SUPPORT OF GULF OF MEXICO HYDRATE RESEARCH CONSORTIUM: ACTIVITIES TO SUPPORT ESTABLISHMENT OF A SEA FLOOR MONITORING STATION PROJECT

SEMIANNUAL PROGRESS REPORT
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Task 3: Acoustic System for Monitoring Gas Hydrates

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Task 3: Coupling of Continuous Geochemical and Sea-floor Acoustic Measurements

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Task 1: Data Management and Archiving System and Matched Field Inversion Software Development for the Sea-floor Monitoring Station

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Task 2: Experiment to generate Shear Waves in the Sea-floor and Record them with a Horizontal Line Array

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Task 3: Coupling of Continuous Geochemical and Sea-floor Acoustic Measurements

* includes seismo-acoustic characterization of sea-floor properties and processes at the hydrate monitoring station until vertical seismic profile (VSP) data can be collected

ABSTRACT

The Gulf of Mexico Hydrates Research Consortium (GOM-HRC) was established in 1999 to assemble leaders in gas hydrates research. The Consortium is administered by the Center for Marine Resources and Environmental Technology, CMRET, at the University of Mississippi. The primary objective of the group is to design and emplace a remote monitoring station or sea floor observatory (MS/SFO) on the sea floor in the northern Gulf of Mexico by the year 2007-8, in an area where gas hydrates are known to be present at, or just below, the sea floor. This mission, although unavoidably delayed by hurricanes and other disturbances, necessitates assembling a station that will monitor physical and chemical parameters of the marine environment, including sea water and sea-floor sediments, on a more-or-less continuous basis over an extended period of time. In 2005, biological monitoring, as a means of assessing environmental health, was added to the mission of the MS/SFO.

Establishment of the Consortium has succeeded in fulfilling the critical need to coordinate activities, avoid redundancies and communicate effectively among researchers in the arena of gas hydrates research. Complementary expertise, both scientific and technical, has been assembled to promote innovative research methods and construct necessary instrumentation. The observatory has now achieved a microbial dimension in addition to the geophysical, geological, and geochemical components it had already included.

Initial components of the observatory, a probe that collects pore-fluid samples and another that records sea floor temperatures, were deployed in Mississippi Canyon 118 (MC118) in May of 2005. Follow-up deployments, planned for fall 2005, had to be postponed due to the catastrophic effects of Hurricane Katrina (and later, Rita) on the Gulf Coast. Station/observatory completion, now anticipated for 2008-9, has, therefore, been delayed.

Although delays caused scheduling and deployment difficulties, many sensors and instruments were completed during this period. Software has been written that will accommodate the data that the station retrieves, when it begins to be delivered. In addition, new seismic data processing software has been written to treat the peculiar data to be received by the vertical line array (VLA) and additional software has been developed that will address the horizontal line array (HLA) data. These packages have been tested on data from the test deployments of the VLA and on data from other, similar, areas of the Gulf (in the case of the HLA software).

The CMRET conducted one research cruise during this reporting period and participated significantly in another. In November, the CMRET conducted a research cruise to the site of the gas hydrates sea-floor observatory, MC118. During this cruise, sediment and microbial samples were collected for Consortium participants, a Consortium – owned TSS motion sensor was installed and used successfully, the University of Georgia's (UGa) microbial filter was operated successfully in concert with the University of South Florida's (USF) mass spectrometer to collect microbes and recover information on the chemistry of the water-column where they were collected, a

storm monitor was collected and another deployed, all markers and instruments left on the sea-floor on previous cruises were located via the Station Service Device (SSD) and their locations recorded with pin-point accuracy due to the attachment of the Ultra-short Base-line (USBL) on the frame of the SSD. In addition many hours of video were logged using the camera systems and recording capabilities on the SSD.

In March, the National Institute for Undersea Science and Technology (NIUST), whose home is the University of Mississippi (UM), conducted sea-trials of its newly acquired autonomous underwater vehicle (AUV), *Eagle Ray*. As NIUST's Seabed Technology Research Center (STRC), headquartered with the Mississippi Mineral Resources Institute (MMRI) at the UM will be providing maintenance and operator support for the AUV, an STRC/CMRET team participated in every aspect of the cruise. The vehicle and the team performed well and set a new depth of dive record for the Eagle Ray, 800m water.

Very productive Semiannual and Annual Meetings of the Gulf of Mexico Gas Hydrates Research Consortium were held in Oxford, Mississippi, in October and February, respectively.

The seafloor monitoring station/observatory is funded approximately equally by three federal Agencies: Minerals Management Services (MMS) of the Department of the Interior (DOI), National Energy Technology Laboratory (NETL) of the Department of Energy (DOE), and the National Institute for Undersea Science and Technology (NIUST), an agency of the National Oceanographic and Atmospheric Administration (NOAA).

Subcontractors with FY03 and FY04 funding have fulfilled their technical reporting requirements in previously submitted reports. Unresolved matching funds issues remain and are being addressed in the report of the University of Mississippi's Office of Research and Sponsored Programs. In addition, Barrodale Computing Services Ltd. (BCS) completed their work for FY05; their final report is the bulk of the semiannual report, 41628R14; Applications of Vertical Seismic Profiling (VSP) Technology for Evaluation of Deep-Water Gas Hydrate Systems (University of Texas Bureau of Economic Geology's Exploration Geophysics Laboratory, EGL) has been completed using data collected from another hydrates site and appears as part of the Consortium's report to DOE, 41628R18. In addition, this report includes the final report for Microbial Activity Related to Gas Hydrate Formation and Sea-floor Instabilities (Mississippi State University).

Noteworthy accomplishments of Consortium researchers during this six month cycle funded with DOE's contributions to this multiagency effort include:

- Progress on the Coupling of Continuous Geochemical and Sea-floor Acoustic Measurements:
    - November cruise participants went prepared to recover sea-floor

instruments. However, electronic challenges dictated that the SSD not leave its cage so no instruments could be recovered. Excellent locations were determined for all MS/SFO instruments remaining on the sea-floor.

- Progress on the Experiment to Generate Shear Waves in the Sea-Floor and Record them with a Horizontal Line Array
    - Accelerometer shear data generated from the MMRI-developed seismic gun shear sled were recovered during an in-water test conducted in Biloxi, Mississippi in June, 2007. These data are being analyzed by the BEG.

- Administration of the Monitoring Station/Sea-floor Observatory project this reporting period has consisted of the following:
    - CMRET organized and carried out a November cruise to MC118.
    - CMRET provided crucial participation in the March AUV cruise sponsored by NIUST.
    - CMRET hosted the semiannual meeting of the Consortium in Oxford October 10-11, 2007. This meeting was attended by 35 hydrates workers and included 13 formal presentations of research results. It was also the opportunity for final arrangements relating to the November cruise. A CD of meeting activities has been published and made available to Consortium participants and other interested parties.
    - CMRET hosted the Annual meeting of the Consortium in Oxford, February 26-27, 2008. The keynote presentation for this meeting was made by students who have synthesized their work at MC118 into a cohesive picture of the chemistry and structure of the mound. This work laid the foundations for federally funded work in the coming year.
    - Reporting to and interacting with sponsoring agencies and their officers as well as with Consortium members. The semiannual progress report, 41628R20, for DOE Award Number DE-FC26-02NT41628 was submitted in December and 42877R06, for DOE Award Number DE-FC26-06NT42877 was submitted in March.
    - Monthly reports have been made to DOE each month of the reporting period.
    - The results of the DOE Peer-Review process were received by CMRET and distributed to those who participated directly in the review process. With input from Consortium members, the CMRET prepared responses to major points made by the Panel. A follow-up peer review of subsurface work at MC118 is planned.
    - The CMRET arranged a meeting of Consortium members making key contributions to the subsurface investigations at MC118. This meeting took place at the University of South Carolina, Columbia, SC, under the supervision of Camelia Knapp. The goals for this meeting were to synthesize subsurface data collected from MC118 and to prepare both oral and written presentations of the data and findings, to date.

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INTRODUCTION / PROJECT SUMMARY

The Gulf of Mexico-Hydrate Research Consortium (GOM-HRC) is in its eighth year of developing a sea-floor station to monitor a mound where hydrates outcrop on the sea floor. The plan for the Monitoring Station/Sea Floor Observatory (MS/SFO) is that it be a multi-sensor station that provides more-or-less continuous monitoring of the near-seabed hydrocarbon system, within the hydrate stability zone (HSZ) of the northern Gulf of Mexico (GOM). The goal of the GOM-HRC is to oversee the development and emplacement of such a facility to provide a better understanding of this complex hydrocarbon system, particularly hydrate formation and dissociation, fluid venting to the water column, and associated microbial and/or chemosynthetic communities. Models developed from these studies should provide a better understanding of gas hydrates and associated free gas as: 1) a geo-hazard to conventional deep oil and gas activities; 2) a future energy resource of considerable significance; and 3) a source of hydrocarbon gases, venting to the water column and eventually the atmosphere, with global climate implications.

Initial funding for the MS/SFO was received from the Department of Interior (DOI) Minerals Management Service (MMS) in FY1998. Funding from the Department of Energy (DOE) National Energy Technology Laboratory (NETL) began in FY2000 and from the Department of Commerce (DOC) National Oceanographic and Atmospheric Administration's National Undersea Research Program (NOAA-NURP) in 2002. Some ten industries and fifteen universities, the United States Geological Survey (USGS), the US Navy, Naval Meteorology and Oceanography Command, Naval Research Laboratory and NOAA's National Data Buoy Center are involved at various levels of participation. Funded investigations include a range of physical, chemical, and, more recently, microbiological studies.

EXECUTIVE SUMMARY

A consortium has been assembled for the purpose of consolidating both the laboratory and field efforts of leaders in gas hydrates research. The Consortium, established at and administered by the University of Mississippi's Center for Marine Resources and Environmental Technology (CMRET), has, as its primary objective, the design and emplacement of a remote monitoring station on the sea floor in the northern Gulf of Mexico by the year 2007. The primary purpose of the station is to monitor activity in an area where gas hydrates are known to be present at, or just below, the sea-floor. In order to meet this goal, the Consortium has begun assembling a station that will monitor physical and chemical parameters of the sea water, sea-floor sediments, and shallow subsea-floor sediments on a more-or-less continuous basis over an extended period of time. Central to the establishment of the Consortium is the need to coordinate activities, avoid redundancies and promote effective and efficient communication among researchers in this growing area of research. Complementary expertise, both scientific and technical, has been assembled; collaborative research and

coordinated research methods have grown out of the Consortium and design and most construction of instrumentation for the sea-floor station is essentially complete.

The MS/SFO was designed to accommodate the possibility of expanding its capabilities to include biological monitoring. A portion of FY04 funding from the MMS was directed toward this effort to support the study of chemosynthetic communities and their interactions with geologic processes. In addition, results will provide an assessment of environmental health in the area of the station. NOAA -NURP has, as a focal point, investigations of the effects of deep sea activities on world atmosphere and therefore, weather. In July of 2005, the Director of the National Institute for Undersea Science and Technology (NIUST) of NOAA-NURP made a portion of that agency's budget available *via* competitive grants to researchers with proven expertise in microbial research. A sea-floor microbial observatory is an objective of that agency and these sponsored projects sited at the MS/SFO are designed to fulfill that directive.

The centerpiece of the monitoring station, as originally conceived, is a series of vertical line arrays of sensors (VLAs), to be moored to the sea floor. Each VLA was to have extended approximately 200 meters from the sea-floor. Sensors in the VLAs include hydrophones to record water-borne acoustic energy (and measure sound speed in the lower water column), thermistors to measure water temperature, tilt meters to sense deviations from the vertical induced by water currents, and compasses to indicate the directions in which the deviations occur. During discussions among the members of the geophysical subgroup of the Consortium, it was discovered that the project may be better served if some vertical arrays are converted to horizontal line arrays (HLAs). The horizontal water-bottom arrays were to have consisted of hydrophones and 3-component accelerometers laid upon, and pressed into, the soft sediment of the sea-floor, arranged in a cross so that they simulate two perpendicular arrays. The contract for the construction of the HLAs has been rewritten to reflect some of the findings of the June, 2007, cruise as well as the input of the geophysicists working with noise data and shear data. The new configuration of the arrays is designed to maximize the likelihood that they may later be useful for monitoring seismic events and hurricanes. Four hydrophone arrays, 500m in length, will be deployed on the surficial deposits of the sea-floor at the MS/SFO at MC118. They will be capable of collecting compression-wave data, via hydrophones, and sending them to the integrated Data Power Unit (IDP). Accelerometers will be added to the MS/SFO at a future date.

The prototype DOE-funded VLA has been completed and tested together with the associated data-logging and processing systems. Processing techniques have been developed for vertical array data by Consortium participants funded by the MMS.

In May, 2005, the Sea-Floor Probe (SFP) was used to retrieve core samples from MC118 as part of the effort to select sites appropriate for deployment of the geophysical and geochemical probes. The northwestern portion of the mound area defined on images recovered during a C&C (Chance and Chance) autonomous underwater vehicle (AUV) survey April 30-May 2, 2005, was selected for probe deployments based on information from these cores. Both the pore-fluid array and the geophysical line array were deployed *via* SFP at MC118 in May, 2005.

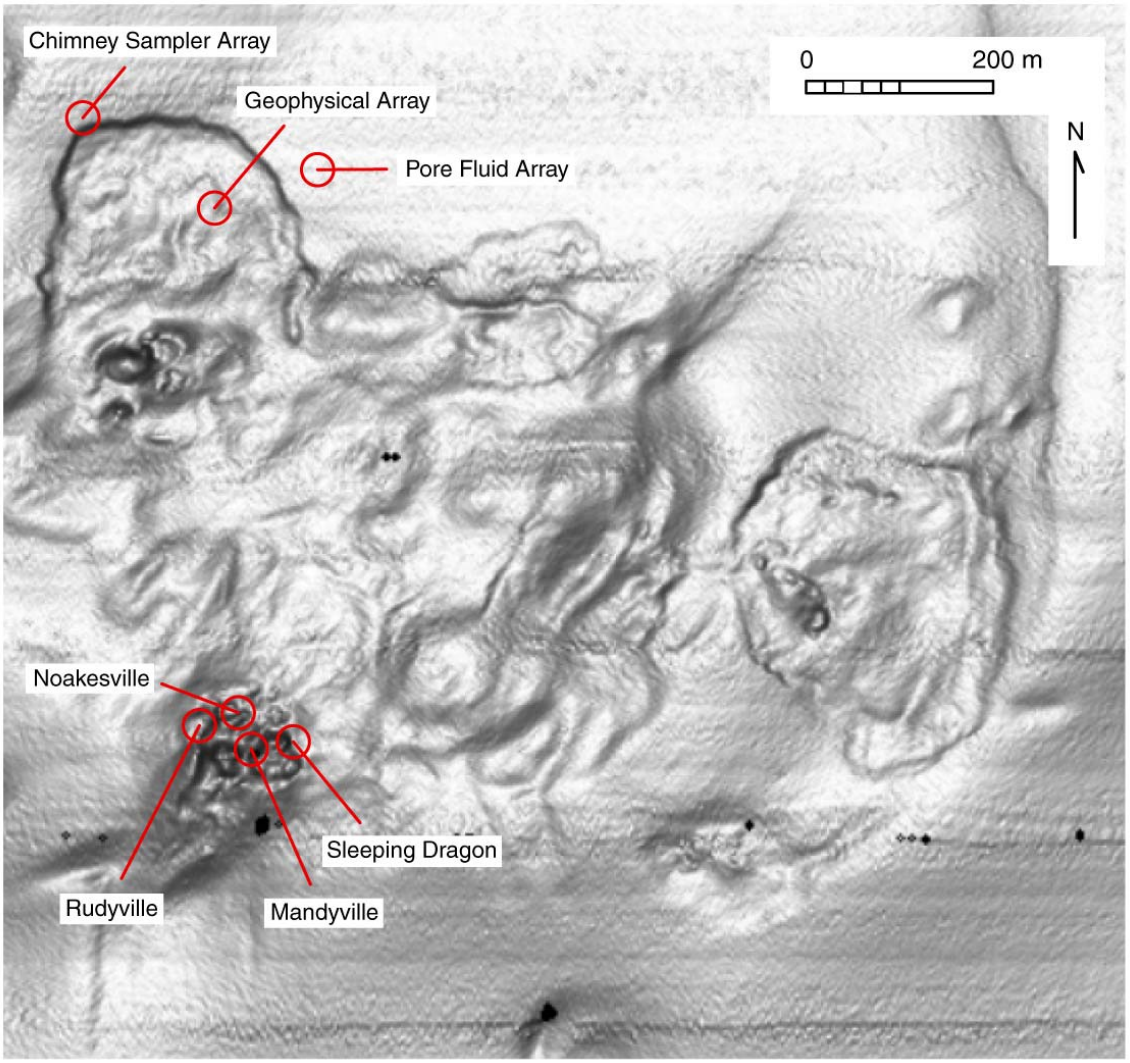
Additional MS/SFO deployments, scheduled for September and October, 2005, were delayed due to the devastation of the Mississippi Gulf Coast and environs by Hurricane Katrina and, to a lesser extent, the Louisiana Gulf Coast by Hurricane Rita. The immediate cause for delay was the removal of the *M/V Ocean Quest*, the vessel that, with its two submersibles, was to have provided the platform from which many of the bottom-founded sensors would have been deployed and cable connections made. It would also have provided the visual survey needed to make optimal choices of deployment sites for station components

In October, 2005, March, April and June, 2006, the CMRET conducted a series of cruises to MC118 aboard the *R/V Pelican*. These cruises accomplished many of the tasks that had been planned for the *Ocean Quest*, including the recovery of more samples from MC118 and the deployment of a microbial filter device. A complete SSDR (surface-source/deep-receiver) survey was made and a drift camera designed, deployed and used successfully to survey the sea-floor, visually. However, a submersible or ROV was still required to accomplish many of the missions for which precise placement of instruments on the sea-floor was required.

Following several “false starts”, anticipating the use of other vessels which never did become available, the CMRET eventually secured seven days of ship time aboard the *R/V Seward Johnson* with use of its manned-submersible, the Johnson SeaLink. This vessel combination was used to retrieve the osmopump packages and data-loggers deployed in 2005, to conduct visual surveys of the observatory site at MC118 and to deploy, and in some cases recover, sensors and experiments. Experiments designed to assess microbial communities and activities, hydrate host materials, and composition of pore-fluids were left on the sea-floor for several months’ data collection. Cruises to recover these instruments and data-loggers were scheduled for 2007.

Delays attributable to hurricane activity in the Gulf of Mexico caused scheduling and deployment difficulties but many sensors and instruments were completed during this period. A second PFA osmosampler was placed on the sea-floor near the southwestern crater at the site designated “Rudyville”. Pore water equilibrators or “peepers” were installed at three sites at MC118. In addition to samples and data collected from these instruments, methane

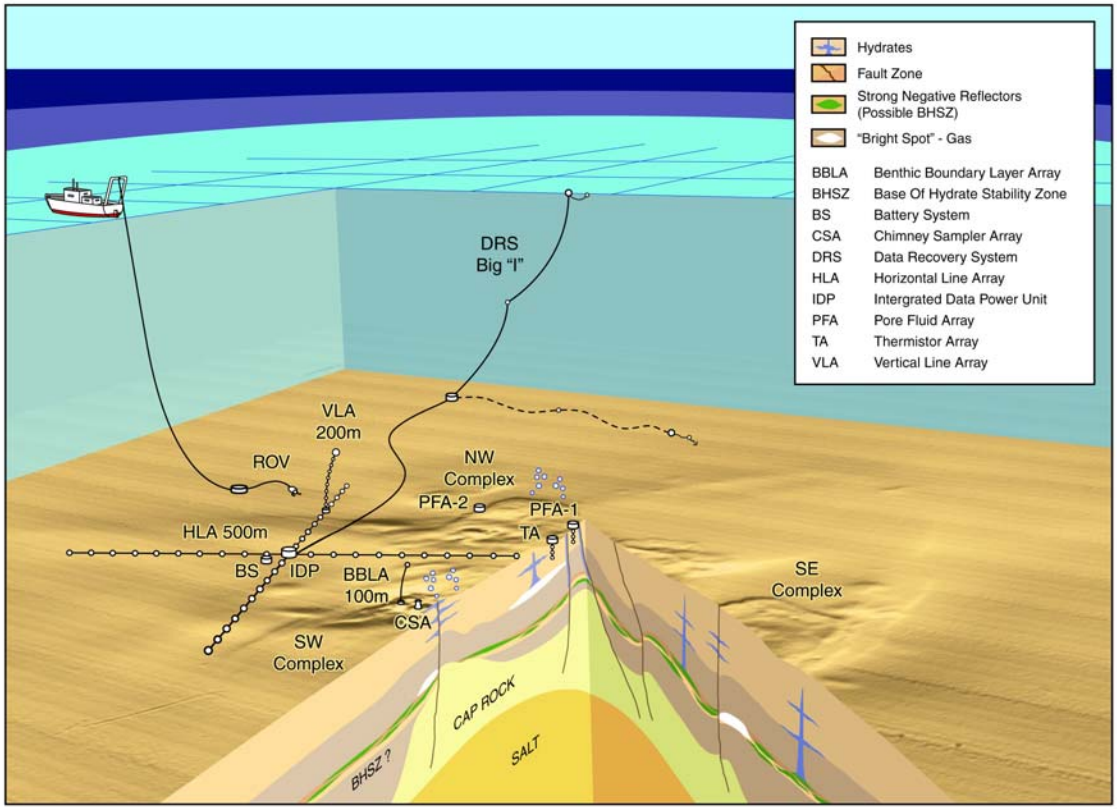
concentration and isotope samples were collected from 8 cores that were collected using the SeaLink at a variety of sites along transects across microbial mats (see location map).



Locations of Monitoring Station/Sea-floor Observatory instruments, MC118.

After 1.5 years, the Pore-Fluid Array's (PFA's) instrument package was recovered and replaced successfully during the September Johnson SeaLink dives. The four ports collecting pore-fluids *via* OsmoSamplers were located in the overlying water and 1.2 m, 3.2 m, and 8.5 meters below the seafloor (mbsf). During the months following the retrieval of the sample box, pore-fluids were extracted from the sampler coils and measured for chloride, sulfate, and methane concentrations and methane isotope ratios. Normal seawater conditions were found in the overlying waters, while at 8.5 mbsf, chloride concentrations provide compelling evidence for the intrusion of brine fluids. Brine was further indicated

by the absence of sulfate. As expected with brine fluids, they were also characterized by high methane concentrations.



Gas Hydrate Sea-Floor Observatory - Mississippi Canyon Block 118

Defining mechanisms of sea-floor hydrate formation to aid in locating hydrates on the sea-floor is a long-term component of Consortium efforts. Laboratory findings relating to hydrate induction time and formation rates have shown that hydrate formation is catalyzed by biosurfactants, products of microbial activity. The microbes' bioproducts' hydrophobic moieties collect methane while the hydrophilic moieties collect and structure water, thus emplacing the components necessary for hydrate formation. This in turn, explains the close affiliation of particular bacteria with hydrate outcrops on the sea-floor and leads to further questions regarding their interactions. Some generalizations can be made regarding hydrate formation: formation rates increase with depth until a maximum is reached and induction time decreases with depth until a minimum is reached. These generalizations are influenced, and in some cases overcome, by other factors influencing hydrate formation such as salinity, the depth of the sulfate zone, availability of gases, bioactivity, clay mineral composition, bioproducts coating sediment grains, and sediment size.

Software has been written that will accommodate the data that the station retrieves, when it begins to be delivered. In addition, new seismic data processing software has been written to treat the peculiar data to be received by

the vertical line array (VLA) and additional software has been developed that will address the horizontal line array (HLA) data. These packages have been tested on data from the test deployments of the VLA and on data from other, similar, areas of the Gulf (in the case of the HLA software).

Researchers at the Exploration Geophysics Laboratory (EGL) have developed a new approach to processing 4-component (4C) seismic data acquired with multicomponent sensors deployed on the seafloor. Utilizing the large elevation difference between source and receiver allows deep-water 4C data to be processed with algorithms similar to those used to make images from vertical seismic profile (VSP) data (also acquired with a large elevation difference between source and receiver). This processing approach produces images that have much higher resolution of geology located near the receiver station than do standard 4C data-processing techniques.

New 4C ocean bottom cable (OBC) seismic data-processing software structured to optimize image resolution in the immediate vicinity of seafloor seismic sensors has been written by EGL researchers. While this novel data-processing strategy offers no advantage for imaging deep geology, it produces optimal images of geology immediately below seafloor sensor stations where hydrate systems are embedded. Preliminary tests of this software have produced impressive high-resolution images of near-seafloor strata.

The CMRET conducted one research cruise during this reporting period and participated significantly in another. In November, the CMRET conducted a research cruise to the site of the gas hydrates sea-floor observatory, MC118. During this cruise, sediment and microbial samples were collected for Consortium participants. Highlights of this cruise:

- The TSS (dynamic motion sensor) acquired by the Consortium *via* Vernon Asper, University of Southern Mississippi, was installed.
- The USBL transducers were installed and the system calibrated. It appeared to work flawlessly.
- The University of Georgia's microbial filter and the University of South Florida's mass spectrometer were deployed and operated separately and in concert with excellent results. The former had been deployed successfully on previous cruises but the latter had never undergone a successful deployment to depth until this cruise.
- The storm monitor deployed in July was recovered successfully, in good condition, and with good data.
- The third storm monitor was deployed.
- Two dives of the Station Service Device (SSD) were made and all markers and instruments left on the sea-floor on previous site-visits were located and pin-point accurate locations acquired for them by virtue of the fact that the SSD frame now carries its own USBL.

- Many hours of video of the sea-floor at MC118 were recovered via multiple cameras on the SSD.
- Sediment samples were recovered from the vicinities of both the Northwest and Southwest crater complexes using push-cores in box-core samples. Precise locations of these cores were made possible by attaching the USBL to the cable immediately above the corer. Specifics of sample collection were followed as per instructions from Mandy Joye (UGa) and Charlotte Brunner (University of Southern Mississippi, USM). Additional samples were collected for Roger Sassen (Texas A&M University) and Rudy Rogers (Mississippi State University, MSU).

CHALLENGES STILL REMAINING…

- Instruments remain on the sea-floor. Due to electrical failures/difficulties, the SSD was not able to exit the lander cage (and maintain power). As a result, no instruments could be recovered and no samples recovered directly using the SSD.
- Video is murky due to the amazing amount of particulate matter in the water column. The source of this suspended material and debris covering the instruments is possibly related to the changes observed in the hydrate outcrops – diminished and exhibiting slump features.

A complete cruise report is available online, at the MMRI website: http://www.olemiss.edu/depts/mmri/programs/ppt_list.html

CMRET scientific crew participated in a cruise March 17-22 to perform sea trials of the NOAA/NURP/NIUST AUV. The AUV, *Eagle Ray*, has been transferred to the University of Mississippi for housing and maintenance. This cruise provided the new team of AUV operators an opportunity to deploy and recover as well as operate this sophisticated piece of equipment. Although the weather was quite rough (12-15' seas early in the cruise), much useful experience was gained. A complete cruise report is forthcoming. The AUV schedule includes surveys with geophysical and geochemical instruments onboard.

CMRET hosted the semiannual meeting of the Consortium in Oxford October 10-11, 2007. This meeting was attended by 35 hydrates workers and included 13 formal presentations of research results. It was also the opportunity for final arrangements relating to the November cruise. A CD of meeting activities has been published and made available to Consortium participants and other interested parties.

CMRET hosted the Annual meeting of the Consortium in Oxford, February 26-27, 2008. The keynote presentation for this meeting was made by students who have synthesized their work at MC118 into a cohesive picture of the chemistry and structure of the mound. This work laid the foundations for

federally funded work in the coming year.

The results of the DOE Peer-Review process were received by CMRET and distributed to those who participated directly in the review process. With input from Consortium members, the CMRET prepared responses to major points made by the Panel. A teleconference with DOE on January 22 helped define what points the DOE feels are in most need of addressing by the CMRET. A second teleconference including project managers from MMS and NOAA took place in mid-February. A follow-up peer review of subsurface work at MC118 is planned.

Partly in response to DOE's comments resulting from the peer review process, the CMRET arranged a meeting of Consortium members making key contributions to the subsurface investigations at MC118. This meeting took place the week of February 3, at the University of South Carolina (USC), Columbia, South Carolina, under the supervision of Camelia Knapp. The goals for this meeting were to synthesize subsurface data collected from MC118 and to prepare both oral and written presentations of the data and findings to date. Three students who have completed their doctorates doing hydrates research at MC118 via Consortium funding, Laura Lapham, Brad Battista, and Leonardo Macelloni, assimilated their data and presented it to three Consortium professionals – experts in marine geophysics and chemistry - for review and comment. The group established a list of priorities with which to go forward in order to establish, fully, the history and character of the hydrate-carbonate mound at MC118.

The CMRET received notification that Consortium post-doctoral student, Laura Lapham has been selected by the DOE as the recipient of their 3rd Methane Hydrates Research Fellowship.

Reporting to and interacting with sponsoring agencies and their officers as well as with Consortium members continues to be a major responsibility of the CMRET. The semiannual progress report, 41628R20, for DOE Award Number DE-FC26-02NT41628 was submitted in December and 42877R06, for DOE Award Number DE-FC26-06NT42877 was submitted in March. Monthly reports have been made to DOE each month of the reporting period.

The following papers and presentations have been completed by Consortium members:

Lapham, Laura, Jeff Chanton, Chris Martens, Ken Sleeper, and J. R. Woolsey, *Microbial activity in surficial sediments overlying acoustic wipe-out zones at a Gulf of Mexico cold seep,* Geochemistry, Geophysics, Geosystems, accepted.

Lapham, Laura, Alperin, **Jeff Chanton, and Chris Martens**, *Applying a diagenetic model to estimate upward advection rates at two Gulf of Mexico brine seeps* Marine Chemistry, submitted.

Lapham, L.L., J .P. Chanton, C.S. Martens, P. D. Higley, H. W. Jannasch and **J.R. Woolsey**. *Measuring long term changes in dissolved ion and gas concentrations and stable isotopes at a hydrate site: Mississippi Canyon 118, Gulf of Mexico*. (in prep).

Traer, J., P Gerstoft, WS Hodgkiss, LA Brooks, PD Bromirski*, Acoustic signature of tropical storm Ernesto,* JASA-EL, submitted 2008.

Brooks, LA, **P Gerstoft**, DP Knobles, Using noise correlation to determine channel switching in an array, JASA-EL, submitted 2008.

Lapham, Laura, Jeff Chanton, Chris Martens, Ken Sleeper, and J. R. Woolsey, 2007, *Methane and biogeochemical gradients within acoustic wipe-out zones at a Gulf of Mexico cold seep*, presented by Lapham at the American Geophysical Union Meeting, San Francisco, CA.

Gerstoft, P, LA Brooks, S Fried, B Kuperman, K Sabra, 2007, *Ocean acoustic interferometry using noise and active sources*, invited paper presented by Peter Gerstoft at the American Geophysical Union Meeting, San Francisco, CA.

The following presentation will be made at the Annual Meeting of the American Association of Petroleum Geologists in San Antonio in April.:

Rogers, R.E., J. L. Dearman, G. Zhang, W.W. Wilson, **C.B. Lutken**, 2008, Gulf of Mexico Sediment Evaluations for Microbial-Mineral-Hydrate Associations, AAPG Annual Meeting San Antonio, April 20-24.

EXPERIMENTAL

All experimental work described in this cooperative agreement has been completed in previous reporting periods. Final reports are being prepared for completion of reporting requirements.

RESULTS AND DISCUSSION

Results and discussion of those results derive from cruise and meeting activities and are reviewed in the summary section (previous).

CONCLUSIONS

This report covers the accomplishments of the six-months from October 1, 2007 through March 31, 2008 for Cooperative Agreement Project #DE-FC26-02NT41628, between the Department of Energy and the Center for Marine Resources and Environmental Technology, University of Mississippi. The efforts of the Hydrates Research Consortium are reviewed; at-sea activities reported; meeting and reporting responsibilities reviewed. All subcontractors have completed the work proposed for this cooperative agreement and are in the process of compiling final reports. Additional sea trials for the SSD have been performed and additional capabilities and needs defined. The NIUST AUV has been transferred to USM and the CMRET team that will be responsible for tending it identified. The CMRET and Consortium have begun to address the concerns of the DOE merit review panel and are preparing for additional review. Additional recoveries and deployments of station components are anticipated for the remainder of 2008.

The Consortium continues to establish and foster cooperations through semiannual meetings and cruises. The USC meeting proved extremely useful and constructive. With several cruises scheduled in the months ahead, the

CMRET continues to monitor the many projects included in the Monitoring Station/Sea-floor Observatory Project and to press on towards it completion.

REFERENCES

None.

ACRONYMS

4-C	four-component
AUV	autonomous underwater vehicle
BCS	Barrodale Computing Services, Ltd.
C&C	Chance and Chance
CMRET	Center for Marine Resources and Environmental Technology
DOC	Department of Commerce
DOE	Department of Energy
DOI	Department of the Interior
EGL	Exploration Geophysics Laboratory
FY	Fiscal Year
GOM	Gulf of Mexico
GOM-HRC	Gulf of Mexico-Hydrates Research Consortium
HLA	horizontal line array
HRC	Hydrates Research Consortium
HSZ	Hydrate Stability Zone
IDP	integrated data power unit
I-O; I/O	Input-Output Corporation
mbsf	meters below sea-floor
MC	Mississippi Canyon
MMRI	Mississippi Mineral Resources Institute
MMS	Minerals Management Service
MS/SFO	monitoring station/sea-floor observatory
MSU	Mississippi State University
M/V	merchant vessel
NETL	National Energy Technology Laboratory
NIUST	National Institute for Undersea Science and Technology
NOAA	National Oceanographic and Atmospheric Administration
NURP	National Undersea Research Program
OBC	ocean-bottom cable
PFA (=PCA)	pore-fluid array
R/V	Research Vessel
SDI	Specialty Devices, Inc.
SFO	Sea Floor Observatory
SFP	Sea Floor Probe
SSD	Station Service Device
SSDR	shallow-source/deep-receiver
UGa	University of Georgia

UM	University of Mississippi
US	United States
USBL	ultra-short base-line (navigation system)
USC	University of South Carolina
USF	University of South Florida
USGS	United States Geological Survey
USM	University of Southern Mississippi
VLA	vertical line array
VSP	vertical seismic profile