

CENTER FOR MARINE RESOURCES AND ENVIRONMENTAL TECHNOLOGY
ACTIVITIES REPORT FOR THE CRUISE GOM3-05-MC118 ABOARD THE *R/V*
PELICAN

MISSISSIPPI CANYON FEDERAL LEASE BLOCK 118
NORTHERN GULF OF MEXICO

October 15-21, 2005

OPERATIONS REPORT OF CRUISE GOM3-05-MC118
INSTALLATION, CALIBRATION, TESTING AND USE OF THE LinkQuest ULTRA-
SHORT BASELINE SYSTEM, CTD SURVEY AND CORING AT THE MOUND,
MISSISSIPPI CANYON 118

By

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INTRODUCTION

In 1999 the Center for Marine Resources and Environmental Technology (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 observatory designed to monitor the activities of gas hydrates on the seafloor and in the shallow subseafloor on a more or less continuous basis. Research efforts of the Consortium are supported, jointly, by Minerals Management Service (MMS), the Department of Energy's National Energy and Technology Laboratory (DOE/NETL), and NOAA's National Institute for Undersea Science and Technology, Seabed Technology and Research Center (NIUST/STRC).

A two-part scientific research endeavor was conducted by the CMRET in October, 2005: installation and testing of the STRC-funded LinkQuest ultra-short baseline (USBL) locating system and collection of water and sediment data and samples in support of site characterization. On October 15-17 the electronics crew from Specialty Devices, Inc. and the CMRET technical team traveled to Cocodrie, Louisiana, and installed the LinkQuest ultra-short baseline (USBL) locating system on the *R/V Pelican*. On the evening of October 17, the *R/V Pelican* set sail for Mississippi Canyon Block 118 where the remainder of the work was conducted. The purposes of this cruise were 1) to install, calibrate, test and put to use the USBL, 2) to collect CTD (conductivity, temperature, depth) data in support of the design of a seismic survey of the block, and 3) to collect sediment and water samples to further characterize the sea floor and shallow subseafloor environments at MC118. Eight CTD casts were made on and around the mound and water samples collected at predetermined depths on recovery of the instrument. Nineteen core samples were recovered with either MMRI's 3m or the ship's 3m core barrels, examined visually, onboard, for evidence of hydrates and gas, and subsampled for further laboratory analyses. Positive indications for hydrate were observed in cores from the northwestern periphery of the mound and from the south-central portion of the mound structure as determined by recently acquired AUV Multibeam, sidescan, and chirp data.

BACKGROUND

In October, 2004, Mississippi Canyon 118 was selected, unanimously, by the Hydrates Research Consortium as the preferred location for the Monitoring Station/Sea-Floor Observatory (MS/SFO). Very little data specific to the site were available at that time other than that provided by Sassen and Roberts in their 2004 report to DOE. Their visit to the site on two dives aboard the Johnson SeaLink in the summer of 2002 revealed hydrates exposed at the seafloor, vents, and seeps centered about a mound approximately 1km² in the south-central portion of the block. The CMRET, through the MMS in New Orleans, obtained access to bathymetric and 2-D seismic data from the area that supported the findings of Sassen and Roberts. The services of C&C were then retained for the purpose of surveying the block with the Hugin3000 autonomous underwater vehicle. This survey was completed May 2, 2005. The images were used to select the locations from which cores were recovered for site assessment prior to the deployments of the Pore-Fluid Array (PFA) and the Geophysical Line Array (GLA) by means of the Sea Floor Probe (SFP), in May, 2005.

This cruise, originally scheduled to effect additional deployments, was redesigned following the catastrophic 2005 hurricane season in the Gulf of Mexico. The *R/V Ocean Quest* and its two submersibles were to have been used in concert with the *Pelican* to deploy major station components and to collect the data/data-logger from the probes deployed in May. When the *Ocean Quest* was removed to Seattle for repair/renovation, the fall cruise schedule was, necessarily, altered. The mission of this *Pelican* cruise was modified to install and test the USBL navigation system. Assuming the success of the preliminary tests, the USBL was then to be used to locate cores collected in support of the site characterization studies being conducted by six Consortium member groups.

OBJECTIVES

Objectives of the cruise were to:

- install, test, calibrate and evaluate the operational capability of the Ultra Short Baseline acoustic navigation system (USBL),
- use the USBL system to simulate operation with a Station Service Device (SSD),
- collect CTD (conductivity, temperature, depth) data in support of the design of a seismic survey of MC118,
- recover sediment and water samples for geochemical, and geological analyses.

All objectives were met.

PARTICIPANTS

R/V Pelican Crew:

- Captain: Joe Malbrough
- First Mate: Steven Rodriguez
- Engineers: Jack Pennington, Chief; Ross Turlington, Brian Matthews, Assistants
- Science Technologist: Jose Montoya
- Cook: Steve Jolkie

University of Mississippi: Mississippi Mineral Resources Institute and the Center for Marine Resources and Environmental Technology (MMRI/CMRET); Seabed Technology Research Center (NIUST/STRC).

Project Management Team: Bob Woolsey, Carol Lutken, Ken Sleeper, Leonardo Macelloni.

Technical Team: Brian Noakes, Andy Gossett and Matt Lowe.

Task 1: Attachment of platform (stiff-arm) to support USBL,

Task 2: Collection of sediment (core) samples in support of site characterization efforts,

Task 3: Collection of CTD data in support of future seismic survey of MC118.

Specialty Devices, Inc. Plano TX

Technical Team: Paul Higley, Scott Sharpe.

Task 1: Installation, test, calibration and operational evaluation of the Ultra Short Baseline acoustic navigation system,

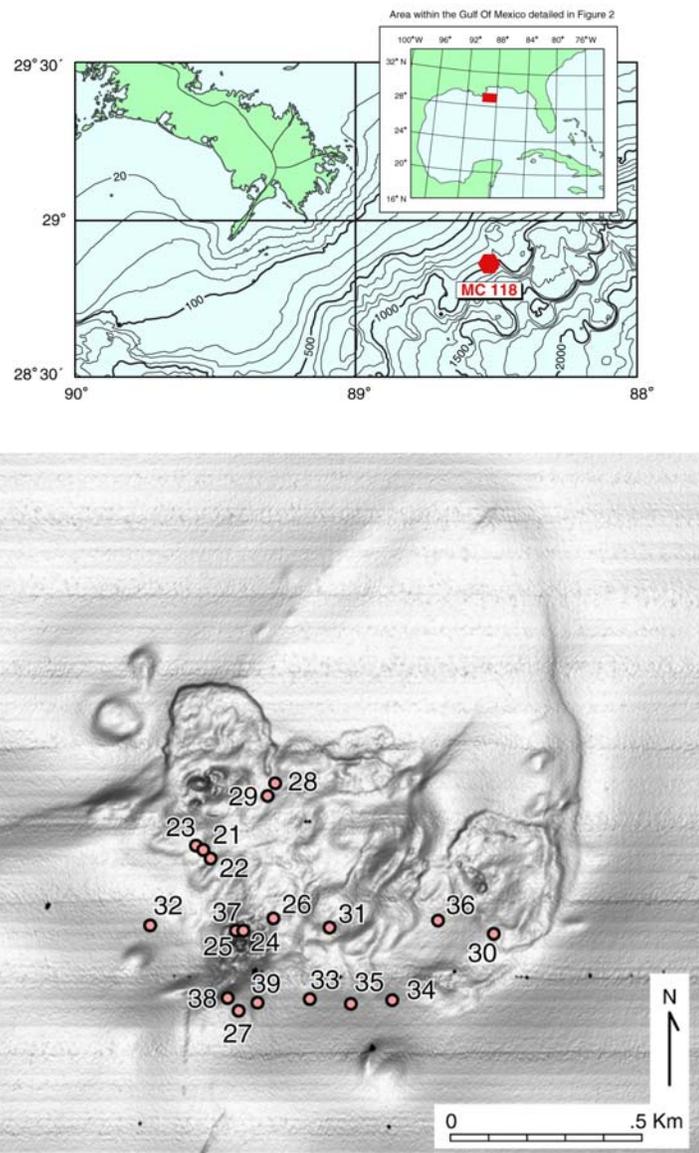
Task 2: Simulation of operation with an SSD using the USBL system.

Florida State University and University of North Carolina, Chapel Hill
Scientific Team: Jeff Chanton (FSU), Laura Lapham (UNC) and Alan Durbin (UNC)
Task 1: Collection of water and core samples for geochemical analyses.
Task 2: Collection of sediment samples for microbial evaluation.

STUDY AREA

The cruise was conducted in the northern Gulf of Mexico, Federal Lease Block Mississippi Canyon 118, (Figure 1) where gas hydrates have been documented at the sea floor by Sassen and Roberts (2004). The block comprises a portion of the continental slope with water depths ranging from 800 to 990m (2620 to 3250ft). The regional bathymetry is dominated by the Mississippi Canyon to the west; however, the block is bounded to the east by a smaller, apparently fault-controlled, canyon. The predominant seafloor feature in the block is the approximately 1km² mound in the south-central portion of the block.

Figure 1. Location of MC118 (multibeam image acquired by C&C Technologies and reprocessed by Allesandro Bosman, University of Rome and Leonardo Macelloni)



INSTALLATION, TEST, CALIBRATION AND OPERATIONAL EVALUATION OF THE ULTRA SHORT BASELINE ACOUSTIC NAVIGATION SYSTEM

Cruise objectives included the installation, test, calibration and operational evaluation of the Ultra Short Baseline (USBL) acoustic navigation system and the integration of the system with the existing GPS and heave/pitch and roll system on the *R/V Pelican* (see figures 2, 3, and 4). Another cruise objective was to use the USBL system to simulate operation with a Station Service Device (SSD) using the present station keeping capabilities of the *R/V Pelican* coupled with the USBL system and the navigation system provided by SDI. Successful simulation of the capability was essential for moving forward with the presently planned SSD configuration.

Pre-cruise efforts included;

writing a software patch program to take the output of an Ashtech heading, pitch and roll system and create a TSS style information string which could be accepted by the USBL system (SDI),
lab tests of the electronics (SDI) and
fabrication of a frame for mounting the deep transponder (CMRET).

The *Pelican's* Ashtech Heading, Pitch, and Roll unit was found to be nonfunctional. The effort to locate a replacement Ashtech unit or TSS sensor resulted in the use of units belonging to the Coastal Studies Institute (Louisiana State University). It was later discovered that the loaner was an older design than the failed original unit and would not accept some of the commands used to interface the Ashtech unit to the Linkquest software and tests of the Ashtech unit were halted. Repair and further tests of this unit will be needed if it is to be used as the heave pitch and roll sensor for the LinkQuest USBL system.

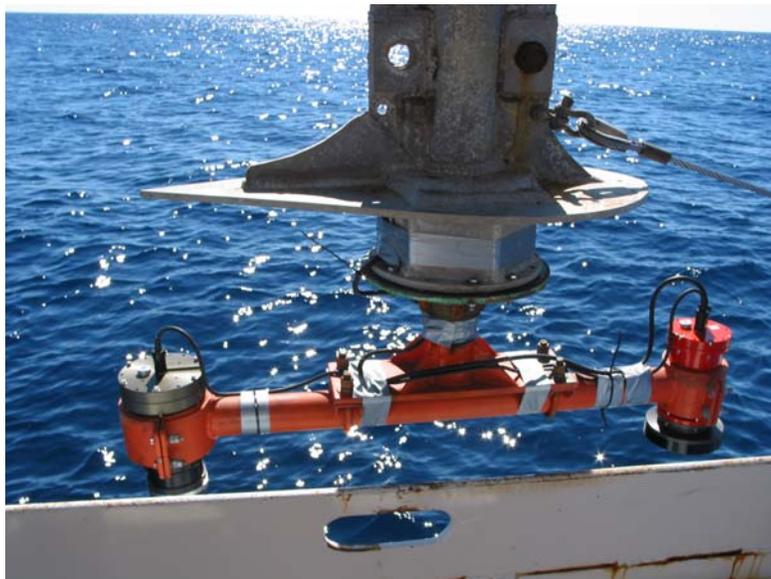


Figure 2. LinkQuest Transmitter and phased array hydrophone assembly on *R/V Pelican* stiff arm using an adapter fabricated by MMRI.



Figure 3. CMRET and SDI technical teams mount the transponder in its protective “cage.”

SUMMARY OF CTD AND CORING ACTIVITIES

Cores were recovered in support of a variety of efforts to expand the base of information available for MC118. CTD and hydrocasts are summarized in Table I and in the cruise logs in the Appendix. Nineteen cores were recovered from sites selected from the dive logs of Sassen and Roberts and from chirp profiles collected by C&C Technologies via the Hugin3000 AUV. The overarching goal was to recover material from the mound and vent areas. Core locations are plotted on the C&C multibeam data, Figure 1. The core log and descriptions appear in the Appendix and in Table II; Coring was facilitated using a ten foot (3-inch core barrel with a 2.5-inch inner diameter) PVC pipe as core liner. Coring commenced before the LinkQuest locator was fully incorporated into the navigation system but by the time the crew was ready to deploy the corer for core #24, the USBL was fully functional, all calibration tests having been completed. The USBL transponder was attached to the ship’s aft cable ~100ft above the core barrel and used to help position the vessel so that more accurate locations were possible (Figure 4). Wire was let out to within ~100m of the sea-floor and the ship positioned with the transponder directly over the target before the gravity core was allowed to free-fall to the bottom. As cores were recovered on the deck, the MMRI crew removed the core catcher, then the entire ten foot pipe from the corer (Figure 5). The core was split into 5 foot sections, capped, then split longitudinally and opened onboard by sawing down the length of the core liner on opposite sides and prying open the

resulting halves. Sediment was, in general, very sticky; numerous hands and clean tools were required to keep the splits intact and uncontaminated.



Figure 4. USBL transponder attached to the cable supporting the gravity corer.



Figure 5. CMRET technical team recovers a gravity core onboard the *R/V Pelican*.

Next, the cores were examined, visually, for signs of hydrate and/or gas expansion. If positive signs for either were observed, samples were to be taken and canned immediately, with Roger Sassen's canning machine, then frozen. If no signs of frozen hydrate or gas were observed, the split cores were to be cleaned, photographed and then sampled, according to the protocol of each group. Materials of particular interest, such as authigenic carbonate and shell material, were also bagged and refrigerated for further study. CTD casts and coring activities were dovetailed, as the activities log (Appendix) indicates. A summary stratigraphy appears in the Appendix. Brief descriptions of sampling activities for the different programs follow.

INDIVIDUAL CORING PROGRAMS

Florida State University and the University of North Carolina at Chapel Hill (geochemistry) - Jeff Chanton (FSU) and Laura Lapham (UNC-CH)

The purposes of this effort were to:

- A) collect cores to characterize geochemistry of the site in terms of methane, sulfate, chloride and dissolved inorganic carbon (DIC) concentrations, methane and DIC isotopes and porosity as a function of depth and
- B) collect water column samples for methane concentration analysis.

Sediment Geochemistry:

Core collection: 19 short (<10 feet) gravity cores were obtained at MC 118, sliced lengthwise, and sampled at ~25 cm intervals. The longest core was 155cm (Core 35) and the shortest was 22cm (core 24).

Sample collection:

9mL mud aliquots were taken for methane concentration in glass serum vials.

9mL aliquots were taken for sulfate and chloride concentrations in 15-mL falcon tubes.

9mL aliquots were collected for DIC measurements in 15-mL falcon tubes.

All samples were frozen for the duration of the cruise. They will be analyzed upon return to the laboratory.

Water column profiles.

A CTD rosette sampler was deployed 8 times and water column methane samples were collected at specific depths and placed within DO (dissolved oxygen) bottles. They were refrigerated and transported to the laboratory for analysis.

The University of North Carolina at Chapel Hill (microbiology); Alan Durbin

Four-10 mL of mud were collected while minimizing contamination. The split core surface was removed with a plastic spoon, and the sample scooped out with another plastic spoon or two, leaving a ~1cm boundary layer between the sampled mud and the PVC core tube. The sample was deposited in a 50 mL tube, the outside of which was wiped off before it was put in a -20 freezer. Each core was sampled 4-6 times; intervals depended on core length and the presence/absence of interesting features, such as reddish bands, that appeared in some of the cores or near hydrocarbon pockets.

Samples were transported back to the lab on both dry and wet ice that was frozen to -20C for ~8 hours transport time.

The University of Southern Mississippi

Samples were recovered from the tops and core-catchers of all cores and at 1m intervals, placed in zip-lock bags, labeled and refrigerated. The samples were collected in support of the MMS-funded project to define the stratigraphy and depositional history of MC118. Dr. Charlotte Brunner is PI of this project.

Mississippi State University

Samples were collected for Dr. Rudy Rogers to continue his efforts to characterize hydrate-producing sediments. Samples were collected from the tops and bottoms of each of the cores, and at 1m intervals within the cores, placed in zip-lock bags and refrigerated.



Figure 6. University of North Carolina and Florida State University researchers sample cores for geochemical and microbial analyses.

CONDITIONS AFFECTING OPERATIONS

Seas were calm throughout the cruise, at no time exceeding 2 feet, and weather was fair. Full penetration of the 3m coring device was rare, presumably impaired by the hardground of the mound at or near the seafloor. Locations were much improved with the use of the USBL location system, as the transponder was located 100 feet and immediately above the core barrel. However, further tests will be required to determine if the Ashtec device is suitable for use with the USBL in the future. Locations for the CTD casts are somewhat problematic as timing of recorded locations was not standard.

SUMMARY OF ACTIVITIES

All objectives were achieved. The USBL system will require further for future use on the Pelican but performed successfully. No hydrate was recovered in the cores but indications of hydrocarbons were abundant, particularly in the mound. Nineteen gravity cores, ranging in length from 1-156cm, were recovered from the area over and adjacent to the mound. Results of the analyses of the various sample sets will be made available to Consortium workers when the analyses are complete.

TABLE I: HYDROCASTS

Site	Date/time	Target	Drop site	First bottle location	Last bottle location	Water depth (m)	Notes
1	10/19/05 ~0200	28 51.2529 88 29.6118	28 51.315 88 29.496			890	core site 23
2	10/19 early am	28 51.8002 88 29.5848	28 51.718 88 29.922			867	north
3	10/19 early am	28 51.2743 88 29.0009	28 51.280 88 28.990			890	east
4	10/19 early am	28 50.7133 88 29.5590	28 50.711 88 29.546			927	south
5	10/19 0830	28 51.2336 88 30.2250		28 51.057 88 30.545	28 50.973 88 30.726	868	west
6 (w/USBL)	10/19/05 2028	28 51.1409 88 29.5383	28 50.5868 88 29.1988	28 51.0285 88 29.6544 (bottom)	28 51.2790 88 29.8885	901 2907'	core site 25 JSL site 6
7 USBL	10/19/05 2215	28 50.8863 88 28.9924	28 50.9101 88 28.9444	28 50.9841 88 29.2613	28 51.0616 88 29.6128	923	JSL site 6 bottom H2O
8 USBL	10/20/05 0135	28 51.0438 88 29.2126	28 51.0986 88 29.2515		28 51.1372 88 29.4403	898	

TABLE II. Summary of core locations, taken from the *Pelican's* onboard surface navigation system; depths taken from the ship's fathometer.

CORE #	LATITUDE	LONGITUDE	TOTAL LENGTH	Water depth
MC118-1005-21	28° 51.2498'	88° 29.5907'	117cm	894m
MC118-1005-22	28° 51.240'	88° 29.592'	72cm	897m
MC118-1005-23	28° 51.2565'	88° 29.6138'	145cm	894m
MC118-1005-24	28° 51.1388'	88° 29.5399'	22cm	893m
MC118-1005-25a	28° 51.1388'	88° 29.5493'	0cm	889m
MC118-1005-25	28° 51.1381'	88° 29.5493'	(5)cm	889m
MC118-1005-26	28° 51.1551'	88° 29.4879'	54cm	889m
MC118-1005-27	28° 51.0215'	88° 29.5468'	152cm	902m
MC118-1005-28	28° 51.3470'	88° 29.4898'	113cm	903m
MC118-1005-29	28° 51.3293'	88° 29.4996'	116cm	889m
MC118-1005-30	28° 51.1402'	88° 29.1340'	134cm	892m
MC118-1005-31	28° 51.1438'	88° 29.3996'	138cm	891m
MC118-1005-32	28° 51.1448'	88° 29.6905'	135cm	897m
MC118-1005-33	28° 51.0420'	88° 29.4290'	103cm	897m
MC118-1005-34	28° 51.0404'	88° 29.3001'	126cm	895m
MC118-1005-35	28° 51.0388'	88° 29.3641'	155cm	893m
MC118-1005-36	28° 51.1557'	88° 29.2240'	142cm	889m
MC118-1005-37	28° 51.1393'	88° 29.5493'	~1cm	889m
MC118-1005-38	28° 51.0431'	88° 29.5633'	89cm	899m
MC118-1005-39	28° 51.0334'	88° 29.5116'	~90cm	895m

APPENDIX: Cruise logs and notes

CRUISE LOG – USBL INSTALLATION AND TEST

10/15/05

0900: UM participants depart Oxford, MS for Cocodrie, LA

1700: SDI participants depart Plano, TX, for Cocodrie, LA

1800: UM participants arrive in Cocodrie

10/16/05

0230: SDI participants arrive LUMCON Cocodrie, LA

Begin loading and equipping the *R/V Pelican*

0900: Found existing Ashtech 4 antenna Heading, Pitch and Roll system not functional.

Loaded and set up other equipment.

Undertook search for a loaner Ashtech system or TSS sensor.

Installed the LinkQuest Transmitter and phased array hydrophone assembly on

R/V Pelican stiff arm using an adapter fabricated by MMRI.

10/17/05

Located and installed TSS unit and replacement Ashtech unit; Began interface with both. Some trouble locating adapted connectors for the Ashtech unit.

Began calibration with the TSS unit.

2100: Depart Lumcon

10/18/05

1250: Arrive on site at MC 118

1400: Lowered LinkQuest transponder and performed shallow water communications check.

Set bottom-mounted LinkQuest transponder using glass floats and Benthos releases for deepwater calibration test

Performed a drive-by calibration and calibration factors were entered.

1900: Calibration complete.

10/19/05

Triggered release and recovered the bottom transponder

Installed the transponder on a SSD simulator using 500 lb weight and 1500 lb concrete weight for “station-holding test”.

Lowered to a bottom-defined target using the transponder navigation. Landed the weight at approximately 40 feet from the target. Maintained the upper weight and the boat position within 100 feet of this target for a 1 hour period. Wind and wave conditions were favorable at less than 1 foot wave and 5 to 10 knot winds. Currents were estimated from a ship drift at 1knot.

12:15: All station-keeping stopped and the ship allowed to drift off target. Predicted cable tension indicating dragging of the bottom anchor occurred at a ship offset of 600 to 700 feet as predicted. The test SSD mooring system was recovered.

10/18/05 - HYDROCASTS

2050: Hydrocast; electrical short identified in CTD cable; continue coring while crew attempts repairs.

2320: attempt to conduct Hydrocast; cable still shorting, will take ~2 hours to repair:
Five target sites for CTD casts selected.

10/19/05

0130: crew conducted CTDs 1, 2, 3, and 4 during the early morning hours

0830: CTD cast at site 5

1920: Mount USBL transponder to CTD rosette

2028: CTD Site 6, rosette in water: Target: Sea Link 6/ core 25
deployment in water @ 28 50.5868, 88 29.1988

2125: rosette hit bottom @ 28 51.0285, 88 29.6544, 2907feet

2150: rosette on deck

2213: CTD site 7: target: 28 50.8863, 88 28.9924

2255: take first bottle @ 28 50.9841, 88 29.2613

2257: take second bottle @ 28 50.9886, 88 29.3517

2117: last bottle taken @ 28 51.0616, 88 29.6128

2130: CTD site 8: target: 28 51.0438, 88 29.2126

Cable problem: cable not wound up correctly, loops lying on deck and crossed over; have to pull out cable by hand and respool

10/20/05

0120: cable repaired,

0134: rosette in water

0201: first sample

10/21/05

0700: Arrived at LUMCON dock

TABLE A. CORING ACTIVITIES

Date: 10/18/05 (USBL not usable)

Core #	Drop time	Drop location Lat, Long, depth(m)	Bottom time	Bottom location Lat, Long, depth(m)	Recovery (cm)	Comments
21	20:03	28 51.2532 88 29.5804 893m	20:10	28 51.2528 88 29.6028 892/894(cable/fath)	117	Used ship's 10 ft core barrel; approached from NE Full penetration; brown then grey-brown mud w/shells, nodules; laminations @46-56cm; d. grey mud w/ lighter carbonate nodules@ >45cm Bottom = ship's location when core hit
22	21:15	28 51.2507 88 29.5966 899 m	21:23	28 51.240 88 29.592 885/897(cable/fath)	72	Lost top ~2cm; H2S odor; grey-brown mud w/shells, nodules; laminations @35-46cm; carbonate nodules@ >76cm Bottom = ship's location when core hit
23	22:10	28 51.2489 88 29.6930 895m	20:20	28 51.2567 88 29.6133 885/894 cable/fath	145	Brownish grades to brownish-grey v. fine mud; red layer@62-63cm;laminations, scattered black; brownish-grey laminated mud stiffer > ~60cm Bottom = ships location when core hit

Date: 10/19/05 (USBL used)

Core #	Drop time	Drop location Lat, Long, depth(m)	Bottom time	Bottom location Lat, Long, depth(m)	Recovery (cm)	Comments
24	14:05	28 51.1409 88 29.5361	14:14	28 51.1388 88 29.5399 893m 23' from target	22	Using ship's 10 ft core barrel with USBL attached (100' above); Target = SeaLink site 6 Black mud w/carbonate nodules, oil pockets; grey and black laminations, strong oil odor
25 (a)					0	Attempt to resample site 24, JSL site 6, 8.
25	15:30	28 51.1408 88 29.5383	15:37	28 51.1381 88 29.5493 889m 62.5' WSW of target (254 deg)	5	Attempt to resample site 24, JSL site 6, 8. Very sticky mixed grey and black mud; H2S odor

26	16:05	28 51.1615 88 29.4769	16:23	28 51.1551 88 29.4879 889m depth 68' 239°SW of target	54	Target = Sea link site 7 Black v. fine mud; med grey mud w/minor silt contains shell and pockets of water; interlayered light and dark grey mud w/ carbonate nodules
27	16:51	28 51.0259 88 29.5440	1700	28 51.0216 88 29.5468 902m 27ft from target	152	Fine brown mud w/very minor silt; 0-10cm lost on deck, recovered; laminations 18-26cm; banding is broader w/depth and brown mud becomes redder
28	17:25	28 51.3500 88 29.4777	1742	28 51.3469 88 29.4898 903m 67' to SW (255deg)	113	Fine brown-grey mud w/ "pin-pricks" ~10-20cm; banded/layered grey and brown mud w/some fine shell and carbonate nodules; stiff grey clay@105- 106cm;
29	18:07	28 51.3253 88 29.4912	1827	28 51.3293 88 29.4996 889m 50' to W (300deg) from target	116	Brown mud w/ minor silt; grey mud; d and light grey mud interlayered; shekk layer @21cm;vuggy spot w/ water surrounded by halo of stiff l.grey clay @38-50cm; brown layer@50-55cm; d. grey vuggy mud beneath; interlayered d. and l. grey clay; H2S odor at 80cm and 115cm.

Date: 10/20/05

Core #	Drop time	Drop location Lat, Long, depth(m)	Bottom time	Bottom location Lat, Long, depth(m)	Recovery (cm)	Comments
30			08:35	28 51.1402 88 29.1340 892m	134	fine, brown mud; interlayered brown and d. grey v. fine mud; bands of l. grey mud w/ black flecks @38-40cm; d. grey mud; red band @60-61cm; grey and reddish-brown banded mud; brown and grey interfingering v. fine muds. Saw oil slick on water surface; sulfide smell
31				28 51.1438 88 29.3996 891m	138	Oily odor. Top4cm black w/oily odor; grey mud w/ black stringers and oil pockets to 46cm;mud is lighter grey w/lighter nodules=v.dry clay/CaCO3?; darker mud, shell, shell hash, oil pockets, nodules

32				28 51.1448 88 29.6905 897m	135	Very fine brown mud to 23cm then interlayers w/grey to 55cm; red band @37-39cm; brownish mud w/darker bands to EOC
33		28 51.0391 88 29.4295	11:40	28 51.0420 88 29.4290 897m 20' @ 010' from trgt	103	v. fine brown mud w/minor silt; d. brown layer @12-14cm; interlayered brown and d. grey mud, some l. grey; black flecks @35-55cm; 68-103=v. fine brownish mud w/water pocket @75cm; >103cm laminated grey and d. grey; core-catcher full of v. sticky brownish mud.
34		28 51.0404 88 29.2965	12:10	28 51.0404 88 29.3001 895m 24' from trgt	126	v. fine loose brown mud to 12cm then interlayered w/grey mud; from 51cm, some d. grey bands and very few black laminae
35	12:30	28 51.0388 88 29.3641	12:43	28 51.0388 88 29.3641 893m	155	Loose brown mud w/minor silt to 22cm; brown and grey interfingering mud; less grey >30cm; @ 40-47cm curved dark band w/black flecks; brown and grey mud interfingering/banded to EOC
36	14:05	28 51.1494 88 29.2305	14:23	28 51.1557 88 29.2240 889m	142	v. soft brown mud w/minor silt; to ~81cm, brown and grey alternate muds stiffer than above; d. grey grades back to brown; reddish band @109-112cm; brown mud w/grey bands, black streaks.
37		28 51.1381 88 29.5492	14:50	28 51.1393 88 29.5493 889m, 7' off target		small recovery of very dark black. fine mud w/strong H2S odor. Using MMRI 3' core barrel.
38		28 51.0364 88 29.5655	About 17:25	28 51.0431 88 29.5633 904m	89	15cm wet brown clay w/silt; sand layer @10-15cm; mottled grey and brown mud to 80cm; darker grey v. fine mud to EOC. Full recovery
39	15:55	28 51.0268 88 29.5166	16:10	28 51.0334 88 29.5116 895m	90	Wet, brown mud w/minor silt (top 4cm fell out); sand @18cm; mottled d. grey, some l. grey, brown, gets darker w/depth. 75-90=CC=brown-grey.

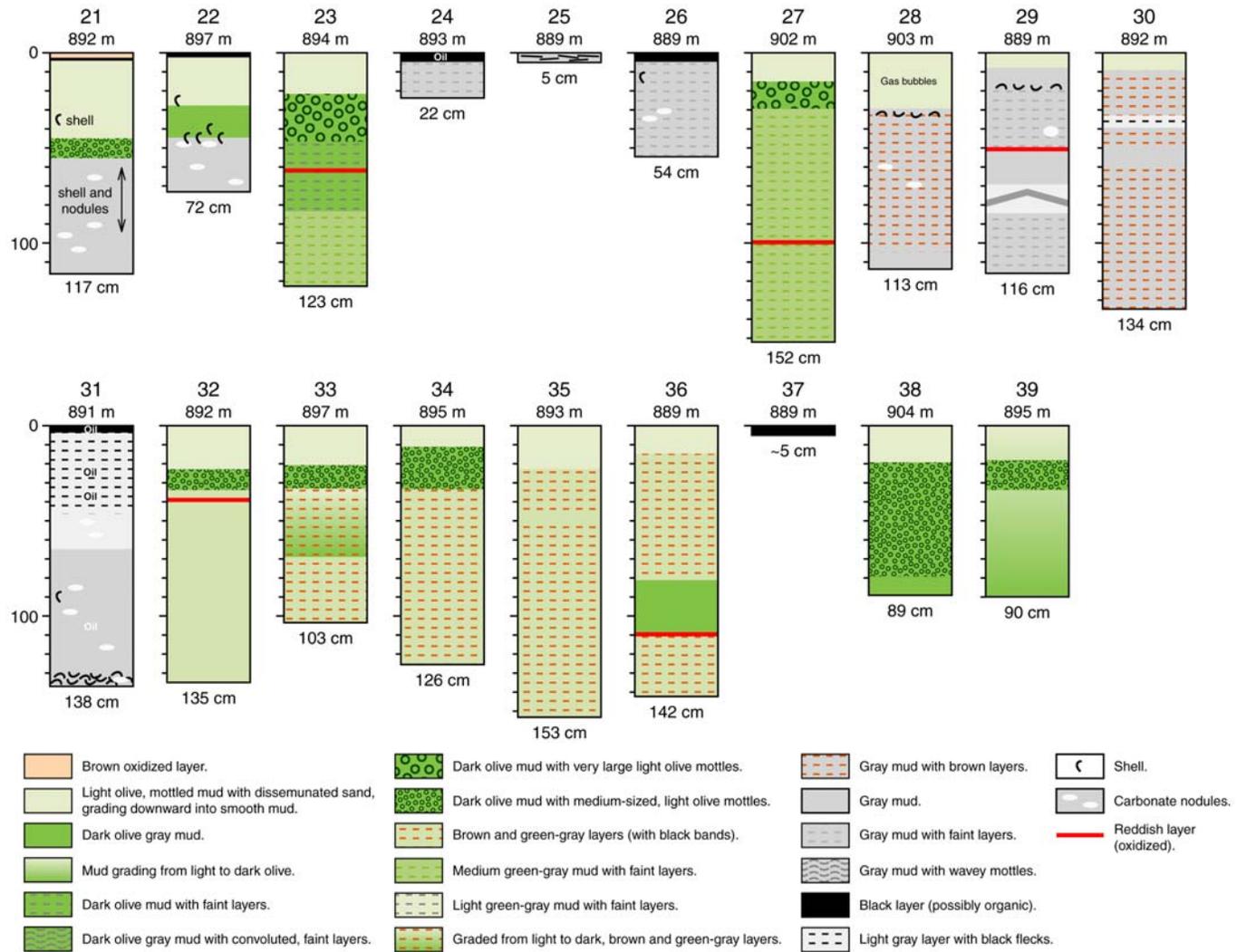


Figure A1. Stratigraphy of cores collected from MC118 during October, 2006, cruise.