Oil & Natural Gas Technology

DOE Award No.: DE-NT0005638

Cruise Report
1-19 July 2009

HYFLUX Sea Truth Cruise
Northern Gulf of Mexico

Submitted by:
Texas A&M University - Corpus Christi
6300 Ocean Dr.
Corpus Christi, TX 78412

Principal Authors:
Ian R. MacDonald and Thomas Naehr

Prepared for:
United States Department of Energy
National Energy Technology Laboratory

October 30, 2009

Office of Fossil Energy

Table of Contents

List of Figures

List of Tables

Summary

The objective of this research cruise was to collect data concerning the concentrations of methane derived from natural seeps and deposits of gas hydrate in the Gulf of Mexico. Collections were planned at the air-sea interface, the water column, and the seafloor. Team members developed innovated techniques and equipment for accomplishing these collections. The HYFLUX Hydrate observatory cruise was completed with the scientific team having occupied all of the planned sampling sites and accomplishing the great majority of planned collections. Collection of sediment cores during the first phase of the expedition was curtained due to operational constraints including weather and equipment malfunction. This deficit was repaid during subsequent days of the expedition. By the conclusion of the expedition, the science team had fulfilled their objectives. Table 1 provides a list of the major study areas occupied by the cruise. Figure 1 provides a map of the vessel track and the principal sampling sites. This report describes the major equipment used, science personnel, and summarizes the operations and preliminary results from each of the study sites. A detailed narrative lists daily activities during the cruise. Finally, the hand-written notes of the ROV dives are copied for future reference.

Study Sites

Sites were identified based on satellite remote sensing and previous knowledge of seep locations.

Table 1. Ports and sampling sites in cruise sequential order. Distance shows approximate distance from previous site.

Site	Longitude	Latitude	Water depth (m)	Dates occupied
GULFPORT	-89.0927778	30.3672222	na	Departure 4 July
MC118	-88.43859900	28.86541200	900	4-9 July
GULFPORT	-89.0927778	30.3672222	na	Repairs 10 July
MC118	-88.43859900	28.86541200	900	11-13 July
GC600	-90.56233200	27.36990000	1200	14-15 July
GC185	-91.48406200	27.77517900	550	16-17 July
FREEPORT	-95.3594444	28.9538889		Demobilize 19 July

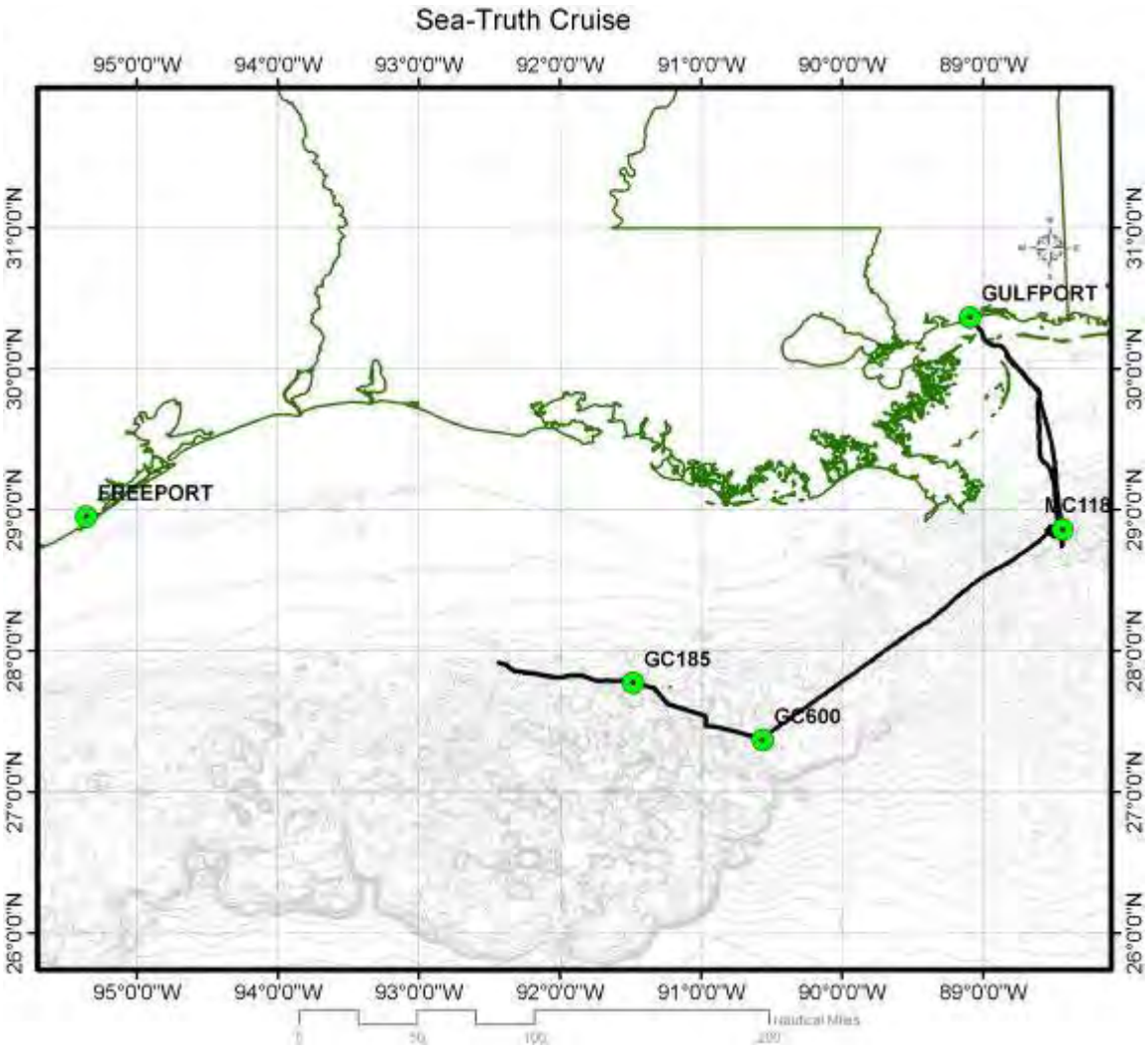


Figure 1. Map shows locations of principal sampling stations and the staging points for the cruise. Trackline indicates collections of air-sea methane concentration data, which was suspended when the expedition during the final transit to Freeport.

Participating Organizations

The HYFLUX Sea-Truth Cruise was a joint effort of the following institutions, agencies, and

- DOE National Energy Technology Lab*
- NOAA Center for Satellite Applications*
- NOAA National Institute for Undersea Science and Technology*
- Texas A&M University (TAMUCC)
- Texas A&M University – College Station (TAMU)
- Scripps Institute of Oceanography (SIO)

* Consulting on cruise planning and program execution. No cruise personnel participating.

- University of California Santa Barbara (UCSB)
- University of Southern Mississippi (USM)
- Florida State University (FSU)
- University of Mississippi, Methane Hydrate Consortium (and participating institutions)
- TDI BROOKS INTERNATIONAL (TDI-BROOKS)
- DEEPSEA SYSTEMS INTERNATIONAL (DSSI)

Major Equipment

Completing of the HYLUX cruise required charters and/or rental agreements to obtain use of several major equipment items. These

Vessel

- TDI-BI Ship, RV BROOKS McCALL was chartered for the expedition (Figure 2A).
- This ship is 155 ft, with 22 Berths available (for Sentry crew; science crew)
- Included with vessel were two winches and piston/gravity-coring equipment as well as a ultra-short baseline (USBL) submersible navigation system.

ROV

- The Max Rover work-class ROV Global Explorer (GE) was operated by a three-person team from Deepsea Systems International (Figure 2B).
- Imaging systems included video cameras recording in MiniDV and Panasonic DVCPro HD formats, Kongsberg Sector-Scanning Sonar, and digital still camera.
- Developed and fabricated specially for this expedition was a 14-bottle niskin array individually fired by commands from the ROV pilot and science staff.

Water Sampling Rosette

- This is 24-bottle rosette with a SBE911 conductivity-temperature-depth (CTD) sensor. Sampling depths were individually selected and bottles were closed with single commands (Figure 2C)

Elevator

- This device was used to deploy autonomous instruments and to recover devices previously left on the MC118 site (Figure 2D)

Surface water sampling

- The surface ocean was monitored continuously using a shipboard seawater pumping system, a Weiss-style Plexiglas equilibrator, and a fully automated GC/FID instrument, which will draw samples from a Weiss-style Plexiglas equilibrator (Fig. 2E).
- The instrument cycled continuously between ambient air, seawater-equilibrated air, and a gas standard, with a 5-7 minute cycle time from the start of one sample to the start of the next.

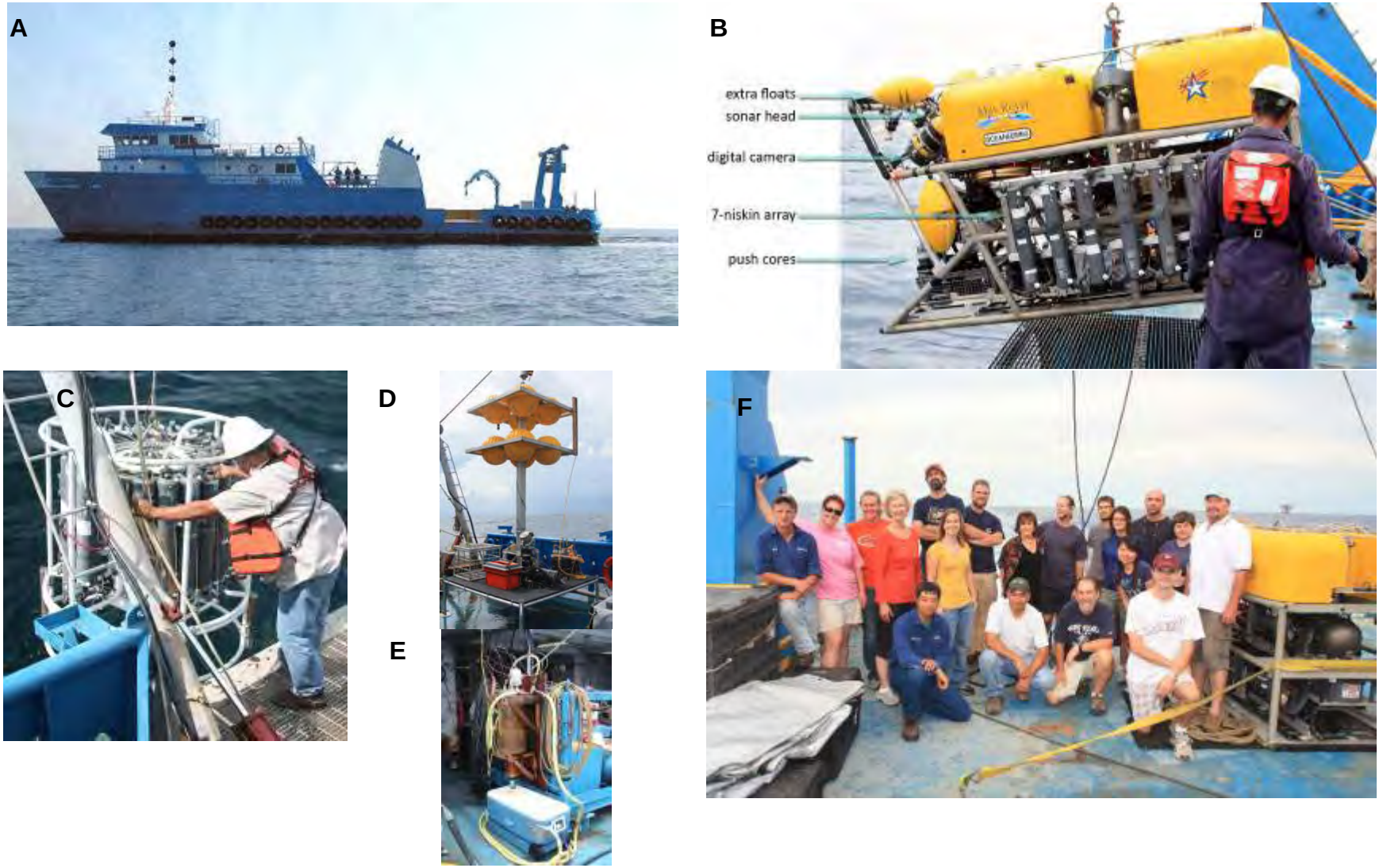


Figure 2. Principal equipment used during HYFLUX cruise. A. RV BROOKS McCALL, B. Global Explorer ROV with niskin sampler array. C. Rosette. D. Elevator with instruments and sampling equipment. E. Seawater equilibrator for surface sampling. F. Science party

Cruise participants

A total of 25 scientists and technicians staffed the cruise (Table 2).

Table 2. Cruise participants for Legs 1 & 2 with roles and affiliations.

	Name	Gender	Group	Role	Transfer
	Leg 1 MC118, Microbiology Participants				
1	**Laura Laphanm**	**F**	**FSU**	**Micro**	**off**
2	Gretchen Robertson	F	Scripps	Water chem	no
3	Miriam Kastner	F	Scripps	Water chem	no
4	Nichole Beasley	F	Scripps	Water chem	no
5	Emily Bockman	F	Scripps	Air/sea	no
6	Shari Yvon-Lewis	F	TAMU	Air/sea	no
7	Lei Hu	F	TAMU	Air/sea	no
8	Rosalie Shapiro	F	TAMUCC	Geochem	no
9	**Julia Doe**	**F**	**UGA**	**Micro**	**off**
10	**Jen Biddle**	**F**	**UNC**	**Micro**	**off**
11	Toshi Mikagawa	M	DSSI	ROV pilot	no
12	Kevin MacArthey	M	DSSI	ROV tech	no
13	ROV 3	M	DSSI	ROV pilot	no
14	Evan Solomon	M	Scripps	Water chem	no
15	John Kessler	M	TAMU	Air/sea	no
16	Paul Clark	M	TAMU	Technician	no
17	Ian MacDonald	M	TAMUCC	Chief Scientist	no
18	Oscar Garcia	M	TAMUCC	Navigation	no
19	Thomas Naehr	M	TAMUCC	Geochem	no
20	Ira Leifer	M	UCSB	Bubbles	no
21	**Marshall Bowles**	**M**	**UGA**	**Micro**	**off**
22	**Kevin Martin**	**M**	**USM**	**Bubbles**	**off**
	Leg 2 GC600, GC852, GC185, HYFLUX only				
1	Emily Bockman	F	Scripps	Air/sea	no
2	Gretchen Robertson	F	Scripps	Water chem	no
3	Miriam Kastner	F	Scripps	Water chem	no
4	Nichole Beasley	F	Scripps	Water chem	no
5	Lei Hu	F	TAMU	Air/sea	no
6	Shari Yvon-Lewis	F	TAMU	Air/sea	no
7	Rosalie Shapiro	F	TAMUCC	Geochem	no
8	**Melissa Miller**	**F**	**Scripps**	**Water chem**	**on**
9	Toshi Mikagawa	M	DSSI	ROV pilot	no
10	Chris Nicholson	M	DSSI	ROV tech	no
11	Kevin MacArthey	M	DSSI	ROV pilot	no
12	**Jeff Chanton**	**M**	**FSU**	**Micro**	**on**
13	Evan Solomon	M	Scripps	Water chem	no
14	John Kessler	M	TAMU	Air/sea	no
15	Paul Clark	M	TAMU	Technician	no
16	Ian MacDonald	M	TAMUCC	Chief Scientist	no
17	Oscar Garcia	M	TAMUCC	Navigation	no
18	Thomas Naehr	M	TAMUCC	Geochem	no
19	**Chris Stubbs**	**M**	**UCSB**	**Bubbles**	**on**
20	Ira Leifer	M	UCSB	Bubbles	no

Operations summary and preliminary results

Operations summary at MC118 (hydrate observatory)

This portion of the expedition was a cooperative effort between the HYFLUX science team and investigators in the Hydrate Observatory (HO) Consortium. Operations during the first week of our cruise were challenged by weather that made safe ROV operations temporarily unfeasible. We also had some critical equipment malfunctions. We had two ROV dives that were prematurely terminated due to buoyancy problems. We completed one ROV dive on 6 July. During this dive we located the "Rudyville" site, which had a vigorous gas plume. We collected several short cores for microbiology and made a series of water collections using the niskin racks mounted on the ROV. Despite problems, the scientific results from MC118 were very positive and the science party was in agreement that we should extend our operations there to complete a full suite of sampling.

We had to shut down diving for two days after that while we waited for improvement in the weather and worked on better procedures for safe ROV launch/recovery. Four members of the HO Consortium transferred off the ship on 9 July and were replaced by two more HYFLUX team members and Dr. Jeff Chanton from the HO Consortium. TDI-BI (the vessel operator) cooperated fully with our efforts to improve ROV operations and sent Dr. James Howell out to assist with this, but we obliged to return to Gulfport on 9 July because the ship's steering gear failed.

We left Gulfport at 9pm on 10 July and arrived at MC118 next morning. No further problems were experienced with traction winch, A-frame, crane, or rudder gear. Weather remained flat calm. We completed four more dives at MC118. Also took two short gravity cores and about 12 rosette casts. We found the active gas vent and were able to sample it several times with niskin bottles on the ROV. Surface surveys showed peaks of methane to 15ppm. The ROV niskin sampling produced peaks of methane to about 1000 nM in the water column. We were able to recover Laura Lapham's equipment using the elevator. We recovered a time-lapse camera that had been deployed in June 2008 as a free vehicle by cutting its anchor line. The camera had ~300 bottom photographs and a temperature record as was in good condition despite having been out for over a year. We recovered additional in-situ instruments that had been deployed by Chanton and Laura Lapham as part of the HO effort. We deployed an “elevator” to recover instruments and to briefly deploy the scanning sonar for acoustic quantification of bubble flow. We collected 7 gravity cores targeting sites of anomalous seismic character.

Preliminary sampling results at MC118 (hydrate observatory)

The station markers and devices deployed during previous efforts at this site were crucial aids to navigation that allowed us to locate hydrate site deposits and gas plumes. Figure 3A shows the array of stations at MC118 (Figure 3A). Surface water sample and air samples were automatically collected during most of the operations at MC118. The results showed water concentrations elevated above an expected background value of ~2nM across much of the site, with a concentration of elevated values over the seafloor locations of gas hydrate and bubble plumes (Figure 3B). ROV operations were also focused in this area (Figure 4).

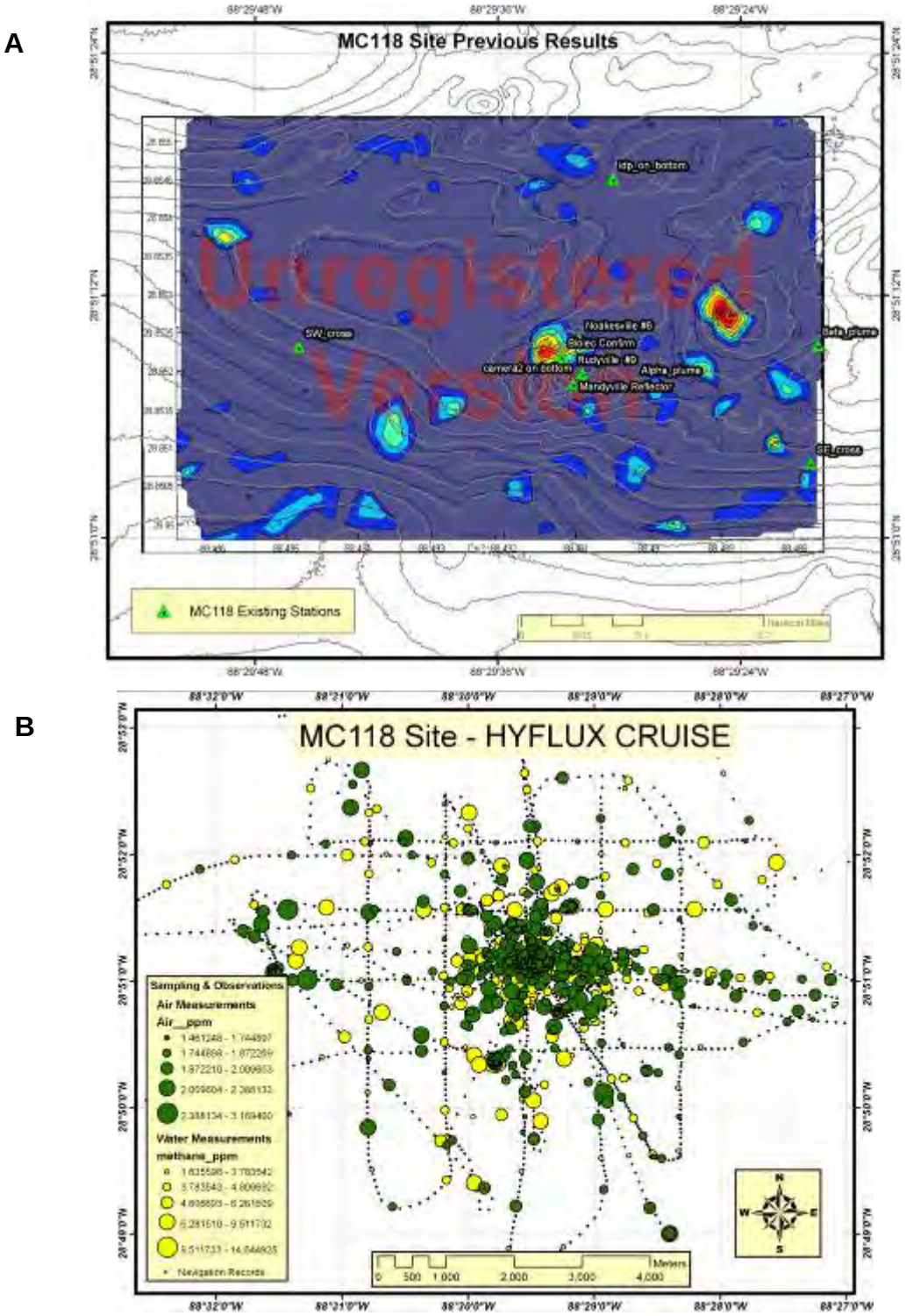


Figure 3 Operations at MC118 re-occupied many of the stations previously established at the site. An AUV survey had identified regions of high CH4 concentrations (A). Surface sampling of air-sea methane concentrations was completed in coarse and fine-scale surveys (B).

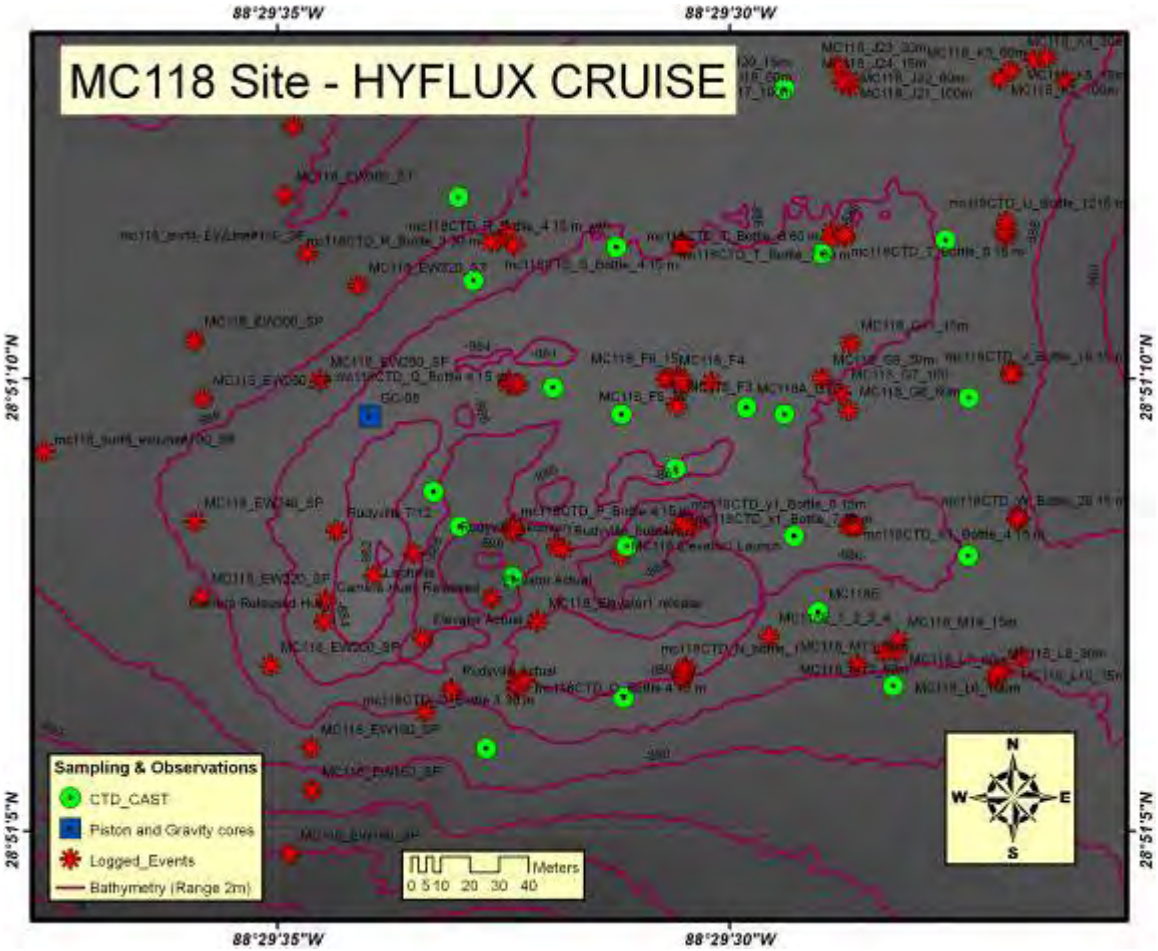


Figure 4 Locations of ROV dives (logged events) and CTD-rosette profiles concentrated near the Rudyville site.

We received a preliminary plot of bottom-water methane concentrations collected by the Hydrate Consortium with Richard Camilli's mass-spectrometer mounted on an AUV. This group had identified two plumes (Alpha and Beta) where they detected peak CH_4 concentrations. We georectified this plot (as a bit-map) based on the coordinates provided and then adjusted the position so that the bathymetric features on the Camilli map corresponded to our navigation--this resulted in a 130 m offset to the west-northwes between the two grids. One of the regions of high CH_4 corresponded closely to the location of active venting at the #9 Rudyville site (Figure 3A).

Oil drops and sheen were frequently observed reaching the surface in the vicinity of the Rudyville gas vent, where they produced a persistent oil slick. A gridded plot of the surface water CH4 concentrations showed regions of high concentrations that corresponded closely to the apparent origin of the oil on the surface (Figure 5A).

We confirmed the presence of CH_4 in the water column with ship-board analyses using a gas chronometer operated by Jeff Chanton (Figure 5B and 3C). Water samples were collected by lowering the rosette over the gas plume location at Rudyville (Figure 3B) and by visually targeting the gas plume using the ROV video and collecting water with the ROV niskin array.

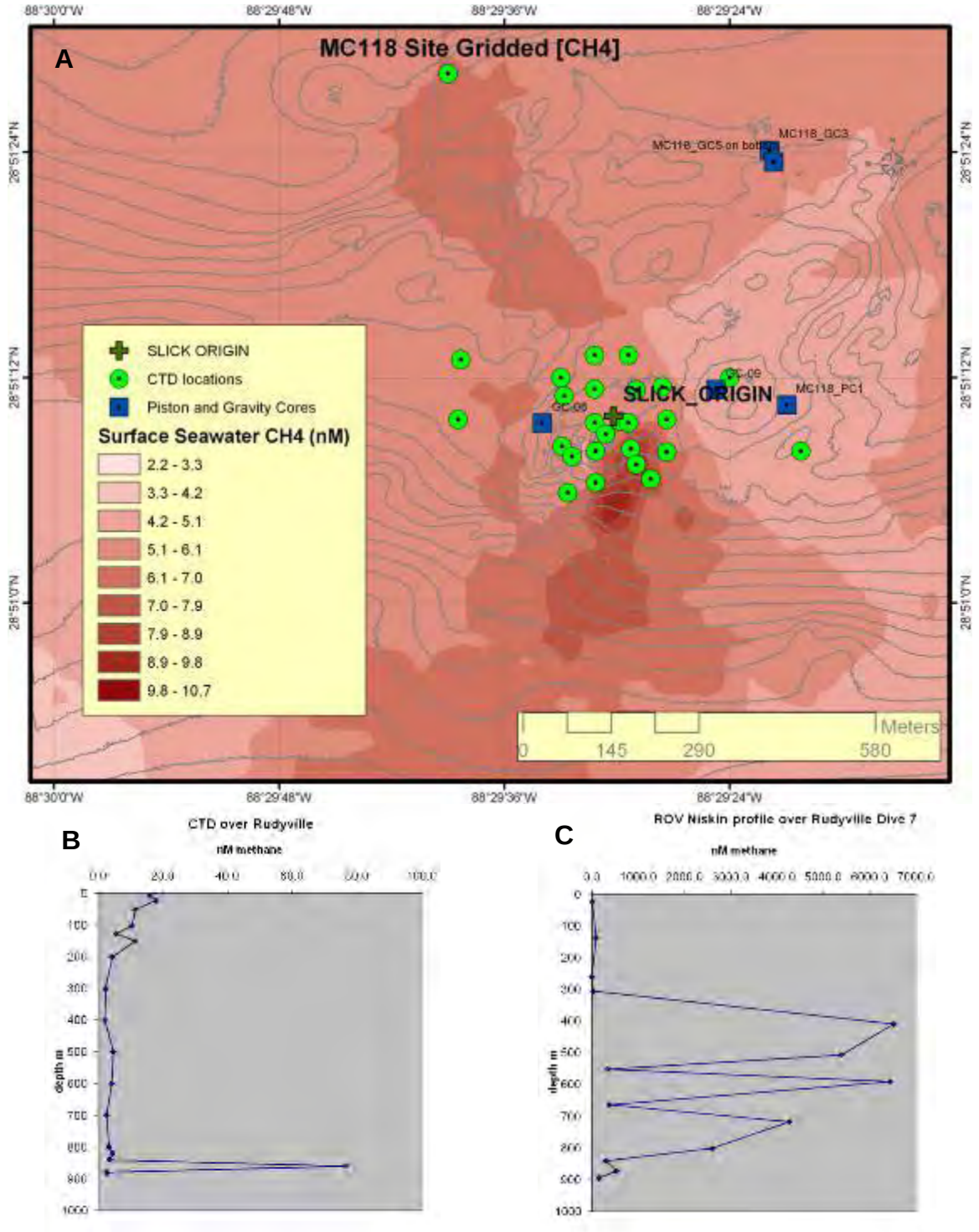


Figure 5. Methane concentrations at MC118: A. Gridded surface show preliminary distribution of surface water methane anomalies.

These preliminary results show that the water column has generally elevated CH4 values over a large area with patchy areas of highly elevated concentrations (Figure 5B).

Targeting the plume with the ROV niskin sampler, however, produced values two to three orders of magnitude greater (Figure 5C). The ROV results also demonstrate conclusively that the niskin bottles were sampling a highly localized water column feature because the values fluctuated sharply at several points in the profile where the ROV deviated slightly from the main portion of the gas plume.

Time-lapse camera deployments at MC118 (hydrate observatory)

In July 2009, during the HYFLUX cruise on board RV Brooks McCall, the Dewey System was found using the Global Explorer ROV. Further attempts to release the system acoustically were unsuccessful. The ROV then released the camera by cutting the anchor tether so that it was able to float to the surface.

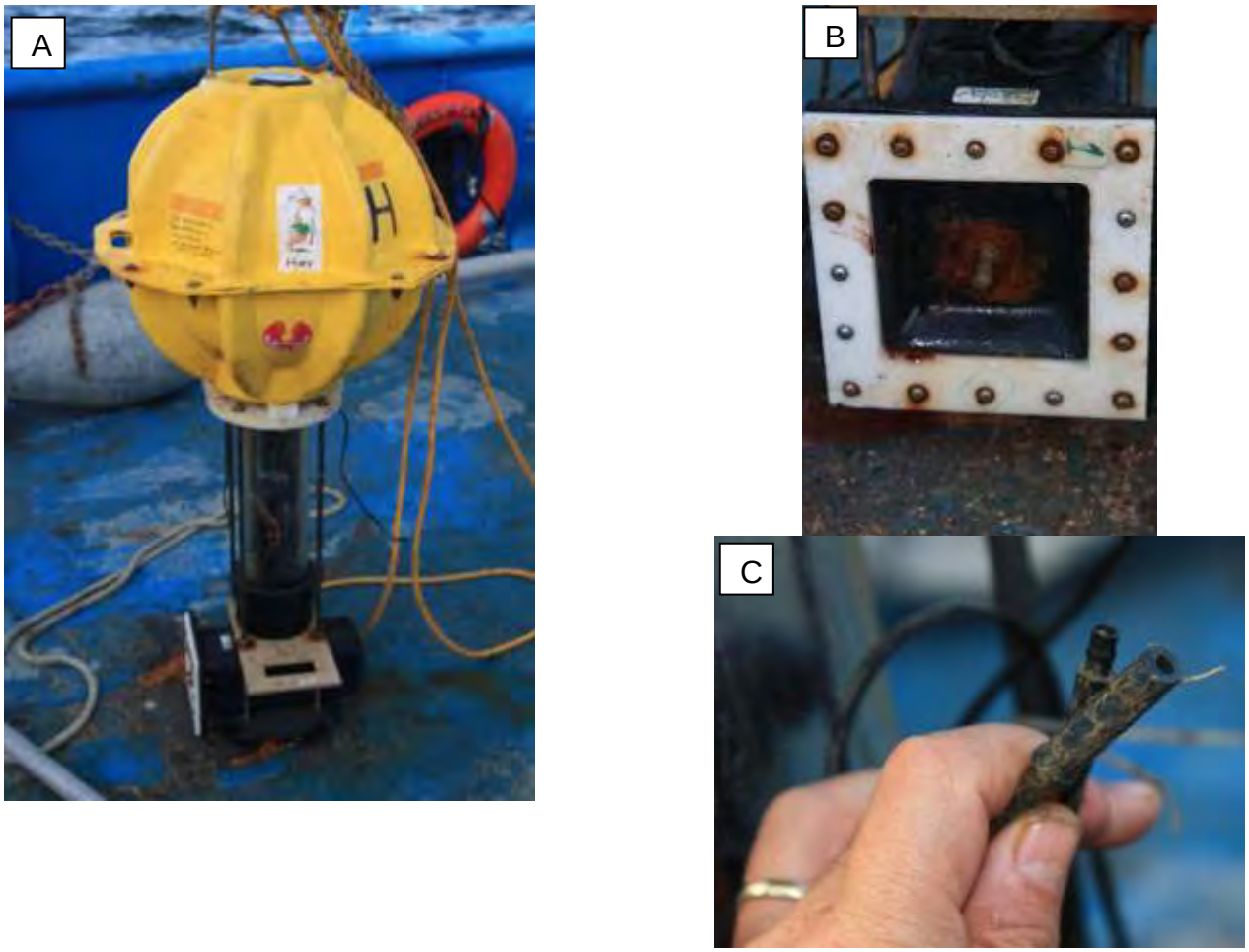


Figure 6 Huey camera system after recover from MC118, 10 July 2009 (A). B. Battery pack was flooded and corroded beyond repair. C. System failed to release because the grounding connector and corroded through--probably damage during deployment.

The camera was found to be intact and functional--no flooding or mechanical damage to the main components (Figure 6A). The battery suffered membrane failure and will need to be replaced (Figure 6 B). Failure mode for the release mechanism was a connector on

the grounding cable from the Benthos transponder (Figure 6 C). The photographs record the connector as having been broken in the earliest images from the sequence (Fig. 2). It is most likely that the connector was damaged during the deployment process and did not complete the circuit for the burn-wire release.

The camera had recorded 25 complete rotations during a 7-day interval. Unfortunately, the "blind" deployment had landed on a steep hill, so half of the images in each revolution did not show the seafloor. The seafloor in view consisted of soft mud with shells. A crab (*Chaceon sp*) and a bathygadid fish (*Coryphaenoides sp*) were captured in multiple images from the site. There were no clearly distinguishable bacterial mats visible in the images.

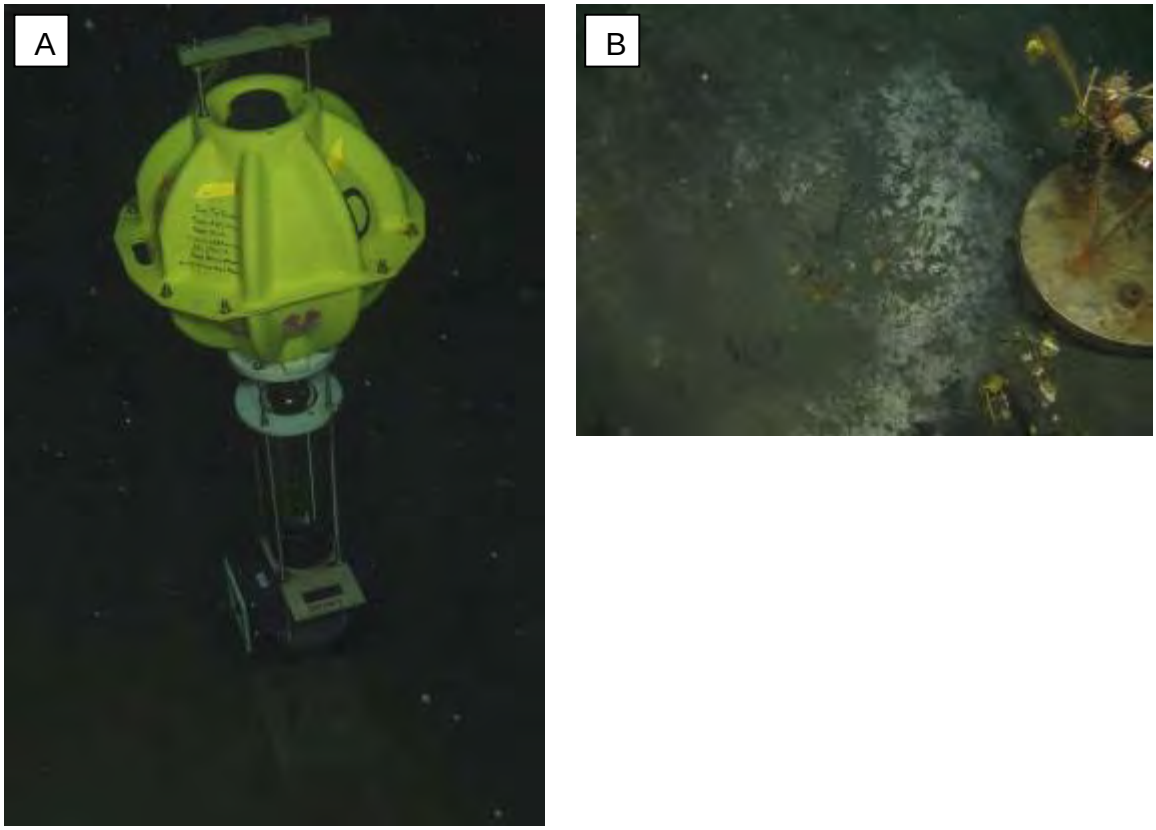


Figure 7. Deployment of Dewey camera system 12 July 2009. A. system in place on bottom. B. approximate field of view for camera (prior to removal of disused instrument array)

System Dewey had been refurbished during the interim. This system was redeployed by the ROV at the active gas vent near the Rudyville vent (Figure 7A). Rotation was fixed (no movement) and the recording interval was set to 30 min. The ROV was able to position the camera to oversee a patch of exposed hydrate, a large bacterial mat, and an active gas seep (Figure 7B). The time-base of the camera was UTC. First flash was 15:44UTC. Depth of site was The strobe was seen to flash repeatedly while the ROV was operating near the site. The depth of the site was 895 m, position 28°51.13'N

88°29.57'W. The transponder for Dewey receives on channel 14.0 and transmits on 11.0. Enable is D and release is E.

Operations summary and results for GC600 (Deep-water site)

This site targeted the source of large, persistent oil slicks observed in satellite SAR data (Figure 8A). The ship departed MC118 on the night of July 13 and transited 12h to GC600. We dived on targets developed from satellite SAR analysis and found very large oil seep with huge hydrate mound after less than 20 min of searching. The seep was less than 50m from the predicted location (Figure 8B). Further exploration located three additional vents spaced about 75m apart along a ridge-line trending to the south. This is also consistent with the satellite observations, which predicted an array of four, closely-spaced oil sources.

The hydrate mounds were associated with mussels and clam shells (no living specimens seen). Three were no tube worms and the bacterial mats were restricted to areas where apparent brine flows had reworked the surface sediment. Extensive carbonate pavements were observed near some of the hydrate mounds, including karsts-like frameworks where gas hydrate has dissolved, leaving behind carbonate lined crevices.

The exposed hydrate was unlike anything previously seen (Figure 9A). Although hydrate is typically white or stained orange-yellow if oil is present, this hydrate was black in color and appeared to be completely saturated with oil. Oil could be seen rising in continuous drops all along the edge of the big mound--which we call Oil Mountain. Also in a steady stream of large, very oil bubbles mixed relatively clean bubbles. Oily bubbles were also observed issuing in a continuous stream from a small vent located about 20 m south of the large mound.

We completed three dives at GC600. The ROV took a push core for microbiology. We collected two piston cores. We located a position where oil drops were arriving at the surface at a high rate and took a rosette cast into that position. We continued diving on July 15, collecting push cores and water samples with the ROV-mounted niskin bottles.

The transit to GC185 (Bush Hill) was conducted at ~4kt and was routed to traverse five sites where satellite data show persistent oil seepage.

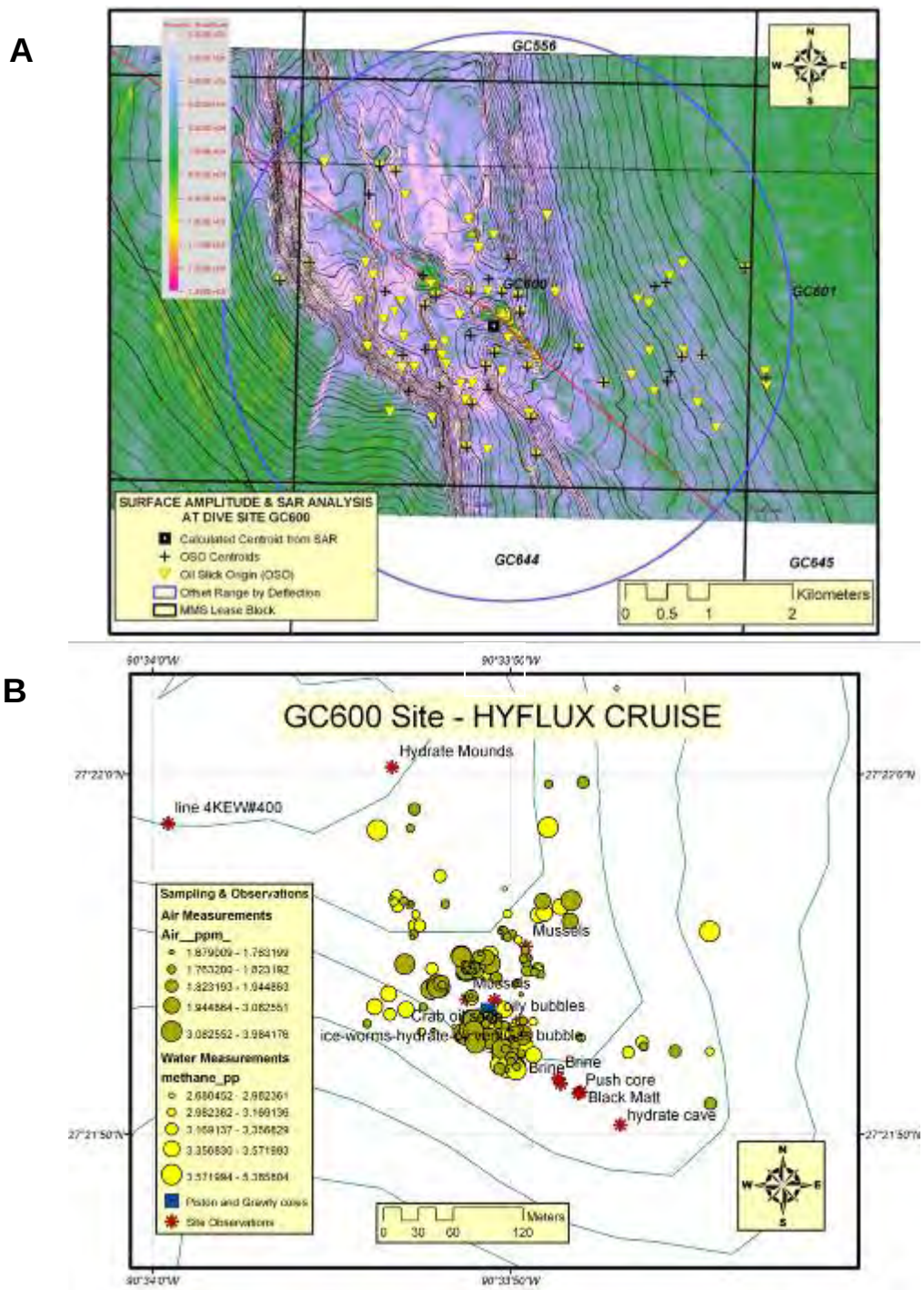


Figure 8. GC600 site. A. Results of satellite SAR analysis predicted a seep located near the center of the GC600 lease block. B. Summary of operations and findings at the GC600 site, which confirmed predictions.

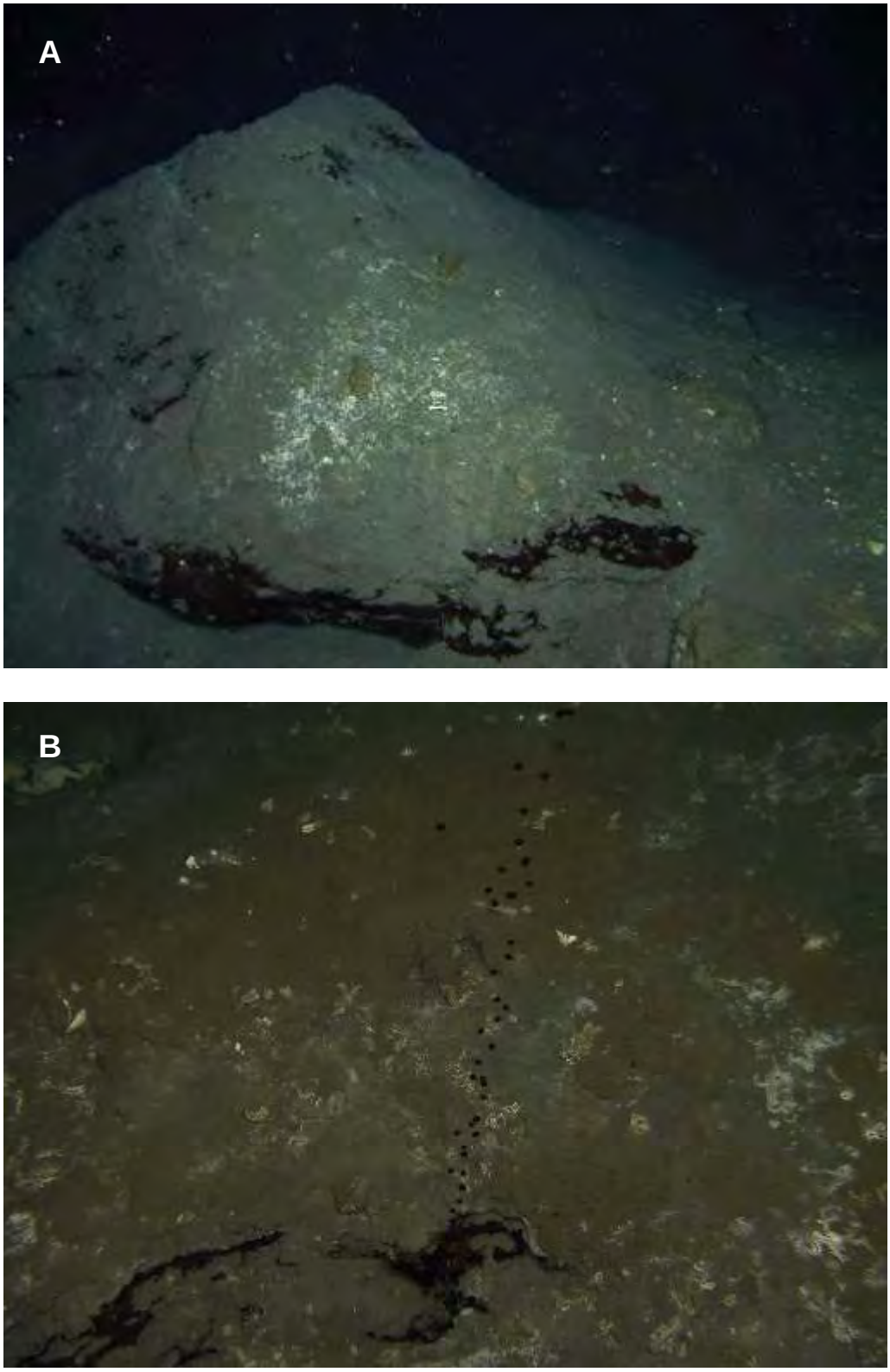


Figure 9 Hydrate features at the GC600 study site. A. Large mound of oil-saturated gas hydrate. B. Discharge of oily bubbles from vent.

Operations summary and results for GC185— (Shallow-water site)

This site (also known as Bush Hill) has been sampled in very many science projects beginning in 1986. It was chosen to provide a shallow-water example of the seep process and because the location of the gas vents was well known. The ROV collected imagery for quantifying bubble flow rates and gas flux. Four push cores were collected in bacterial mats for the microbiology effort. Four profiles of water samples (12-14 samples per profile) were collected as the ROV maneuvered in the bubble stream. Effort at GC185 concluded at 00:00 on July 17. A surface survey visiting several seeps identified in satellite data was completed during the transit back to Freeport, Texas. The cruise demobilized on 19-20 July 2009.

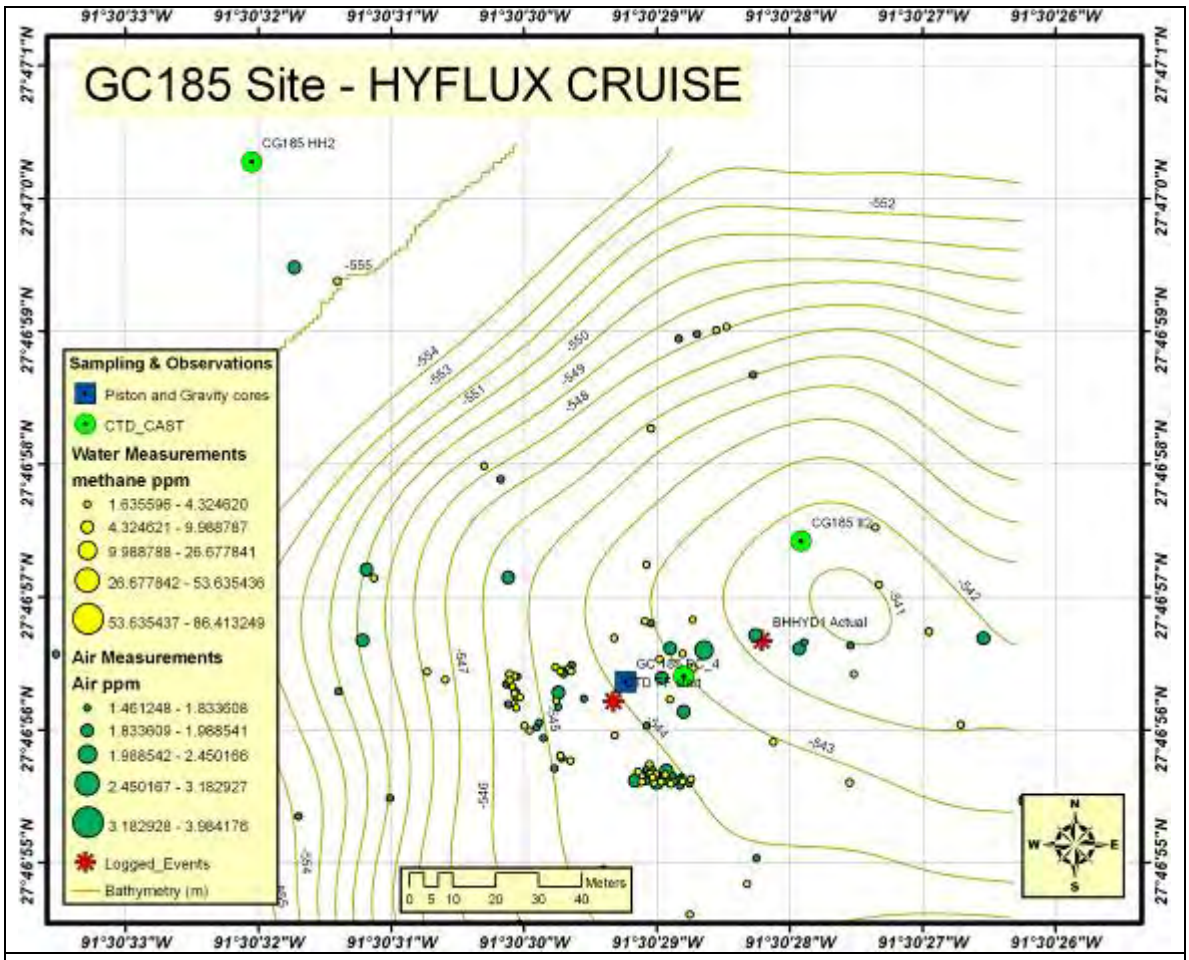


Figure 10. Summary of operations and collections at GC185 site.

Daily narrative of cruise operations

Wednesday, 1-3 July, 2009

Location and general activities

The RV Brooks McCall (BMCC hereafter) was mobilized with the ROV Global Explore (ROV hereafter) onboard. These operations were completed at the East Pier, Dock 3 of the Gulfport Municipal Port. The ROV team set up the deck winch and the top-side control system. The SeaBird 911 niskin rosette and CTD (rosette hereafter) had previously been placed onboard the BMCC and were made ready for sea. We took onboard a second oceanographic winch with conducting cable for operating the rosette. Repairs to the traction winch--used for piston and gravity coring--were completed. The Kongsberg ultra-short baseline navigation system (USBL) transponder was installed in the ship's moonpool. All science personnel reported. We completed safety briefings and orientations.

Major problems or delays

Departure was delayed by about 6 hours due to recurring problems with the traction winch. A critical piece of gear needed for piston coring was found to be missing, but there was no time to have a replacement sent. Determined to conduct gravity coring instead.

Saturday, 04 July

Location and general activities

Arrived on-station in MC118 site at 10:00 (all times in this narrative are local Cental-daylight saving time). Continued set-up of ROV in preparation for launch. There were continued problems with the traction winch and uncertainty as to whether it would function sufficiently to support coring.

ROV operations

HYFLUX 1 21:15 to 23:50 at 28°51.17' 88°29.5'
Test-fired niskin bottle array successfully.
ROV too heavy--recovery by hauling in on umbilical cable.

Air-Sea surface sampling

Not yet initiated. Set-up for instruments still in progress

Rosette-CTD samples

Two CTD casts were carried out:

mc118.cal	Jul 04 2009 15:29:30	28 51.3594	88 25.4793
mc1189acal	Jul 04 2009 23:46:24	28 51.3574	88 25.2663

Other scientific activity

Not Applicable (NA hereafter)

Major problems or delays

NA

Sunday, 05 July

Location and general activities

On station at MC118 completing background rosette casts, refining ROV configuration and USBL calibration

ROV operations

Several tests adjust ballasting. These are listed as HYFLUX 2 15:15-21:55

Air-Sea surface sampling

Initiated at end of day. Total of 13 water and equilibrator samples collected.

Rosette-CTD samples

Five rosette casts completed:

Sample designation	Date & time	Latitude N	Longitude W
mc1189acal	Jul 05 2009 14:03:42	28 50.6505	88 32.5467
mc1189acal	Jul 05 2009 15:13:10	28 50.6505	88 32.5467
mc118alfa	Jul 05 2009 17:29:15	28 51.1613	88 29.4970
mc118alfaA	Jul 05 2009 18:16:32	28 51.1357	88 29.3376
mc118E	Jul 05 2009 22:17:17	28 51.1236	88 29.4838

Other scientific activity

Preparing elevator and acoustic bubble monitoring devices.

Major problems or delays

ROV requires extended testing to adjust buoyancy. One issue is that the surface waters are relative low-salinity, so buoyancy changes significantly with depth. Traction winch continues to present problems, which has prevented calibration of the USBL system. Launch and recovery of the ROV is very difficult over the p

Monday, 06 July

Location and general activities

On station at MC118 site. Attempted elevator launch; unsuccessful due to heavy seas.

ROV operations

HYFLUX 3 19:26-23:48. Located Rudyville station despite difficulty with USBL navigation. Found timelapse camera from June 2008 deployment. Collected push cores (three successful) at Rudyville vent from bacterial mats. Collected 10 niskin bottles with ROV.

Air-Sea surface sampling

Air-sea system active all day. Processed a total of 218 water and equillibrator samples.

Rosette-CTD samples

None

Other scientific activity

Successful collection of three push cores for microbiology.

Major problems or delays

Elevator launch was unsuccessful due to heavy seas and difficulties deploying the elevator over the starboard side with the deck crane. Recovery of the ROV was difficult due to excessive movement during transit from water to deck.

Tuesday, 07 July

Location and general activities

On station at MC118. Attempting to rectify problems with ROV launch and recovery. Collected gravity cores at MC118 site

ROV operations

Suspended due to heavy weather

Air-Sea surface sampling

Completed surface survey in 5km grid covering the larger MC118 area. A total of 104 air and 103 equillibrator samples were processed.

Rosette-CTD samples

None

Other scientific activity

Collected two gravity cores near point Bravo. Both attained better than 3 m penetration. One was sulfurous.

Major problems or delays

Weather delay

Wednesday, 08 July

Location and general activities

On station at MC118. Continued heavy weather and problems with ROV launch/recovery. Collected gravity cores at MC118 site

ROV operations

Suspended due to weather and launch/recovery prolems

Air-Sea surface sampling

Totals of 105 air and 103 water samples were processed.

Rosette-CTD samples

None

Other scientific activity

Preparing elevator for launch.

Major problems or delays

ROV cannot be safely deployed or recovered using the deck crane over the port side of the ship. We are working to adapt the A-frame for launch recovery. This requires functioning traction winch and a refit of the back-deck area such a welding grating over the instrument launch shoot. In light of on-going problems, we have delayed the crew change until 9 July.

Thursday, 09 July

Location and general activities

On station at MC118. Continued heavy weather and problems with ROV launch/recovery. Personnel change. TDI representative Lara Miles has been replaced by Dr. James Howell. Conducting detailed operations review to guarantee safe and effective ROV operations.
Returned to Gulfport to repair steering gear and traction winch

ROV operations

Suspended pending operational review.

Air-Sea surface sampling

Totals of 59 air and 59 water samples were processed. A number of these samples were collected during the transit to Gulfport and revealed extremely high methane values.

Rosette-CTD samples

Completed a grid of rosette profiles and CTD casts over so-called Bravo site where oil drops were seen surfacing.

Sample designation	Date & time	Latitude N	Longitude W
mc118F	Jul 09 2009 05:48:21	28 51.16 N	088 29.52 W
mc118F2	Jul 09 2009 05:59:18	28 51.15 N	088 29.51 W
mc118G	Jul 09 2009 06:24:52	28 51.16 N	088 29.49 W
mc118H	Jul 09 2009 06:49:56	28 51.20 N	088 29.55 W
mc118I	Jul 09 2009 07:14:44	28 51.22 N	088 29.52 W
mc118J	Jul 09 2009 08:13:11	28 51.22 N	088 29.49 W
mc118M	Jul 09 2009 11:26:35	28 51.11 N	088 29.47 W

Other scientific activity

Launched elevator with acoustic bubble measurement device. Used survey information from previous dives to attempt to position it near the gas vent at Rudyville. However, it proves difficult to get it within the required ~40m of the vent.

Major problems or delays

Safety review of ROV and all deck operations. Because the cruise is short-handed, we need to ensure that all scientific personnel working on deck are aware of and following safety procedures. At 15:00 the ship's steering gear failed. Problem was traced to hydraulic rams that control rudders. Replacement parts are on-hand at Freeport Texas and were trucked over-night to Gulfport to meet the vessel.

Friday, 10 July

Location and general activities

Transit and port: Arrived in Gulfport at 11:30 to make repairs. Departed at 21:00 and transited back toward MC118.

ROV operations

None

Air-Sea surface sampling

A total of 54 air and 53 water samples were processed. Most of these samples were collected along the transit back to MC118, which followed a different route from the transit to Gulfport.

Rosette-CTD samples

None

Other scientific activity

Major problems or delays

We have lost fully over 24 hours from our schedule over and above the weather down-time. It will be necessary to extend the cruise by 2 days to make up this deficit.

Saturday, 11 July

Location and general activities

Arrived at MC118 site, operating in the vicinity of the Rudyville station 28°51.129' and 88°29.53'. Completed rosette cast and ROV dive. Released elevator with push cores and acoustic bubble sensor.

ROV operations

HYFLUX 4-- 10:24-23:30. Collected 10 niskin samples in the main plume at Rudyville vent. Found and released elevator. Found time-lapse camera that had been stuck on bottom since June. Released it by cutting the anchor tether. Recovered "peeper" pore

fluid sampler deployed during past operations at this site. Digital photographs of vent site.

Air-Sea surface sampling

A total of 108 air and 103 water samples were processed. Samples from over Rudyville during ROV operations and in a large-scale grid after vehicle was recovered.

Rosette-CTD samples

CTD cast for sound velocity.

Mc118-svp	Jul 11 2009 13:21:33	28 51.13 N	088 29.54 W

Other scientific activity

Deployed second time-lapse camera using winch and acoustic release. Camera is set for sampling at 30-s intervals. The timebase for photographs is UTC. The Benthos acoustic release is set at Rx=14.0, Tx=11.0, Enable="D", Release="E". Camera will be positioned with ROV on next dive.

Major problems or delays

Elevator was damaged during launch--one of the glass floats was broken. Further use during this cruise is not contemplated. Did successfully deploy and recover acoustic bubble sensor with this device as well as recovered Laura Lapham's pore sampling instruments.

Sunday, 12 July

Location and general activities

Continued operations in the vicinity of the Rudyville station 28°51.129' and 88°29.53'. Completed rosette casts and ROV dive.

ROV operations

HYFLUX 5-- 15:05 - 22:00, 890m depth. Deployed University of Southern Mississippi acoustic bubble sensor mounted on ROV. Collected 11 ROV niskin samples from gas plume at Rudyville. Successfully tracked bubbles to 300 m depth with use of ROV sonar. Positioned time-lapse camera at Rudyville vent site. Collected digital photographs. Avoided bottom contact to limit contact with potentially methane-contaminated sediments.

Air-Sea surface sampling

Completed large area grid over MC118 site during night-time. Totals of 84 air and 84 water samples were processed.

Rosette-CTD samples

Completed 15 rosette profiles--again attempting to collect a gridded array over locations where oil can be seen surfacing.

Sample designation	Date & time	Latitude N	Longitude W
Mc118- N	Jul 12 2009 04:37:15	28 51.1078	88 29.5196

Mc118- O	Jul 12 2009 05:01:15	28 51.0985	88 29.5449
Mc118- P	Jul 12 2009 05:22:24	28 51.1394	88 29.5498
Mc118- Q	Jul 12 2009 05:47:06	28 51.1599	88 29.1570
Mc118- R	Jul 12 2009 06:08:38	28 51.1847	88 29.5473
Mc118- S	Jul 12 2009 07:04:05	28 51.1908	88 29.5209
Mc118- T	Jul 12 2009 07:25:21	28 51.1896	88 29.4830
Mc118- U	Jul 12 2009 07:45:41	28 51.1921	88 29.4603
Mc118- V	Jul 12 2009 08:06:42	28 51.1631	88 29.4560
Mc118- W	Jul 12 2009 08:26:51	28 51.1340	88 29.4562
Mc118- X2	Jul 12 2009 10:31:06	28 51.1376	88 29.4882
Mc118- Y1	Jul 12 2009 10:51:19	28 51.1358	88 29.5190
Mc118- Z	Jul 12 2009 11:12:10	28 51.1630	88 29.6415
Mc118- AA	Jul 12 2009 11:31:51	28 51.2167	88 29.6394
Mc118- BB	Jul 12 2009 11:52:33	28 51.1636	88 28.5177

Other scientific activity

Bubble-quantification with

Major problems or delays

None

Monday, 13 July

Location and general activities

Continued operations in the vicinity of the Rudyville station 28°51.129' and 88°29.53'. Completed rosette casts and ROV dive. Gravity coring over night.Deployed University of Southern Mississippi acoustic bubble sensor mounted on ROV. Launched the ROV twice to increase niskin sampling. Transited to GC600 site at conclusion of ROV operations.

ROV operations

HYFLUX 6-- 15:00 - 19:30, 890m depth. Collected 13 ROV niskin bottles in plume. Successfully following bubbles to ~100m depth using video and sonar. Avoided bottom contact.
HYFLUX 7 20:00 - 21:54 880m depth. Short dive to collect push core for U. Georgia, Athens. Collected single short core at Rudyville vent. Collected 14 niskin bottles in plume. Successfully tracked bubbles to 136m depth. Final niskin bottle at 25 m.

Air-Sea surface sampling

Totals of 39 air and 39 water samples were processed. System suspended for maintenance and to allow rapid transit.

Rosette-CTD samples

Collected 4 background rosette profiles.

Sample designation	Date & time	Latitude N	Longitude W
Mc118- SEEPC	Jul 13 2009 12:44:28	28 51.47	88 29.65
Mc118- SEEPB	Jul 13 2009 14:14:37	28 51.20	88 29.40
Mc118- SEEPBG	Jul 13 2009 16:08:35	28 51.1458	88 29.5546

Mc118- SEEPBG3	Jul 13 2009 16:31:43	28 51.1649	88 29.5326

Other scientific activity

Two gravity cores collected during the night.

Major problems or delays

Tuesday, 14 July

Location and general activities

Transit to GC600 sampling site at 27°21.91' and 90°33.85'. ROV dives to explore suspected seep location successfully located major seep vents along ridge-line.

ROV operations

HYFLUX 8-- 16:10 - 23:52, 1230m depth. Found very active oil and seep with massive gas hydrate deposit. Seep was found at precisely the predicted location on the seafloor--confirming the predictive ability of the satellite interpretation. Gas hydrate was noteworthy for being saturated with oil to the point that it was black in color. Collected 11 ROV niskin bottle in plume. Following this plume was difficult, but samples near bottom were in plume. Chemosynthetic fauna was restricted to mussels and Calyptogena shells.

Air-Sea surface sampling

Totals of 92 air samples and 94 water samples were processed.

Rosette-CTD samples

One background rosette profile

Sample designation	Date & time	Latitude N	Longitude W
Mc118- CC	Jul 14 2009 04:06:31	28 25.5374	89 08.0172

Other scientific activity

Collected push core for microbiology. Piston cores for pore fluid sampling.

Major problems or delays

None

Wednesday, 15 July

Location and general activities

GC600 sampling site near 27°21.91' and 90°33.85'. Completed two ROV dives, air-sea sampling in vicinity of surfacing oil drops. Three piston cores.

ROV operations

HYFLUX 9-- 16:10 - 23:52, 1230m depth. Video and sonar quantification of bubble and oil plumes was completed with ROV at main site. Careful digital photo documentation of large hydrate deposit. Oil flow from hydrate and nearby vent continuous. Collected 13 ROV niskin bottles in plume.

HYFLUX 10-- 16:10 - 23:52, 1230m depth. Additional video documentation and quantification of bubble flows. Collected 14 ROV niskin bottles in plume.

Air-Sea surface sampling

A total of 96 air and 97 water samples were processed targeting location of surfacing oil drops.

Rosette-CTD samples

Sample	Date time	Latitude N	Longitude W
GC600EE	Jul 15 2009 15:00:28	27 22.12	90 32.78
GC600EE	Jul 15 2009 15:00:28	27 22.12	90 32.78

Other scientific activity

Piston cores (2) for pore fluid and hydrocarbon sampling.

Major problems or delays

UC-Santa Cruz acoustic instrument has proven inoperable despite numerous tries to make it work on the ROV. This portion of the project will have to be completed with visual data.

Thursday, 16 July

Location and general activities

Transiting slowly to GC185 site to allow surface air-sea survey. Arrived at GC185 at 15:00 27°46.9' and 91°30.5'. Completed ROV dives and other sampling operations.

ROV operations

HYFLUX 11-- 18:53 - 20:45, 545m depth. Located main vent at BHHYD1 station. Completed inspection of site where previous DOE work was carried out. Gas hydrate mound has disappeared although gas venting continues. Collected 13 ROV niskin samples in plume--tracked plume almost to surface.
HYFLUX 12-- 22:20 - 00:00, 540m depth. Collected 2 push cores in white mat. Collected 13 ROV niskin samples in plume. Were again about to track plume almost to surface.

Air-Sea surface sampling

Totals of 100 air and 101 water samples were processed.

Rosette-CTD samples

Collected one background rosette profile.

Sample	Date time	Latitude N	Longitude W
CG185 FF	Jul 16 2009 21:49:24	27 46.94	91 30.48

Other scientific activity

Found tube worm settlement array of Bob Carney. Appears intact. Juvenile tube worms were visible. Took piston core to East of main vent. Took piston core to east of main area.

Major problems or delays

Friday, 17 July

Location and general activities

Remained GC185 near 27°46.9' and 91°30.5'. Completed ROV dives and other sampling operations.

ROV operations

HYFLUX 13-- 16:37 - 19:30, 545m depth. Took push cores in orange and white mat. Relocated main vent and performed visual quantification of bubble flow. Collected 13 ROV niskin samples in plume.
HYFLUX 14-- 20:50 - 23:50, 545m depth. Survey of northern portion of GC185 site. Detailed video of large carbonate outcrop. Visual quantification of additional vent plumes. Collected 14 ROV niskin samples in plume

Air-Sea surface sampling

Totals of 87 air and 89 water samples were processed including samples in transit 55 nmi west from GC185 site.

Rosette-CTD samples

Collected profiles over site and targeting areas of surfacing oil drops.

Sample	Date time	Latitude N	Longitude W
CG185 GG	Jul 17 2009 18:02:30	27 47.728	91 31.297
CG185 HH	Jul 17 2009 18:06:22	27 46.609	91 29.682
CG185 HH2	Jul 17 2009 18:12:15	27 47.0046	91 30.5342
CG185 II	Jul 17 2009 18:33:10	27 46.591	91 29.705
CG185 II2	Jul 17 2009 18:55:23	27 46.9570	91 30.4653
Gc135JJ	Jul 17 2009 19:20:26	27 46.576	91 29.671
Gc135KK	Jul 17 2009 19:41:33	27 46.579	91 29.657
Gc135LL	Jul 17 2009 20:08:02	27 46.548	91 29.690
GC135MM	Jul 18 2009 06:12:48	27 49.7016	91 52.7985

Other scientific activity

NA

Major problems or delays

None

Saturday, 18 July

Location and general activities

Transit and demobilization

Sunday, 19 July

Location and general activities

Return to Freeport, Texas and demobilize cruise.

Table 3. Gravity cores(GC) and piston cores (PC) collected during the

Core	date	lat	long_	Latitude	Longitude
MC118_GC1	7/7/2009	28 51.1757	88 29.3495	28.852928	-88.4892
MC118_GC2	7/7/2009	28 51.6016	88 29.1663	28.860027	-88.4861
MC118_GC3	7/8/2009	28 51.4019	88 29.3646	28.856698	-88.4894
MC118_GC4	7/8/2009	28 50.7675	88 29.2871	28.846125	-88.4881
MC118_GC5	7/8/2009	28 51.3916	88 29.3610	28.856527	-88.4894
GC-08	7/13/2009	28 51.1596	88 29.5663	28.85266	-88.4928
GC-09	7/13/2009	28 51.1892	88 29.4122	28.853153	-88.4902
PC_GC600-1	7/15/2009	27 21.8909	90 33.8438	27.364848	-90.5641
PC_GC600-2	7/15/2009	27 21.8876	90 33.8428	27.364793	-90.564
PC_GC600-3	7/16/2009	27 21.8883	90 33.8461	27.364805	-90.5641
GC 185 PC_4	7/17/2009	27 46.9393	91 30.4873	27.782322	-91.5081

Written dive notes.

HYFLUX ROV LOG

Dive	1	Site	MC118	Latitude	28°51.17'
Date	7/4/2009	Logger	JRM	Longitude	88°29.5

Time Local	Depth m	Sample	Comment
2125	0		Launch – fairly smooth some
			Comm issues w/ Radio & accent
2155	867		Moving ROV to Center of Calibration Circle
2200	870		ROV slowly sinking at 10% up thrust
			Forgot to Calculate for weight of Niskin Bottles
2209	872		ROV on Bottom
2210			Pulling ROV up By Drop Weight
2212	871		All Stop Ship Moving to Location
2218	835		Fired Niskin #1, 2, 3, 4, 5, 6, 7 Starboard
			Coming up Slowly
2222	827		Firing Niskin #1, 2, 3, 4, 5, 6, 7 Port
			↑ Miss Fire ↓ Miss Fire
			~~Coming up Slowly Full Thrust up~~
2236	840		Directly under Clump weight
2240	819		Coming up slowly
2250	500		" "
2303	100		Stop winch, drive ROV to stern, look @ clump weight
2313	140		look @ weight
2348	0		Surface, power off ROV
2350	0		on deck

HYFLUX ROV LOG

Dive	2	Site	MC118	Latitude	28°51.17'
Date	7/5/2009	Logger	JB	Longitude	88°29.5'

Objectives
Calibrate USBL
Recover instruments
ROV cores
Scout plume site Alpha–water collections if found
Scout plume site Bravo–water collections if found

Time (local)	Depth	Sample	Comment
15:15	0		Launch in water – too heavy, pull back on deck (to 20)
15:49	0		2nd launch float test
15:58	0		Back on ship to change hook
			is current too strong? – water spouts + oil slicks are distracting
			~~ weather kicked up, scrap plans
17:12			3rd float test
17:20			Back on deck
20:00	41		4th Xsea launch
20:23	561		Sonar file saved C:/Desktop/ROV2
20:29	717		Dive to clump weight
20:46	867		Too much flotation, prepare to raise
21:02	601		Still rising, lost beacon signal
21:05	461		beacons are back
21:15	200		vehicle 200m bsl
21:18	100		winch all stop
21:45	0		vehicle on surface
21:55			back on deck

HYFLUX ROV LOG

Dive	3	Site	MC118	Latitude	28°51.17'
Date	7/6/2009	Logger	Jen	Longitude	88°29.5'

Objectives
- Calibrate USBL
- Recover instruments
- ROV cores
- Scout plume site Alpha--water collections if found
- Scout plume site Bravo--water collections if found

Time	Depth	Sample	Comment
19:26 PM	0		~~Sub~~ ROV in water
19:45	450		going down P50 stop word
19:57	860		~~start tape D3A~~
			sonar file C//Desktop/gulfdive3
20:06	836		winch all stop, see clump weight
20:21	865		pick up sonar, see clump weight 30m off bottom
20:25	893		seafloor
20:30	897		head to radar/sonar reflector
20:32			start tape D3A
20:35	892		crater / mat, mussels, clams
20:36	892		crabs, BFR (big fin rock)
20:46	862		clump weight again → no nav yet
20:53	869		find marker 9 - Rudyville 270 heading
20:58	895		see camera
21:09			HD on - pics of camera stopped 3:20
21:11	897		see acoustic crate Rudy's hydrate machine/osmosampler
21:14			hydrate - yellow HD on 3:42 stop
21:17			bubbles 3:46 - 5:09
21:22			core 1 outside mat
21:30			core 2 grey mat

HYFLUX ROV LOG

Dive	3	Site	MC118	Latitude	28°51.17'
Date	7/6/2009	Logger	JER	Longitude	88°29.5'

Objectives
Calibrate USBL
Recover Instruments
ROV cores
Scout plume site Alpha--water collections if found
Scout plume site Bravo--water collections if found

all @ Ruby site

Time	Depth	Sample	Comment
2134	898		core 2 in sediment, grey area
2135			tape stopped, start tape D3R 937
2141			core 2 in gulper
2142			core 3 in sediment thick white mat
2148			core 3 in gulper
2149			core 5 moving to place
2158			fish (40'd it)
2210			core 5, white mat, close to hydrate
2214			core 5 fell out, stopped - 8cm in, move to larger mat area
2215			5:52 #8 close up on hydrate 6:08
2219			dropped core 5
2220			pick up core 4, in sediment fluffy mat
2223			lost core 4
2229			core 6 in sediment
2235			core 6 in gulper, some fell out
2239			change tapes, start tape D3C 10:39am
2249			give up fight to get core #5, leave in mat near hydrate mound
2259			back @ marker 9

see back to back

time	depth	Comments
2302	895	Fire S2 in bowl of Rudyville
		* S1 was accidentally fired
2307	900	bubble plume
2310		double bubble plume
2313	895	S3 fired
2315	875	S4 fired * outside plume?
	850	bubbles HD
	700	Bubble visible
2329	647	P-2
2333	558	P-3
	482m	Just saw big burst of bubbles
2336	432	more bubbles HD Video
2340	399	P-4
2348	275	P-5
2359	125	P6 still seeing occasional bubbles

HYFLUX ROV NISKIN LOG

Dive	3	Site	MC118	Latitude	28°51.17'
Date	7/6/2009	Logger		Longitude	88°29.5

Bottle	Time	Depth	Comment
S1	?	?	accidentally fired
S2	2303	899	Fired in bowl of Rudy in Ice
S3		895	S3 fired in plume
S4		875	S4 fired - just outside plume?
S5		850	
S6		800	
S7		700	P side 1 ~~115~~
P1		650	P-2
P2		551	P-3
P3			
P4			
P5			
P6			
P7			

HYFLUX ROV LOG

Dive	3	Site		Latitude	28°51.17'
Date	7/6/2009	Logger		Longitude	88°29.5'

Objectives
Calibrate USBL
Recover instruments
ROV cores
Scout plume site Alpha--water collections if found
Scout plume site Bravo--water collections if found

Time	Depth	Sample	Comment
2125	898		Core 1 outside mat
2129	898		core 1 in quiver
2131	898		core 2 in grey area next to mat
2141	898		Core 2 in quiver
2142	898		Core 3 in sediment thick white mat stopped pushing core
2148	898		Core 3 in quiver
2219			dropped core 5
2233			lost core 4, most fell out
2229	898		Core 6 in fluffy white sediment

/

HYFLUX ROV LOG

Dive	4	Site	MC118 RUDYVILLE	Latitude	28.85215
Date	7/10/2009	Logger	JKM	Longitude	-88.492165

Objectives

1. find rudyille and elevator - Note direction from sonar to bubble plume
2. bubble flux measurements
3. push cores from elevator (6)
4. recover peepers & osmo lander
5. release camera
7. More push cores
8. ROV niskins in plume

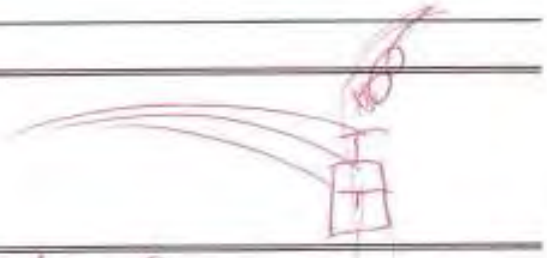
Time Local	Depth	Sample	Comment
1024L	—		Launch — very smooth
1049	636	—	Oil drops on surface
1102	892		On bottom - untangle cable search elevator
11[illegible]	894		at Elevator Transponder
			ball at angle (patch missing) Missing milk
			crate  180°T
			burn cable cut — 28°51-1283' 88°29-548'
1124			at elevator - removing remaining
1130			possible foul release line.
1138			definite foul release line great chance
			of accidental release. - maneuvering back
			to Rudy ville bubble stream.
1145			dump weight on bottom
1154	894		looking for vent. — h
1205			still looking for vent.
1215		Tape B	Start new tape - back at elevator
1231	896		still looking
1254	896		still looking gorgonian
1313	891	F10	Lophelia colonies - Hi def still photos

21 51.1303 88 29956

HYFLUX ROV LOG

Dive	4	Site	MC118	Latitude	
Date	7/10/2009	Logger		Longitude	

Objectives 1. Bubble flux



Time	Depth	Sample	Comment
1317	892		Start Tape C
1329	896		At Laura's osmo lander
1336	898		Not osmo-lander - Nekesville
			recovering peeper 28° 51.134' 88° 29.5583
1350	899		Placing peeper at elevator
1404			capture peeper in box
1406			Going to clump weight
1417	899		At RTLC site - burn wire
			cable detached from
14:27	901		Starting Tape D
			9:45:00 end bubbles w/Funnel
			11:37:00 start bubbles w/Funnel
14:54:08			15:03:00 sea bed characterization
15:20			Push core to test oiliness
15:28:30			Digital Photos
21:45			A piece of yellow hydrate floated with the push core
15:31:			Almost back in
15:35			PC with hydrate in place
15:45			Starting Tape E inserted
			started to take PCs near bubble plume

HYFLUX ROV LOG

Dive	4	Site	MC 118	Latitude	
Date	7/10/2009	Logger	Near bubble plume	Longitude	

Objectives

Time	Depth	Sample	Comment
3:45 pm	904	PC#1	Near plume close to hydrate outcrop, about half full
	"		
3:55	"	PC#2	Near PC#1, fuel
4:05 pm	"	PC#3	Near the above PCs
4:15	"	PC#4	For Tom, Near above 3 PCs
4:20		Pick up Peeps	Peeps pick-up, = Laura's people. The top of it broke off. Decided to leave it.
4:35			Picked up ~~A~~ milk-crate and moved it to the elevator. Reached the elevator at 4:45pm. Working on clipping it to the elevator.
4:55 pm			Transport to pick-up Ian's camera
			on way reached Marker #1 at Mandyville. N28 51.6031 W088 29.1654.
5:03			Found Ian's camera, transferred to elevator, but it could not be safely placed on it. The decision was to cut the rope and let it float to the surface.
5:30			Trying to cut rope to release camera
			it was cut at 5:35 pm and camera floated

HYFLUX ROV LOG

Dive	4	Site	Mc 118	Latitude	
Date	7/11/2009	Logger	JM	Longitude	

Objectives

Time	Depth	Sample	Comment
18:00			recovered camera
18:15	550		Push core containing hydrate came loose and fell to bottom
18:40	891		at bottom
18:48	894		Start Tape 61
18:44	896		Trying to right PC milk crate on elevator
18:55			crate free
19:10	896		At elevator – manipulating pc rack
19:29			Picked up milk crate dropped push core – hard to take thing on/off elevator Navigation very limited – can't find Rudyville
19:55			Very limited what we can do w/ ROV
2023			Released weight
			Page of

At bubble plume

HYFLUX ROV ~~CORE~~ LOG

Dive	4 Rudyville Site	MC118 Rudyville	Latitude	
Date	7/12/2009 Logger		Longitude	-88.492165

Time	Core ID	Depth	Sample	ROV/Elevator	Comment
10:30 pm					Hydrate in push #2 core through funnel,
					Lost some hydrate when core placed in place
10:40 pm					Ascending with ROV to surface in
					Plume, then straight-up, while triggering
					the Niskin bottle
11:05 pm					Tripped bottle #7 port side at
					650m
					Bottle #2 on starboard side was tripped accidentally
					#3 at starboard tripped at 550m
					#4 at 500m
					#5 at 300m
					#6 at 275m
					#7 at 35m

HYFLUX ROV LOG

Dive	5	Site	Rudyville	Latitude	28°51.1257'
Date	7/12/2009	Logger	Ian Leifer Ian MacDonald	Longitude	88°29.5744'

Objectives
1. ~~find camera~~ and move to Rudyville
2. position camera.
3. bubble viz
3. plume niskin
4. Push cores at Rudyville bacteria
5. Transit to Bravo
6. find Bravo bubble plume and get fixes.

Time	Depth	Sample	Comment
1505			Launch
1620	895		At camera — That was easy
1651			Searching for Rudyville
1709	895		Still searching
1757			Found abandoned site from yesterday. Head S.
1818	898		Found Rudyville Bubble Viz
18:25:43			Looking at Plumes (3) start regular Video
18:26:35			Kevins Strument in a plume
18:27:04			Out of plume
18:27:26			In plume
18:27:58			all 3 plumes in frame!
18:29:43			Back in plume
18:30:35			Pulsing more, may
18:36:00			Backing out to let Viz Clear
			Mostly Blocked Up Hydrate
18:37:30			Stopped Regular Video
			Seems to be oil droplets on HD video housing

HYFLUX ROV LOG

Dive	5	Site	Rudyville	Latitude	28°51.1257'
Date	7/12/2009	Logger	Jon Lefler	Longitude	88°29.5744'

Time	Depth	Sample	Comment
18:49:18	893		IronCam Flashed us
			Current from NW a few meters up in the
			water column
18:49:03			recording bubbles
18:49			2.2m Altitude some bubs through funnel
52:10			In funnel
			a few lit
18:54:05			0020 1:30 - in plume @ + 3m altitude
18:54:50			at seabed
			- N plume of three plumes in a row
19:00:00		Task	Accidentally Moving Rudys old rusty thing
19:04:0			Hydrate Bubble / Cubes escape funnel
19:07:50			Only one Plume
19:19:13			
			1250 Fwd
~~19:08~~			10:02 on HD Video overview
19:20:43			looked like some bubbles were trailing hydrate
			Initially all three plumes (high flux) were active
			o.l.?
			End, only South

Dive	5 Rudyville Site	Latitude	28°51.1257'
Date	7/12/2009 Logger	Longitude	88°29.5744'

Time	Depth	Sample	Comment
7:30			190° is the heading
			starboard #1 Niskin at bottom 897m in
			[illegible] away from plume, completed tape
7:35			D5 Tape A, introduced Tape B, see hydrate
			accumulation under ROV
7:40			Moving Ian's camera out of plume, much
			sediment dust in area
7:50			move to bubble site
7:55			port #1 bottle at 897m in
8:10			Tripped #2 at 519m
8:20			Again at bottom, moving up to 842 #3 bottle
			on port side was tripped at 8:25
8:35			at 804m #4 bottle
			At 800 m #5 bottle
			A 738m #6 bottle port side from a
			heading of 100
20:40			descending to position camera
2050			Core #8 attempt — lost it
20			Core #8 got next to hydrate
			grey top uneven, but not
			too disturbed
21 55	895		Deployed camera Dewy facing

bubbles

HYFLUX ROV CORE LOG

Dive	6	Site	Rudyville plume	Latitude	28°51.1257'
Date	7/13/2009	Logger	Tia Lester	Longitude	88°29.5744'

1. Find Rudyville
2. plume sample
3. Recover ROV & niskins
4. Return Rudyville
5. Core Samples
6. Plume Sample

Time	Core ID	Depth	Sample	ROV/Elevator	Comment
15:20:20		872m			at seabed
15:25					Start Tape A
15:31:16		894m			at Rudyville Central Square
15:32:42					Sonar recording
15:34:14					Range on sonar to 5m
~~15:35:10~~		~~890m~~			~~Heading 270 4m altitude #1 starboard~~
15:38:45		893.0			Heading 270m 4m altitude
15:					current seems to be from 90°
					← Black Out →
					← current Bubbles
15:50:09					Back at Plume
15:52:18		875m			Heading 360° Bottle 2
15:54:38		870m			Sonar says 1m diameter plume
15:55:27		860m			Sonar shows intrusion
15:56:26		843			heading 60° very edge
15:57:35		850m			2.5m wide plume
16:					not seeing ROV bubbles
16:00:					in plume a bit moving back
16:01.		797m			220° Heading Bottle 4
					1

HYFLUX ROV LOG

Dive	6	Site	Rudyville plume	Latitude	28°51.1257'
Date	7/13/2009	Logger	Ira Leifer	Longitude	88°29.5744'

Time	Depth	Sample	Comment
16:03:00	814m		120° Heading Bottle 5
			3m diameter about
			16 m From plume
16:08:23	750m		in plume
16:09:34	797		Heading 180° Bottle 6
16:15:4	680		in plume
16:			Bottle
16:16:10	672m		Heading 125 7
	5		
16:17:50	650m		In plume
16:22:00	597m		New Tape 16:22:00 D6 TB
			Bottle 8
16:23	581m		150° Heading HD Recording to 2:55:17 tape
16:24:38	570m		HD Recording of Bubbles to 5:20:00
16:25:47	556		in bubble
16:27:53	540m		HD Recording Bottle # 9 ~~10~~ 10
	527		60° Heading 2&3
16:31:48	~~486~~		90° Heading Bottle 11
	443		HD Recording to 9:38:09
			2

Dive	6	Site	Rudyville plume	Latitude	28°51.1257'
Date	7/13/2009	Logger	Leifer	Longitude	88°29.5744'

Time	Depth	Sample	Comment
16:35:00	407m		No sign of bubbles
			some bubbles coming from frame
			(starting at top of HSF to HSF + 80m)
			(a pulse left @ ~500m
16:41:28	310		may be in plume, a bunch of bubbles
16:42:20	292m		Heading 110° Bottle #12
16:44:00			Ian sees few oil drops @ surface
16:49:078	173m		Heading 15 Bottle #13
			some bubbles in area
17:03			Lights off Bottle #14
17:08:35	20m		260°
17:10:00	0m		making Bubbles salinity change makes it shimmer
Recovered ROV to deck			
1937	894	Rover IV #9	This is grey mat on top of hydrate slope - broke handle of #4 sediment too soft to core try again No good

HYFLUX ROV CORE LOG

Dive	~~X~~7	Site	Rudyville plume	Latitude	28°51.1257'
Date	7/13/2009	Logger	JRM	Longitude	88°29.5744'

Time	Core ID	Depth	Sample	ROV/Elevator	Comment
20:05				ROV on	In sediment near plume - no mat
					Short core — Shook out
20:15					Camera flashed
2017					Core in quiver - right
2023		Sonar			record of bubbles with
		Video			running to
20 ~~26~~ 27		892	S1	Trip	bottle H 170° T
2034		872	S2		H 90° T using sonar to
2037		840	S3		H 90° orient plume
2044		801	S4		H 120° bubbles vis.
2050		717	S5		in plume H 95°
2056		663	S6		Bubble vis 150
2103		590	S7		120
2103		551	P1		H 95°
2109		506	P2		H 85° bubbles
2117		409	P3		86° bubble
2124		306	P4		76 bubbles
2126		260	P5		170° b bubbly
2132		138	P6		95° bubbles
2154		25	P7		90° no bubbles visible

Coming up

4

HYFLUX ROV CORE LOG

Dive	~~X~~7	Site	Rudyville plume	Latitude	28°51.1257'
Date	7/13/2009	Logger	JRM	Longitude	88°29.5744'

Time	Core ID	Depth	Sample	ROV/Elevator	Comment
20:05				ROV on	In sediment near plume - no mat
					short core — Shook out
20:15					Camera flashed
2017					Core in quiver - right
2023		Sonar			record of bubbles with
		Video			running to
20 ~~26~~ 27		692	S1	Skip	bottle H 170° T
2034		672	S2		H 90° T using sonar to
2037		640	S3		H 90° orient plume
2044		801	S4		H 120° bubbles vis.
2050		717	S5		in plume H 95°
2056		668	S6		Bubble vis 150
2103		590	S7		124°
2103		551	P1		H 95°
2109		506	P2		H 85° bubbles
2117		409	P3		86° bubble
2124		306	P4		76 bubbles
2126		260	P5		170° b bubbles
2132		138	P6		95° bubbles
2154		25	P7		90° no bubbles visible

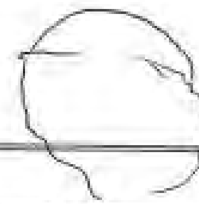
Coming up

4

HYFLUX ROV LOG

Dive	8	Site	GC600	Latitude	27°21.91'
Date	########	Logger	[redacted]	Longitude	90°33.85'

Objectives: Find vents
mat core
plume sample



Time	Depth	Sample	Comment
1610	~~1220~~		launch
1703	1215		BIV shells, bacteria mats carbonate
1709			large berm – like a elongate
	HDV		ridge. Turns out to be exposed
	still		hydrate w/ thousands of ~~and~~ ice
	PIX		worms
1725		P2	tripped with port side of ROV
			near expose
1729	second vent site w/ mixed plume of		
1	large very oily bubbles & smaller clear		
	relatively unoiled bubbles		
17:47	HDTV of oily bubble		
1755	1216 moved to NNW ~ 30 m attempt collection		

of carbonate – asphalt? – Hard – not asphalt
bottom contact released lots of oil & gas
1803 still trying for rock
1809 Tube B
1812 Mussels Heading NW

HYFLUX ROV LOG

Dive	8	Site	GC600	Latitude	27°21.91'
Date	7/14/2009	Logger	OSCAR	Longitude	90°33.85'

Time	Depth	Sample	Comment
1814	1216		Cluster of mussels w/ Chacoon
			saw a few clean bubbles but didn't find Vent
18:20	1215		Mussel Bed, Mat of hydrate
18:25	1215		Clusters of Mussels
18:38	1212		Grassy bubbles
18:40	1212		HD Recording Grassy bubbles
18:43	1210		Rocky Ridges
18:51			Mussels, hydrates, Clamps
18:55			Exposed hydrate with oil
18:58	1201		Mussels
18.59	1201		Pot Molds (??Rock??) TL
19:05			Top of the Mound Going back to first vent seen.
1910			approaching main vent
1915			lost power
1939	1215		Navigating back to main vent —
briefly lost telemetry.			
1941	HDTV video of Oil mountain & vigorous vent		
2004	F		
2012	F-10		Oily vent II ; smaller
hydrate mound			— saw it in sonar

HYFLUX ROV ~~CORE~~ LOG

Dive	6	Site	Rudyville plume	Latitude	28°51.1257'
Date	7/13/2009	Logger	Oscar/Ira	Longitude	88°29.5744'

Time	Core ID	Depth	Sample	ROV/Elevator	Comment
2029		1224		Found	another hydrate dump
20:33				Blue,	Bacterial Mat
20:43		1228		Push	Core
20:50				Push	Core on ROV
20:55				Bacterial	Mats, Hydrates
21:02				Hydrate	Core
21:11				Going	Back to bubbles
21:54					
				Fra	~~Begin~~ logging
22:08		1213 m			Bottle 3/Sample 2
		[redacted] m			did not fire
22:13:26		1222 m			180° Heading Bottle 3
2214:50		1209 m			180° Bottle 4
		1190			
22:1200		1186			187° Bottle 5
22:19:00		1155			152° Bottle 6
22:23:08		#			Heading Down
22:37:31		1219 m			Grab 0.1 Seep
				Following	Plume from Barrio Oscar

Page ___ of ___

HYFLUX ROV LOG

Dive	8	Site	GC600	Latitude	27°21.91'
Date	7/14/2009	Logger	Ira Leifer	Longitude	90°33.85'

Time	Depth	Sample	Comment
22:40:00	1219m		Searching for Barge Oscar
22:47:00			Found
	1221m		Almost no current
22:48:20			250° Bottle 7
22:50:29	1217m 1214m		separating
22:51:51	1206m		90° Heading Bottle 8 = #2 on stbd side
~~22:54:10~~	~~1176m~~		~~250° Heading Bottle 9~~ "Oh shit stuck again" anon.
	[illegible]		
23:07:03	1000m		Bottle 10
23:18:22	550m		Bottle 11
23:26:00	300m		Bottle 12
23:30:23	150m		Bottle 13
23:52:40	30m		Bottle 14

9 & 10

HYFLUX ROV LOG

Dive	9	Site	GC600 oil mountain	Latitude	27° 21.91'
Date	7/15/2009	Logger		Longitude	90° 33.85

Objectives: Bubble visualization
360 fly-around of Oil Mountain
plume sampling

Time	Depth	Sample	Comment
1618	1223	On	bottom. Need to transit NE
1644	1214	Found	smaller hydrate mound - probably NW of oil Mountain.
1705	Still	searching.	
1707	1220	At	oil mountain Video of hydrate
1715	—	preparing	for plume sampling
1722	12	P1	230° Stuck No Sample
1726	1216	P2	300
1728	1207	P3	
1729	1184	P4	
1732	1184	P5	03
1737	1088	P6	oil drop
1741	1025	P7	-No oil viz
1756			Back at Seep Site
~18:00:00	1219		Start Recorder (NOT HD) recording main camera
			After hitting, lots more oil from right in video
			Recorded 1st @250/F4 then ← (maybe too bright?) 190/F8
16:20-ish			Second viz attempt @ 250/F5.6

Dive	~~8~~ 9	Site	GC600	Latitude	27°21.91'
Date	7/15	Logger		Longitude	90°33.85'

Time	Depth	Sample	Comment
			After droplets stay under BMS,
18:27:30			form dots.
			@ 26 min MiniDV tape
			need to add Lips to gap [above: During bubble]
18:40			Returning to the bubble plume & sampling
			2-3 m above bottom the gas bubbles
			appear, deeper only The oil bubbles are seen
18:50			#1S, 1213 m
			#2S 807 m 360° heading
19:15			#3S 549 m
19:20			#4S 456 m 90° heading
19:27			#5S 300 290° "
			#6S 150
19:50			#7S 25 20°
Dive #10			descending at ~ 21:25 07/15/09
22:50			Found bubble plume
22:53			Niskin #1 pot 1221 m 248° heading
			#2P at 1200 m 218° "
			#3P 999 m 60° "
23:12			#4P 907 m 75°

HYFLUX ROV LOG

Dive	10	Site	GC600 oil mountain	Latitude	27° 21.91'
Date	7/15/2009	Logger		Longitude	90° 33.85

Time	Depth	Sample	Comment	Following Up the bubble plume
23:20			#5 p at 789m	40° heading
23:23			#6 p at 701m	
			#7 p 596m	15° "
23:33			#1 s 498m	10' "
23:38			#2 s 400m	38°
			#3 s 301m	360°
23:45			#4 s 248m	95°
23:46			#5 s 198m	80°
			#6 s 69m	
23:59			#7 s 39m	

HYFLUX ROV CORE LOG

Dive	#5	Site	MC118 Rudyville	Latitude	28.85215
Date	~~7/2009~~ 7/12	Logger		Longitude	-88.492165

Time	Core ID	Depth	Sample	ROV/Elevator	Comment
	#8	15cm		ROV	grey 2 layers
	~~#3~~	~~12cm~~	~~lost~~	~~ROV~~	~~grey un even surf bacteria~~
	#3	2.17		ROV	

HYFLUX ROV LOG

Dive	11	Site	GC185 Bush Hill	Latitude	27°46.94
Date	7/16/2009	Logger		Longitude	91°30.48'

Objectives: Find vent
plume sampling
(Dive 12) Return to plume (BH-HYD1) push cores
bubble visualization
plume sampling

Time	Depth	Sample	Comment
1853	545	At	BHHYD1 Hydrate mound has eroded away. Taking still photo
			Lots of exposed hydrate
1904	545		found large gas vent & mound bed east of North triangle frame
1905	545		found mound site — it has completely disappeared, leaving a ridge line of carbonate casts
1916			Driving around tubeworm/mussel community
1917			Found Bob Carney's tubeworm settlement array — several tubeworms growing
1928			Drove around whole complex. Tubeworm clusters seem unchanged
1940	545		Photographing small bubble vent
Next			
1946	546	P1	South of plume
1947	545	P2	Plume at front of sub
1949	543	P3	50°
1951	531	P4	180° Bubbles 2 m-wide plume
1955	500	P5	0° Bubbles plume expanded to 5 m

Dive	11	Site	GC185 Bush Hill	Latitude	27°46.94
Date	7/16/2009	Logger		Longitude	91°30.48'

Time	Depth	Sample	Comment
20:00	450	P6	0° bubbles visible
2005	400	P7	10° a few bubble
2011	346 ~~3??~~	S1	10° not visible
	~~294~~	~~S2~~	Subarashi bubbles
2015	294	S2	a few bubbs.
2023	199	S3	15° a few bubbles visible
2032 91	104	S4	150m - saw a few bubbles
2042	61	S5	See some bubbles - maybe off sub
2044	28	S6	
2045	16	S7	

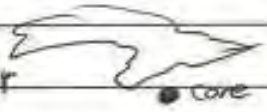
HYFLUX ROV LOG

Dive	12	Site	GC185 Bush Hill	Latitude	27°46.94
Date	7/16/2009	Logger	IRA	Longitude	91°30.48'

Time	Depth	Sample	Comment
22:28:00			334.8°
22:29:20			-Negative nudge [CCW]
:30			1,9° 1,9° → right for
30 15			Negative [CCW] spar buoy
:26			-2.5° maybe right at plume
31:15			Negative Nudge CCW
31:25			-6.9°
31:55			Negative Nudge CCW
31:02			·365°
33 30			Negative Nudge CCW
33 40.			362.22°
23 37:37			174.5 Stopped at seabed
38 30			187.
38:55			197
39 30			CCW
39:40			188,9 should be seeing bubbles
40:25			CCW
32			199,1
41:20			
25			206,4 edge of table
42:00			

HYFLUX ROV LOG

Dive	12	Site	GC185 Bush Hill	Latitude	27°46.94
Date	7/16/2009	Logger	Ira Leifer	Longitude	91°30.48'

Time	Depth	Sample	Comment
9:59:00	425m		Untangling Tether
2207	593m		At Seabed Near Bushes
			Started Video re
22:09:20			Passing Triangle frame & Bubbles
22:100			15-20ft from Triangle Frame to collect
	5420m		Bacterial Matt Pushcore
			In yellow surface next to white matt
22:13:42			Push core in Quiver 
22:15:49			Begin collecting at edge of mound w/oil push core
22:18:22			Very easy
			4m distance
22:24:10			347-349
22:25:15			Nudging
22:25:29			357.8
22:26:00			Nudging
22:26:10			365.2°
26 45			Nudging
26:54			368.5 Should see plume
28:00			Nudging

HYFLUX ROV LOG

Dive	12	Site	GC185 Bush Hill	Latitude	27°46.94
Date	7/16/2009	Logger	Ira	Longitude	91°30.48'

Time	Depth	Sample	Comment
42:12			212°
42:50			
42:58			At Plume 186.0 2m distant
44:25			CW
			185.0
45:00			CW
45:12			180.9
			CW
35			Fish
45:49			191.8° Fish
25			CW Nudge
46:34			196.2° past plume
47:30			
47:37.1			Edge of frame in FOV
22:49			Bubbles in FOV
			F5.6 1/1250
			5 Scratch
23:01			New tape B
23:11			End of bubble viz did a 3-m pass.

HYFLUX ROV LOG

Dive	12	Site	GC185 Bush Hill	Latitude	27°46.94
Date	7/16/2009	Logger	Ira Leifer	Longitude	91°30.48'

Time	Depth	Sample	Comment
23:16:33	540m		Flew thrugh plume
23:17			Rising to 10 m to the shore off the Bubbles
23:22:			
23:19:	541m		4.8° N 3m altitude
			Down current
			Starboard bottle 1
23:29:00	529m		2m diameter
			-4.8° bubbles at edge of bottel
			Starboard bottle 2
	512		5 m diameter from sonar
	504m		17° heading Bubs at edge of ROV
23:26:40			Starboard Bottle 3
23:30:57	475m		3m diameter from sonar
23:33:47	~~450m target~~		
	450.00		27° heading Starboard Bottle 4
	430 m		3m diameter — may have been out of plume ROV was 5 m to east
23:37:10	419m		60° heading Starboard Bottle 5
23:49:00	362m		Port 1 54° heading
23:53:25	320		14° heading Port 2 Bottle

HYFLUX ROV LOG

Dive	12	Site	GC185 Bush Hill	Latitude	27°46.94
Date	7/16/2009	Logger	Ira	Longitude	91°30.48'

Time	Depth	Sample	Comment
			25.9m depth searching for bubbles
00:00:00			New Tape C.

Dive	13	Site	GC185 Bush Hill	Latitude	27°46.94
Date	7/17/2009	Logger	IRM	Longitude	91°30.48'

Time	Depth	Sample	Comment
1637	541		On bottom Taking P.C. in orange b.m. edge of mound/TW mnt - looks good this short core ~5"
1644	541	Push Cores	Taking 2nd core in white mat next to orange mat oil squeezed out on recovery - fell out try again - fail again too short - reposition for another orange mat.
1655	↓		Still trying to get 2nd core - recovery very short & falling out of tube - Moving to new area.
1709	546	PC	New core attempt - White mat E of HYDI site - good core - interface looks good - oil drops releasing.
1712	Relocating		to main gas vent for plume sampling
17:20			shifting to look from west at 2m altitude
17:28:29	549		279° Heading Starboard 1m
	5		

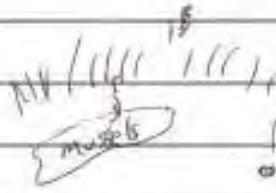
Dive	13	Site	GC185 Bush Hill	Latitude	27°46.94
Date	7/17/2009	Logger	IRA	Longitude	91°30.48'

Time	Depth	Sample	Comment
17:28:40	535		Forming a sheet stretching to East
17:28:49	529m		35° Heading Starboard 2
			Bubbles @ Robot Arm, both Bottles
	520		Shift in current to from east
			west ~~~ east
17:32:48	504m		76° Heading bubbles @ robot arm
			Starboard 3
17:35:00	479m		~~8~~ 4 m long from sonar
17:45:00	542m		Saw the shark
17:53:13	475		dispersing
17:55:00	449		197° Heading Starboard 4 bubbles all around
17:57:03	425m		127° Heading Starboard 5 Bubble plume is really faint
18:01:13	372m		129° Heading Very Few Bubble Starboard 6
18:05:58			Back at 413m, heading down
18:18:00			470 major plume spreading very rapid
			Hot Density Layer ?
18:21:50	396m		270° Heading Starboard 7

Dive	13	Site	GC185 Bush Hill	Latitude	27°46.94
Date	7/17/2009	Logger	IRA	Longitude	91°30.48'

Time	Depth	Sample	Comment
18:25:10	360		216° Heading
18:29:50	301		150° Bottle 3 Port
			Port 1 may have fired with Port 3 Bottle
			"Even says so
18:32:25	272m		seen on sonar 15 m in front
18:39:14	221		29° Heading Bottle 4 Port
			Lost Bubbles for a minute
			Been tracking
18:44:00	151m		56° Heading Bottle 5 Port
18:47:39	120m		Bubbles accellerated maybe due to warmer water
			also seems to be a stronger current
18:52:36	74m		90° Heading Bottle 6 Port
			Since
18:57:30	40m		98° Heading Bottle 7 Port

Dive	14	Site	GC185 Bush Hill	Latitude	27°46.94
Date	7/17/2009	Logger	Ira	Longitude	91°30.48'

Time	Depth	Sample	Comment
20:50:06			
20:51:14	541		At Seabed Start Video
			Catfish
20:57:01	543		Scorpion Fish
			Coming up South Side
			
			Bubbles
21:17:30	544m		107° Port 1 Bottle 30m North of center
21:32:19	546m		Dead Moose Rack colonized w corals
	542m		& a Convict Fish
10:00:07	543		42° Heading Port 2 Bottle
			3m altitude Secondary Plume
10:02:37	531		26° Heading Bubbles on Robot arm
			Port Bottle 3
10:06:00	503		10° Heading Port Bottle 4
			Back out East

Dive	14	Site	GC185 Bush Hill	Latitude	27°46.94
Date	7/17/2009	Logger	Ira	Longitude	91°30.48'

Time	Depth	Sample	Comment
22:07:39	489m		4m wide plume (weak target
22:10:50	452		53° Heading Port Bottle 5
22:12:00	437		~~[illegible]~~ Lots of Snow not here last dive Found again
22:19:34	404		162° Heading Port Bottle 6
22:24:02	363		Top of marine Snow Layer Lowering
22:29:19	363		Top of Snow Layer Back to Seabed
22:39:42	542m		At Bubble Plume
22:44:10	516m		35° Heading Port Bottle 7 ~~[illegible]~~
22:46:00		Squid	Ink from Squid followed up for several meters
22:48:10	474m		Start to see layer
22:49:47	455		Really Bad Marine Snow
22:57:04	437		Tracking One Bubble

Page___ of___

Dive	14	Site	GC185 Bush Hill	Latitude	27°46.94
Date	7/17/2009	Logger		Longitude	91°30.48'

Time	Depth	Sample	Comment
			Very erratic behavior in layer
			up and down draft
		359m	Out of layer!
22:57:48		348m	Starboard 1 Bottle 79° Heading
			In currents
			Shift above layer
23:02:10		293	150° heading Starboard 2 Bottle
			(only one bubble)
23:08:00		231	184° Starboard 3 Bottle
			Miriam Bubble Queen
			Evan Bubble King
			Ira Bubble Wizard
			Toshi Bubble Divers
			Kevin
23:27:56		100.00	To 320° Heading Starboard 4 Bottle
23:30:15		73m	Icm accuracy 350° Starboard 5 Bottle
23:33:29		40	14° Heading Starboard 6 Bottle
		20	Starboard 7
23:45:00		25m	297°