam. A series of low-lying mounds were found, composed mainly of dead *Lophelia* structure and coral rubble. At 1330, the ROV found a larger carbonate block with approximately 1-2 m of vertical relief. The carbonate block was covered in mixed live and dead *L. pertusa* and gorgonians (particularly *Callogorgia* sp.) on the top with *Lamellibrachia* tubeworms and bacterial mats around the periphery of the carbonate and on the sediment. Live *L. pertusa* colonies (< 1 m^2) were observed only on the top and edges of the carbonate block. After surveying and photographing this particular carbonate block, the ROV explored the area accessible from the tether. A series of carbonate blocks were observed in the area, with attached *Callogorgia* sp. and live *L. pertusa* colonies. Observed megafuana included

blackbelly rosefish, *Laemonema* spp., *Chaceon fenneri,* and *Eumunida picta.* The ROV then continued following the ridge structure on a southwest (~130º) transect, observing a series of low-lying mounds of mainly dead *L. pertusa* with few tubeworms until approximately 1400. At this time the ship began to transit to the north to explore the perimeter of a high relief area noted in the multibeam.

The mounds continued during the northward transit. At approximately 1430 the ROV came off the bottom to confirm the location of the garage, but had some difficulty locating it. There was apparently an issue with one of the vertical thrusters. The garage was located and the ROV entered it to come back down to the bottom at 1515. The ship began to transit at a heading of 210º, roughly parallel to the line the ROV ran before. The carbonate and dead *L. pertusa* mounds continued along this line, and were frequently colonized by multiple species of gorgonians, sponges, live *L. pertusa*, and the occasional tubeworm.

At approximately 1600 hrs, the ROV turned due south towards the center of the reflectivity on the 3D-seismic. The area contained numerous smaller carbonate blocks and increased frequency of bacterial mats and solitary tubeworms. At approximately 1745, the ROV encountered a large aggregation of *Lamellibrachia luymesi* with numerous *Acesta oophagia* on the distal tips. The ROV reached the center of the high reflectivity at approximately 1800 and turned due east. This area contained patchy solitary tubeworms (most likely pogonophorans), small white sponges, and white bacterial mats. At 1830 the depth began to drop off, and the ROV was retrieved.

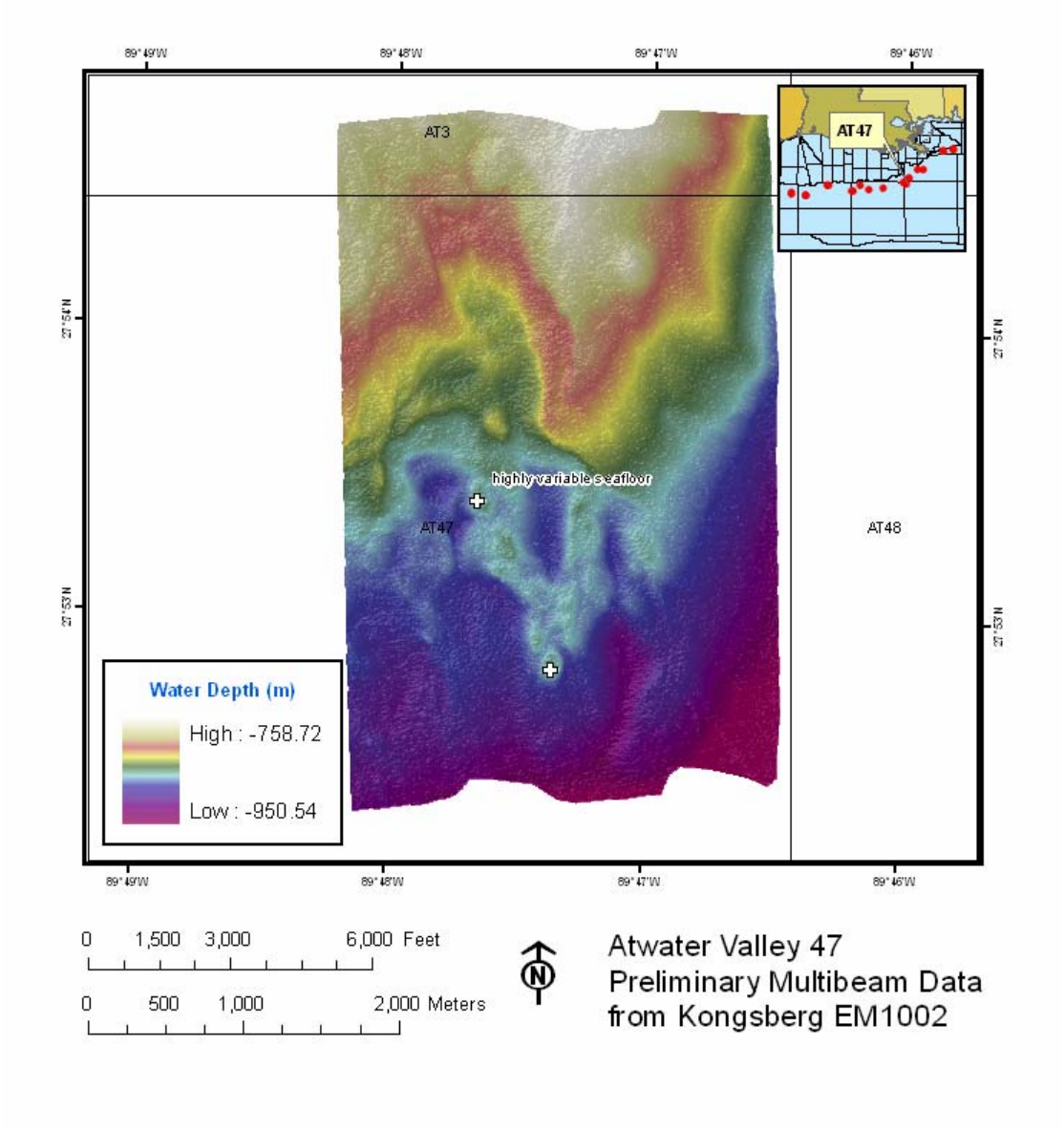

Figure 17. AT47 Multibeam bathymetry

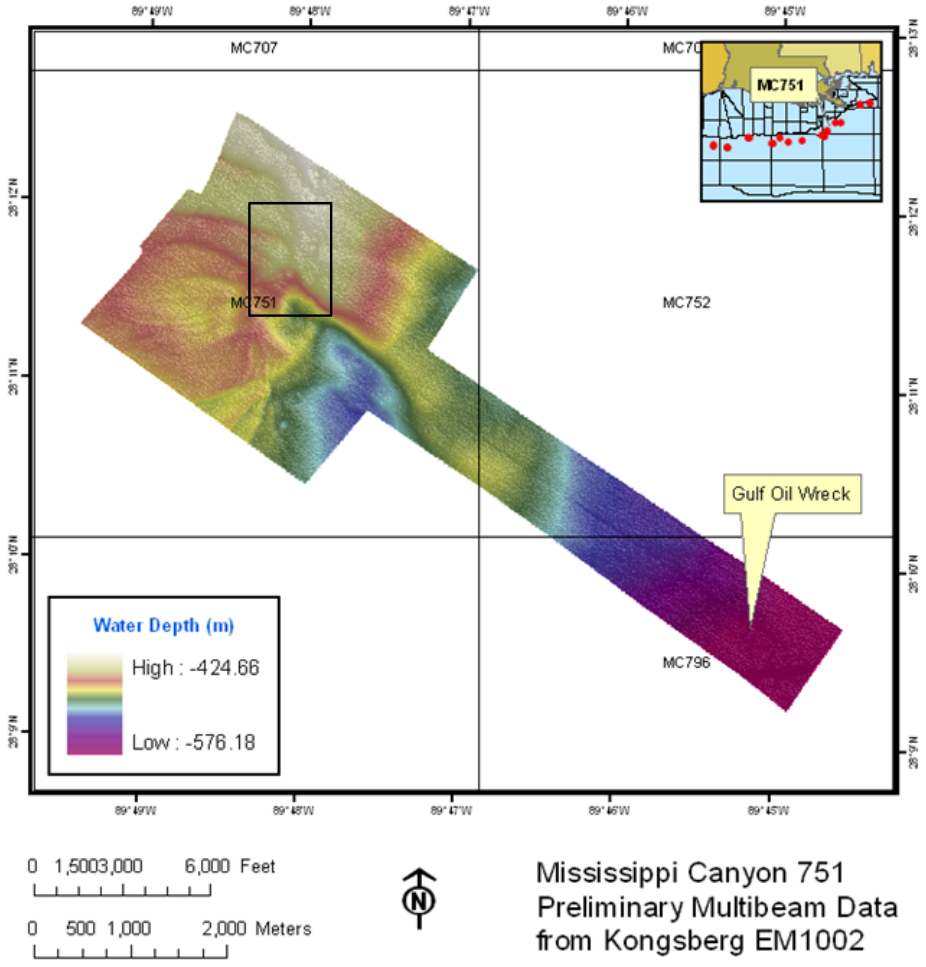

Figure 18. MC751 Multibeam bathymetry. The black box surrounds the area surveyed by the ROV.

Day 11: September 30, 2008

Overnight from Sept 29-30, the ship acquired multibeam bathymetry data over MC885. When this long survey was complete at approximately 0900, the ship began its transit to VK906. The CTD cast began at approximately 2200, followed by a long multibeam survey.

MC885 Site Selection

The MC885 exploratory site is a circular bathymetric high (1.3 by 1.3 km, up to 30 meters of vertical relief) with moderately high positive seafloor amplitude response from 3-D sesmic data. It is located ~1 km east of a mound where *Lophelia pertusa* has been previously observed. Th (**Figure 19**)e exploratory site and the previously visited sites are on a large salt supported bathymetric high (3 by 4 km). This site shows clear indications of vertical gas migration on vertical seismic cross-sections.

VK906 Site Selection

The VK906 site is a very large (5 by 5 km) plunging nose that extends 230 m from the deepest to shallowest extent of the patchy, moderately high positive seafloor amplitude response. Shallow salt (as shallow as 150 meters) supports the feature as indicated on vertical seismic cross-sections. Visits by submersible dives to the crest of the only closed bathymetric high on the nose at the northern part of VK906 and into the southernmost part of VK862 found *L. pertusa* colonies. The preferred dive sites are along the break in slope of the steep sided western and southern flanks of the nose.

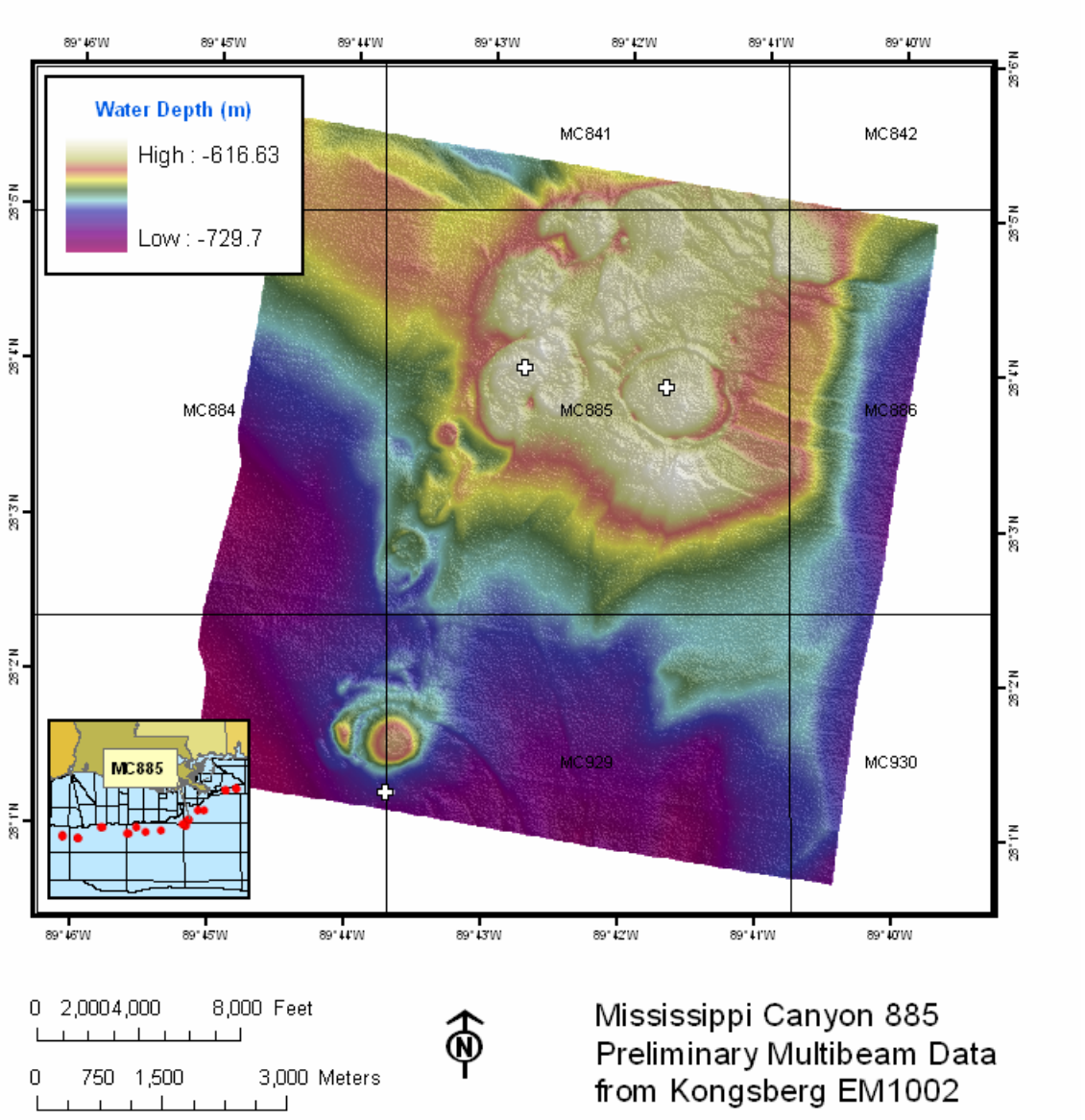

Figure 19. Multibeam bathymetry of MC885/929. The western point marked and the series of mounds running to the south were previously explored, while the eastern point has not been investigated to our knowledge.

Day 12: October 1, 2008

The multibeam survey at VK862-906 concluded at approximately 0600 on Oct 1st. The ridge line on the southern and western flanks is clearly visible in the multibeam bathymetry (**Figure 20**). Based on the multibeam data, the northwestern corner of this series of high-relief features was selected as the launch target for the ROV dive.

VK 906: ROV Dive SV9

The ROV was launched at approximately 0800. There was a school of about 10, 2m long sharks on the surface as the ROV began its descent. When the ROV reached the bottom, there were a few sonar targets in the area and the vehicle proceeded to the east in that general direction. After approximately 30m, a carbonate outcrop colonized by a large antipatharian, bamboo corals and anemones was located. The ROV began to transit at a heading of between 150 and 180° along a series of similar outcrops with different relative abundances of gorgonians, bamboo corals, and antipatharians with low-lying fields of anemones in between. At approximately 0900, the LED array developed a hard ground and was secured. This had a significant effect on the quality of the video and still photography, so at 0930 the decision was made to recover the ROV. The ROV was recovered at approximately 1000. The ground fault was in the connector to the LED array and it was replaced.

VK 906: ROV dive SV10

The ROV was launched again at approximately 1200 on the same coordinates as it left the bottom on the previous lowering. The school of black-tip reef sharks was encountered once again as the ROV was lowered through the water column (but the video was recording this time). The ROV landed on the bottom at approximately 380m. There were a number of large (~1 foot long) squid in the area. The ROV headed south along the ridge line, but soon ran off into mainly soft bottom. The heading was changed to 090° to climb back up the slope to the top of the ridge in search of hard-grounds.

At approximately 1300, as the ROV came back up to the ridge line, a large carbonate outcrop was encountered with bamboo corals and anemones. The ROV appeared to be getting dragged by its tether, so it was turned to locate the garage. After it was found, the ROV located another carbonate outcrop before running south beyond the northern extension of the ridge line. The ROV turned due south at approximately 1345 and came across another field of anemones. At the next mound visible on the multibeam at 390 m, there was a series of outcropping carbonates at 1400 hrs colonized by *Acanella* sp. bamboo corals and *Muricedes* sp. gorgonians with a number of barrel fish in the area. The ROV then turned to 130° in the direction of the next area of high-relief on the bathymetry.

At this next feature at approximately 1430, there were numerous low-lying carbonate outcrops with anemones and occasional pogonophorans and bacterial mats at 400m depth. The ROV continued to explore the southern line of features, transiting over a number of carbonate outcrops. These were colonized by antipatharians, gorgonians, bamboo corals, and a high abundance of anemones. A large area of numerous small carbonates colonized by bamboo corals was encountered at approximately 1500. The ROV then passed over a small field of anemones (1515) followed by another area of bamboo corals (1530), and another field of anemones (1545). This bottom type continued over the entire southern ridge line until 1630 when another outcrop

was discovered with a large antipatharian, bamboo corals and a few small colonies of live *Lophelia*. The garage was set down nearby at approximately 410 m and the ROV began sampling at 1730. Following a long struggle with a very flexible black coral, a sample was obtained. A bamboo coral was also sampled. Sampling of *L. pertusa* was attempted but was unsuccessful. [Although it appeared unsuccessful, this small piece of *L. pertusa* was in fact found in the biobox.] Sampling was complete at 1930 and the ROV began to transit east towards the high relief bathymetry at the center of the site.

At 2000, the ROV sampled a large, red antipatharian. The sample was retained in the manipulator during the transit rather than attempting to transfer the sample to the biobox at this point. The ROV continued to transit over occasional large outcrops with numerous anemones and usually one large antipatharian colony per boulder. At 2045, the ship began a transit at a heading of 080° towards the large mounds south of the known area in VK862/906. The ROV began to run up the side of the mound at approximately 2100 hrs. It was composed of loose carbonate substrate, possibly dead coral material. There were few epifaunal organisms on the mound aside from the ubiquitous white anemones. At 2115, a few living *L. pertusa* tips were seen on the mound. The garage was set down and the antipatharian colony placed in the biobox. The ROV returned to the live *Lophelia* and collected it, depositing a portion of it in the biobox at 2135. The box was closed and the ROV called to the surface.

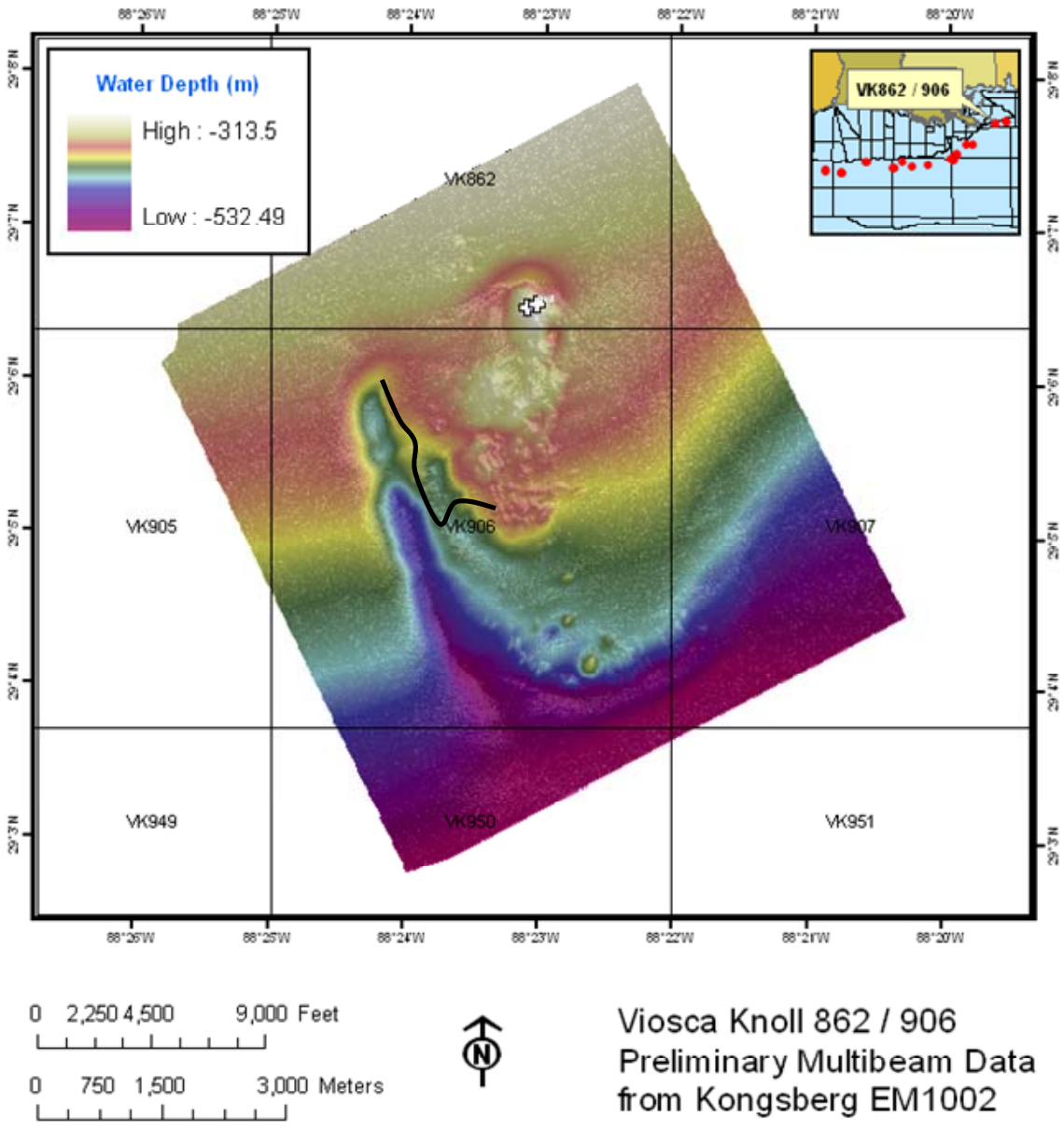

Figure 20. Multibeam bathymetry of VK862/906. Line indicates approximate dive track. Points indicate previously explored areas of VK 862.

Cruise Summary:

During the 12 working days at sea, we collected multibeam data at 13 sites and completed 10 lowerings of the ROV over 8 different sites. There were 2 ROV operations days lost to weather conditions, 1 dive never reached the bottom, and 3 other dives were ended with under two hours of bottom time due to technical problems with the ROV (see table). During almost every dive the manipulator failed, and this severely limited our capacity to collect physical samples for future genetics work. On most of the latter dives, only one attempt was made to collect samples in areas of high coral diversity and density due to the anticipation of manipulator failure and the extremely long amount of time required to sample (1-5 samples obtained in 1-3 hours).

The entire cruise was limited to sites in less than 600 m water depth due a complete loss of telemetry at greater depths. When the USBL transponder on the surface failed later on the cruise, the replacement USBL system was only rated to 500 m and was highly inaccurate. Due to these issues, much of the site selection was completed on board. Four of the dives were completed at known sites but on previously unexplored areas of these sites revealed by the multibeam surveys. Despite many of these issues, the photographic sampling of the ROV in conjunction with the multibeam and CTD data (conductivity, temperature, depth, dissolved oxygen, pH, transmissivity, and fluorometry) yielded valuable data on the abundance of corals under different environmental conditions and geological settings.

At Green Canyon (GC) 140, there were abundant gorgonians and antipatharians, but no scleractianians (including *Lophelia pertusa*) were observed. It is possible that the elevated temperature due to the shallow depths of this site prevented the deep water scleractinians from colonizing the explored areas. At Garden Banks (GB) 201, the seismic data indicated an abundance of hard substrate, but the majority of it appeared to be covered by a thin sediment veneer. It is possible that the abundance of pockmarks seen on both the multibeam bathymetry and directly observed on the seafloor gave rise to increased levels of local sedimentation, preventing coral recruitment and survival. At GC234, the multibeam data revealed a long, linear ridge feature that was a continuation of the known coral ridge at that site. Exploration of this area revealed the presence of additional mounds and low-lying ridges colonized by *L. pertusa*, but the majority of the coral at this site was dead. We also collected a specimen of *Paragorgia* sp., the first occurrence of this genus in the Gulf of Mexico. At Mississippi Canyon (MC) 751, a large area of carbonate outcrops was colonized by living *L. pertusa* as well as numerous species of gorgonians and antipatharians. This site exhibited fairly low relief, but was at the head of a small canyon-like feature that may serve to channel sediment away from the area. This type of feature should be a consideration in future site selection. A number of samples were obtained at this site, and it should become a focus of future investigations during this study. The final dive at a previously unexplored area of Viosca Knoll (VK) 906 revealed a long ridge system with gorgonian and antipatharian corals at the edge of another narrow canyon-like feature. At the southern portion of the site, there was also a series of mounds revealed by the multibeam survey. We explored one of these mounds at the very end of the dive and it appeared to be composed of a combination of dead *L. pertusa* skeleton and carbonate rubble. There were some live *L. pertusa* here as well, growing from the rubble on a fairly flat seafloor. This type of habitat for *L. pertusa* has not been observed previously in the Gulf of Mexico, and should be another good target for future exploration and research.

On one level, this was a successful reconnaissance cruise that explored a number of new sites in the Gulf of Mexico, gathered CTD and multibeam data at a number of sites, discovered new areas of *L. pertusa* abundance including one new site, and collected one gorgonian species not previously known from the Gulf of Mexico. However, many of the larger objectives of the program that were initially intended for this cruise were not accomplished due to technical issues with the ROV. These included surveying sites down to 1000 m depth, primarily surveying previously unobserved sites, and obtaining replicate samples to complete a portion of the genetics objectives. Many of these technical problems were beyond the control of the ROV operators, who went to extraordinary lengths to attempt to remedy these issues and worked well beyond what was expected of them during the cruise. In the end, despite numerous operational difficulties, this first, natural-site, reconnaissance cruise collected a limited number of samples to initiate the genetics and taxonomic work, and obtained sufficient mulitbeam and observational data to assist with future planning on the project.

DATA LOGS

Table 3. Summary of submersible operations during the second leg of the NOAA Ship Nancy Foster / SeaVision ROV reconnaissance cruise.

Date	Dive	Site	launch	recovery	on bottom	Issues
9/21	SV1	MC539	11:45	13:00	0:15	loss of telemetry, tether caught in propeller
9/22	SV2	GC140	9:30	20:00	9:30	delayed launch due to video malfunction, failure of tilt mechanism
9/23	SV3	GB201	8:30	18:30	9:30	garage on side - lost temperature probe, frozen manipulator
9/24						weather
9/25						weather
9/26	SV4	GC246	8:30	9:30	0:00	loss of telemetry due to depth (>600m)
9/26	SV5	GC234	12:30	19:15	5:15	frozen manipulator
9/27	SV6	GC140	8:15	16:30	7:20	frozen manipulator, garage hung up - damaged bioboxes
9/28	SV7	EW1009	17:30	19:00	0:30	flooded USBL, loss of depth and heading, ground in LED array, restricted tether length
9/29	SV8	MC751	10:00	19:00	8:00	poorly functioning USBL, frozen manipulator, malfunctioning thruster
10/1	SV9	VK906	8:00	10:00	1:30	poorly functioning USBL, ground fault in LED array
10/1	SV10	VK906	12:00	21:45	9:00	poorly functioning USBL
				total	50:50	

Table 4. Navigation Marker positions.

Marker	Date	Site	Dive	TIME	UTMX	UTMY	DEPTH m	LONGW	LATN
16	22/9/08	GC140	SV2	11:58:01	2110809.5491	10098741.2923	271	91.544378	27.821705
FV2	22/9/08	GC140	SV2	14:41:01	2111497.0934	10098910.8044	285	91.542245	27.822149
9	26/9/08	GC234	SV5	15:48:02	2215074.6603	10074274.0926	473	91.222913	27.750634
	27/9/08	GC140	SV6	11:11:18 *	2113159.3798	10094542.2165	244	91.537262	27.810078

Table 5. Collections[1] made by ROV.

Sample ID	Tentative ID	Date	Site	Dive No.	Found on	Found with	Comments	Genetics			Voucher				FTA Card	Collection Method	AVG_LAT (WGS84)	AVG_LON (WGS84)	Depth (m avg)
								Frozen	RNA	EToH	95% EToH	Formalin	Dried	Frozen					
L2-08-GC140-C1	Yellow Gorgonian	22/9/2008	GC140	2		crab, anthomastis, soft coral, hydroids		X	X	X	X	X				Grab	27.82178	-91.544401	274.1
L2-08-GC140-C2	Majoid	22/9/2008	GC140	2	C1		female				X					Grab	27.82178	-91.544401	274.1
L2-08-GC140-C3	Hydroid-Hecate	22/9/2008	GC140	2	C1					X						Grab	27.82178	-91.544401	274.1
L2-08-GC140-C4	Callogorgia	22/9/2008	GC140	2				X	X	X	X	X				Grab	27.82178	-91.544401	274.1
L2-08-GC140-C5	Paramuriceid	22/9/2008	GC140	2		Crabs, barnacles		X	X	X	X	X				Grab	27.82178	-91.544401	274.1
L2-08-GC140-C6	Hydroid-turritopsis (?)	22/9/2008	GC140	2	C5					X		X				Grab	27.82178	-91.544401	274.1
L2-08-GC140-C7	Brittle Star-astroschema	22/9/2008	GC140	2							X					Grab	27.82178	-91.544401	274.1
L2-08-GC140-C8	Brittle Star	22/9/2008	GC140	2							X					Grab	27.82178	-91.544401	274.1
L2-08-GC140-C9	Galatheid	22/9/2008	GC140	2	C5						X					Grab	27.82178	-91.544401	274.1
L2-08-GC140-C10	Galatheid	22/9/2008	GC140	2	C5						X					Grab	27.82178	-91.544401	274.1
L2-08-GC140-C11	Anthomastus sp.	22/9/2008	GC140	2	C5						X	X				Grab	27.82178	-91.544401	274.1
L2-08-GC140-C12	Paramuriceid	22/9/2008	GC140	2							X	X				Grab	27.82178	-91.544401	274.1
L2-08-GC140-C13	Big Yellow Gorgonian	22/9/2008	GC140	2		hydroids, aplacopharon		X	X	X	X		X			Grab	27.82178	-91.544401	274.1
L2-08-GC140-C14	Hydroid-turritopsis (?)	22/9/2008	GC140	2	C13					X		X				Grab	27.82178	-91.544401	274.1
L2-08-GC140-C15	Aplacophoran	22/9/2008	GC140	2	C13									X		Grab	27.82178	-91.544401	274.1
L2-08-GC140-C16	Aplacophoran (2)	22/9/2008	GC140	2	C13						X					Grab	27.82178	-91.544401	274.1
L2-08-GC140-C17	Small Carbonate Rock	22/9/2008	GC140	2							X		X			Grab	27.82178	-91.544401	274.1
L2-08-GC140-C18	Large Carbonate Rock	22/9/2008	GC140	2							X		X			Grab	27.82178	-91.544401	274.1

Sample ID	Tentative ID	Date	Site	Dive No.	Found on	Found with	Comments	Genetics			Voucher				FTA Card	Collection Method	AVG_LAT (WGS84)	AVG_LON (WGS84)	Depth (m avg)
								Frozen	RNA	EToH	95% EToH	Formalin	Dried	Frozen					
L2-08-GC140-C19	Anemones (4)	22/9/2008	GC140	2							X					Grab	27.82178	-91.544401	274.1
L2-08-GC140-C20	Barnacles (8)	22/9/2008	GC140	2	C5						X					Grab	27.82178	-91.544401	274.1
L2-08-GC140-C21	Callogorgia	22/9/2008	GC140	2				X	X	X	X	X				Grab	27.82178	-91.544401	274.1
L2-08-GC140-C22	Glass sponge	22/9/2008	GC140	2							X					Grab	27.82178	-91.544401	274.1
L2-08-GC140-C23	Anthomastus sp.	22/9/2008	GC140	2							X					Grab	27.82178	-91.544401	274.1
L2-08-GC140-C24	Rock	22/9/2008	GC140	2									X			Grab	27.82178	-91.544401	274.1
L2-08-GC140-C25	Brittle Star (2)	22/9/2008	GC140	2							X					Grab	27.82178	-91.544401	274.1
L2-08-GC140-A1	Brittle Star (2)	22/9/2008	GC140	2							X					Grab	27.82220	-91.54206	289.1
L2-08-GC140-A2	Callogorgia sp.	22/9/2008	GC140	2				X	X	X	X					Grab	27.82220	-91.54206	289.1
L2-08-GC140-A3	Gorgonian	22/9/2008	GC140	2							X					Grab	27.82220	-91.54206	289.1
L2-08-GC140-A4	Brittle Star	22/9/2008	GC140	2							X					Grab	27.82220	-91.54206	289.1
L2-08-GC140-D1	Callogorgia	22/9/2008	GC140	2				X	X	X	X	X				Grab	27.82224	-91.542271	289.3
L2-08-GC140-D2	Anemone	22/9/2008	GC140	2							X					Grab	27.82224	-91.542271	289.3
L2-08-GC140-D3	Rock	22/9/2008	GC140	2									X			Grab	27.82224	-91.542271	289.3
LV-08-SV5-C1	Callogorgia	26/9/08	GC234	SV5				X	X	X	X		X			Grab		Peter	
LV-08-SV5-C2	Paragorgia sp. ("Bubblegum Coral")	26/9/08	GC234	SV5		Brittle Stars		X	X	X	X		X			Grab		Peter	
LV-08-SV5-C3	Brittle Star	26/9/08	GC234	SV5	C2						X					Grab			
LV-08-SV5-C4	Brittle Star	26/9/08	GC234	SV5	C2						X					Grab			
LV-08-SV5-C5	Brittle Star	26/9/08	GC234	SV5	C2						X					Grab			

Sample ID	Tentative ID	Date	Site	Dive No.	Found on	Found with	Comments	Genetics			Voucher				FTA Card	Collection Method	AVG_LAT (WGS84)	AVG_LON (WGS84)	Depth (m avg)
								Frozen	RNA	EToH	95% EToH	Formalin	Dried	Frozen					
L2-08-SV6-C1	black coral	27/9/08	GC140	SV6		egg pouch, stalked barnacles		X	X	X	X	X				Grab			
L2-08-SV6-C2	egg pouch	27/9/08	GC140	SV6	C1							X				Grab			
L2-08-SV6-C3	stalked barnacles	27/9/08	GC140	SV6	C1						X					Grab			
L2-08-SV6-C4	gorgonian	27/9/08	GC140	SV6				X	X	X	X	X				Grab			
L2-08-SV6-C5	meshed black coral	27/9/08	GC140	SV6				X (2 cryovials)	X	X	X	X				Grab			
L2-08-SV6-C6	barnacles	27/9/08	GC140	SV6	C5			X			X	X				Grab			
L2-08-SV6-C7	black coral	27/9/08	GC140	SV6				X	X	X						Grab			
L2-08-SV6-C8	brittle stars	27/9/08	GC140	SV6							X					Grab			
L2-08-SV6-B1	black coral on rock	27/9/08	GC140	SV6		hydroids, barnacles		X	X	X	X	X				Grab			
L2-08-SV6-B2	barnacles	27/9/08	GC140	SV6	B1						X	X				Grab			
L2-08-SV6-B3	hydroids	27/9/08	GC140	SV6	B1					X						Grab			
L2-08-SV6-B4	bamboo coral	27/9/08	GC140	SV6				X	X	X	X	X				Grab			
L2-08-SV6-B5	rock with black coral	27/9/08	GC140	SV6		B1							X			Grab			
L2-08-SV8-01	Thecate Hydroid	29/9/08	MC751	SV8	Lophelia (02)					X		X				Grab			
L2-08-SV8-02	Lophelia	29/9/08	MC751	SV8		hydroids					X	X			X	Grab			
L2-08-SV8-03	Rock	29/9/08	MC751	SV8												Grab			
L2-08-SV10-A1	black coral (white)	1/10/2008	VK906	SV10				X	X	X	X	X				Grab			
L2-08-SV10-A2	Lophelia	1/11/2008	VK906	SV10							X				X	Grab			
L2-08-SV10-A3	Bamboo coral	1/12/2008	VK906	SV10							X					Grab			
L2-08-SV10-A4	Rock	1/13/2008	VK906	SV10									X			Grab			
L2-08-SV10-B1	black coral (red)	1/14/2008	VK906	SV10												Grab			

Sample ID	Tentative ID	Date	Site	Dive No.	Found on	Found with	Comments	Genetics			Voucher				FTA Card	Collection Method	AVG_LAT (WGS84)	AVG_LON (WGS84)	Depth (m avg)
								Frozen	RNA	EToH	95% EToH	Formalin	Dried	Frozen					
L2-08-SV10-B2	hydroid (Eudendrium sp.)	1/15/2008	VK906	SV10	B3											Grab			
L2-08-SV10-B3	Lophelia	1/16/2008	VK906	SV10		sponge, hydroids					X				X	Grab			
L2-08-SV10-B4	Sponge	1/17/2008	VK906	SV10	B3											Grab			

[1] All frozen samples shipped via FedEx were delayed and received thawed. Samples were lost

Table 6. Locations of CTD casts.

Date	Site	Dive no.	Temperature [ITS-90, deg C]	Conductivity [S/m]	Salinity [PSU]	Pressure Strain Gauge [db]	Depth [salt water, m]	Oxygen SBE 43 [mg/l]	OBS Seapoint Turbidity [FTU]	Fluorescence Seapoint	pH
21/9/2008	MC539	SV1	X	X	X	X	X	X	X		X
22/9/2008	GC140	SV2	X	X	X	X	X	X			X
23/9/2008	GB201	SV3	X	X	X	X	X	X	X	X	X
26/9/2008	GC246	SV4	X	X	X	X	X	X	X	X	X
26/9/2008	GC234	SV5	X	X	X	X	X	X	X	X	X
27/9/2008	GC140	SV6	X	X	X	X	X	X	X	X	X
28/9/2008	EW1009	SV7	X	X	X	X	X	X	x	X	X
29/9/2008	MC751	SV8	X	X	X	X	X	X	X	X	X
1/10/2008	VK906	SV9	X	X	X	X	X	X	X	X	X
1/10/2008	VK906	SV10	X	X	X	X	X	X	X	X	X

Table 7. Multibeam sites.

Site	Date	CTD #	Latitude	Longitude	Time (UTC)	Depth
VK826	9/21/2008	JD265_1	29 08 31.20 N	088 02 16.20 W	1:17	610
GC140	9/22/2008	JD266_1	27 47.16 N	091 42.20 N	4:30	330
GB201	9/23/2008	JD267_1	27 45.67 N	092 43.79 W	7:20	nr
EB478	9/24/2008	JD268_1	27 23.37 N	093 36.01 W	5:40	627
GB535	9/24/2008	JD268_2	27 29.89 N	094 03.94 W	14:56	nr
GC234	9/25/2008	JD269_1	27 44.13 N	091 15.83 W	22:20	555
GC246	9/26/2008	JD270_1	27 42.68 N	090 40.56 W	08:11	755
GC535	9/27/2008	JD271_1	27 34.70 N	091 50.13 W	8:31	nr
MC751	9/28/2008	JD272_1	28 09.24 N	089 44.28 W	16:42	nr
AT47	9/29/2008	JD273_1	27 53.60 N	089 45.74 W	8:20	nr
MC885	9/30/2008	JD274_1	28 04.95 N	089 43.11 W	1:43:10	nr
VK682	10/1/2008	JD275_1	29 02.27 N	088 23.60 W	2:09:34	500

APPENDIX A – SEAVISION ROV

NOAA/MMS/USGS
DEEP WRECKS - LOPHELIA II
GULF OF MEXICO RESEARCH CRUISE 2008

Discussion: From September 2, 2008 to October 17, 2008, SeaVision Marine Services LLC (SeaVision) utilized a Saab-SeaEye Falcon DR remotely-operated vehicle (ROV) to support deepwater research efforts for the referenced NOAA/MMS/USGS cruise. Throughout the cruise, we collected navigation data for the NOAA *R/V Nancy Foster*, the ROV, and the ROV deployment garage (with onboard CTD). The following discussion summarizes the data collection techniques, processing, and datums used for each leg of the cruise.

Cruise Leg 1

Principal Hardware:

Applanix POS/MV Inertially Aided Differential GPS System (provided by NOAA)
- provides base positioning, heading, pitch, roll, and heave corrections

Applied Acoustics EasyTrak Lite Ultra-Short Baseline Tracking System
- offsets measured relative to available ship survey data for vessel
- quoted accuracy = 1% of slant-range (ie, 10 meters per 1000 meters of range)

Principal Software:

Hypack Hydrographic Survey Acquisition and Processing Package
Psi-Plot Scientific Spreadsheet, Plotting, and Processing Software

Horizontal and Vertical Datum:

North American Datum of 1927
Universal Transverse Mercator (UTM) Zone 15/16 (Feet)
- Zone according to location in Gulf of Mexico
- Latitude and Longitude in Navigation Files are WGS-84

Depth Below Sea Level (Meters)

Processing/Smoothing:

1. Processed in Hypack to manually remove spurious data (spikes in elevation, stray points)
2. Exported to text file with date, time, x, y, z, longitude, latitude information
3. Processed in Psi-Plot to smooth navigation data.
    a. Each coordinate type (X-Easting, Y-Northing, Z-Depth) is taken individually. Though a given point in space is actually described by three coordinates, all of the points (and therefore the coordinates) are time-stamped so that piece-wise sampling and smoothing should provide a reasonably accurate representation of the actual ROV track.
    b. A Savitsky-Golay smoothing filter is applied to each coordinate type using a window that surrounds the actual value. The window is measured such that the actual value to be assigned after applying the smoothing is the n-th value, and the window extends from n-10 to n+10.
    c. The Savitsky-Golay filter is a form of polynomial regression that slides the window across the entire raw data set. By applying this type of filter, we can satisfy two assumptions regarding ROV navigation – that the navigation track is generally smooth, and that the track is generally simple. However, using a Savitsky-Golay filter with polynomial regression provides an advantage over traditional averaging algorithms by helping to preserve some local maxima, and minima, which may be real features due to short excursions from a transect track in order to explore or investigate particular features.

Cruise Leg 2

Principal Hardware:

Applanix POS/MV Inertially Aided Differential GPS System (provided by NOAA)
- provides base positioning, heading, pitch, roll, and heave corrections

Applied Acoustics EasyTrak Lite Ultra-Short Baseline Tracking System
- offsets measured relative to available ship survey data for vessel
- quoted accuracy = 1% of slant-range (ie, 10 meters per 1000 meters of range)

Principal Software:

Hypack Hydrographic Survey Acquisition and Processing Package
Psi-Plot Scientific Spreadsheet, Plotting, and Processing Software

Horizontal and Vertical Datum:

North American Datum of 1927
Universal Transverse Mercator (UTM) Zone 15/16 (Feet)
- Zone according to location in Gulf of Mexico
- Latitude and Longitude in Navigation Files are WGS-84

Depth Below Sea Level (Meters)

Processing/Smoothing:

4. Processed in Hypack to manually remove spurious data (spikes in elevation, stray points)
5. Exported to text file with date, time, x, y, z, longitude, latitude information
6. Processed in Psi-Plot to smooth navigation data.
    a. Each coordinate type (X-Easting, Y-Northing, Z-Depth) is taken individually. Though a given point in space is actually described by three coordinates, all of the points (and therefore the coordinates) are time-stamped so that piece-wise sampling and smoothing should provide a reasonably accurate representation of the actual ROV track.
    b. A Savitsky-Golay smoothing filter is applied to each coordinate type using a window that surrounds the actual value. The window is measured such that the actual value to be assigned after applying the smoothing is the n-th value, and the window extends from n-10 to n+10.
    c. The Savitsky-Golay filter is a form of polynomial regression that slides the window across the entire raw data set. By applying this type of filter, we can satisfy two assumptions regarding ROV navigation – that the navigation track is generally smooth, and that the track is generally simple. However, using a Savitsky-Golay filter with polynomial regression provides an advantage over traditional averaging algorithms by helping to preserve some local maxima, and minima, which may be real features due to short excursions from a transect track in order to explore or investigate particular features.

NOTE: For dives SV8, SV9, and SV10 (September 29 and October 1), the USBL system malfunctioned severely. Only navigation data for the vessel has been recorded.

Note on Actual Accuracies

Stated accuracies for USBL systems do not take into account additional errors that may result from inaccuracies in system mounting, latency in heave/pitch/roll observations, excessive ship noise, or excessive ship motions. A conservative estimate for positioning accuracy on Cruise Legs 1 and 2 is likely between 10 and 15 meters. For Cruise Leg 3, accuracy is likely between 5 and 10 meters.

APPENDIX B – OBSERVATION LOG

Table of Contents

Observation Log

21 September 2008 - MC539-SV1

12:13 ROV Dive 1: ROV stopped at 642m; video is going in and out
MLP said USBL on ROV has been off 15-20m than actual depth from the SBE 19+ on garage.

ROV touched bottom-mud suspended in column-touched in center of target

ROV tether failing under pressure, coming up; moving, going to attempt deploy on ledge of target

22 September 2008 - GC140-SV2

9:45 ROV deployed

9:47 ROV in water

10:02 On bottom. 281.5m-USBL, MBeam approx. 271m
Mud bottom-rock rubble in area, marine snow

10:07 Small primnoid on small carbonate

10:09 Several anemones on bottom

10:12 Callogorgia and black coral (284m)

10:23 Yellow crinoids? or soft coral? (282m)

10:25 Sea pen, stalked white anemones, black sea urchin (?), spatangoid (?)

10:28 Fish on bottom
Carbonate nodules/fragments

10:29 Bamboo coral (?)
Gorgonian (white, 40cm high): plexaurid (large calicies)? or paramuncid?

10:30 Tubeworm(?), Yellow sponge
Argentinids (pink)-Argentinia striata?

10:35 Yellow crinoids, stalked white anemones

10:36 Scorpaenid, yellow soft coral

10:37 Hemanthias leptus

10:38 Large school of anthiines (long pelvic fins)-H. leptus?

10:40 Red sea star

10:41 Cerianthid anemone

10:42 Soft coral, pencil urchin

10:43 Cerianthid, scorpaenid (279m)

10:48 Berycidae fish
Carbonate nodules

10:49 Scorpaenid

10:50 Large Callogorgia-primnoid
Primnoid with brittle star

10:58 Small scorpaenids at base of white anemones

11:00 Cerianthids, crinoids, white anemones

11:02 Pencil urchin**,** red starburst corals (Anthomastis sp.)

11:03 Sea Pens

11:04 Scorpaena sp.(tab above eye)

11:06 Hemanthias leptus? (2)

11:13 On bottom-white anemone field

11:19 Cage on bottom- large anemone field

11:21 Carbonate rubble with white anemones

11:23 Scorpaenid next to anemone (279m)

11:24 tube-like structure on bottom (~3in. diameter) (280m)

11:25 large scorpaena sp.
several crinoids in area
carbonate rubble (280m)

11:27 sea pen and primnoid (?)
large brittle star on coral

11:35 moving northward

11:37 C. americana

11:38 Chain catshark (S. retifer) (281m)

11:40 Anthomastis, white anemones (Actinia)

11:41 Sea pens

11:42 Primnoid with brittle stars

11:44 Lizard fish? Bembrops?
Mottled fish on bottom

11:49 Black mantis shrimp
Yellow orange gorgonian collected (sample no. 1)

11:55 Bebryce (?) in bucket

11:58 Deploying marker no. 16

11:59 Gorgonian covered with brittle stars (Astroschema? fleshy, curly arms)

12:06 Catshark (S. retifer)

12:08 Callogorgia specimen collected (sample no. 2)
Starboard side of garage-"A" bin

12:09 Chain catshark
Yellow flat starfish (pentagon star)

12:13 Fly trap anemone (Actinoscyphia), large crab, fields of crinoids

12:23 Large gorgonian with brittle stars and crabs grabbed by manipulator (sample no. 3)

12:31 Sample no. 3 placed in garage bay

12:34 Yellow sea whip (Ellisella?)

12:39 Lid closed on garage bay #1-"A"

12:42 deepbody boarfish (Antigonia capros)

12:57 flying high above bottom finding garage

13:01 garage on bottom

13:02 sea star

13:04 gorgonian

13:09 sea pen (3) : 1 at one location (2 of 3) slightly farther down line

13:10 sea pens (2)
field of seawhips/pens?

13:11 Pencil urchin, brittle star on gorgonian

13:13 fish

13:15 up off bottom

13:16 back on bottom
sea pen, pencil urchin, crinoids

13:18 sea pen

13:20 squid, soft corals

13:21 crinoid, feather coral

13:25 wiggling something in Anthomastus

13:27 scorpion fish(?), sea star

13:31 unknown (soft coral?)

13:32 crinoid

13:33 squid

13:34 sea whip, gorgonian, brittle star, fish

13:35 gorgonian

13:36 fish

13:37 crinoid, seafan

13:39 shrimp?

13:40 pencil urchin, yellow crinoid

13:42 Galatheid, stalked crinoids?

13:43 long-armed pentagon star

13:45 Many yellow (stalked) crinoids, primnoids (Callogorgia)

13:46 Galatheid on rock

13:47 Asteroschema starfish on Calligorgia americana

13:51 Collecting Calligorgia specimen with Asteroschema

14:03 Gephyroberyx darwini

14:09 Stalked crinoids

14:09-14:13 Large white gorgonian, black coral, red commensal crab
white anemones, hydroids, red crab
brotulid?->bythitidae
Large community of organisms associated

14:19 Lanternfish

14:22 Brotulas (Bythitidae) associated with large black coral (3)

14:25 Large brown sacs attached to black coral-egg masses?
attached to large carbonate slab

14:32 Sample of black coral removed for species identification

14:35 Sample placed in garage bay 2-starboard rear

14:37 Removed marker no. FV2 from B bin

14:40 Stalked crinoids common

14:41 P. longispina? Rochinia, Bythitidae? (separate dorsal and anal fins) in view on large black coral
Marker FV2 dropped by large black coral
Scorpaenid: Pantinus longispinus (very elongated dorsal spines 1-3. -2-3x longer than rest of spines, large fleshy tabs over eye)

14:45 Taking still photographs of large black coral colony

14:50 Attempting to sample yellow crinoids-failed.
Flourometra sp?

15:15 Sampling Callogorgia colony-deposited in rear right bay

15:36 Large carbonate slab-sponges on underside of slab.
Assemblage of primnoids and gorgonians on top surface
Bythitidae, another small fish at base of slab-small roughy

15:42 Sampled yellow gorgonian with crab, but crab swam off
Atheroschema *(Asteroschema?)* starfish clinging to gorgonian (bin "C")

15:48 Large group of stalked crinoids (bright yellow)

15:49 Back to large exposed block/boulder of carbonate rock

15:50 Berycid-Gephryoberyx? Bright red, large size

15:52 Collecting primnoid-Callogorgia with thin brown brittle stars (2)

15:58 Placed Callogorgia in bin "C"; Lost brown brittle star from yellow gorgonian. Other brittle star dropped into bin.

16:12 Hermit crab
Moving to south 200'

16:15 Large Callogorgia loaded with brittle stars and Flourometra

16:17 In transit to south, heading 180'

16:18 Deepbody boarfish-Antigonia capros

16:21 Stalked white anemone fields

16:23 lanternfish
white anemones

16:35 Slender sea stars (2)

16:36 Sea stars abundant, few soft corals, corkscrew sea whip

16:38 Orange gorgonian

16:39 Sea stars and sea biscuits

16:42 Large burrow with crab on wall-Tilefish burrow?

16:54 Purple primnoid: feather-like on carbonate rubble

17:21 High relief carbonate slabs (258m)
Gephyroberyx

17:23 Cerianthids
Large carbonate boulders

17:24 basket stars (2), pencil urchins, white stalked anemones

17:26 Large isolated boulders

17:27 Anthias nicholsi (2), yellowfin bass (252m)
Callogorgia with fish

17:29 Very spiny urchin (2)

17:31 Deepbody boarfish (5), yellow gorgonian, cushion star, Gephyroberyx (246m)
Longline

17:35 Deepbody boarfish (3)-Antigonia capros

17:40 Large carbonate ridge
Anthias nicholsi, Hexactinellid, Moray eel (Gymnothorax sp.), Gephyroberyx

17:43 Carbonate plates and a thin layer of rubble

17:45 Chaunax sp. *video clip*

17:52 Back on Chaunax to get video for website. Anatomy of Chaunax? How water pass to opercular opening?

17:59 Scorpionfish
Long, flat slabs of rock-thin carbonate crusts

18:00 Yellowedge grouper, Moray eel

18:02 Large snowy grouper (Epinephelus niveatus), short bigeye, Gephyroberyx

18:04 White glubose sponge
Large pinnacle rock-good fish habitat

18:05 Anthias nicholsi (227m)
Thin tan carbonate crusts
Very interesting carbonate hard grounds
Cone-spined urchins common on crest of feature (228m)

18:12 Light coat of silt on crusts, possibly due to hurricane Gustav, Edward, Ike

18:14 "Pillow" shaped in cross section at crest of slabs

18:15 Crest of feature almost completely lacking soft corals

18:18 Large crab

18:55 Thin carbonate bottom over mostly mud
Crimson rover? (Erythrocles monodi) near tube anemomes
Field of white anemones

19:24 Returned to garage-recovery started

23 September 2008

GB201-SV3

8:45 On bottom; depth approx. 525m

8:50 Mud bottom, long "brush" corals

8:57 Carbonate rubble, possibly black corals

8:59 Black "brush" corals, small fish
Carbonate rubble
Rattail (Macrouridae)

9:01 black "brush" coral?

9:03 Scorpionfish
Mostly mud bottom, carbonate rubble sparse

9:10 Looking for garage

9:15 Back on bottom, mud bottom

9:16 Carbonate rubble

9:19 Still transecting along mainly mud bottom
none to little attached fauna

9:21 ROV having DP troubles

9:24 Mostly mud bottom- sparse patches of carbonate rubble
little to none attached fauna

9:26 midwater fish (520m)
depression/crater

9:30 Carbonate rubble, few larger slabs

9:48 Mainly mud bottom, sparse carbonate rubble (500m)
zoarcidae?

9:49 Tube-like structures

9:50 glass bottle (garbage)

9:52 Giant isopod (Bathynomus giganteus) in burrow
Cerianthid anemones

9:55 Rochinia spider crabs
Cerianthids

10:02 Mud bottom

10:12 Luidia starfish? Fine mud bottom
Scorpaenidae

10:21 Setarches scorpionfish (brick red)

10:28 Carbonate rock with Actinia anemones (white)
Brachyura crabs with striped legs

10:30 Royal red shrimp

10:31 Stomiid-Gonostoma?

10:32 Urchin or cerianthid

10:42 Seepage and bacterial mat with bubbles

10:45 Gas hydrate mound with small tubeworms and subsurface oil

10:49 Small mound with tubeworms

11:06 Flatfish (light grey with white spots)

11:13 Mantis shrimp

11:16 Mantis shrimp

11:18 Sea star

11:19 Onid. fish with black sports on forked tail

11:29 Small skate

11:32 Ratfish (3)

11:36 Bacterial mat, burrows

11:40 small stalk with zoanthids

11:42 Large demersal fish (2) (gray)

12:03 Large antipatharian (Leiopathes sp?)

12:05 Helicolenus? One under black coral, one on large rock slab

12:19 Callogorgia colonies on carbonate slabs

12:28 Large fish- Aulopus? (benthic, long, slender)

12:33 Messing with garage

12:52 Done messing with garage

12:58 Corals, field of anemones, urchin, brittle stars

12:59 Callogorgia with brittle stars; more anemones

13:00 Chain catshark

13:01 fish, sponge, urchin, Callogorgia colony with Asteroschema

13:07 Actinia

13:11 fish

13:13 Axiidae

13:18 fish

13:24 ratfish (might actually be a rattail if also Nezumia sp.)

13:26 sea whip

13:29 rattails (2) (Nezumia sp.) *Changed from ratfish*

13:43 fish (Bembrops or Aulopus?)

13:44 beard fish, sea star

13:48 Bembrops or Aulopus

13:49 Bembrops or Aulopus

13:50 Anemone (Actinia)
sea star (Asteropectinidae?)

13:54 fish

13:55 fish (2) + (1)

13:56 crater

14:01 Callogorgia with Asteroschema, Actinia, and crab

14:04 Pockmarks

14:06 Actinia anemones on a rock

14:07 Chloropthalmid? Greenage Parasudis?

14:11 Bembrops? (arched back, flat head, forked tail, mottled body)

14:25 Chloropthalmid, mid water fish on/near bottom

14:54 Off bottom

15:00 On bottom, 350m, bearing 115'

15:01 Bacterial mats in complex topography

15:03 Very large burrows/holes

15:05 Mantis shrimp, mud bottom

15:16 Sponge

15:17 Actinia anemone cluster

15:18 Callogorgia

15:19 Gephyroberyx (6), Helicolenus dactylopterus (?) under rock
Isolated section of exposed carbonate slabs with undercuts
Bathynectes

15:37 Bembrops?

15:38 Unidentified fish

15:40 Carbonate nodules? Large group -2-3 inches diameter
Large basket star

15:44 Small starfish

15:47 Bembrops?

15:50 Burrows and mounds in mud
Unidentified fish-not bembrops-no mottling

16:08 Stichopathes

16:14 Carbonate nodules, sea pens, Bembrops

16:17 Hovering fish, just above bottom

16:19 Pockmark field with pink fish-Pristipomoides

16:22 Long-armed pentagon star

16:23 Beardfish (Polymixia)
Large pock marks

16:24 Large carbonates with mud veneer

16:27 Large gas pock marks

16:30 Mud vents? Mounded topography

16:33 Red dory?

16:34 Mounded topography

16:37 Sea star (2)

16:44 Mantis shrimp (328m)

16:47 mounded topography

16:57 mud

17:00 pockmarks (small)

17:01 squid

17:02 field of pockmarks (shallow)

17:05 deep hole/burrow (~1m diam)

17:08 shrimp
more shallow pockmarks

17:13 large star fish

17:15 move shallow pockmarks

17:30 Stichopathes

17:32 Gorgonian, basket star, sea star

17:35 Angel shark

17:36 Basket star

17:38 Skate

17:52 Stalked crinoids

26 September 2008 - GC246-SV4

8:05 ROV in water

8:40 Dive aborted-Lost video signal and telemetry

26 September 2008 - GC234-SV5

12:44 ROV in water

13:04 400m-midwater fishes in water column-lanternfish?

13:12 On bottom (525m)
Squid, midwater fish, lanternfish
Muddy bottom, no carbonates

13:15 Squid off bottom

13:16 Tube anemone (dark center, pale outer rim and tentacles)

13:19 Lanternfish-midwater

13:21 Midwater fish-stomis?

13:22 Large anemone

13:23 Large silver midwater fish-tubeye?

13:25 Pockmarks? Multiple pits

13:30 Jelly fish above bottom

13:35 Cerianthid

13:39 Urophycis floridana (3) (or U. earlli or U. cirrata?)

13:42 Close up of Urophycis (good close up video)

13:51 Tinselfish (Grammicolepis)

13:55 Lophelia, Callogorgia, and Astroschema

13:59 Bacterial mats
Gephyroberyx? (2) and Lophelia matrix (dead)

14:03 Euminida picta

14:06 Tubeworms, primnoids, and Lophelia all in area

14:07 Small section of live Lophelia
Tinselfish (Grammicolepis)

14:08 Euminida picta (2) on sediment

14:10 Tinselfish (Grammicolepis)

14:11 Callagorgia, tinselfish; Asteroschema on Callogorgia

14:28 Many rocks, Hoplostethus sp. (many), Gephryoberyx?

14:32 Conger? Hiding in rocks

14:35 Grammicolepis

14:36 Conger oceanicus

14:41 Large school of Hoplostethus around dead Lophelia

14:54 Lone Hoplostethus

14:57 Bacterial mats
gas bubbles emitted

15:03 Cauliodis? (midwater, silvery fish)
Chaetognath in frame

15:10 Tinselfish and Laemonema (L. goodebeanorum, not L. melanurom?)

15:13 Chaunax, cerianthid

15:23 Bacterial mats, Euminida, Urophycis

15:32 ratfish and small white gorgonians (Paragorgia)

15:35 carbonate outcrop- Callogorgia

15:39 Maroon topped anemones with white stalk
Variety of soft corals, including Callogorgia

15:43 Ratfish, Callogorgia collected

15:45 Sampled placed in box "C"

15:48 Marker no. 9 placed on seafloor near Callogorgia site

15:53 Blackbelly rose fish and white soft coral

16:01 White coral collected

16:03 Sample placed in bin "C"

16:15 Photo taken of white double stalk gorgonian (Paragorgia)

16:22 Bathynectas longispinus among soft corals

16:24 Clump of sargassum laying on bottom

16:36 Soft bottom topography

17:23 Large rock with sponges, soft corals, Blackbelly rose fish underneath rock

17:24 Euminida picta

17:25 Lophelia around large sponge

17:32 Old mussel and clam shells
Lucinid or vesicomyid clam middens with carbonate slabs on top

17:35 Roughie
Urophycis (U. cirrata?)- had opercula spot

17:37 Fly trap anemone and Euminida picta

18:00 Nezumia aequalis?

18:02 Peristedion sp.

18:10 Pancake batfish (Dibranchus?)

18:20 Giant isopod-Bathynomus

18:32 ROV dive completed (505m)

27 September 2008 - GC140-SV6

8:32 On bottom-carbonate rubble (233m)
Cerianthids, spiky urchins

8:38 Urchins are dominant fauna in area
2 different species: one pencil and one long spiked urchin

8:39 Soft coral and Antigonia
Mostly mud and sparse carbonate rubble

8:42 Numerous long spined urchins
sea biscuits

8:46 larger carbonate and rubble pieces
scorpaenid

8:48 less carbonate rubble

8:49 Venus flytrap anemone

8:50 snowy grouper next to large carbonate boulder
urchin

8:54 bare mud-small carbonate rubble pieces sparsely distributed
barrelfish (H. perciformis)

8:55 soft coral

8:57 large carbonate boulder-high relief (23m tall)

8:58 Cerianthids

8:59 high profile: 2-3m boulders with crinoids attached
anthiines, sponges, hydroids on boulders

9:00 cable/line on sea floor over large high profile boulders (garbage)

9:01 high profile boulders-3m tall with crinoids attached

9:02 Antigonia, Gephyroberyx hiding under rock ledge
Large sponge

9:05 determining where the garage is

9:13 abundant crinoids in rock outcrops of moderate relief (1m)
Gephyroberyx, sea stars, searobin?

9:14 Carbonate rubble; 3-4m vertical relieg outcrop
sponges and numerous crinoids attached; gephyroberyx
Rock ledge? Hoplostethus?

9:16 carbonate rubble, anthimes

9:20 Antigonia

9:21 cool brittle stars (black with barred arms)

9:23 conger eel swimming out in open
very large rock/boulder/outcrop
Gephyroberyx (2)

9:24 gorgonians and sponge attached to top of large rock
Antigonia aggreations
numerous moderate to high profile rock outcrops with sparsely attached fauna

9:26 Serraniin?
Black/black-barred brittle stars abundant under

9:29 carbonate rubble on mostly mud bottom

9:31 barrelfish, Cerianthids common
high profile (4-5m) rock outcrop, sparse fauna attached

9:32 large boulders, two basket stars

9:36 banded brittle stars, whip corals, basket stars
huge boulders

9:38 massive carbonates and slabs

9:39 white sea fans

9:43 large carbonate blocks, sea whips

9:51 barrelfish, more crimson rover? cf. Shulzea beta?
photos taken earlier in dive

9:57 large boulders and Antigonia; fields of Actinia anemones

9:59 small flounder, small crinoids, and basket star

10:03 Actinia and greeneye (Chlorophthalmus)

10:05 small flounder
large wire cable (3" in diameter)

10:08 White sea plume

10:09 Hemanthias leptus

10:15 white gorgonian

10:23 stalked crinoids

10:29 Bembrops

10:30 White gorgonian

10:33 mostly mud, sparse rubble

10:34 Gorgonian, Callogorgia with brittle stars

10:50 Carbonate blocks, soft corals, large Anthias?
Small Anthias nicholsi

10:58 Huge black coral
Antipatharian with yellowfin bass (Anthias) (4-5 among Bianeles)
Piece of black coral collected-bin "C"

11:03 snowy grouper (2) at base of rock

11:28 bamboo coral, large rock with high profile
brittle stars, shark egg case

11:32 Collected orange gorgonian colony- bin "C"
previously placed marker from bin C on sea floor near collections of soft corals

11:38 dropped small gorgonian sample on bottom

11:40 retrieved small sample of white soft coral

11:44 two snowy grouper

11:45 diversity of soft corals on carbonates
lizard fish(?), Antigonia capros

11:47 Lots of primnoids

11:50 Large black coral with big school of gephyroberyx (~20)

11:51 Large black coral with yellowfin bass

11:55 Snowy grouper under ledges

11:57 ~30 Gephyroberyx-large aggregation
Barrelfish, Antigonia, Primnoids, Callogorgia, Sea Whips on carbonate blocks

12:01 2 snowy groupers

12:19 collected soft coral sample released

12:25 collected subsample of soft coral colony

12:27 sampled deposited in bin "C"

12:32 collecting bamboo coral (Isididae)-dropped in bin "C"

12:49 bamboo coral dropped into bin "B"

12:54 off bottom

12:57 ROV out over soft bottom

12:59 Gephyroberyx, Anthias, bamboo corals on large carbonate slab

13:01 small brine seep outflow
Bamboo corals and black corals

13:07 Bamboo corals and white gorgonians

13:10 Soft bottom with bamboo corals and black corals

13:17 Giant cautilevered carbonate slab
Ellisella barbadensis
Tenacetipathes (bottle brush coral, charcoal color)

13:21 Barrelfish (lunate pectoral fins)

13:34 Hermit crab

13:35 Goldline tilefish? Blueline
Callogorgia and carbonate rocks
Large antipatharians-Leiopathes on large carbonate block

13:41 Anthimastis-red colonal anemones
Alcyonacean: true soft coral

13:48 Callogorgia on large carbonate slab

13:52 Assorted black corals on carbonate blocks and rubble

14:02 Large bamboo coral

14:30 Carbonate rubble and small blocks

14:31 Bushy black corals-Leiopathes

14:33 Gephyroberyx

14:37 Back over soft mud bottom

14:44 Ostrich plume black coral, mud bottom

14:45 Mud bottom-occasional bamboo corals

14:55 Pentagon starfish on mud bottom

15:03 Tilefish (Lopholatilus chamaeleonticeps) and Gephyroberyx

15:09 Large rock with variety of soft corals

15:11 bamboo coral

15:23 large rock outcrop 20-25' relief
Gephyroberyx

15:27 Large rock outcrops

15:35 Large carbonate blocks

15:40 Large carbonate slab

15:44 Rocks heavily silted, then out over mud bottom

15:48 Large carbonate boulders

15:52 First of three large solitary rock outcrops (~20' in profile)
Few fish or solitary corals

15:55 Great view of diverse carbonate morphology

16:00 ROV returning to surface. End of dive; too dangerous

28 September 2008 - EW1009-SV7

17:31 ROV in water-No depth, USBL, or compass

17:46 Still on descent in the black

17:54 Seeps on soft bottom-Beggiatoa-mud bottom
umbilical wrapped around itself above garage-very short tether available for transit away from garage

18:01 ROV on bottom-mud with seep areas and white bacteria

18:05 Pink cucumber and rattail
dead crab with a large claw

18:08 Urophycis sp.
Chimaera (ratfish)

18:12 Urophycis sp.

18:13 Mud bottom

18:26 Dive terminated due to darkness approaching and short in LED light array

29 September 2008 - MC751-SV8

10:30 In water-water column very clear

10:39 Lost ambient light, no depth overlay

10:59 Temperature logger dropped out of bin but still connected with cable tie

11:00 ROV on bottom
Soft bottom, few soft corals

11:04 Fishtail (Urophycis?)
Slicks visible on surface from vessel-oil seeps

11:07 Fly trap anemone

11:08 Urophycis? Goodebeanorum?

11:10 Dead Lophelia rubble?

11:11 Midwater fish-sculling lower caudal lobe

11:14 Brisingid starfish
Murioea-Red

11:15 Carbonate outcrops
dead Lophelia; many gorgonians

11:16 Dead Lophelia clump with inverts on top
Large soft coral (pink, very large polyps)

11:19 Live Lophelia cluster

11:20 Eumunida picta in Lophelia bunches

11:22 strong bottom currents

11:29 looking for garage

11:45 Lophelia colonies

11:49 500m

11:53 repositioning ROV

11:55 Off Lophelia

11:57 some rubble

11:58 Living Lophelia (small colony)
ROV set down

12:02 Lophelia in the claw (deposit?)

12:10 Attempting to close lid

12:22 Large flabellate Paragorgia and Callogorgia

12:27 Overhead and gorgonians

12:32 Large sea fan, white

12:36 Brittlestars actively feeding

12:38 Hake in burrow, flytrap anemone, Urophycis

12:44 Carbonate outcrops with extensive soft corals, blackbelly rose fish

12:54 great gorgonian site

12:57 Lophelia

13:01 Blackbelly rose fish, gorgonians

13:19 midwater

13:20 Lophelia and gorgonians, Paragorgia

13:24 Pyrosoma attached to anemone

13:29 Basket stars, red antipatharians (Leiopathes), live Lophelia

13:30 Polyps extended on Lophelia, still photo taken

13:33 Callogorgia on rocky ridge

13:36 Pyrosome

13:37 Large carbonate block
Lophelia colony, large tube worm aggregates, Eumunida on Lophelia
bacterial mats and active seep areas

13:40 Small Lophelia colonies on fringe of rock?
Tubeworms abundant on edge of carbonate rock, evidence of seep activity on mud

13:44 Chaceon fenneri (Golden crab)
Tubeworms covered by Beggiatoa
Small colonies of Lophelia on fringe

13:50 Pyrosome over sand

13:53 Brisingid starfish on field of dead coral

13:58 Giant isopod in burrow

14:00 Urophycis/Laemonema
Flytrap anemones

14:03 Callogorgia sp. with Asteroschema and E. picta

14:04 tubeworms; slimehead anemones

14:06 Lophelia, Callogorgia with Asteroschema

14:07 some type of coral with urchin, some echinoderm

14:09 sea star

14:10 Lophelia, Callogorgia, Asteroschema, Euminda picta
ledge of Lophelia on them
tubeworms and chinostycids

14:12 tubeworms with crabs (E. picta), huge mats, Lophelia

14:15 sea star, Lophelia, Callogorgia with associated fauna

14:17 close up of Lophelia with E. picta and urchin
tubeworm mats in background

14:20 E. picta, tubeworms

14:21 Lophelia, E. picta

14:22 Callogorgia on large mound, E. picta, Lophelia, fly trap anemone

14:25 fish

14:28 Venus flytrap anemones, corals, sponges

14:29 dead coral, tubeworms

14:30 fish, Callogorgia, Conger eels

14:31 Laemonema fish

14:32 tubeworms, flytrap anemones

14:33 bubblegum coral, Callogorgia

14:34 soft coral, "bubblegum", Paragorgia (white)

14:35 pencil urchin, live Lophelia mixed with dead coral

14:36 E. picta

14:38 Soft coral
Ruffled brown sponge, Callogorgia

14:49 Callogorgia (large colony), brittle stars, E. picta, white soft coral

14:40 Pencil urchin, brittle stars, Lophelia, Callogorgia

14:42 E. picta, spider crab, Paragorgia

14:43 tubeworms, large mound with some Lophelia

14:44 paramuricidae

14:45 fish, anemones

15:23 sea star

15:27 anemone

15:28 anemone

15:29 anemone

15:30 anemone

15:33 sea star

15:34 urchin

15:35 venus flytrap anemone on coral, clams, tubeworms, plentiful bacterial mats, sea star

15:36 Hard coral, Venus fly trap anemone, fish, Callogorgia

15:40 soft coral, tubeworms, anemones

15:42 solitary tubeworms

15:44 Lophelia, mostly dead, some living
Bamboo coral and variety of pink soft coral

15:45 Large crab

15:46 red crabs, very large Callogorgia, Hyphogorgia, Muricedes

15:48 3 crabs

15:50 hake, dead Lophelia, Gephryroberyx, Thesea, crab, barnacles all on big Thesea

15:53 dead Lophelia, E. picta

15:54 E. picta

15:55 dead Lophelia

15:57 Lophelia, eel, anemones, unknown white coral and Thesea (?)

16:00 spiny urchin

16:01 sea star

16:02 unknown white coral and Thesea?

16:03 dead Lophelia, with unknown pink/orange coral growing on it

16:04 E. picta, brittle star, large sponge

16:06 same mound as earlier (15:50)

16:07 sea cucumber

16:09 Venus flytrap anemone

16:13 anemones, orange coral

16:14 Callogorgia

16:16 Hake

16:19 anemone

16:22 Lophelia in soft sediment

16:28 crabs

16:37 tubeworms, flytrap anemone

16:38 flytrap anemone

16:42 tubeworms

16:46 soft sediment, flytraps

16:49 tubeworms, cerianthids

16:58 white bacterial mats on soft sediment

16:59 Sparse tubeworms in soft sediment

17:00 sea star, tubeworms in sediment, with blotchy white bacterial mats

17:01 large black hole with two burrows inside, covered in white bacteria mat

17:14 lone tubeworm on soft sediment with bacterial mats, venus fly trap anemones

17:19 two tubeworms on soft sediment

17:21 **m**antis shrimp, white bacterial mats

17:22 white sponges, fly trap anemone, Rochinia

17:23 venus flytrap anemone

17:24 tubeworms in soft sediment

17:25 Peristedion

17:26 tubeworms in soft sediment, large shrimp

17:28 fish burrow

17:29 small boulders, tubeworms, zoanthids

17:34 tall tubeworms

17:38 mantis shrimp

17:39 tubeworm bush (small)

17:42 seastar, blackbelly rose fish

17:43 Acesta clams, tubeworms (large aggregation)

17:56 Mud bottom

17:57 Bacterial mat

18:00 Actinia

18:01 Peristedion-armored sea robin

18:02 Swimming shrimp

18:05 Mantis shrimp

18:08 Soft bottom, patchy tubeworms

18:11 Isolated tubeworms?

18:14 shrimp

18:18 sea anemones

18:19 colonial sea anemones

18:21 sea anemones in bunches

18:22 soft corals, fish

18:23 orange fish

18:25 fish

18:26 shrimp

18:27 tubeworms

18:28 fish, Chaunax

18:30 rat tail fish, Nezumia abuonalis

18:35 ROV coming up

1 October 2008 - VK906-SV9

8:05 ROV in water

8:10 School of sharks on descent

8:31 midwater fish-paralepid

8:32 on bottom

8:33 squid

8:34 mud bottom

8:35 fish- rattails

8:37 fish- rattails

8:38 hake in burrow (making the burrow?)

8:39 Anemones, carbonate block with E. picta and actinia

8:40 Barrel fish, antipatharian

8:43 Anemones

8:44 crab, bamboo coral, Gephyroberyx, anemones

8:45 Purmecid? barnacles, brittle stars

8:46 Many anemones

8:47 Hoplostethus, stomiids

8:51 anemones

8:52 sponges and anemones (actinia, venus flytrap) on carbonate

8:53 Antipatharian also on carbonate, crinoids

8:56 Haplostethus, brotula (fish)

9:00 Bamboo corals around base of carbonate black with Actinia attached to the top of carbonate
Blackbelly rosefish

9:02 mud bottom

9:09 shrimp

9:10 anemones, gorgonian

9:11 squid, anemones and bamboo coral

9:12 shrimp, anemones

9:13 blackbelly rosefish, field of bamboo corals
carbonate outcrop with Actinia

9:14 beryx? (splendens), gorgonian, bamboo corals, and anemones all on carbonate outcrop

9:16 brisingid

9:17 large antipatharian colonies, bamboo corals

9:18 gorgonian

9:21 Bamboo corals, pencil urchin, anemones

9:23 Heading back to garage and coming back up- LED light out

1 October 2008 - VK906-SV10

12:05 In the water

12:10 School of blacktip sharks (~70m)- Carcharhinus limbatu

12:15 Bill Shedd chums for sharks

12:18 Blacktips don't eat cantaloupe

12:26 Descending

12:33 ROV on bottom, squid (380m)

12:36 Squid, very dark (x2), Paralepidid

12:42 Another dark squid

12:43 Shrimp, fish in burrow

12:47 Squid again

12:59 Mud bottom

13:01 bamboo corals on big rock

13:02 anemones, Brisingid sea star

13:19 Actinia and bamboo coral, orange gorgonian, Callogorgia

13:27 Golden crab? darts into burrow

13:29 Phycis/Urophycis

13:47 Phycis in pit

13:51 Squid on bottom
Large oblong burrow

13:55 Pancake batfish? Dibranchus? Left side of screen

13:59 Actinia, flytrap anemone, Hoplostethus, carbonate outcrops, barrelfish, Muriceides furta (Orange gorgonian), school of barrelfish, Gephyroberyx, large carbonate boulders

14:10 Huge Leiopathes colony, barrelfish, diverse soft coral assemblage, actinia, small brown anemone in mud, gephyroberyx, large school of barrelfish, Pogonophoran tube worms (always on soft sediments), black tubes and small plumes

14:33 Longline
Actinaria and other invertebrates

14:35 Longline with Actinaria attached, crab

14:37 Chlorophthalmus
gas seep area

14:38 Small carbonate blocks
Actinia, large blackbelly rose fish, Urophycis?

14:40 More longline

14:45 Fly trap anemones, Actinia, anthozoans-colonial brown anemones, Hoplostethus

14:50 Marluccius? barred pattern on soft sediment

14:53 Actinia on carbonate debris
Orange octoral- Scleracis?
Blackbelly rosefish, bamboo corals, and Gephyroberyx

14:57 Pencil urchin, soft bottom

15:00 Large forest of bamboo coral, Hoplostethus on carbonate slabs

15:13 Large field of Actinia, covered with soft sediments

15:27 Large field of Actinia, carbonate slabs
Black coral, flytrap anemone, Bythitidae, Euminda

15:31 Vast fields of Actinia; bamboo corals, blackbelly rosefish

15:35 Conger eel, Brisingid starfish, blackbelly rosefish (2), large hake

15:38 Off edge of feature, back over soft sediments

15:40 Another large field of Actinia; roughies, bamboo corals, Euminida picta, flytrap anemones
Carbonate boulders

15:45 Carbonate rubble, Euminda, Actinia

15:48 Large Leiopathes, Actinia

15:50 Urophycis, flytrap anemone
Bamboo corals with white clumps (small basket stars?)

16:02 Nettostomatid eel?

16:07 Conger oceanicus?

16:09 Roughies, field of Actinia

16:11 Leiopathes with fly trap anemone
Blackbelly rosefish, barrelfish, red gorgonians

16:21 Zeiidae-Dory over soft bottom

16:22 Large carbonate boulder
Hoplostehus, huge Leiopathes, Actinia, flytrap anemone, Euminda (eating squid)
Small clump of Lophelia, conger eel

16:32 Cerianthids, squid

16:44 Small tubeworms?

16:48 Shrimp

16:49 Squid (2)

16:50 Pencil urchin, anemones

16:51 Small carbonate mound with bamboo corals
Antipatharian on small carbonate mound

16:52 Crinoid and lots of anemones, some fish

16:53 Blackbelly rosefish, bamboo coral, tubeworm

17:01 Fish and Actinia

17:05 Actinia

17:06 Anemone (Cerianthus?), Shrimp

17:07 Small fish

17:08 Sea anemone

17:10 More anemones, sea fan (white) on carbonate block

17:11 Many Actinia and small Lophelia?

17:14 Shrimp, crab

17:15 small fish

17:16 fish

17:19 Actinia

17:20 small fish

17:28 chumming for sharks

17:32 back to large rock with Lophelia

17:54 Collected branch of Leiopathes

17:59 Jaws stuck in closed position, placed in bin "A"

18:00 black coral in the box

18:04 Back at the rock (second black coral sample)

18:23 Drop Marker no. 9

18:24 Bamboo coral sample

18:29 Group of Barrelfish

18:30 Sampling Lophelia

18:34 Deposit Lophelia in box A (?)

18:40 Attempting second sample

18:42 More barrelfish

18:47 Back at the rock

18:54 Another (?) sample

18:56 More antipatharian in box (Leiopathes presumably)

19:10 Field of actinia; Trachyscorpia cristulata, bamboo corals, Hoplostethus, Blackbelly rosefish
Carbonate slabs

19:13 Phycid hake, field of Actinia, bamboo corals, red Leiopathes sp.

19:15 Flatfish, Trachyscorpia cristulata, Actinia, Barrelfish, Red Leiopathes
carbonate rubble

19:16 Bamboo coral, Red Leiopathes

19:17 Mud bottom

19:22 Red Leiopathes, Large colony of white(?) Leiopathes, Blackbelly rosefish, Hoplostethus school around black coral

19:24 Barrelfish, Actinia, attached carbonate rubble

19:25 Bamboo corals

19:26 Mud bottom

19:28 Laemonema

19:32 Laemonema sp., Nezumia sp.

19:34 Gadiform?

19:36 Phycid hake

19:38 Large hake- Phycis? Urophycis?

19:39 Rattail (Nezuma sp.), Batfish (Dibranchus?)

19:40 Shrimp with long antennae

19:47 Flatfish

19:49 Laemonema sp.

19:51 Pencil urchin

19:53 Shrimp, Laemonema sp., Red Leiopathes with galatheid, carbonate rubble, venus flytrap anemone

19:57 Specimen collection- Red Leiopathes

20:03 Large carbonate outcrop with Actinia attached and a few fly trap anemones

20:05 Laemonema sp., carbonate outcrop, mud, cerianthid, field of Actinia on carbonate rubble

20:06 Pencil urchins

20:08 Nezumia sp., pencil urchins, large (high profile~2m) outcrop covered with flytrap anemones, sponges, actinia, large Leiopathes, aggregate of Hoplostethus, Conger oceanicus

20:10 Great footage of Leiopathes, gooseneck barnacles, galatheoids in coral

20:11 Mud habitat, pencil urchins, Nezumia sp., Actinia on carbonate rubble, Laemonema sp., Red Leiopathes, Large colony of (white) Leiopathes (~1m across and split in the middle)

20:14 Carbonate rubble, carbonate blocks, actinia abundant, cerianthid

20:15 Large (~1m across) colony of Leiopathes (white), pencil urchins, Nezumia sp.

20:18 Hoplostethus?

20:19 High profile carbonate outcrop (~2-3m)
E. picta, flytrap anemones, actinia attached, massive Leiopathes (white) colony (>1m across)

20:20 Mud bottom

20:21 Pencil urchins

20:27 Carbonate mound with flytrap anemones
Beryx decadactylus

20:28 Barrelfish (huge school)

20:31 Antipatharian

20:39 Pencil urchins, carbonate rubble

20:39 Cerianthid, rattail

20:41 Blackbelly rose fish (2)

20:44 shrimp

20:46 Pencil urchin

20:52 Scleracis sp.

20:55 Axiid (lobster), blackbelly rose fish, pencil urchins

20:56 Duckbill eel

20:57 Rattail fish

21:00 Blackbelly rose fish

21:01 Crab, fly tray anemone, Actinia

21:03 Antipatharian (2 different species)

21:04 Cerianthid, more Actinia

21:07 Longline on bottom
Duckbill eel-Nettostoma

21:14 Lophelia (small amount of small colonies)

21:21 Old longline, encrusted with invertebrates

21:23 Small colonies of Lophelia

21:38 Lophelia sample in Bin “B”, lid closed

21:39 End of dive-ROV coming back to surface