CENTER FOR MARINE RESOURCES AND ENVIRONMENTAL TECHNOLOGY and SEABED TECHNOLOGY REASERCH CENTER UNIVERSITY OF MISSISSIPPI

Activities Report for Cruise GOM2-06-MC118 aboard the *R/V Pelican*
DeepSee Drift Camera Reconnaissance
Mississippi Canyon Federal Lease Block 118
Northern Gulf of Mexico
March 24-28, 2006

By
Ken Sleeper[1], Paul Higley[2], and Karen Lloyd[3]

[1]Seabed Technology Research Center
University of Mississippi
University, MS 38677

[2]Specialty Devices, Inc.
2905 Capital Street
Wylie, TX 75098

[3]Department of Marine Sciences
University of North Carolina, Chapel Hill
Chapel Hill, NC 27599

PARTICIPANTS

University of Mississippi: Center for Marine Resources and Environmental Technology (CMRET) and Seabed Technology Research Center (STRC):

Project Management Team: Bob Woolsey, Ken Sleeper and Leonardo Macelloni.
Technical Team: Brian Noakes and Andy Gossett.
TASKS: 1) Direct reconnaissance at MC118,
2) Video up-load and storage, and
3) Deployment and recovery of the DeepSee drift camera system.

Specialty Devices, Inc.

Technical Team: Paul Higley and Scott Sharp
TASKS: 1) Design and construction of the DeepSee drift camera system,
2) Design and lay-out of electronics system for video recovery,
3) Over-seeing of instrument and electronics setup and operations.

University of North Carolina, Chapel Hill:

Scientific Team: Karen Lloyd
TASKS: Recovery of sediment samples for microbiological analysis.

R/V Pelican Crew:

Craig LeBouef, Captain; Joe Thomas, First Mate; Jack Pennington, Chief Engineer; Ross Turlington, Science Technician; Sam Labuf, Assistance Engineer; and Steve Joltki, Cook.

INTRODUCTION

A scientific research cruise was undertaken to Mississippi Canyon Federal Lease Block 118 (Fig. 1) from March 24-28, 2006, aboard the *R/V Pelican*. This was the third Consortium cruise following the devastating effects of Hurricane Katrina including disruption of all marine operations in the Gulf of Mexico. A major loss to the program was the use of the *R/V Ocean Quest*, which left the Gulf region primarily due to damage of the port facilities at Gulfport, MS where it was being renovated. The first task planned for the *Ocean Quest's* manned submersibles was to conduct a visual survey of the site. This cruise, dubbed the DeepSee, was designed specifically to address this first task. The concept of using a drift camera for site reconnaissance was presented to the Consortium by Ian McDonald, Texas A&M at Corpus Christi, in November, 2005. The DeepSee utilizes a drift camera system to image the sea floor in real time. The system is particularly attractive as it does not require a vessel with dynamic positioning; such vessels have been in extremely high demand in the wake of storm damage. Specific objectives for this cruise were developed and are presented below:

1. Equip and utilize the multi-purpose cable for concurrent lifting and fiber optic transmission.
2. Advance the development of the Station Service Device, a light tethered, hybrid ROV vehicle specifically designed for the installation and continued operation of the Seafloor Observatory.
3. Design and deploy a system to conduct visual reconnaissance of the sea floor in the area of the three vents identified at the site in 2002 by Sassen and Roberts, and
4. Utilize the real time video stream to identify areas of interest and attempt to sample these areas.

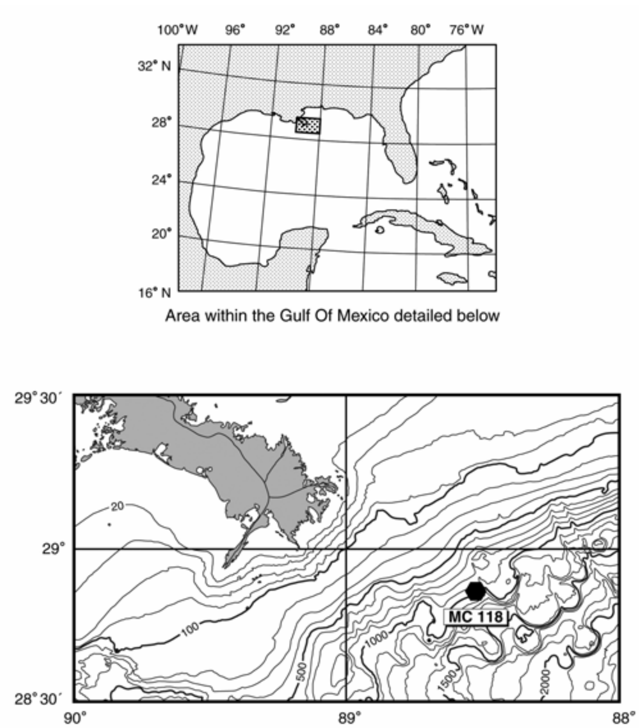

Figure 1. Location of Mississippi Canyon Federal Lease Block 118.

BACKGROUND and FUNDING

In 1999 CMRET took the lead role in establishing the Gulf of Mexico Hydrates Research Consortium. The Consortium has as its primary objective the emplacement of a permanent seafloor station designed to monitor the activities of the gas hydrate stability zone, including the seafloor, the shallow sub-seafloor, and the near-water column. Research efforts of the Consortium are jointly supported by the Department of the Interior's Minerals Management Service (MMS), the Department of Energy's National Energy Technology Laboratory (DoE/NETL), and NOAA's National Institute for Undersea Science and Technology, Seabed Technology Research Center (NIUST/STRC). Funding for ship time for this cruise was provided by MMS. Components for the DeepSee drift camera system, including the multi-purpose cable, were funded by NOAA/NIUST. The structural frame constructed to mount the system was funded by MMS.

In the fall of 2004, Mississippi Canyon Block 118 was selected as the site for the Monitoring Station – Sea Floor Observatory. The first phase of Observatory installation was conducted in May, 2005, and consisted primarily of the deployment of two autonomous seafloor probes. More details of the installation are provided in the GOM2-05-MC118 cruise report. The second phase was disrupted by the severe 2005 hurricane season in the Gulf. Second phase activities are scheduled to resume in the summer of 2006 with two cruises currently scheduled, one of which will utilize the Johnson Sea Link manned submersible.

MULTI-PURPOSE CABLE

In early March, the new multi-purpose cable was tension-wound on a removable spool on the *R/V Pelican*. This cable is intended to provide Station Service Device (hybrid ROV), Deep Receiver geophysical and seafloor Sled capabilities. The cable has a 12,000 pound working load and is triple armored with a coaxial electrical pair and a central, single mode, single fiber optic conductor. The design of the cable will provide heavy lifting, command and control, and data recovery functions of the Station Service Device.

A day was required to add fiber-optic capability to the multipurpose cable. Adding this capability required opening the pressure-compensated electrical termination and splicing the fiber-optic cable to a bulkhead fiber-optic underwater connector. The top-side cable termination was also spliced through a slip ring installed on the trawl winch. A very low loss of 2 db was measured through the 3000 meters of cable and across both sets of optical splice terminations.

DEEPSEE SYSTEM

A deep ocean video inspection framework was built for this cruise (Fig. 2). The main communications and control computer system from the presently under-design Station Service Device (Fig. 3) was incorporated in the DeepSee to utilize the fiber-optic capabilities of the armored cable on the winch. This provided a command and control capability for two-way, multiple channel, high data rate communications over the fiber in this cable. A shipboard computer and software program controls acquisition of multiple video channels, Ethernet communications, multiple serial channels and high speed back link between the Station Service Device command and control unit and the computer on the ship. The DeepSee includes a high resolution low light color video camera, two deep ocean underwater lights, and an altimeter (Fig. 4). A pressure-compensated junction box from the Station Service Device allowed interfacing the components on DeepSee. Also installed on DeepSee were mounts for an acoustic release and a core tube mount. Power for DeepSee was provided by modifying pressure compensated battery packs with newly installed AGM batteries. Dual battery mounts allow quick replacement of batteries for minimal down time when the battery pack runs down. The ballast weights were made to be easily redistributed to compensate for different payloads and battery pack locations. The USBL was mounted on the DeepSee and the position of the USBL and DeepSee were integrated into the video record providing accurate real time positioning of the seafloor in the video records.

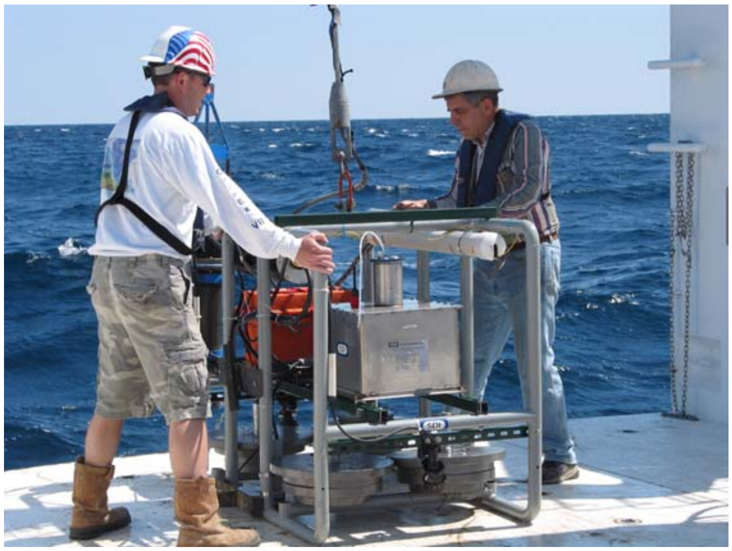

Figure 2. The DeepSee ready for deployment.

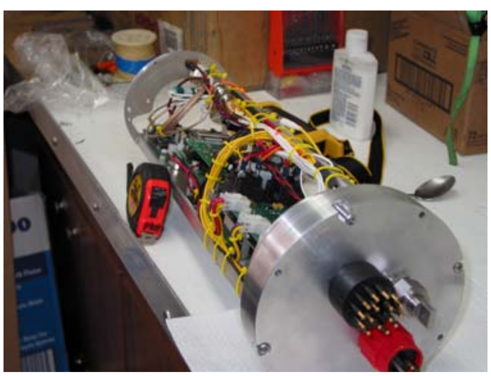

Figure 3. The communications and control computer system prior to encasement in the pressure vessel.

Figure 4. Lower side of the DeepSee with camera, altimeter, adjustable ballast system and pressure-compensated junction box within the field of view.

SEDIMENT and MICROBIAL SAMPLING

Mounts were installed on the DeepSee frame to accommodate core barrels and acoustic releases. During pre-cruise planning, the concept of using the real time video data to direct coring and sampling activities at the site was very attractive. The framework was envisioned as the driver to force a core barrel into shallow sediments at sites of interest. Acoustic releases could also be used to deploy instruments at sites precisely located with the DeepSee. These concepts were developed in direct response to the loss of reconnaissance and deployment vehicles when the *R/V Ocean Quest* departed the Gulf area.

Early in the course of this cruise it became apparent that modifications in the system were needed to facilitate coring. Specifically, a forward-looking camera and lighting system are needed to locate targets in advance of the arrival of coring devices. A forward-looking Sonar system would also facilitate identifying sites of interest for both coring activities and instrument deployments. Direct coring from the DeepSee was, therefore, not attempted during this cruise.

Pilot samples, however, were obtained from recesses in the DeepSee cage after driving the frame into the seafloor. On the final leg of reconnaissance, just prior to retrieval of the DeepSee, the cage was driven into the seafloor in an area with bacterial mats and shell material. The material collected included bits of mud, carbonate, and bacterial mat. These samples were either frozen (~ 2 g) or fixed for later analysis with fluorescent *in situ* hybridization (FISH) studies (~ 1 g). The samples fixed for FISH were fixed in filtered 3% paraformaldehyde for one hour, and washed twice in equal volumes of phosphate/boric acid/saline buffer (PBS) and ethanol. Fixed and fresh samples were immediately frozen at -20°C until their return to Chapel Hill, NC. These samples will be analyzed with FISH and general cell-staining techniques to get an initial idea of the microbial groups present at the sediment-water interface.

DRIFT CAMERA RECONNAISSANCE

The real time, video reconnaissance survey of the site was conducted in two separate deployments totaling approximately 18 hours. The equipment operated nearly flawlessly and close to ten hours of video were captured on VHS tape. The best images were obtained while operating one to two meters above the seafloor. Plans to add a surge-arrester will aid in maintaining constant height above the seafloor. Latitude, longitude, heading, time and date are captured on each frame of the video for future reference.

The survey was conducted using a Hy-Pac navigational system with bathymetry acquired by C&C Technologies *via* the Hugin3000 autonomous underwater vehicle (AUV) imported as a base image. Ship and DeepSee positions were plotted in real time on the image using GPS and USBL locators, respectively. Sites of interest were plotted. The captain set a course designed to make a slow pass of the ship and DeepSee over an area of interest, maintaining a speed of approximately 1.5 knots and adjusting the course to correct for currents and wind. Slow “drift” speeds and currents dictated that the survey pattern be irregular with the captain maneuvering the ship to maximize coverage of points of interest.

Reconnaissance efforts were concentrated in the three vent areas at the site and, to a lesser extent, the areas of high backscatter identified by the C&C AUV side scan sonar survey of the site. Approximately 16 traverses were made across the mound in attempts to drift over the targeted areas. The survey paths vary one from the other as the captain tried to read the currents, ship speed, and target locations with each pass across the hydrate mound. Authigenic carbonate rocks, bacterial mats, shell beds and *gorgonia* (corals) were present in and around the crater-like vents. Bubble streams were also observed.

Screen captures of various features are presented below (Figures 5-8).

Figure 5. Authigenic carbonate near southwest vent area.

Figure 6. Bacterial mat and shell debris in area of high backscatter.

Figure 7. *Gorgonia* near the northwest vent.

Figure 8. *Gorgonia* near the northwest vent.

CONCLUSIONS

The cruise was successful and met the stated objectives. The multi-purpose cable was used, successfully, to tow the "proto-SSD"; fiber-optic transmissions can occur concurrently with heavy lifting. The next and final adaptation for the cable is to incorporate a slip ring adapter for the coaxial conductor. The cruise fulfilled the objective of furthering the advancement of the Station Service Device by completing the design and construction of several components (primarily the command and control computer) and the acquisition of other components (cameras, lights, altimeters etc.). The DeepSee drift camera system performed nearly flawlessly and provided approximately ten hours of real-time seafloor video imagery. A much-need reconnaissance of the site has now been completed. Use of the DeepSee as a sampling and deployment platform will require some system alterations.