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

Activities Report for Cruise: GOM3-07-MC118, aboard the *R/V Pelican*
SSD/ROV 2nd Sea Trial Cruise
Mississippi Canyon Federal Lease Block 118, Northern Gulf of Mexico
July 2-8, 2007
By

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CRUISE OBJECTIVES

1) Conduct 2nd Sea Trial test of the Station Service Device (SSD) to test modifications implemented following 1st test and provide further training for vehicle operators.
2) Attempt recovery of several microbial experiments at SW Crater, Mississippi Canyon 118 (MC118).
3) Provide opportunity for University of South Florida to test their Fluorescents/Mass Spectrometer system at SW Crater, MC118.

PARTICIPANTS

University of Mississippi: Center for Marine Resources and Environmental Technology (CMRET) and Seabed Technology Research Center (STRC):
- J. Robert Woolsey; Chief Scientist
- Matt Lowe, Brian Noakes; Mechanical Systems Engineers
- Andy Gossett; Data Acquisition Specialist
- Simona Caruso; Visiting Scholar, University of Rome

Mississippi Sate University: Department of Chemical Engineering
- Rudy Rogers; Hydrate-microbial synthesizer experiment

University of North Carolina-Chapel Hill: Department of Marine Sciences
- Laura Lapham; Pore-Fluid Sampling system

Stanford Research Institute (SRI)-St. Petersburg, International/University of South Florida:
- Tim Short; Fluorescents/Mass Spectrometer
- Ryan Bell; Graduate Student

Specialty Devices, Inc.
- Paul Higley; Chief Engineer, Consultant
- Scott Sharpe; Data Acquisition, Consultant.

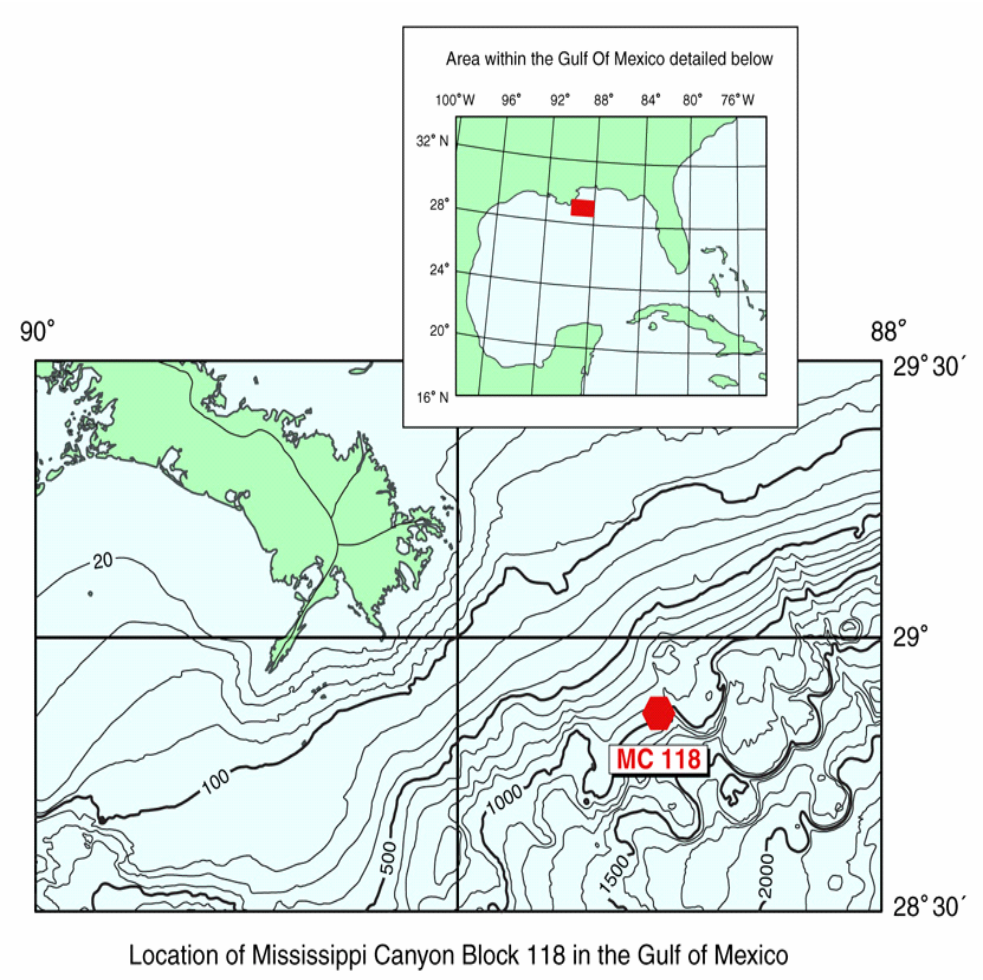
Droycon Ltd.
- Derek Ross; Bio-battery experiment

Pelican crew:

Louis Faulkner, Captain
Joe Thomas, First Mate
Jack Pennington, Chief Engineer
Sam Lebouef, Engineer
Jordan Westmoreland, Technician
Sean Guss
Alex Fortsyte, cook

INTRODUCTION

A scientific research cruise was undertaken to Mississippi Canyon Federal Lease Block 118 (MC118), from July 2-7, 2007 aboard the R/V *Pelican*. The primary objective of the cruise was to conduct further tests of the custom-built Remotely Operated Vehicle (ROV), the Station Service Device (SSD), following modifications to the trim flotation, ballast system and tether cable; and, acquire additional training for the SSD operators. Also of interest was the collection of several microbial and pore fluid experiments from the SW crater. Additionally, a tertiary objective was to test the University of Florida, X-Ray Fluorescents/Mass Spectrometer system for high resolution analysis of hydrocarbon fluids in solution in the lower water column at an active gas hydrate/vent site.



Location of Mississippi Canyon Block 118 in the Gulf of Mexico

EVENT LOG

7/1/07

Sun PM: All participants arrived at the LUMCON facility, Cocodrie, LA, and began the mobilization process: installation of 3000m, mechanical/fiber optic cable; USBL positioning system; SSD/ROV system with Lander Cage (LC), Mid-weight, and deck handling equipment; SSD control systems; Navigation and positioning equipment, tools and supplies.

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Mon PM:

14:15: Main mobilization and installation of equipment completed; depart LUMCON Dock, aboard the R/V *Pelican* for MC118, SW crater study site. ETR, 14 hours.

19:10: The SSD (Figure 2) was powered up and tested.

20:10: SSD Battery pack charge completed.

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Tue AM:

04:23: Arrive on station, SW crater site, MC118, N 28.85223, W 88.49236; continue rigging of SSD system electronics, fiber optics and mechanics. Estimated time to deploy: early PM. Notified SRI/USF Mass Spec team of available time for their test and to initiate deployment of equipment when ready. SRI/USF advised Mass Spec fusing element malfunctioning, unable to deploy test.

Tue PM:

14:02: SSD/LC completed dry and wet check out, commenced test dive (#5, #1-4 were made in March) SW Crater site. To save time, attempted ultra-short base-line (USBL) calibration by alignment of significant sonar targets with assumed bathymetric features on program multibeam base map. Three features identified and aligned within 3 to 5m error. Margin of error deemed acceptable for purposes of cruise objectives.

14:55: SSD/LC on bottom, SW crater site in vicinity of Mandyville. Loop current velocity ~ 1 kt, W to E, (.5 kts near seafloor).

15:13: initiate SSD/Vehicle exit from Lander Cage. On Vehicle exit, noted problem with excess positive ballast. Unable to effect control of ballast problem; decided to abort.

15:40: Vehicle cannot be recovered in Cage due to ballast problem, must attempt recovery with vehicle outside of cage. Commence slow assent.

17:14: Safely recovered SSD aboard.

17:25: Pelican struck by lightning; no visible damage, but problems noted in ship's directional input to USBL system. Attempting damage assessment and control.

Notes on Dive #5: 1) Determined ballast problem due to miscalculation of syntactic foam flotation volume recently installed. Corrected same. 2) SRI/USF still unable to correct element problem. 3) No obvious problem or solution to ship's erratic directional sensor input signal to USBL system. Problem could be in rental TSS master motion sensor. Calm seas mitigating negative potential problem affecting positioning at present. 4) New tether allowed a greater range of operation between the SSD and its seafloor cage. 5) Several sea floor landings were made and the SSD exited and re-entered the cage. 6) The dive ended when the fiber optic communications in the SSD tether failed due to a surge load

on this tether. The surge load was the result of a maneuver to correct a steep cage angle incurred when the cage and SSD were set down on the sea floor while moving too fast for a landing. While operators are still learning how to land the vehicle on the sea floor it nevertheless became obvious that the long-awaited SSD tether was not as robust as desired. As a result, the SSD was retrieved outside of its cage. 7) While the tether was expected to survive this shock loading, the need for better visibility of the tether winch was also recognized. 8) The SSD ran on its battery pack for a total of 11 hours during this dive. The remaining battery capacity was well above 50% and the battery pack required less than 4 hours to recharge fully.

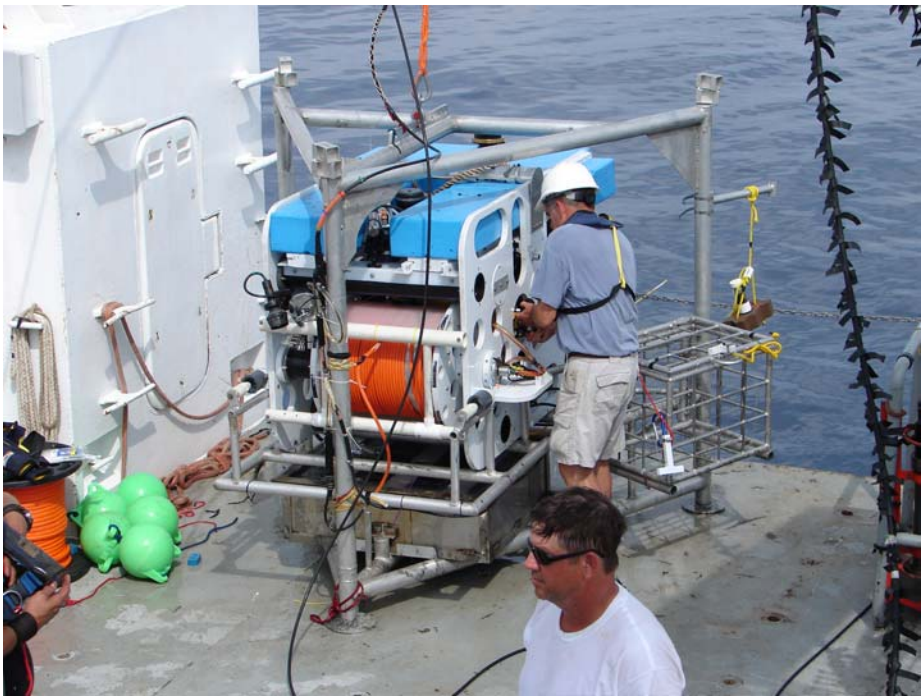

Figure 2. Paul Higley, SDI, checks out the SSD prior to deployment.

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Wed AM: Morning hours spent correcting ballast problem encountered on previous dive.

10:35: SSD/LC completed dry check out, lowered below surface for wet check out (see Figure 3). USBL system not functioning; dive aborted; SSD recovered on deck.

11:07: USBL stiff-leg mounted transducers raised for inspection. Electrical cables found to be shorted to frame. Assumed to have happened when Captain exceeded speed limitations for transducers submerged when trying to escape thunder storm on previous evening.

14:10: USBL system wet tested back on line; SSD initiates descent.

15:03: SSD/LC lowered on Dive #6 to search position 3 to 5m above seabed; loop current velocity increased to ~1.5 kts, W to E, (.75 kts near seafloor).

15:15: Sonar targets identified in vicinity of Rudyville (see location map, Figure 4), but unable to sustain consistent lock on position. Apparently, more a problem of ship's directional sensor in-put (after lightning strike) or rental TSS motion sensor.

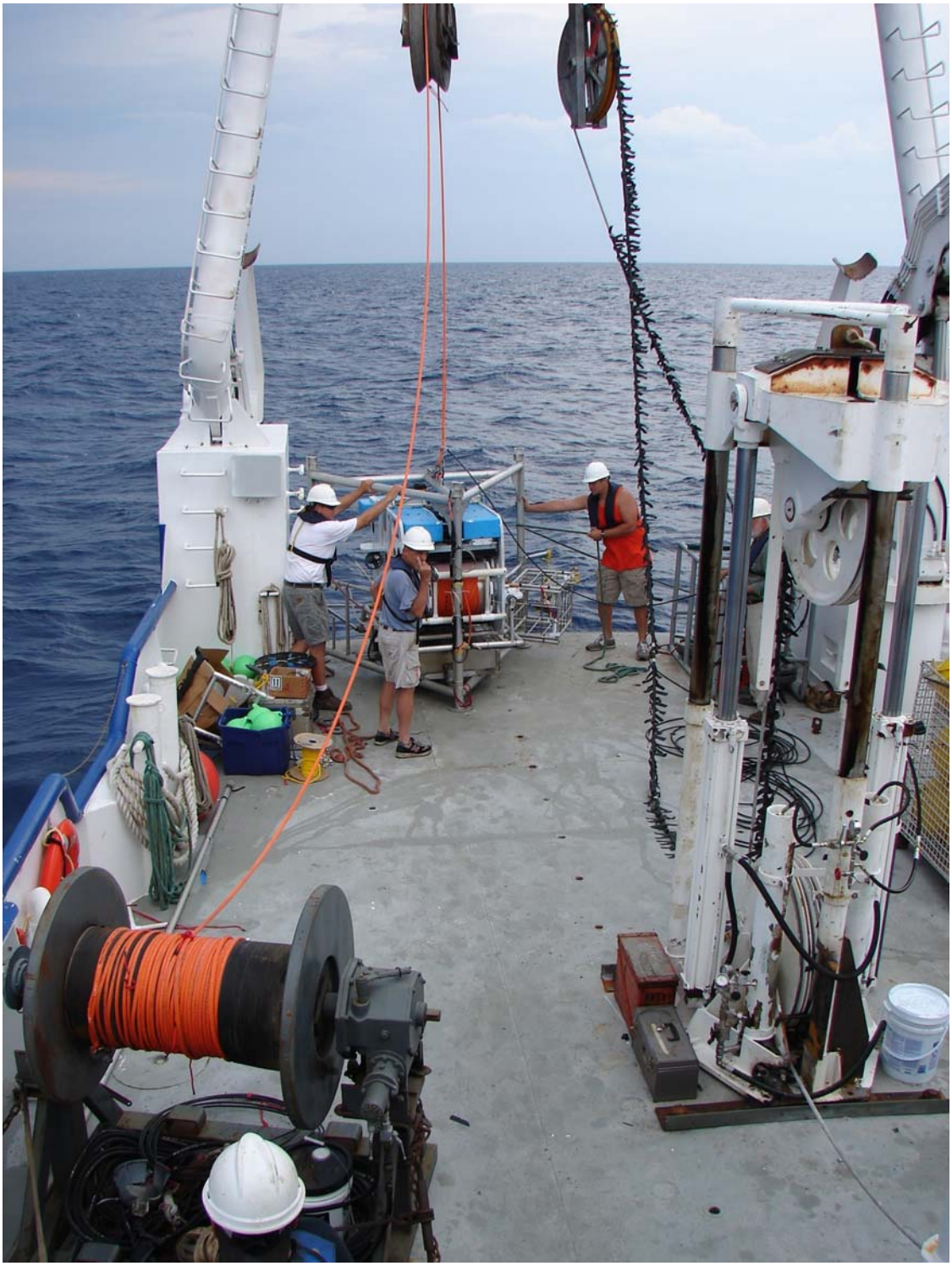

Figure 3. SDI and CMRET teams prepare to deploy the SSD followed by the mid-water weight. Note that the cable to the mid-water weight is threaded through the heave compensator and that the cable by which the SSD will be deployed is not.

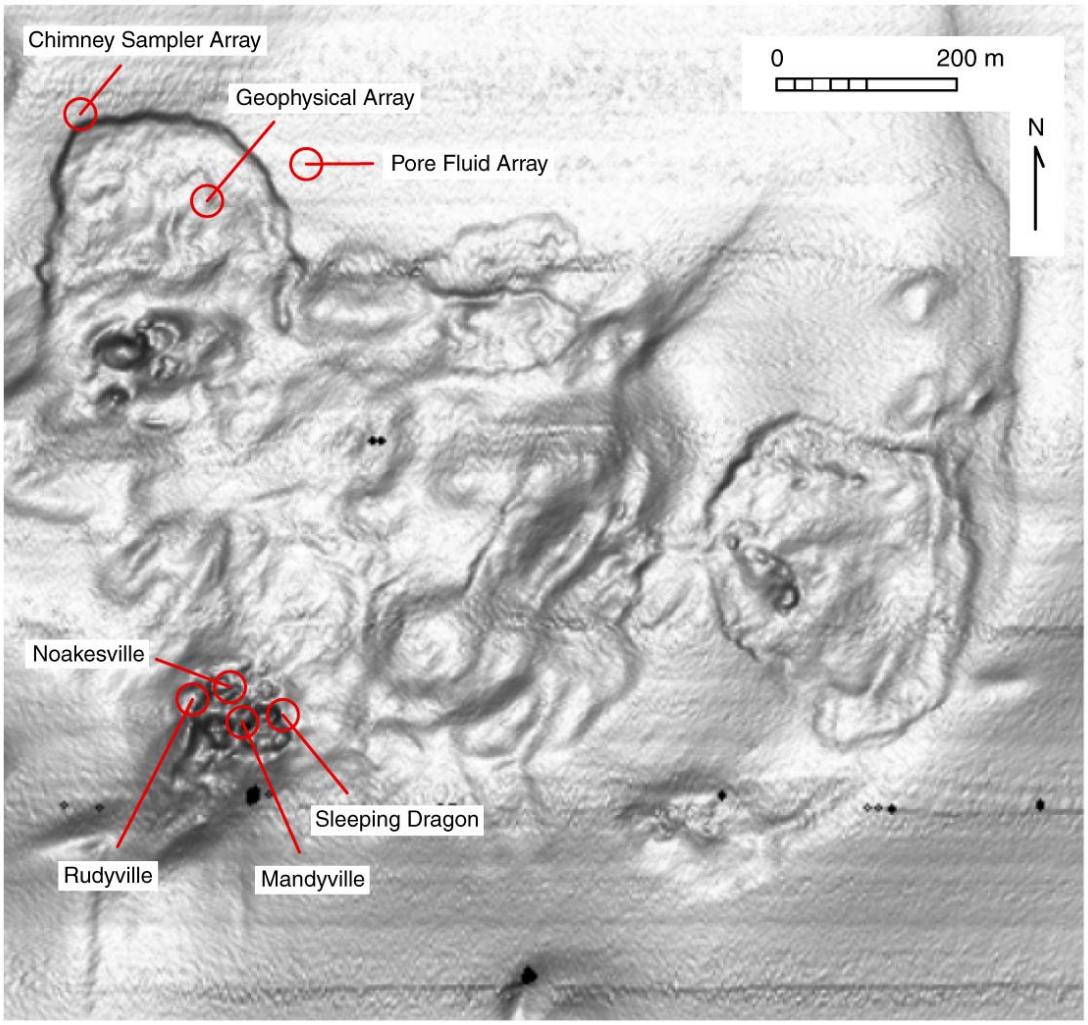

Figure 4. Site locations on the mound at MC118 (image acquired by C7C Technologies and reprocessed by Leonardo Macelloni and Alessandro Bosman).

15:36: SSD/LC set down in small space between rocks.
15:43: SSD clears LC, discovered LC landed in crater approx. 5m deep, surrounded by rocky rim crest.
15:48: SSD flown up and out of crater and maneuvered NE, then N, in direction of Rudyville via base map and sonar.
16:02: Rudyville site with Biolec (microbial battery, MMS), RUDY (microbial hydrate synthesizer, NIUST) and Laura (pore fluid experiments, NETL), deployed during 9/06 JSL cruise, located at base of a second crater, just over crater rim from LC crater.
16:11: Initiate recovery process beginning with Biolec experiment.
16:20: Returning directly to LC, to SW.
16:26: LC in sight on video, but tether snagged in rim rock.

17:04: SSD tether freed from rocks and perched on crater rim with clear view of LC at crater bottom. LC observed to be too close to crater wall to provide sufficient straight-away for SSD recovery in cage. Decided to attempt recovery out of cage as on previous day. Biolec device to be held in jaw of manipulator arm on retrieval.
17:16: Initiated recovery. LC feet in stiff mud, offering resistance to ship's hoist; when jerked free, LC and SSD impacted rim rocks. SSD video lost.
18:28: SSD/LC secured on deck. Damage assessment initiated.
19:47: Damage report; tether, fiber-optic element broken,
20:50: Initiate replacement of F/O Tether Cable.

Notes on Dive #6: 1) Once on the bottom the SSD traversed a long distance (30 to 40 meters) from the cage including around a rock ledge and finally up and over the ledge and down into the Noakesville area (see Figure 5). 2) The area was confirmed to be Noakesville with the Biolec (Figure 6) experiment located and all eight lights still flashing. 3) The Biolec experiment was picked up. 4) John Noakes experiment was left until a heavy lift line could be attached. 5) The SSD traversed back up and out of the Noakesville area, over the rock ledge and back along the rock wall. 6) optical communication was lost as the lack of a winch mounted tether guide resulted in a poor view of the tether as it wound onto the winch. This, in turn, resulted in the tether wrapping around the winch axle and breaking the optical fiber. An improved camera view of the tether winch and a more rugged guide will be required as well as 7) improved SSD to cage latch down capability to prevent damage during deployment and recovery.

Figure 5. Noakesville appears onscreen in the control room.

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Thu, AM/PM Day spent effecting necessary repairs. Repairs were made to the tether and tether guides. The fiber optic cables were shortened and re-terminated on board. SRI/USF team advises that the Mass Spectrometer system cannot be repaired onboard.

Figure 6. SSD retrieving the Biolec. Flashing confirmed *via* the SSD's camera.

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Fri, AM:

08:45: Repairs completed; loop current has increased to 1.5 kts. Sea state calm. SSD/LC descent initiated. Maneuvering ship and SSD/LC for Rudyville site.

09:15: SSD powered up on the cage batteries and deployed on Dive #7.

09:42: Bottom contact, sonar and video. Positioning lock-on erratic; bottom current ~ .75 kts.

10:07: Current and erratic USBL position lock-on complicating maneuvering for close approach to Rudyville. Estimate SSD/LC position 20m south of Rudyville; Landing LC.

10:13: Initiate SSD exit; proceed toward Rudyville.

10:27: Lost video.

10:37: Unable to restore video; Notified Bridge and Chief Eng. To initiate immediate SSD/LC retrieval.

11:33: Mid-weight at surface. Mechanical and F/O Cable fouled around Mid-weight frame. Kink in F/O Cable probable cause of video failure. Fouling probably caused by to rapid adjustment of hoist while raising and lowering LC during sonar/video traverse of seafloor.

12:22: SSD/LC Safely recovered on deck. Initiate damage assessment.

Notes on Dive #7. 1) While the SSD was maneuvering around the sea floor damage was detected in the winch actuator apparently a result of the Dive #6 tether wrapping on the winch axle. A clutch which will limit the maximum force that is transmitted to, or developed by, the actuator will be needed for the future to prevent damage to the actuator. 2) The optical link was lost part way up during recovery and regained later during recovery. 3) The Cortland Fiber optic line had become fouled on the DeepSee mid-water weight and far exceeded the allowable minimum bend radius. 4) The link recovered once the stress on the Cortland cable was diminished. A change in the spacing and application of weights and floats to this mid-water weight will prevent this from re-occurring.

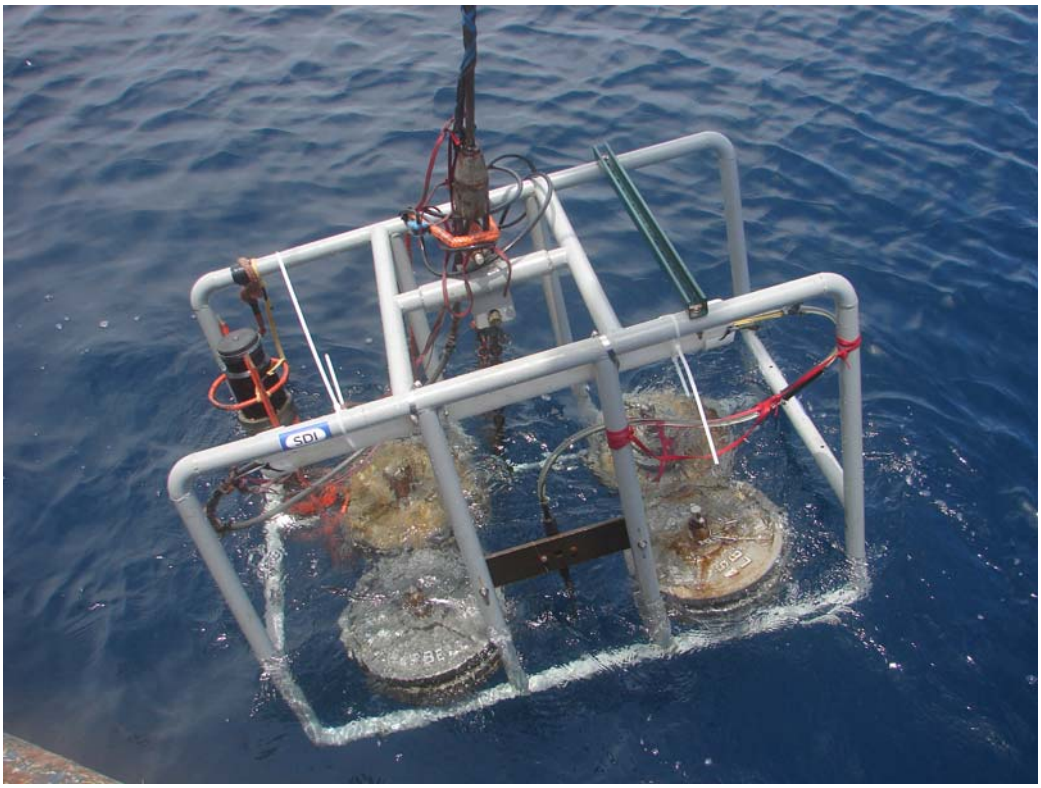

Figure 7. Deployment of the mid-water weight that stabilizes the SSD by buffering it from the heave and pitch action of the ship via the tether.

Fri, PM:

Tether winch motor gear box found to be stripped; swapping the sister motor used to drive the ballast trim float to replace the failed motor on the winch. Positioned ballast trim flotation in neutral position and locked down.

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Sat, AM:

10:20; Repairs to SSD completed and tested, dry and wet. Several problems threatening launch: Video intermittent; navigation and positioning continue to be erratic; ballast trim locked in neutral will limit maneuverability. A 25 lb. weight was added to the Cortland cable

below the DeepSee frame to prevent this cable from washing up and wrapping on the cage as a result of ship heave motions. The SSD was outfitted to carry down 1 peeper, a recovery basket, a nylon heavy object recovery line and latching hook to recover either the Noakesville or Rudyville experiments. A freshening breeze of 12 kts from South, 90 degrees to Loop Current from West and increased to 2 kts at surface.

10:46; Decided to attempt deployment; commenced dive #8.

11:55; Begin search mode to relocate Rudyville, ~3m off bottom, with video and sonar. Search complicated by problems noted above affecting handling of SSD, as well as increasing difficulty for Captain to maneuver and hold ship in position with wind normal to surface current and resultant effect on SSD handling.

Sat, PM:

12:50: USBL positioning increasingly erratic with screen icons (ship and SSD) jumping as much as 20 to 30m.

13:53: Sonar target acquired and interpreted as Mandyville Marker. Video visibility rapidly decreasing near bottom due to changing water mass and increased bottom current. Cannot appropriately maneuver ship under adverse surface conditions (wind 15-18 kts) to enable a close- up video look at target. Decided to land LC at 20m distance (as close as achievable after 30min effort), launch SSD and proceed to target.

14:22: SSD launched with difficulty due to bottom cross current.

14:43: SSD arrived at target. Found to be rock spire 2m high. Return to LC.

15:18: SSD recovered in LC. Resume search for recognizable target.

15:37: Identified area *via* sonar interpreted to be between Rudyville and Noakesville, however Captain having difficulty maneuvering ship into sustainable position for landing LC.

15:47: LC successfully landed in suitable location. Launching SSD from LC to continue search for Rudyville site. Conditions further deteriorating.

16:02: SSD underway. Captain advises he can no longer hold ship in prescribed watch circle. Recommends immediate recovery.

16:07: SSD in video sight of LC and video abruptly lost.

16:10: Signaled hoist operator to begin assent of LC with SSD in tow.

16:35: Video signal back on, SSD tether cable observed to be under load indicating SSD IN TOW. Heave Compensator working well, relieving surge loading. Seas increased to 2m with 18kt wind.

17:17: SSD/LC safely secured on deck.

17:28: Ship navigated to selected position for deployment of (pre-rigged) Storm Monitor, north of NW Crater. Deployed same and acquired bottom position, N28.854736 , W88.481135, by triangulation on acoustic release.

17:35: Departed station MC118 for Cocodrie base.

Notes on Dive #8: 1) The SSD operated near the bottom, was picked up and set down in new locations attempting to locate known sites. 2) The water clarity was excellent during all these July dives. 3) The SSD located many objects with the scanning sonar but most were identified as rocks when the SSD drove close enough to get a visual sighting of the objects. 4) Each dive on this cruise required replacement of the 150 psi regulator on the ballast air supply line. The problem was traced to an inability to vent over pressure in this

line as the vehicle is raised from the sea floor. An overpressure relief valve should be installed on this line.

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Sun, AM: 09:30: Arrived dock side. Commenced unloading/demobilization.

SUMMARY

Cruise Objectives:
1) Conduct 2nd Sea Trial test of the Station Service Device (SSD) to test modifications implemented following 1st test and provide further training for vehicle operators.

SSD Sea trials were conducted, testing modifications implemented following the preliminary trials. The need for further modifications was noted as follows and are herein described and recommended:

1) A suitable high strength, flexible fiber optic cable should be acquired for the SSD together with a dedicated winch of adequate line pull and capacity to accommodate the cable and SSD requirements. This will eliminate the need for the secondary flex cable and support winch and greatly facilitate launch and recovery. It will also eliminate the fiber optic transition link from the UNOLS cable to the flex cable (in current use) which will also facilitate handling.
2) A locking mechanism is required to secure the SSD Vehicle in the Lander cage. This will eliminate damage to the vehicle during deployment /recovery and transit to and from the bottom.
3) A third USBL locator is required on the Lander cage. This will help provide continuous positioning of the Lander during bottom reconnaissance prior to landing and deployment of the SSD Vehicle.
4) Additional video cameras are needed on the SSD, looking forward and down, to facilitate bottom reconnaissance and object/feature recognition prior to landing and object recovery.
5) A heave or surge compensation device to remove the majority of the ship heave motion from the lowering line used to lower both the Lander cage and the SSD cage to the sea floor.
6) A clutch mechanism for the tether winch to prevent damage to the winch actuator from surge loads between the SSD and the cage. 4. SSD major component spares are needed and should include as a minimum winch and trim actuators, thruster motors, tether spares, slip ring spares, major electronic component spares, and a ballast fill and vent control valve assembly.
7) A ballast fill line over pressure relief valve should be installed.
8) Added lift to the SSD will increase the weight that can be picked and recovered.

Note: Provisions for the above recommendations are currently being implemented.

2) Attempt recovery of several microbial experiments at SW Crater, Mississippi Canyon 118 (MC118).

Several attempts to recover the various microbial experiments were made. The Biolec (microbial battery) was successfully picked up but was lost in transit back to the surface. Improved position monitoring with the added USBL locator and added video cameras for improved visual observation should facilitate location of objects of interest, such as experiments, on the seafloor. A more accessible, secure basket for retrieving objects of interest will also improve the recovery factor.

3)Provide opportunity for University of South Florida to test their Fluorescents/Mass Spectrometer system at SW Crater, MC118.

The South Florida team attempted to test their Fluorescents/Mass Spectrometer system which failed due to an electrical problem that could not be repaired at sea. They have requested to try again on our next cruise should there be space available.