ACTIVITIES REPORT FOR THE CRUISE GOM01-13-MC118 ABOARD THE R/V PELICAN

MISSISSIPPI CANYON FEDERAL LEASE BLOCK 118
NORTHERN GULF OF MEXICO
June 30 – July 3, 2013


By
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NIUST-UVTC
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Lewis Fortner – Instrument Shop Manager
Kirby Strickland – Instrument Shop Assistant Manager
Peter Geiser – Electronics Technician and graduate student

SRI
Tim Short – Chemical Engineer
Ira Leifer - geophysicist

University of Georgia
Thad Biercke – Mate

University of California, Santa Barbara
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Sam LaBoeuf – Chief Engineer
Ben Zilkey – Asst Engineer
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Mike McCoy - Culinary Expert
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Pelican crew:
INTRODUCTION
A scientific research cruise was undertaken to Mississippi Canyon Federal Lease Block 118 (Fig. 1), June 30 - July 3, 2013, aboard the R/V Pelican. A portion of the MC118 block has been reserved by the Bureau of Ocean Energy Management (BOEM) for research, initially by the Gulf of Mexico Hydrates Research Consortium (GOM-HRC) to investigate marine gas hydrates in their natural environment. The Consortium has chosen the site for the installation of a seafloor observatory to monitor and evaluate the forcing factors involved with the formation and dissociation of gas hydrates. Part of the administration of the GOM-HRC is to plan and execute cruises to test instrumentation designed for use at the observatory. This task is that of the Mississippi Mineral Resources Institute (MMRI) and its marine component, the Center for Marine Resources and Environmental Technology, located at the University of Mississippi (UM).

The systems being tested on this cruise have all been deployed at least once before and are now in the “mature” stages of development. They are:
- Noakes (UGa) Lander or ABCMS system which contains lights and photo-capability, a high throughput filter system capable of collecting 32 filtrate samples on demand, and a Membrane Input Mass Spectrometer – MIMS - developed by SRI International for marine survey work;
- Leifer’s (UCSD-Santa Barbara) scanning 3-D multibeam system for imaging gas plumes;
- The MMRI – designed and built ABIL (Autonomous Benthic Instrument Lander).

OBJECTIVES
1) Employ the I-SPIDER to deploy and/or augment lander systems.
2) Deploy ABIL (Autonomous Benthic Instrument Lander) with UltraShort BaseLine (USBL), CTD, and USM’s sonar scanner aboard, at the site of the previously discovered resistivity anomaly “A” for long-term collection of data relating to seep activity.
3) Complete work on Noakes’ Lander and Tim Shorts’ MIMS including surveying across a known vent, confirmed via photo-capability of the lander, to complete testing possibilities of the MIMS- primarily detection of hydrocarbon gases in the water-column - not shown on previous outings.
4) Deploy Leifer’s lander with sonar rotator and collect survey data to affirm the utility of the system. Use fiber-optic cable and maintain deployment as long as possible and practical.
5) If time permits, use the I-SPIDER to conduct video-surveying and confirm positions via I-SPIDER’s USBL of instruments on the seafloor at MC118: PFA-1, PFA-2, Thermistor array, Noakes’ Box, Rogers’ Box, Biolec.
BACKGROUND

**Navigation:** Cruises to the Observatory site at MC118 require accurate navigation and referencing of seafloor features and equipment via use of Ultra-Short Baseline (USBL) positioning system. During spring 2013, MMRI/CMRET marine Systems Specialist, Matt Lowe, worked with LUMCON to install USBL transponders in the hull of the *Pelican*. This effort will save time on every cruise executed by groups that use USBL navigation because it eliminates the need to deploy calibration instruments on the seafloor (and later recover them), mounting receivers on the ship, and the several hours required to run the survey and calibrate the receiving instrumentation. The navigation station appears as Figure 2.

**Cruise Electronics:** The MMRI/CMRET shop has consolidated electronic equipment that we must transport from Oxford to the coast and back again when we participate in cruises. They have constructing custom-protective cases specific to particular pieces of equipment. All is designed to protect equipment while traveling and to make the most efficient use of bench space onboard the research vessel (R/V). The consolidated system appears as Figure 3.

**Systems:** The Noakes Landers, including the MIMS and the sonar rotators have been tested in the past but have experienced failures of one or more components. This cruise was scheduled as a “clean-up” cruise to give researchers access to an area of known venting so they could field-test the modifications to their systems. The plan is to use the I-SPIDER to deploy the landers and support one or more in survey mode.
Figure 2. Left, HyPack navigation software, used to communicate with USBL instruments as well as with the Captain and winch operator. Right, Global Mapper with bathymetry, used to select target locations and to plot instrument and hazards locations.

Figure 3. Max Woolsey (NIUST) checks the electronics systems to be sure that all systems are communicating. This system is used to monitor all USBL-tagged locations, including remotely operated vehicles, like the I-SPIDER.
CRUISE ACTIVITIES
This objectives of this cruise demanded heavy use of the I-SPIDER so required the MMRI/CMRET Rochester fiber-optic cable. The Noakes lander also was deployed using this cable on the Pelican’s main winch (Figures 4 and 5).

Figure 4. The Noakes Lander is attached to the fiber-optic cable following on-deck systems checks.
Figure 5. Deployment of the multipurpose Noakes lander took place off of the *Pelican*'s stern.

Following the failure of the MIMS battery system, the Noakes lander was deployed without the MIMS. During more than 10 hours survey time, the other functions of the lander performed flawlessly, with the exception of some electronics issues firing the
bottles. During this dive, oil droplets, hardgrounds, bacterial mats and additional lifeforms were identified (see Figure 6). However, the primary mission of this lander is to provide real-time chemical surveying to inform seafloor and near-seafloor water column research. While the lander was deployed and following its recovery, Tim worked with the spare battery and MIMS system to attempt to couple it to the lander for another attempt at chemical surveying.

Figure 6. This photograph of the television screen shows the view of the seafloor from the Noakes Lander. Note bubbles rising from the seafloor.

The ABIL with sonar rotator was deployed via the I-SPIDER (Figure 7) at a site with known venting, but removed, laterally, to allow the sonar to sweep the vent site. The ABIL will be left to collect data from this site until a follow-up cruise of either CMRET or ECOGIG.

Following the deployment of the ABIL, the I-SPIDER was converted into survey mode. A large screen television had been purchased for the purpose of better viewing of seafloor video than had been possible using computer monitors. This saves bench space in the lab as well as improving real-time viewing of the surveys.

Several remarkable sitings were made during this dive of the I-SPIDER. Most importantly, we were able to locate and view, multiple times, the first Pore-fluid array (PFA) that was developed and deployed by the MMRI/CMRET in May, 2005, to collect pore-fluid data from the shallow subsurface to about 8m. This was the first GOM-HRC
deployment. The osmo-box on this probe had been swapped during a 2006 dive of the Johnson Sealink but the PFA-1 had never been positively sited since that cruise, partly due to navigation inconsistencies associated with the cruise. Finding this probe has been a goal of the Consortium for years but its location is particularly vital to the safe and successful execution of the resistivity survey, scheduled as part of the CMRET’s hydrates project with the Department of Energy (DOE). We were also able to locate Ian MacDonald’s camera and confirm that it is still perfectly oriented and presumably functional.

Figure 7. The ABIL ready for deployment via the I-SPIDER.
The next and final dive of the Noakes lander was made with the backup MIMS and battery system. Although the firing of the bottles in the rosette was only partly functional the other systems performed as well and better than anticipated. We were able to locate and get positions on multiple vents and were able to document methane spikes associated with these vents thereby verifying the utility of this system in locating methane plumes in the water-column. For more detail, please see the attached report from UGa.

With relative ease, capabilities of the I-SPIDER were used to improve the UCSB sonar lander (see Figures 8, 9, and 10). Employing the two systems together, a survey and deployment dive was executed and data from vent activity were collected as well as data from the site of MacDonald’s camera. Sorting through these data should enable the distinction of bubbles from cable from hardware.

Figure 8. Ira Leifer begins the process of securing the multibeam instruments to his lander.
Figure 10. Steven Tidwell and Brian Noakes put the finishing touches on the adapted UCSB lander.
CONCLUSIONS
A four-day cruise was executed in the northern Gulf of Mexico to test new configurations of landers that have been developed especially to investigate the benthic boundary layer and shallow subsurface in an area of known hydrate stability. All systems were used successfully, seafloor equipment was located successfully and new vents and water-column plumes were documented via mass Spectroscopy and multibeam systems and verified visually with the multiple cameras of the I-SPIDER.
06/30/13 – Sunday, travel from Oxford to Cocodrie
07:30 - Matt, Steven, Brian depart Oxford for Cocodrie in the 1-ton with goose-necked trailer; the portable shop accommodates the I-SPIDER
09:00 – Marco, Max, Francesca, Carol depart Oxford in the MMRI van.
   MMRI vehicles are heading south on Hwy 7, I-55, 310, 90, 182 to La Hwy 57 and Cocodrie.
16:00 – MMRI van arrives in Cocodrie behind MMRI shop. UCSB, USM, SRI, are already onsite. Mobilization in progress: cable, shop container, etc.
17:00 – UGa arrives in Cocodrie.
   Topside box set up.
   Kevin Martin, USM, will not go to sea but we will deploy his lander with multibeam at a site with active venting as determined by SSD and I-SPIDER visuals. Kevin instructs Steven and Marco (and Carol) in physical deployment as well as in siting of seafloor location.

   Safety Meeting held in Galley

   Science meeting held in Galley to lay out (ideal) sequence of events.
~22:00 – Depart Cocodrie for MC118.

07/1/13 – Monday, transit to MC118
Beautiful day with seas 1-2'
12:40 – Arrive on site MC118.
12:45 – Marco gives Alex and Nic target location for CTD cast for speed of sound in water, for navigation program: 28*51’16”; 88*29’30”.
   We will drift while doing the cast, so as to get our drift direction and surface speed. CTD cast provides the offsets for the navigation – derived from the speed of sound in the water, which varies with each trip.

   CTD down
13:35 – CTD back on deck.

   Motoring back to target to dive Noakes’ lander.
14:05 – Noakes’ lander off the stern – uneventful.
   @ 20m, hold while Tim checks the MIMS: 28*51’08.77”; 88*29’33.78”.
   Check that all systems are working.
14:45 – lander back on deck. Fiber switch lost coms.
16:20 – Noakes’ Lander back in water after cable (coms) swap-out (deck test, etc.);
   Hold @20m again.
16:55 – going down – MIMS not working. Control system OK.
17:15 – lander back on deck following re-boot. Lithium battery smoking; literally blew its top. Sam recovers directions for correct procedure to put fire out. This was very expeditious as the Pelican had had a lithium battery fire on the previous cruise. The area was hosed for 15-20 minutes. MIMS removed from the lander.

17:30 – lander functions are evaluated. Retain coms in tech lab.

MIMS activities suspended. Battery has been used successfully in the past. Tim has no clue what went wrong. He will pop the cap.

18:55 – Noakes Lander deployed without the MIMS.

19:15 – bottom sited in lander’s fixed, downward-looking camera.

Surveying all recorded, including two seeps represented by bubbles emerging from the seafloor, numerous forms of marine life; and carbonate outcrops.

07/2/13 – Tuesday, surveying at MC118 using Noakes’ lander and Leifer’s sonar rotator.
Weather fair. Seas nearly flat.
05:20 – Noakes’ Lander off bottom.
07:00 – preparing Kevin’s multibeam scanner for deployment via the Automated Benthic Instrument Lander (ABIL).
08:20 – ABIL and I-SPIDER over stern. Released with truck wheel weights.
08:40 – bottom in view.
08:50 – release package to seafloor.

To the NE of the deployment – some carbonate slabs, various, sparsely distributed lifeforms: “spider”, fish, sea cucumber.

To the E-SE is a lone paramuricea (on Michela’s map). Crabs (a lot!) in slabs.

09:11 – back at deployment site where everything looks great. The ABIL is suspended about 5m off the seafloor (to the top of the floats) and the sonar – mounted some distance from the lander - is sweeping.

10:45 – Moving toward sites of PFA-1 (?) and geothermal array for equipment check and preparation for resistivity survey.

11:00 – onsite PFA-1. Going down with I-SPIDER to look. 88°29.5741 W; 28°51’27.12" PFA-1!!! Found by heading North to target and by using sonar. Passed over PFA-1 again drifting SW: 88°29’31.6307”; 28°51’28.3256”.

11:42 – bringing I-SPIDER up.

12:00 – SPIDER on deck.

Prepping Noakes’ lander for another dive, this time with the backup MIMS and battery.

13:00 – Lander over the stern and in the water.
Fired bottle; launch filter 1.
Holding at 20m to test MIMS communications.
28°51.1107’; 88°29.4806’ 880m water
Edge of target circle.
13:40 – bottles are “down.” Battery dead?
13:52 – small methane spike on MIMS at Plume 1.
Another methane spike north of Plume 2.

Boat turned. Now moving NE and forward.
Touched bottom east of crater rim – bounced intentionally for filter-collection.

14:22 – dive terminated
Waiting for ship to come about for good recovery (angle of the cable) to stern.
14:40 – pause at 138m (~thermocline) to check chemistry. 28°51.059”; 88°29.531”.
Pause again at 90m to check chemistry.
15:02 – continue recovery of Noakes’ lander.
15:03 – lander on deck.
15:30 – It is now raining in earnest. We are having difficulty making all the electronics connections.

The shop team is adapting the I-SPIDER to accommodate Ira’s sweep sonar and additional lander features.
17:26 – I-SPIDER and UCSB lander in the water. This incarnation of the I-SPIDER includes the SPIDER’s cameras, lights, floats, and bottle (electronics). Together with Ira’s lander with his sonar rotator.
18:01 – Ira’s lander is on the bottom at Ian MacDonald’s camera site. The lander (on cable) came through bubbles, past Ian’s camera and we set it down just North of the camera. Ira is working to identify and distinguish the features like the cable and post of the lander frame from the bubble plume in the image. It is also challenging to track the orientation of the image returned since it is ever-changing while never representing an image referenced to the seafloor.
18:30 – picked up to reorient lander.
18:58 – Set down north of the 3 plumes.
19:40 – lander picked up. Proceeded to cruise slowly over camera and plumes, repeatedly, collecting sonar data as well as video.
21:00 – headed for Cocodrie.

07/03/13 – Arrive in Cocodrie; demobilize; depart Cocodrie for points north.
~ 10:00 – reach dock at LUMCON.
Table 1: Landmarks at MC118 and waypoints for this cruise.

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The University of Georgia and SRI International
Cruise Report

The University of Georgia (UGA) and SRI International personnel traveled to the LUMCON facility in Cocodrie, LA to board the RV Pelican on June 30, 2013. Both the Lander and MIMS were set up and tested prior to the Pelican’s departure. Lander communications with the video, lights, pumping mechanism and sample changer were tested and showed to be operational. The rosette was test fired prior to final cocking of the sample bottles. The UGA MIMS was tested in the wet lab prior to leaving the dock and all systems were operational. After installation on the Lander, however, there were communication problems over the optical fiber line and the MIMS mass analyzer electronics mass calibration file got corrupted. Instead of trouble shooting the problem, the UGA MIMS was replaced with the SRI MIMS which was brought as a backup. The SRI MIMS was operational after installation on the Lander. The MIMS was left running overnight with the ionization filament on to keep the system warm and to allow time for the residual gas background to approach optimal level.

The Pelican departed for MC 118 late in the evening and arrived onsite around midday July 1, 2013. During transport to MC118, the MIMS, CTD, optode dissolved oxygen sensor, and altimeter were installed in the Lander. Prior to deployment, but while installed on the Lander, the MIMS was shielded from the sun to keep the internal temperatures within acceptable range. Ice packs and water spray were also incorporated to cool the MIMS. The USBL was attached to the Lander to allow for accurate tracking of its position on the seafloor.

The Lander was deployed at MC118 at 1405 h and lowered to a depth of 20 m to test the MIMS operation (Figure 1). A communication error was experienced on the MIMS which required the Lander to be brought back on deck. After resetting the MIMS and checking fiber connections, the Lander was once again deployed at 1600 h to a depth of 20 m. It appeared that the MIMS was working properly so the Lander was sent deeper. At approximately 80 m, all communications with the MIMS were lost and at 300 m it was decided to bring the Lander back to surface.

Figure 1. Lander deployment, using the Pelican’s main winch.
The Lander was returned to deck at which time it was discovered that the lithium battery pack for the MIMS had failed. Both the battery pack and the MIMS were removed from the Lander along with the altimeter, CTD and optode dissolved oxygen sensor as they are routed through the MIMS. The MIMS was brought inside the Pelican dry lab for tests to determine if any electronic damage had occurred as a result of the battery failure.

Communications to the Lander were tested and no errors were found. It was decided to deploy the Lander at 1855 h without the MIMS to continue surveying the seafloor. The Lander was in the water until July 2 at 0600 h when it was returned to the Pelican’s deck. During the deployment, the Lander recorded video which included two seeps represented by bubbles emerging from the seafloor, numerous marine life; and carbonate outcrops (Figure 2). The streaming video was also viewed on the University of Mississippi’s large screen monitor mounted on the lab wall. This allowed more cruise participants to view the video during the deployment. The winch operator also had wireless video which enabled him to monitor the Lander’s height above the seafloor and adjust accordingly to keep it from unintentionally hitting bottom (Figure 3). Filter samples were collected during deployment with the intent of analyzing for microbial activity. UGA personnel attempted to fire the rosette water sampler, but encountered a communication error. It was later determined that the batteries had already run down to below operational levels stopping communication with the rosette. Once on deck, the filter samples were removed from the filter packs, rolled and placed into plastic vials. The vials were stored in liquid nitrogen for transport back to Athens, Georgia, where they could be placed in a freezer until analysis.

While the Lander was surveying the seafloor, the MIMS was thoroughly checked and found that no damage was experienced as a result of the battery failure. Once the Lander was back on deck, the MIMS was once again installed along with a backup battery pack. The Lander was redeployed with the MIMS at 1300 h to a depth of 20 m. All systems proved operational and the Lander continued to the seafloor. During this deployment, three bottles samples were collected from the rosette before the battery was too low for communication. While deployed, the MIMS detected several methane spikes while hovering approximately 2-5 meters above the seafloor (Figure 4). No seep bubbles were observed during this deployment, but the MIMS was
able to detect the presence of dissolved light hydrocarbons. One small peak and two larger peaks were observed in the MIMS signal intensity for the diagnostic ion for methane \((m/z\ 15)\) between 1:55 and 2:06 pm (Figure 5). Small increases in the MIMS signal intensity for the diagnostic ion for ethane \((m/z\ 30)\) were also observed concurrent with the larger peaks for methane (Figure 2). Video was also collected during the deployment and recorded various marine life and carbonate outcrops. The Lander was back on deck by 1500 h. The filter samples collected during the second deployment were removed, packed and stored in liquid nitrogen. A total of 13 filter samples were collected during the deployments and will be analyzed for microbial activity.

Figure 4. Methane spikes detected by MIMS.

Figure 5. MIMS data from the sea floor at MC118 near a suspected seep. The diagnostic ion for methane is \(m/z\ 15\) and the diagnostic ion for ethane is \(m/z\ 30\). The signal for \(m/z\ 5\) is the electronic baseline for the MIMS mass analyzer detector amplifier.
After the final deployment, the MIMS and peripheral hardware were removed from the Lander and packed for transport back to St. Petersburg, Florida. The remaining components of the Lander, including communication housing and filter rack, were removed and packed for transport back to Athens. The R/V Pelican returned to the LUMCON dock by 1000 h July 3 and the Lander and MIMS were unloaded. The UGA and SRI team departed Cocodrie later that afternoon.

At this time, it is unclear why the MIMS was having communication errors, but it is thought that the battery failure may have played a role in the disruption. Lithium batteries are considered highly efficient for powering instrumentation, but can cause problems upon failure. Most likely, one of the batteries in the pack was in the process of failing which caused communication difficulties. As a result of the survey, it has been decided to eliminate the separate battery pack for the MIMS and utilize the Lander battery power. This change in power supply will increase the deployment time for the MIMS and open up space for additional instrumentation on the Lander frame. The internal battery pack in the rosette was also deemed insufficient for the Lander survey work. Most rosettes are designed for short term deployments and not intended to be in the water for hours or days at a time. The rosette will also be powered by the Lander batteries allowing for a longer deployment time.

Cruise Participants:

University of Georgia
Scott Noakes
Lewis Fortner
Kirby Strickland
Peter Geiger

SRI International
Tim Short
Sonar equipment:
- Sonar control unit in pressure vessel (ICPU) in crate
- Reson 7125 transmitter/receiver
- ROS heavy duty rotator
- Ocean Server compass in housing
- Imagenex sonar
- Cables: Reson Rx, Reson Tx, compass, rotator, Imagenex, power octopus
- Lander: frame, mast, side brackets (2), rotator frame (modified this cruise), Imagenex bracket (modified this cruise)
- 7 48V deep sea batteries
- Laptop pc “Spectrum 4000” set up with “rxp” remote desktop to control the Reson ICPU control unit (black pressure vessel)

Chromatography equipment
- Los Gatos Research cavity ringdown spectrometer
- Vacuum scroll pump and housing
- CO2 and CH4 calibration gasses (2)
- Tedlar bags for calibration
- Calibration wye (1)
- Black sampling hose reel (cardboard reel)
- Hydrogen bottle kit
- Chromatography laptop, supply,
- Chromatography tool box

Tool Kits
- Main Tool kit
- Electronics tool kit
- Tap and die kit
- Lander hardware kit
- 80/20 hardware kit
- ¼-20 hardware kit
- 5/16-18 hardware in boxes
- Attachment kit
- 48V battery chargers (2)
- Label maker
- Ethernet and computer cable kit
- Power driver, charger, battery (2)
- Sonar connector/dummy kit
- Sonar 48V power supply (on loan from RESON)

Kits needed but not here:
- 40/20 brackets and hardware
- Washers for ¼-20 and 5/16-18

Day 1
Arrived at LUMCON, Cocodrie, LA port to transfer equipment and personnel to R/V Pelican, ~1300
Loaded the boat and organized material departure ~1800
Pre-survey safety meeting followed by science coordination meeting led by Carol Lutken, Assoc. Director of MMRI.
Proceed to MC118 methane hydrate site located at 28 51.02956’ N and 88 29.53157 W in the Gulf of Mexico to drop rosettes, samplers, spectrometers, and the BRI sonar lander.
Los Gatos Research Greenhouse Gas cavity ringdown spectrometer connected to scroll vacuum pump and sampling line attached above the rear of the R/V Pelican bridge, ~15 m. Power supply power cable adapted with new outlet on boat, and setup. Data collection began prior to departure.

Day 2
Assembly and testing of sonar ICPU, RESON transmitter/receiver, Imagenex sonar, rotator, and compass.
Battery charging in rotation during the day.
Unsuccessful attempt to integrate compass NMEA data stream into Reson sonar data in the header. Set system up to run compass separately with Ocean Server software and logging. Tested all software running and saving data logs contemporaneously. No issues found with multiple logging. Logging allowed to continue for several hours.

Day 3
Assembly and modifications to the sonar lander.
Assembled lander mast, angle brackets (2), and sonar head rotator bracket assembly.
Discovered that the rotator had a space issue between the rotator plug and the mounting bracket, also rotation frame mast height is wrong for proper plastic bearing alignment.
Called ROS in San Diego to ask if rotator cable connector could be rotated 90 degrees to accommodate the rotator mounting bracket, but engineer advised not to because the connector wires are up against the motor.
Modified the rotator bracket to allow for control/power cable space, better alignment, and adjusted the height of the rotator frame axle by adding stacks of 3/8 shim washers between the rotator mounting bracket and rotator frame bracket.
Reconstructed the Imagenex sonar mounting bracket. The original bracket had one piece attached to the rotation frame axle and a stationary support bracket. New bracket attached to rotator frame axle only.

RESON transmitter bracket squares needed drilling out to accommodate larger bolts required by transmitter mounting holes.

RESON receiver bracket spacing oversized for receiver length, but existing hardware was installed with some effort.

Installed a 1” 80/20 post on the left corner of the lander’s facing side, 26” from the point of rotation at 55.1 degrees off center to allow for rotation reference. Length = ________.

4 48VDC Deep Sea batteries and 2 24 VDC Deep Sea batteries were added to the lander frame to support the sonar system and the camera system installed by UMiss technician Matt Lowe.

Installation of 4 cameras and deep sea LED lights by Matt Lowe of UMiss, lander compass, and fiber data cable converter to convert ICPU Ethernet to the boat’s fiber optic data cable.

Rotation Adjustment

Used ‘Lander Rotator Controller.exe’ software interface to adjust rotator range of motion and limits. Used installed rotator reference pole to determine range of motion (center of UMiss front camera)

Rotator values for range: position 60 (far left), position 236 (center, facing), and position 400 (far right). The compass attached to the rotation frame was used for bearing when the frame was in the center facing position. “Facing” was the word the group used to describe the lander orientation on the seafloor. Excessive lander tilt on the bottom in several locations makes the orientation useful only before landing. After landing, a second compass installed by the UMiss group provided lander orientation.

Deployment and survey

12:00Z Lander deployed in water and recording/logging turned on in Compass, RESON SeaBat, and Imagenex Delta T software.

Begin pogo landings on the bottom near MC118, sonar observations with RESON and Imagenex sonars, watching with the 4 cameras on a large quadrant split screen.

Help from Marco [team] with navigation and location of seep bubble plume.

After initial sonar settings adjustments, sonar observations, rotator frame scanning, and sonar interpretation discussions begin.

1:12Z flying through the plume in seconds (Marco)

1:57Z plume shows as a horizontal line perpendicular to the seabed (Ira)

1:58Z Horizontal line perpendicular to the seabed could be a bubble plume. The horizontal structure fades in brightness as lander rises or rotator moves away.

2:21Z lander on deck, lights and cameras off, sonar logging and recording off, files saved, ICPU shut down.

Total deployment time: 2 hrs 21 min

Day 4

Clean up and organize lab, get kits together, clean lab.

Document connections, get video and stills from Max Woolsey, acquired a copy of atmospherics and marine data from Carol Lutken. Trade info with Max Woolsey.
Moved and organized all inventory to MAClab RV except lander and related items
Disassemble lander and sonar equipment, file sonar cables in cable box, bubble wrap
sonar components and store under RV.
Break down lander mast, supports, rotator frame
Remove and store batteries in lander
Use R/V Pelican winch to winch lander frame to roof of RV, and tie down.
Move out, break down, and storage completed at 4:00pm local time.

Data acquired for analysis
Data saved to İCPU computer D:\2013\MC118\*
RESON data files
DeltaT data file
Ocean Server Compass log file
Carol Lutken’s weather, current, and water quality data
Max Woolsey’s lander dive video and stills