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HYDRATE RESEARCH ACTIVITIES THAT BOTH SUPPORT AND DERIVE FROM THE MONITORING STATION/SEA-FLOOR OBSERVATORY, MISSISSIPPI CANYON 118, NORTHERN GULF OF MEXICO

Submitted by:

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Task 2: Seismic Data Processing at the Gas Hydrate Sea-floor Observatory: MC118.

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

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Task 4: Noise-Based Gas Hydrates Monitoring.

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TASK 2: Processing and Interpretation of TGS-NOPEC Industry Seismic Data and Integration with Existing Surface-Source/Deep-Receiver (SSDR) High Resolution Seismic Data at MC118, Gulf of Mexico.

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TASK 3: Seismic Data Processing at the Gas Hydrate Sea-Floor Observatory: MC118.

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TASK 4: Geochemical investigations at MC 118: Pore fluid time series and gas hydrate stability.

John Noakes, Scott Noakes, and Chuanlun Zhang, The University of Georgia, Athens, Georgia, and Tim Short, SRI International, St. Petersburg, Florida.
TASK 5: Automated Biological/Chemical Monitoring System (ABCMS) for Offshore Oceanographic Carbon Dynamic Studies.

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TASK 6: Microbial techniques to extract carbon from stored hydrocarbon gases.

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TASK 7: Scoping study using Spatio-Temporal Measurement of Seep Emissions by Multibeam Sonar at MC118.

Paul Higley, Specialty Devices, Inc., 2905 Capital Street, Wylie, TX 75098
TASK 8: Validate high-frequency scatter on SSDR data by acquisition of targeted cores and velocity profiles at MC118 Hydrate Mound.

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TASK 9: Recipient shall model carbonate/hydrate mound in Mississippi Canyon 118 using modified version of (THROBS).

PHASE 3 Subcontractors and Tasks for FY 2009:

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Bob A. Hardage, Bureau of Economic Geology, John A. and Katherine G. Jackson School of Geosciences, the University of Texas at Austin, University Station, Box X, Austin, TX 78713-8924.
TASK 3: Near seafloor geology at MC118 using converted shear-waves from 4C seafloor sensor data.

Laura Lapham and Jeff Chanton, Department of Oceanography, Florida State University, Tallahassee, Florida, 32306-4320.
TASK 4: Geochemical investigations at MC 118: Pore fluid time series and gas hydrate stability.

John Noakes, Scott Noakes, and Chuanlun Zhang, The University of Georgia, Athens, Georgia, and Tim Short, SRI International, St. Petersburg, Florida.
TASK 5: Automated Biological/Chemical Monitoring System (ABCMS) for Offshore Oceanographic Carbon Dynamic Studies.

Ira Leifer, Marine Science Institute, University of California at Santa Barbara, Bldg. 2, Room 3357, Santa Barbara, CA 93103-5080.
TASK 6: Quantification of Seep Emissions by Multibeam Sonar at MC118.

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TASK 7: Modeling a carbonate/hydrate mound in Mississippi Canyon 118 using modified version of (THROBS).

PHASE 4 Subcontractors and Tasks for FY 2010

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TASK 2**:** Integration of Multiple Methods of Geological and Geophysical investigations to advance Shallow Subsurface Characterization at MC118.

Sabodh Garg, Science Applications International Corporation, 10260 Point Campus Drive, MS A-3, San Diego, CA 92121.
TASK 3: Modeling a carbonate/hydrate mound in Mississippi Canyon 118 using modified version of (THROBS).

Laura Lapham and Jeff Chanton, Department of Oceanography, Florida State University, Tallahassee, Florida, 32306-4320.
TASK 4: Geochemical investigations at MC 118: Pore fluid time series and gas hydrate stability.

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TASK 5: Automated Biological/Chemical Monitoring System (ABCMS) for Offshore Oceanographic Carbon Dynamic Studies.
Ira Leifer, Marine Science Institute, University of California at Santa Barbara, Bldg. 2, Room 3357, Santa Barbara, CA 93103-5080.
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INTRODUCTION / PROJECT SUMMARY

The Gulf of Mexico Gas Hydrates Research Consortium (GOM-HRC) was organized in 1999, with the goal of establishing a monitoring station/sea-floor observatory (MS/SFO) to investigate the hydrocarbon system within the hydrate stability zone (HSZ) of the northern Gulf of Mexico. The intention has been to consolidate research effort and to equip the MS/SFO with a variety of sensors that will enable more-or-less continuous monitoring of the near-seabed hydrocarbon system and to determine the steady-state description of physical, chemical and biological conditions in its local environment as well as to detect temporal changes of those conditions.

The purpose 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 provide researchers with an improved 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, now the Bureau of Ocean Energy Management, BOEM) 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, now NOAA/OER (Ocean Exploration and Research) in 2002 via their National Institute for Undersea Science and Technology (NIUST). Some nineteen industries and nineteen universities have been active participants in Consortium/Observatory research; the United States Geological Survey (USGS), the US Navy, Naval Meteorology and Oceanography Command, Naval Research Laboratory (NRL) and NOAA's National Data Buoy Center are involved at various levels. Funded investigations include a range of physical, chemical, and biological studies. Studies of the benthic fauna as a proxy for seafloor hydrocarbon venting comprise a recent addition to the emphasis areas of the Consortium.

The project is administered by the Center for Marine Resources and Environmental Technology (CMRET), the marine arm of the Mississippi Mineral Resources Institute (MMRI) of The University of Mississippi (UM).

EXECUTIVE SUMMARY

In 1999, a consortium of leaders in gas hydrates research in the Gulf of Mexico was assembled for the purpose of consolidating both laboratory and field efforts. 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. The primary purpose of the station is to monitor activity

within the zone of hydrate stability 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 developed and assembled components for a station that will monitor physical and chemical parameters of the sea water, seafloor sediments, and shallow sub-seafloor sediments on a more-or-less continuous basis over an extended period of time. Study of chemosynthetic and other benthic communities and their interactions with geologic processes is a component of the Observatory; results will provide an assessment of environmental health in the area of the station including the effects of deep sea activities on world atmosphere and, therefore, weather.

Central to the establishment of the Consortium is the need to coordinate activities, avoid redundancies and promote effective and efficient communication among researchers. Complementary expertise, both scientific and technical, has been assembled; collaborative research and coordinated research methods have grown out of the Consortium and design and construction of most instrumentation for the seafloor station are essentially complete.

In October, 2004, Mississippi Canyon 118 (MC118) (Figure 1) was selected by unanimous consensus of the GOM-HRC at their semiannual fall meeting as the location likeliest to fulfill the research needs and goals of the group. Criteria for selection included evidence of gas hydrates on the sea-floor, active venting and availability. Based upon roughly five years of site evaluations, sensor design, fabrication, testing and data collection and evaluation, selection of the site was followed by MMS placing a research restriction on the unleased block so Observatory research might continue even if the block should subsequently be leased, as is now the case. *MC118 is the only research reserve in the Gulf of Mexico and the Seafloor Observatory is the only such facility in the Gulf.*

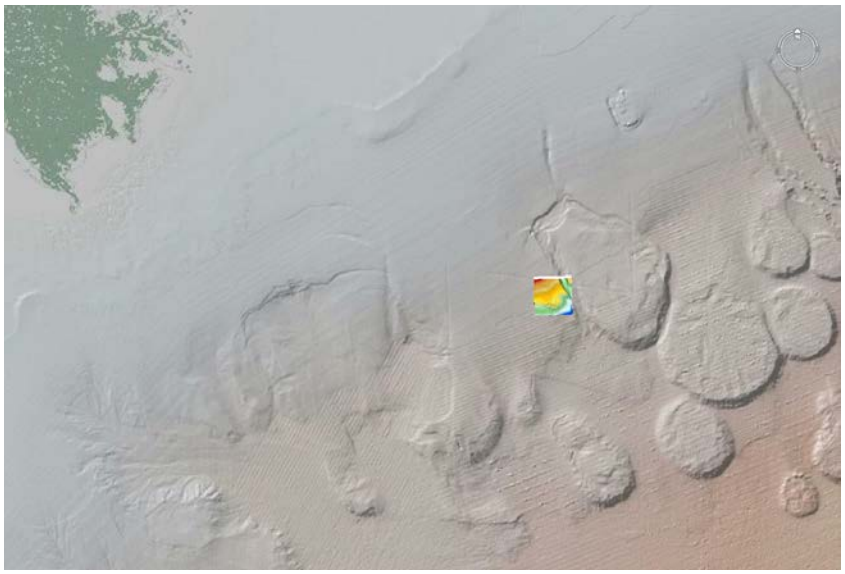


Figure 1. MC118 is located ~30 miles off the toe of the birdsfoot delta on the edge of a massive slump on the continental slope.

During this reporting period, the CMRET planned and commenced one cruise to MC118 and participated in three ECOGIG (Ecosystem Impacts of Oil and Gas Inputs to the Gulf - Gulf Recovery Initiative) cruises, one Autonomous Underwater Vehicle (AUV) cruise directed by the NIUST Underwater Vehicles Technology Center (UVTC) and two Landers cruises, planned and executed by ECOGIG scientists. In these latter cases, CMRET scientists participated in many ways but those relating to CMRET activities involved data acquisition and preliminary processing, in the case of the AUV cruise and Lander design, development, equipping, deploying, and recovery in the case of the second. The AUV recovered multibeam and polarity-preserved chirp data that will be processed by scientists at the STRC. The multibeam data will be used to produce bathymetry and backscatter images while the chirp data allow us to image, in great detail, the shallowest (~60m) portion of the subsurface. Although most of the work accomplished was for another project, we gained valuable experience of and with our newly put-into-service Integrated Scientific Platform for Instrument Deployment and Emergency Recovery or I-SPIDER and Station Service Device (SSD), The March Landers cruise witnessed the extremely successful debut of the I-SPIDER as it was used to reconnoiter potential lander deployment sites and to deploy the landers from the main winch via our fiber-optic cable. Both Remotely Operated Vehicles (ROVs) were used successfully in reconnaissance and recovery/servicing capacities.

A cruise report for the June-July Consortium cruise is in prep and will be posted shortly at http://www.mmri.olemiss.edu/Home/Publications/Cruise.aspx. The ECOGIG cruise reports can be found at https://ecogig.org. An April coring cruise was cancelled due to horrific weather conditions and a replacement cruise scheduled for June 30-July 3. Activities of this successful cruise will be touched upon in this report and covered in greater detail in the Final Report for this project, due October 31.
During this six-month period, we have:

1. deployed and recovered - at GC600 - the newly designed and built landers for the ECOGIG project.
2. performed lander operations at GC600 with the SSD and the I-SPIDER including:
    a. video location and disposition of the lander; locate a bubble stream;
    b. remove a probe from the lander and place it in mud;
    c. video surroundings for potential CSA (Chimney Sampler Array) deployment sites; and
    d. place chimneys on the seafloor, one over a bubble stream (remove each from the lander and place at a suitable site for determining flux of gas from seafloor sediments, i.e. where bacterial mats are abundant or bubble streams are visible).
3. with the NIUST AUV team, recovered multibeam and subbottom chirp data from 50m above seafloor for GC600 and AT357. MMRI/STRC will process and interpret the data.
4. with the NIUST AUV team, recovered multibeam and subbottom chirp data from 15m above the seafloor, of coral colonies at AT357 for a very high resolution bathymetry study. MMRI/STRC will process and interpret the data.
5. with the NIUST AUV team, effected a single dive of MM over AT357 that resulted in 4666 images that will be mosaicked to produce a single image of very diverse

benthic assemblage.

6. used the I-SPIDER, successfully, on three successive cruises both surveying and deploying instruments;
7. completed the consolidation of electronics into a single “topside system” that greatly increases our ability to control and monitor at-sea operations;
8. installed Ultra-short Baseline (USBL) transponders in the hull of the R/V *Pelican* to maintain our exceptional navigation/locating capabilities while at sea;
9. made significant progress in processing the 2012 multibeam data from MC118;
10. established a processing protocol for the new polarity-preserving chirp data from MC118;
11. produced images from the April 2011 Ocean Bottom Seismometer (OBS) data from MC118.

REFERENCES

(References for individual reports follow the appropriate section directly)

EXPERIMENTAL/RESULTS AND DISCUSSION

PHASE 1 Tasks for FY 2006:

Task 1: Design and Construction of four Horizontal Line Arrays

This task is complete. Although the HLAs are still not deployed at the Observatory site, they are complete and ready for deployment, thus satisfying the obligation of SDI, the subcontractor. However, SDI has agreed to continue to work with MMRI toward the eventual goal of deployment of all arrays. The next possible opportunity will likely not occur until late 2013 or sometime in 2014.

Task 2: Seismic Data Processing at the Gas Hydrate Sea-floor Observatory: MC118.

This task has been completed: software has been written, tested on data from another hydrates location, and awaits data from the MS/SFO.

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

The Final Report for this task, supported in all four Phases, is found in the GOM-HRC’s Technical Progress Report to DOE, 42877R24.

Task 4: **Noise-Based Gas Hydrates Monitoring.**

This task is complete.

PHASE 2 Tasks for FY 2008:

TASK 1: Project Management Plan
This task is complete.

TASK 2: Processing and Interpretation of TGS-NOPEC Geophysical Company Industry Seismic Data and Integration with Existing Surface-Source/Deep-Receiver (SSDR) High Resolution Seismic Data at MC118, Gulf of Mexico.
This task includes processing and interpreting industry seismic data collected and provided by TGS-NOPEC, Inc. Geophysical Company and integrating them with existing Surface-source/Deep-receiver (SSDR) high resolution seismic data at from Mississippi Canyon Block 118, Gulf of Mexico (GOM), in order to image and understand the complex geologic structures at the Observatory site and how they relate to gas hydrate formation and dissociation. In their request for continued funding for this project, USC included funds to purchase an additional, deeper, 3-D dataset from WesternGeco. A final report of findings for all phases of this task can be found in the GOM-HRC's Technical Progress Report to DOE, 42877R24.

TASK 3: Seismic Data Processing at the Gas Hydrate Sea-Floor Observatory: MC118.
This task is continued into Phase 3.

TASK 4: Geochemical investigations at MC 118: Pore fluid time series and gas hydrate stability.
The Final Report for this task, supported in all four Phases, is found in the GOM-HRC's Technical Progress Report to DOE, 42877R24.

TASK 5: Automated Biological/Chemical Monitoring System (ABCMS) for Offshore Oceanographic Carbon Dynamic Studies.
The University of Georgia (UGA) and SRI International (SRI) research team has developed a unique survey instrument capable of surveying the methane rich seafloor and collecting biomass and suspended sediment samples on demand. This project is extended into Phase 4.

TASK 6: Microbial techniques to extract carbon from stored hydrocarbon gases: Exploring Extent of Microbial Involvement in Seafloor Hydrate Formations/Decompositions and Establishing that Mechanism
This task continues into Phase 3.

TASK 7: Scoping study using Spatio-Temporal Measurement of Seep Emissions by Multibeam Sonar at MC118.

The multibeam scanning sonar project is continued under Phase 4 and progress is reported in that area of this report.

TASK 8: Validate high-frequency scatter on SSDR data by acquisition of targeted cores and velocity profiles at MC118 Hydrate Mound.

Development of a Shallow Sediment Velocity Probe (SSVP) for use in the Gas Hydrates Research Consortium Sea Floor Observatory Program at MC118.

Introduction

A need for improved knowledge of sediment characteristics as part of the studies of the Gas Hydrates at the MC118 site prompted a desire to measure the velocity of these sediments. The successful installation of the Pore Fluid Array and Temperature Array with sensors installed to depths below the bottom of nearly 10 meters at MC118 opened the possibility of installing acoustic sensors on a similar probe as a method of measuring sediment velocity.

Background

The concept includes developing a series of acoustic sensors that can be attached to this type of a probe, survive the installation trauma and operate at sufficient depths to allow this concept to work. This also requires developing a data acquisition package that can survive these conditions and is capable of driving and communicating with acoustic sensors to achieve a measurement accuracy sufficient to meet the needs of the studies at MC118. SDI has offered to include this development as part of an ongoing electronics package development aimed to provide rapid acoustic shallow water sediment measurement capability.

The sediment probe being designed by SDI is being adapted to also serve as an attachment to an MMRI sediment coring device. The MMRI sediment coring device is intended to collect core samples of gas hydrates or hydrate-bearing sediments in the Woolsey Mound portion of MC118. Inclusion of the sediment probe on this coring device presents the opportunity to collect a vertically graduated sample of the speed of sound, temperature and shear strength of hydrate-bearing sediments simultaneously with the collection of a core sample of this material. This application of the SDI sediment probe, as married to the MMRI sediment coring device, will be the 1st use of the sediment probe. This use is scheduled for a 2014 MMRI cruise to MC118.

Activities during this period

The development and construction of the sediment probe (Figure 2) has been completed during this period.

The probe was designed to be capable of serving as an addition to the MMRI gravity core through addition of an electronics package on the top of the weight of the gravity core and a sensor string enclosed in a tube to be attached along the side of the core tube. The gravity core is being fitted with a USBL positioning system and a battery pack for the sediment probe. An acoustic sound source and an accelerometer have been

included in the sediment probe electronics housing. The sound source is used for the speed of sound measurements and the accelerometer is dual purpose. It detects bottom contact and measures the deceleration rate. The bottom contact serves to trigger a time series of temperature measurements and a time delayed series of speed of sound measurements. The deceleration rate is used to determine the shear strength of the material through which the probe penetrates.

The sediment probe electronics and internal battery also enable the sediment probe to operate as a stand-alone device if mounted on a weighted steel probe without a core barrel.

The software and hardware for this probe were completed and a series of lab tests were used to verify its operation prior to the planned deployment cruise. The battery pack for this sensor has been included in the electronics housing eliminating the need for an external battery pack. The external battery pack was originally planned for the stand-alone sediment probe where multiple insertions and retrievals were planned before recovering the system to the boat. However, the internal pack has sufficient capacity to allow use as a stand-alone device. The possibility of adding the external battery was retained should longer term stand-alone use be desired.

Design Overview and Progress

The sediment probe attachment to the MMRI gravity core consists of a 10 meter long pipe with imbedded hydrophones and an electronics package attached to the top of the gravity core weight. The sediment probe electronics package is positioned with the acoustic source transducer installed on the end plate of the electronics package. This provides a line of sight for the acoustic source to the sensors in the receiving array in the seafloor adjacent to the core barrel. The sediment probe electronics package includes the controller/data logger, a sensor interface and A/D converter an accelerometer sensor, the battery power supply and the acoustic source.

The operational plan for use with the gravity core includes, lowering the sediment probe/coring device to a depth of 30 to 50 meters above the sea floor, using the USBL system to navigate the sensor to the desire location, free falling the sediment probe/gravity core into the sea floor, detecting the bottom insertion with the accelerometer sensor, leaving the probe in place for a suitable time to measure sediment velocity distribution and temperature profile along the probe length and having the ship winch pull the probe free of the sea floor and recovered to the deck for data and core sample recovery.

Schedule

The sediment probe development and construction of the electronics and software has been completed.

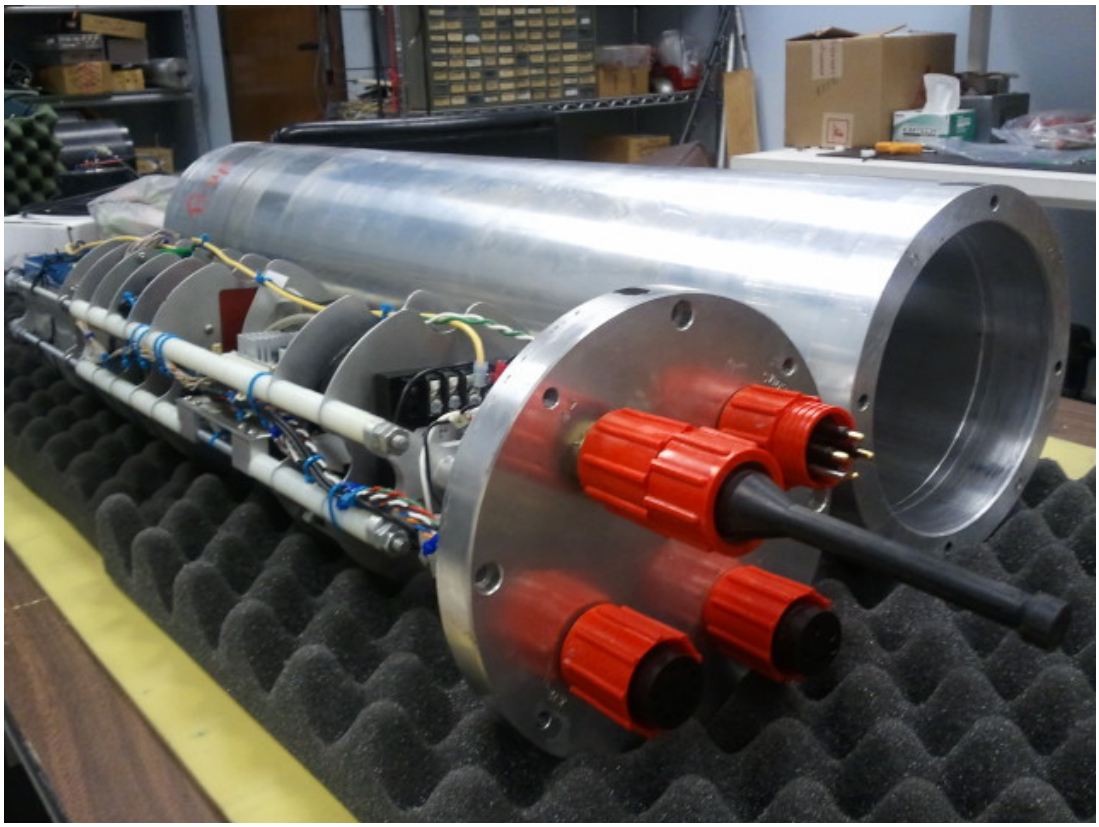


Figure 2. Electronics and housing for the speed of Shallow Sediment Velocity Probe, SSVP.

TASK 9: Recipient shall model carbonate/hydrate mound in Mississippi Canyon 118 using modified version of (THROBS).
This project continues into Phase 4.

TASK 10. **Administrative oversight of the Monitoring Station/Sea-floor Observatory Project.**
Administration of the Consortium is the responsibility of the University of Mississippi and includes formal Project Proposals to federal funding agencies, Technical Progress Reports, Final Project Reports, informal monthly updates, reports of Consortium meetings, cruise reports, participation in national meetings, organizing meetings between researchers, organizing and participating in program reviews, organizing and participating in research activities, including research cruises. This responsibility was completed for FY08 with the completion and acceptance of the year-end report to DOE, 42877R12. Further administrative duties and responsibilities are addressed in Phase 4.

PHASE 3 Tasks for FY 2009:

TASK 1: Project Management Plan

This task is complete.

TASK 2: Geological and Geophysical Baseline Characterization of Gas Hydrates at MC118, Gulf of Mexico

Temporal evolution of the gas hydrate system at Woolsey Mound *via* time-lapse seismic monitoring. This final technical report appears in technical report, 42877R24.

TASK 3: Seismic Data Processing at the Gas Hydrate Sea-Floor Observatory: MC118.

The previous technical report, 42877R24 addressed three aspects of the Ocean Bottom Seismometer (OBS) data treatment: data quality evaluation, survey geometry sorting, and separation of the seismic wavefield. Due to the death of Dr. McGee and the departure of Dr. Macelloni, the MMRI/CMRET does not have a resident geophysicist available to complete this project. We have, therefore, entered into a contractual agreement with long-time collaborator, Vaughn Geobel of Lookout Geophysical Company to complete this task. He is familiar with the project and has remained in close communication with Dr. Macelloni, so that the transfer of information can be as clean and efficient as possible. He first evaluated the data for consistency and then presented an estimate of time required to finish the job. He has made weekly reports of progress and has managed to complete the analyses though a final report is forthcoming.

Some of the resulting images appear below, Figures 3 and 4..

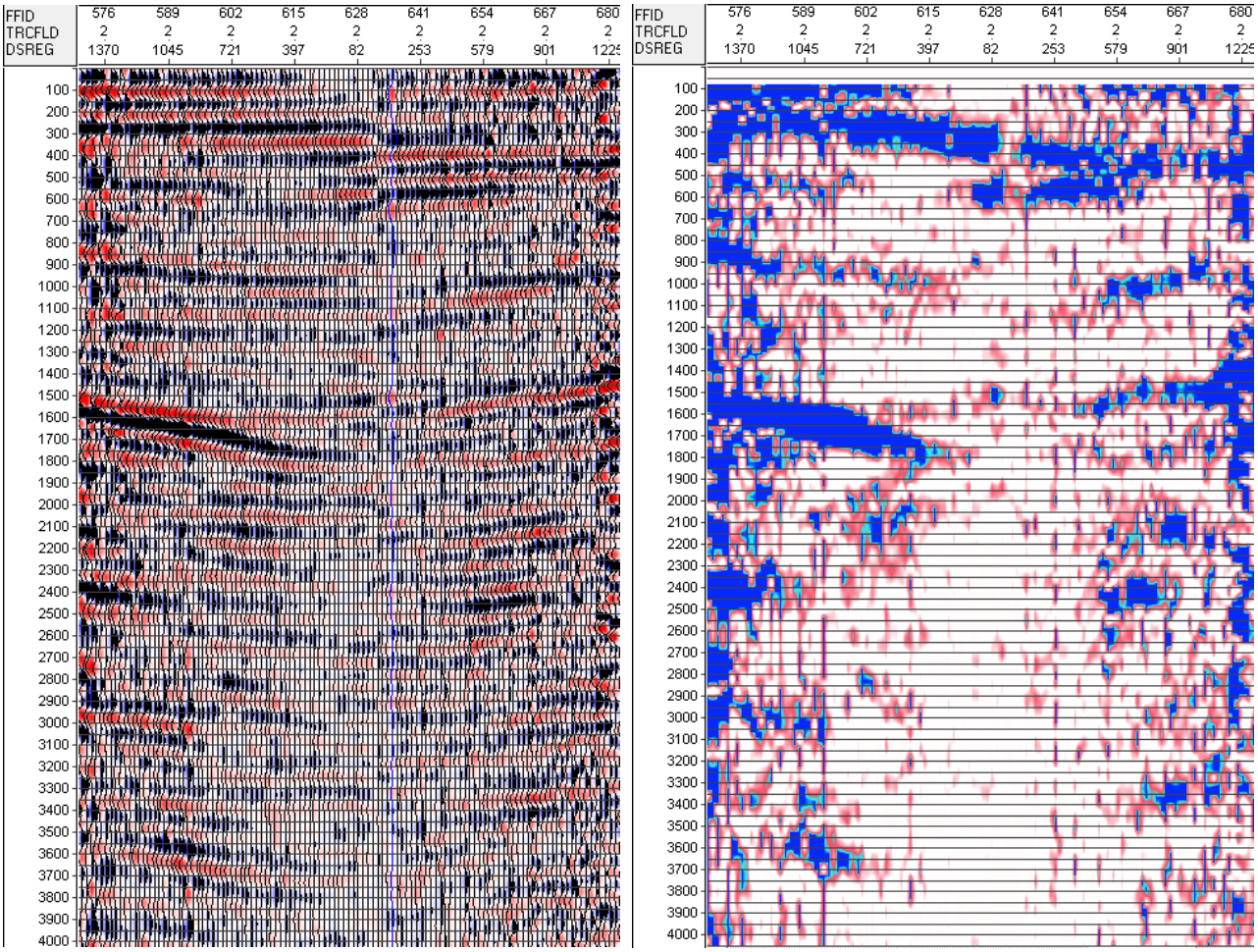


Figure 3. OBS 10, Line 4, Rs and Rs envelope.

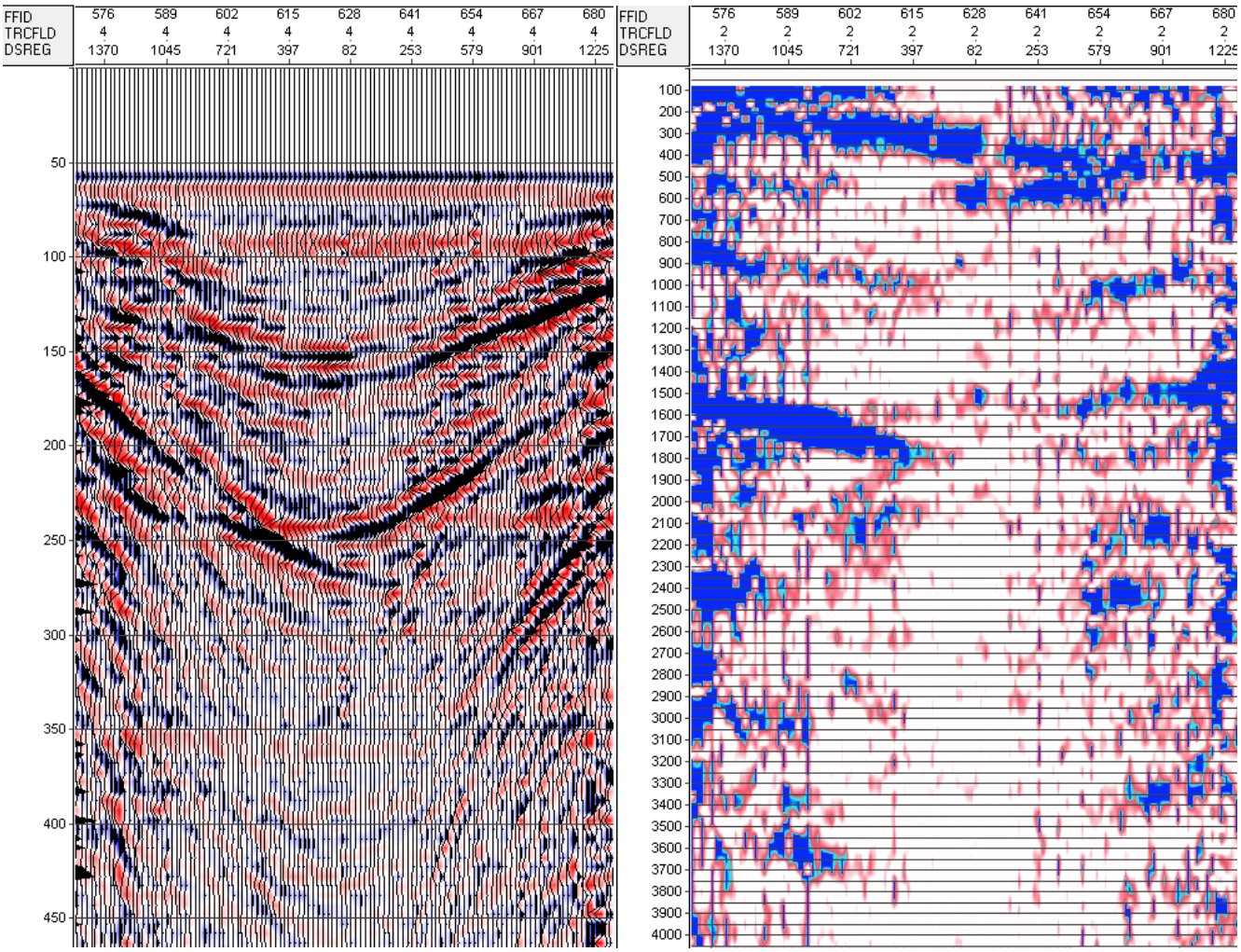


Figure 4. OBS 10, Line 4, Rp and Rp envelope.

TASK 4: Geochemical investigations at MC 118: Pore fluid time series and gas hydrate stability.

The Final Report for this task, supported in all four Phases, is found in 42877R24.

TASK 5: Automated Biological/Chemical Monitoring System (ABCMS) for Offshore Oceanographic Carbon Dynamic Studies.

The University of Georgia (UGA) and SRI International (SRI) research team has developed a unique survey instrument capable of surveying the methane rich seafloor and collecting biomass and suspended sediment samples on demand. This project is extended into Phase 4 and progress is covered in that section of this report.

TASK 6: Microbial techniques to extract carbon from stored hydrocarbon gases: Exploring Extent of Microbial Involvement in Seafloor Hydrate Formations/Decompositions and Establishing that Mechanism

This task is complete with the final report already having been submitted in the July-December, 2010 (42877R18) reporting period. In brief, these results include the Mississippi State University's (MSU) team's findings that indigenous microbes play an important part in the nucleation, accumulation, and dissociation of near-surface hydrates, that microbial techniques can be used to extract carbon from stored hydrocarbon gases—i.e., to assist in the production of the occluded hydrocarbon gases, and most recently, the intriguing finding that microbial cell wall material inhibits hydrate formation, a necessary occurrence for the bacterial cell's survival, as it prevents hydrate formation-heats from being liberated directly onto cell surfaces. ***They found the hydrate inhibitor to be peptidoglycan, a chemical common in microbial cell walls.*** Data were gathered showing this water-insoluble peptidoglycan polymeric compound, to be increasingly effective as an inhibitor - to hydrate formation - by increasing its surface area through cell lysing. A smaller, water-soluble, molecular component of the peptidoglycan polymer was tested and shown to retain hydrate-inhibiting properties. In tests comparing with a methanol standard, this water-soluble, glycan strand performed better in delaying gas hydrate formation (i.e., longer induction times) than similar amounts of methanol, the current industry standard used to inhibit hydrate formation in pipelines.

TASK 7: Scoping study using Spatio-Temporal Measurement of Seep Emissions by Multibeam Sonar at MC118.

The multibeam scanning sonar project is continued under Phase 4 and progress is reported in that area of this report.

Task 8: Administrative oversight of the Monitoring Station/Sea-floor Observatory Project.

Administration of the Consortium is the responsibility of the University of Mississippi and includes formal Project Proposals to federal funding agencies, Technical Progress Reports, Final Project Reports, informal monthly updates, reports of Consortium meetings, cruise reports, participation in national meetings, organizing meetings between researchers, organizing and participating in program reviews, organizing and participating in research activities, including research cruises. This responsibility was completed for FY09 with the completion and acceptance of the year-end report to DOE, 42877R18. This responsibility continues through the life of the project and a compilation of administrative duties and responsibilities is presented in Phase 4, Task 7.

Task 9. Project Summary Updates:

These appear as Task 8 in Phase 4.

PHASE 4 Tasks FOR FY2010

TASK 1: Program Management Plan
This task is complete.

Task 2: Integration of Multiple Methods of Geological and Geophysical investigations to advance Shallow Subsurface Characterization at MC118, site of the Gulf of Mexico Hydrates Research Consortium's Seafloor Observatory
The focus of this task is to collect, assemble, integrate, and interpret multiple geo-datasets that have been/will be collected to investigate the characteristics of the hydrocarbon system at the site of the Seafloor Observatory being installed by the Gulf of Mexico Hydrates Research Consortium at MC118.

Progress has been made in data acquisition as well as in integration of datasets. However, completion of this task must, necessarily, follow completion of the collection and consolidation of all datasets for the six subtasks. Progress on each is as follows:

Subtask 2.1. Recipient shall contract heat-flow data collection surveys across the hydrate mound area at MC118.
This study was completed and reported upon in the technical progress report, 42877R24. The purpose of the study was to determine the thermal properties impacting the Observatory site and thus provide information regarding the general extent of hydrate stability as well as specifics regarding the role(s) of major faults in functioning as conduits for fluids migrating from depth to the seafloor, and which faults are open conduits and which are not.

A summary paper has been written and submitted to the Journal of Geophysical Research. This paper addresses the distribution of heat-flow in the carbonate complex at Woolsey Mound. The heat-flow values and hydrate compositions obtained from samples collected during a 2002 submersible dive and from core samples collected during the January, 2011 Jumbo Piston Coring cruise were used in the compositional simulator developed by SAIC (Phase 4,Task 3) to model the hydrate stability zone.

Subtask 2.2. Recipient shall contract to have giant piston cores collected from areas of interest at the Observatory site. Jumbo Piston Cores (JPCs) were collected in January, 2011. This subtask was completed and a report of activities (42877R22) made during a previous reporting period.

Subtask 2.3. Recipient shall process and interpret the polarity-preserving chirp data collected with the AUV-borne system, to define the shallow geometry of the fluids/gas pipe system and integrate these results with the geological (core analyses) and geophysical data.
CMRET and UVTC have established a processing protocol for the polarity-preserving chirp data from MC118.

Subbottom profiles have been converted and processed for stratigraphic interpretation/analysis. Using a converter developed in-house, the files logged by the subbottom profiler (SBP) in GeoAcoustics condensed format (.gcf) are merged with vehicle log files and exported in a variant of the SEG-Y (.sgy) geophysical data format. This allows additional processing to be carried out using standard seismic tools, thereby allowing for analysis of sediment elastic properties and, eventually, the creation of pseudo-3D volumes. The 3D representations can be combined with vehicle-derived bathymetry and backscatter measurements to derive a greater understanding of the seafloor structure. This process will allow selection of the most promising sites for the DCR deployment. A time-lapse analysis will be made comparing the 2005 and 2012 datasets.

Subtask 2.4 The recipient shall perform sedimentological, lithological, paleontological and geophysical analyses of the newly recovered cores (Phase 4, subtask 2.2) and shall integrate the results with previous core studies. The University of Southern Mississippi core-logging team opened, photographed and described the cores from the JPC cruise during the summer of 2011. Electric log analyses were performed at Stennis Space Center's office of NAVOCEANO.
A summary of the lithostratigraphy appeared in the previous Technical Progress Report (42877R24) The biostratigraphic/time analysis is anticipated in the near future.

Subtask 2.5 Recipient shall collect solid outcropping gas hydrates and/or authigenic carbonate/hydrates samples at the MC118 Observatory site using the existing pressure-chamber sampler in conjunction with the STRC ROV. The construction of the small pressure vessels is complete and they have been fitted to the SSD Remotely Operated Vehicle (ROV). The CMRET/SDI/STRC team will attempt to complete this task in September, 2013 or later when cruises are scheduled aboard Louisiana Universities Marine Consortium's (LUMCON's) R/V *Pelican*.

Subtask 2.6. The recipient shall refurbish 4C nodes, donated by CGG Veritas for deployment and use in shear experiments as defined in Phase 2 task 3, and Phase 3 task 3.
This subtask was rewritten and rebudgeted from 3 years of DOE awards to the CMRET. It now reads:
Phase 3, Task 3: Near seafloor geology at MC118 using converted shear-waves from 4C seafloor sensor data (Subcontractor: John Collins, Woods Hole Oceanographic Institution)
This task is complete. The data have been delivered to CMRET in both SEED and SEGY formats and CMRET has, after inspecting the data, copied and delivered a set to UT-Austin (Hardage) for 4-C analyses and to enable them to fulfill the FY08 subcontract. In addition a copy of the data was delivered to UCSD (Gerstoft) for analysis of ambient noise in the data. A full report of cruise activities is available at the MMRI website: http://mmri.olemiss.edu/Home/Publications/Cruise.aspx

As noted earlier, UT's responsibilities have been largely transferred to the University of Mississippi. UM continues to work with UT and UCSD to complete the analyses of the

Ocean Bottom Seismometer (OBS) data. Most recently, UM has entered into a contractual agreement with Lookout Geophysical Co. to complete the data analyses and preliminary interpretation of the data for this task. Progress on this subtask is discussed further under Phase 3, Task 3.

TASK 3: Modeling a carbonate/hydrate mound in Mississippi Canyon 118 using modified version of (THROBS).

SAIC subcontract for Year 3 with the University of Mississippi was finalized towards the end of September 2010. A no-cost extension till the end of June 2012 was granted in the fall of 2011. An additional no-cost extension till the end of June 2013 was approved in the fall of 2012.

Technical Progress

During 2011, work was continued on debugging and testing the new equation-of-state package (HYDGAS). As reported in January 2012 letter report, the contract funds were nearly exhausted (around 97% of the total) by the end of 2011. Since the remaining amount is insufficient to complete this HYDGAS package, a decision was made in January 2012 to suspend this effort pending the availability of additional support. Effort is continuing on identifying additional resources that may become available for this work. If we are successful in obtaining additional support, we will complete the HYDGAS package, and perform preliminary calculations to characterize the effect of a gaseous mixture on hydrate formation at the Hydrate Mound.

In June 2012, SAIC was informed by the University of Mississippi that recently very accurate heat flow data were collected at 15 sites in and around MC118. We have used the completed HYDGAS correlations to compute the base of the hydrate stability zone (for 100% methane gas, and a mixture of methane, ethane and propane) at these 15 sites. This work is included in a multi-author paper to be submitted to a peer-reviewed journal. During the current report period, work was continued on revising the latter paper.

TASK 4: Biogeochemical investigations at MC 118: Pore fluid time series and gas hydrate stability: Integrating geochemical and geophysical studies to characterize the sulfate methane transition zone of a complex carbonate hydrate mound in Northern Gulf of Mexico

Including Phase 1, TASK 3: Coupling of Continuous Geochemical and Sea-floor Acoustic Measurements (Subcontractor: Florida State University, FSU). This task is complete and a final report appeared as Appendix B in technical report, 42877R24.

TASK 5: Automated Biological/Chemical Monitoring System (ABCMS) for Offshore Oceanographic Carbon Dynamic Studies: Development of the Marine Lander Survey Vehicle for Gas Hydrate Research

The Lander was prepped for deployment in April 2013 only to be set aside due to poor conditions offshore. However, the additional time the postponement allowed gave birth to the ability to have wireless video transmission to a remote computer at the winch

operator station. The remote video is intended to allow the winch operator to monitor the Lander elevation above the seafloor and correct altitude as needed to keep the Lander from unintentionally coming in contact with the seafloor. Also, the Lander software was modified to include the pumping volume through the sample filters. This information is stored in the sample information section of the data file along with a description of where the sample pumping first started.

In early June, CAIS (Center for Applied Isotope Studies) personnel traveled to the SRI facility in St. Petersburg to participate in the MIMS calibration and final preparations for the upcoming deployment scheduled in early July. The MIMS calibrated without difficulty and all systems appeared ready for deployment (Figure 5). In the final preparations for the upcoming cruise, it was determined that a vacuum release valve was needed to relieve vacuum on the pump should the system need to be shut down and restarted. This addition will be added after the upcoming cruise.

Figure 5. MIMS calibration system and test prior to deployment.

TASK 6: Quantification of Seep Emissions by Multibeam Sonar at MC118.

The lander, sonar, rotator, and associated electronics were readied for deployment in July 2013, from the R/V *Pelican* at MC118. The goal is for the system to visualize bubble plumes.

Atmospheric measurements using a Los Gatos Research Fast Greenhouse Gas cavity Ringdown spectrometer, which measures methane, carbon dioxide, and water vapor were collected during transit from California to Louisiana, and continue during the RV Pelican cruise. Addition of a scroll vacuum pump allows 10 Hz data aquisition. Preliminary consideration of the data suggests an enhancement in atmospheric methane was observed in the vicinity of MC118 in the air, as well as a strong enhancement in the more coast atmosphere, site of significant petroleum production activities. Further atmospheric greenhouse gas data collection is planned for the return trip to California.

A two-part manuscript describing methane measurements during the drive from California to Cocodrie, Louisiana in 2010 is published in Atmospheric Environments.

Some further development has been done on the bubble model for the fate of bubbles from MC118, including as noted before, more realistic treatment of Type II

hydrate effects through collaboration with Jonathan Levine (Colorado School of Mines). These simulations have been used to explain the persistence of bubbles observed in the HYFLUX experiment for a bubble plume from MC118. Submission of a manuscript still is planned within the next month or so.

Task 7: Administrative Oversight of the Monitoring Station/Sea-floor Observatory Project.

Administration of the Consortium is the responsibility of the University of Mississippi and includes formal Project Proposals to federal funding agencies, Technical Progress Reports, Final Project Reports, informal monthly updates, reports of Consortium meetings, cruise reports, participation in national meetings, organizing meetings between researchers, organizing and participating in program reviews, organizing and participating in research activities, including research cruises. For this reporting period, these include:

- Technical semiannual progress report 42877R26 covering progress of DOE-funded projects as well as additional Consortium accomplishments for the time period July 1 – December 31, 2012, was completed and submitted to DOE during this reporting period. Regular monthly reports documenting progress of subcontractors and the Consortium in general have been less formal, taking the form of email and telephone updates;
- Final Reports have been submitted and accepted from UCSD, USC, MSU, FSU, SAIC and SDI;
  Cruise Report for the July 16-21 cruise to MC118 (Consortium) and MC297 (ECOGIG); A cruise report for the July cruise can be found at http://www.mmri.olemiss.edu/Home/Publications/Cruise.aspx.
- Visiting Scholars Francesca Marra and Alessandra Conti, Marine Geoscientists, from the University of Rome, La Sapienza have nearly completed their projects. Francesca Marra has worked to complete the mathematical/statistical analyses of the geochemical data recovered during three deployments of the Benthic Boundary Layer Array (BBLA) at MC118. She spent two months working with Primary Investigator Rich Camilli at Woods Hole Oceanographic Institution, primarily to understand the background scientific thinking and justification for the array but also to investigate possible environmental settings and changes affecting the data. Alessandra Conti has processed and interpreted AUV multibeam data, correcting for noise, navigation errors and extracting bathymetry and backscatter from which she has produced images and morphological, biological and geological analyses. She is working on a submission for Deep Sea Research II.
- UM-led publications in peer-reviewed journals are listed in the Publications section of this report and include two new publications and another in preparation.
- Designed and built two instrument landers for the ECOGIG GRI-I project;
- Deployment and recovery - at GC600 – of the newly designed and built landers for the ECOGIG project;
- performed lander operations at GC600 with the SSD and the I-SPIDER including:
  - video-recorded location and disposition of the lander;
  - located a bubble stream;
  - video-recorded surroundings for CSA (Chimney Sampler Array) deployment

sites; and
    - placed chimneys on the seafloor, one over a bubble stream (removed each from the lander and placed it at a suitable site for determining flux of gas from seafloor sediments, i.e. where bacterial mats are abundant and/or bubble streams are visible).
- with the NIUST AUV team, recovered multibeam and subbottom chirp data from 50m above seafloor at two new sites. MMRI/STRC will process and interpret the data.
- with the NIUST AUV team, recovered multibeam and subbottom chirp data from 15m above the seafloor, of coral colonies at AT357 for a very high resolution bathymetry study. MMRI/STRC will process and interpret the data.
- with the NIUST AUV team, effected a single dive of MM over AT357 that resulted in 4666 images that will be mosaicked to produce a single image of very diverse benthic assemblage.
- used the I-SPIDER, successfully, on three successive cruises both surveying and deploying instruments;
- completed the consolidation of electronics into a single “topside system” that greatly increases our ability to control and monitor at-sea operations;
- installed Ultra-short Baseline (USBL) transponders in the hull of the R/V *Pelican* to maintain our exceptional navigation/locating capabilities while at sea;
- made significant progress in processing the 2012 multibeam data from MC118;
- established a processing protocol for the new polarity-preserving chirp data from MC118;
- produced images from the April 2011 OBS data from MC118.
- UM Consortium scientists planned, contracted for and executed a research cruise to MC118, site of the GOM-HRC MS/SFO, aboard the R/V *Pelican*, June 30 - July 3. DOE participants included a crew from UGa and SRI with the Lander and MIMS (Membrane-induced mass spectrometer) who made 2 very productive dives. A group from UCSB successfully recorded bubble stream activity at MC118 with a 3D sonar rotator. Achievements of this cruise will be covered in greater detail in the Final Technical Report, but include:
    - Performed lander operations at MC118 with the newly upgraded Noakes lander, uncluding MIMS;
    - Deployed, landed, recorded bubble activity and recovered the UCSB MMRI-CMRET adapted sonar rotator;
    - A sonar rotator system built by the University of Southern Mississippi was deployed at MC118 for a long-term deployment via MMRI-CMRET ABIL (lander).

Task 8. Project Summary Updates:

Periodic website updates are the responsibility of the CMRET together with DOE. Publications are added to the Consortium list as they appear or as notification is received and a list of recent publications accompanies this report.

The Consortium website continues to be expanded and updated though there is much information still awaiting posting. Unfortunately, reductions in personnel as well as

funding have necessitated shifting personnel from this important task to other more pressing duties. It is a goal of the CMRET to get many of the older reports, logs and other data posted. Geological and geophysical pages for the website include core locations and descriptions, cruise reports, meeting presentations, online geophysical data collected by the CMRET, reports of meetings and many maps derived from Consortium effort.

Several new peer-reviewed publications have come out in the six months covered in this report. The heat-flow paper has been submitted for publication. Fortunately, the new DOE award is in place and will keep research lively at MC118. We continue to be involved in ECOGIG work, designing, building and deploying landers at selected sites in the northern Gulf, and processing AUV data recovered by NIUST UVTC.

CONCLUSIONS

This report covers the accomplishments of the six-month period from January 1 through June 30, 2013, of funding of Cooperative agreement Project #DE-FC26-06NT42877, 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: one cruise, in progress at the end of the reporting period, to deploy for several months, a sonar rotator on an ABIL (lander), deployments of the UGa lander and the UCSB 3D sonar rotator. Additional cruises with the ECOGIG project have provided opportunities to operate and adapt our vehicles and other capabilities making us more adept at at-sea operations. Polarity-preserved chirp data can now be processed; new polarity-preserved chirp and multibeam data from MC118 are being processed and will soon be analyzed for morphologic features and hazards on the seafloor as well as the shallow subsurface. Industry data have been analyzed and integrated with high-resolution data validating a capability to merge multiple datasets to predict hydrate in the shallow subsurface with greater accuracy than any known single method can provide. Innovative data processing techniques and approaches are being employed to evaluate seismic datasets, both standard and Consortium-developed, and an improved image of the subsurface structure of the carbonate-hydrate mound at MC118 is emerging. HLA configuration and deployment challenges continue and we continue to develop new deployment and recovery approaches and techniques to overcome them. A preliminary hydrate 3-gas model is approaching completion and has been used with actual MC118 data to predict the range of hydrate stability at our observatory site. Manuscripts have been submitted and resubmitted and, in some cases, accepted and published in peer-reviewed journals and Proceedings of Professional Societies' meetings. New funding sources continue to be sought. Additional efforts to monitor developments resulting from the vast amounts of hydrocarbons spilled into the seawater at MC252 are ongoing, with Consortium researchers making significant findings/contributions to unraveling that developing predicament. A new DOE Cooperative Agreement has been reached to conduct resistivity work and attempt to link findings to oceanographic parameters at MC118.

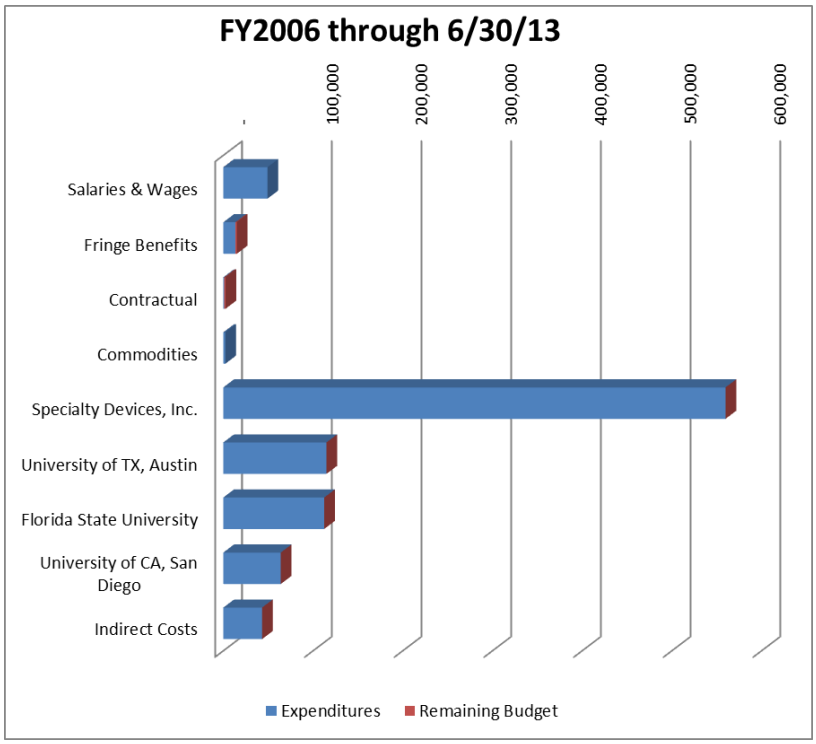
ACRONYMS AND ABBREVIATIONS

3-D	3-dimensional
4-C	four component
ABCMS	Automated Biological Chemical Monitoring System
ABIL	Autonomous Benthic Instrument Lander
AT	Atwater Valley (Federal Lease Block)
AUV	autonomous underwater
BBLA	Benthic Boundary Layer Array
BOEM	Bureau of Ocean Energy Management
CAIS	Center for Applied Isotope Studies
CMRET	Center for Marine Resources and Environmental Technology
CMSHYD	stand-alone computer program; Sloan's statistical thermodynamic approach
CSA	Chimney Sampler Array
DOC	Department of Commerce
DOE	Department of Energy
DOI	Department of the Interior
ECOGIG	ECosystem impacts of Oil and Gas Inputs to the Gulf
EOS	equation-of-state
FY	Fiscal Year
GOM	Gulf of Mexico
GOM-HRC	Gulf of Mexico-Hydrates Research Consortium
GC	Green Canyon (Federal Lease Block)
GRI	Gulf Recovery Initiative
HF	heat flow
HLA	horizontal line array
HRC	Hydrates Research Consortium
HSZ	Hydrate Stability Zone
HYDGAS	new hydrate equation-of-state
IDP	Integrated Data Power Unit/Interconnection and Data Recovery device
I-SPIDER	Integrated Scientific Platform for Instrument Deployment and Emergency Recovery
JPC	Jumbo Piston Core/Coring
LUMCON	Louisiana Marine Consortium
MC	Mississippi Canyon (Federal Lease Block)
MIMS	membrane induction mass spectrometer
MMRI	Mississippi Mineral Resources Institute
MMS	Minerals Management Service
MS/SFO	monitoring station/sea-floor observatory
MSU	Mississippi State University
NAVOCEANO	U.S. Naval Oceanographic Office
NETL	National Energy Technology Laboratory
NIUST	National Institute for Undersea Science and Technology
NOAA	National Oceanographic and Atmospheric Administration
NRL	Navy Research Laboratory
NURP	National Undersea Research Program

OBS	ocean bottom seismometer
OER	Ocean Exploration and Research
ROV	remotely operated vehicle
R/V	Research Vessel
SAIC	Science Applications International Corporation
SBP	sub-bottom profiler
SDI	Specialty Devices, Inc.
SFO	Sea Floor Observatory
SFP	Sea Floor Probe
SRI	SRI, International
SSD	Station Service Device
SSDR	Surface-Source Deep Receiver
SSVP	shallow sediment velocity probe
STRC	Seabed Technology Research Center
THROBS	SAIC's hydrate simulator
UCSB	University of California, Santa Barbara
UCSD	University of California, San Diego
UGA	University of Georgia
UM	University of Mississippi
USBL	ultra-short baseline navigation system
USC	University of South Carolina
USGS	United States Geological Survey
USM	University of Southern Mississippi
UT	University of Texas
UVTC	Underwater Vehicle Technology Center
WHOI	Woods Hole Oceanographic Institution

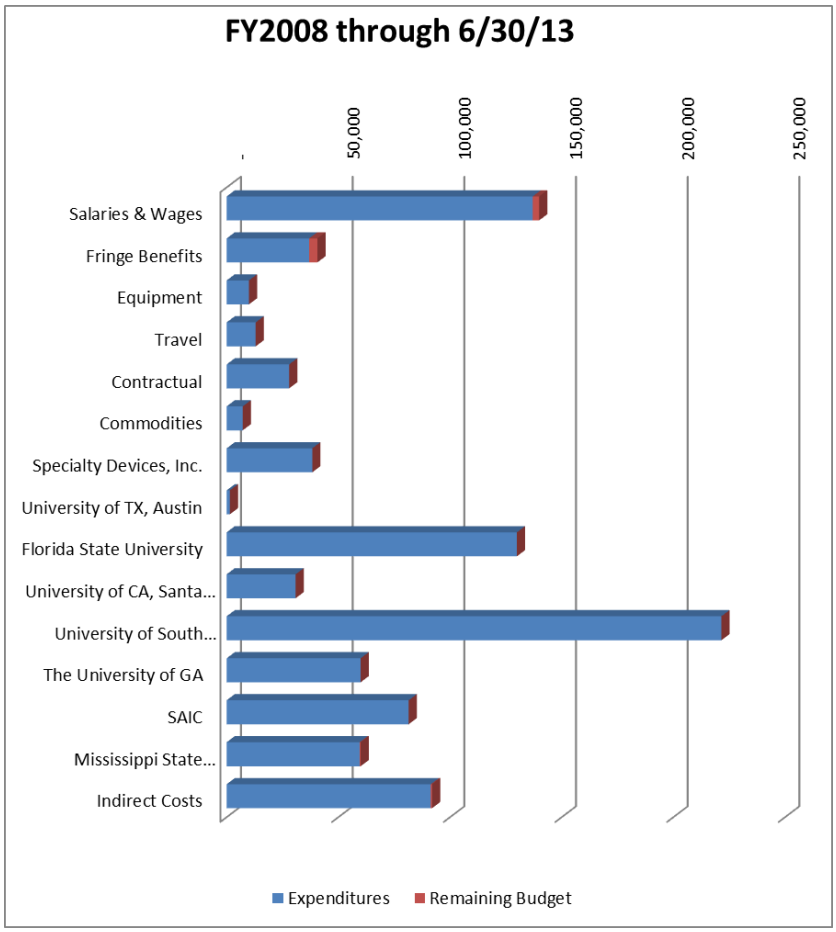
COST STATUS

As can be seen in the figures and tables that follow, Phase 1 (FY06) and Phase 3 (FY09) funds are essentially spent. Funds remaining in Phase 2 (FY08) are primarily the salary and fringe and overhead that should be spent out in July. Significant funds remain in Phase 4 (FY10). All subcontractors are working to resolve remaining budget issues with their respective offices of research. The no-cost extension through July, 2013, should see most work completed. We are striving to complete the project by that time.



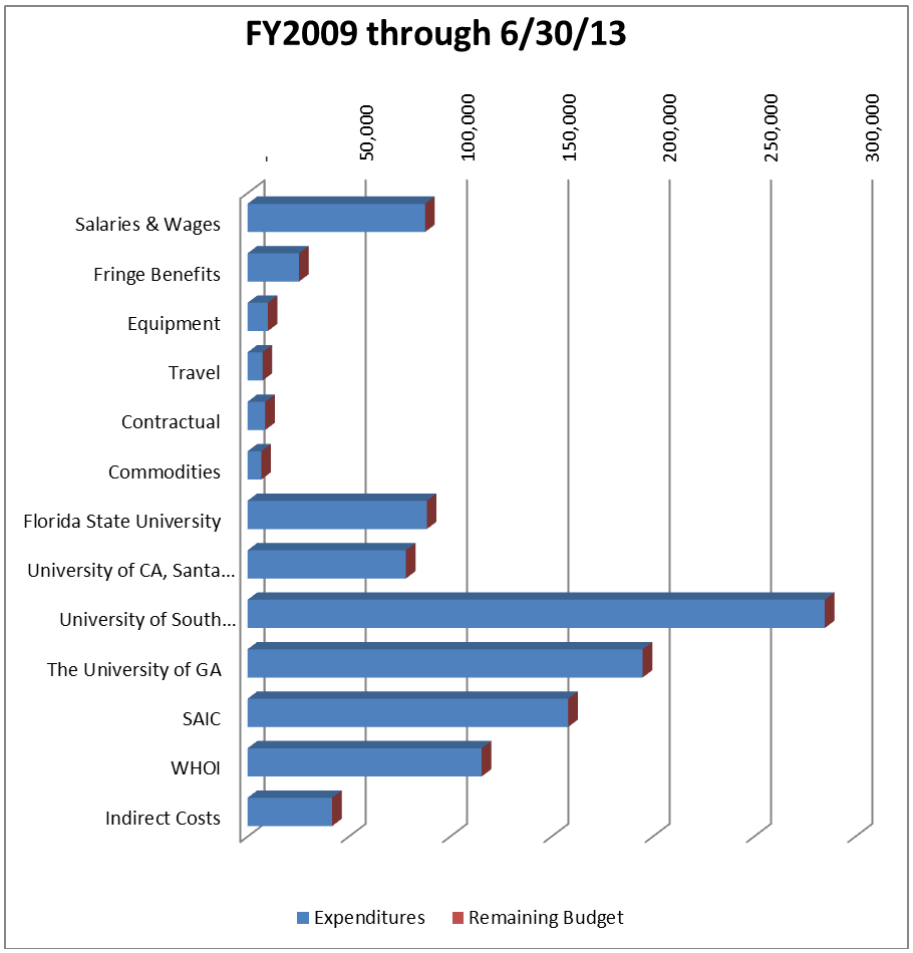
Mississippi Mineral Resources Institute
DOE DE-FC26-06NT42877
Funding Status as of 6/30/13

FY2006	Expenditures	Remaining Budget
Salaries & Wages	49,309	(229)
Fringe Benefits	13,471	1,646
Contractual	1,026	1,474
Commodities	2,176	(2,176)
Specialty Devices, Inc.	559,912	-
University of TX, Austin	114,979	21
Florida State University	112,520	-
University of CA, San Diego	64,113	-
Indirect Costs	43,155	187
Total	960,661	923



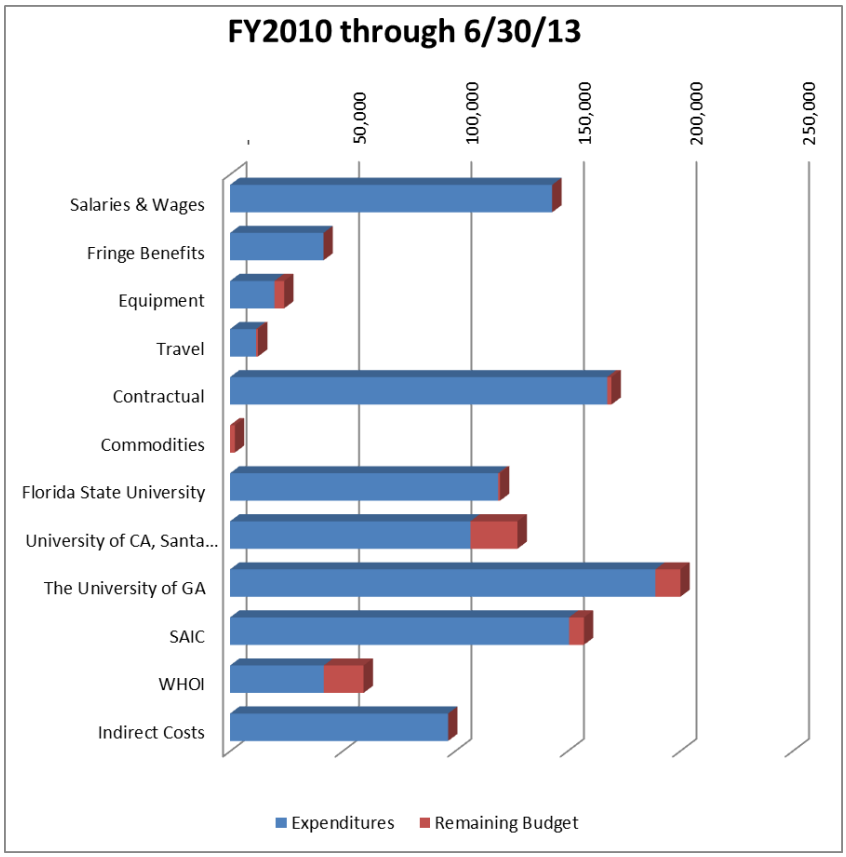
Mississippi Mineral Resources Institute
DOE DE-FC26-06NT42877
Funding Status as of 6/30/13

FY2008	Expenditures	Remaining Budget
Salaries & Wages	137,017	2,894
Fringe Benefits	36,929	3,691
Equipment	10,000	-
Travel	13,000	-
Contractual	28,000	-
Commodities	7,215	-
Specialty Devices, Inc.	38,336	-
University of TX, Austin	1,445	-
Florida State University	129,972	-
University of CA, Santa Barbara	30,881	-
University of South Carolina	221,516	-
The University of GA	60,000	-
SAIC	81,527	-
Mississippi State University	59,539	463
Indirect Costs	91,404	571
Total	946,781	7,619



Mississippi Mineral Resources Institute
DOE DE-FC26-06NT42877
Funding Status as of 6/30/13

FY2009	Expenditures	Remaining Budget
Salaries & Wages	87,602	-
Fringe Benefits	25,405	-
Equipment	10,000	-
Travel	7,400	-
Contractual	8,717	2
Commodities	6,767	-
Florida State University	88,508	-
University of CA, Santa Barbara	78,118	-
University of South Carolina	284,899	-
The University of GA	195,029	-
SAIC	158,252	-
WHOI	115,550	-
Indirect Costs	41,775	-
Total	1,108,022	2



Mississippi Mineral Resources Institute
DOE DE-FC26-06NT42877
Funding Status as of 6/30/13

FY2010	Expenditures	Remaining Budget
Salaries & Wages	143,151	-
Fringe Benefits	41,514	-
Equipment	19,694	4,306
Travel	11,549	851
Contractual	167,582	1,918
Commodities	-	2,108
Florida State University	119,127	854
University of CA, Santa Barbara	106,822	20,921
The University of GA	189,052	11,069
SAIC	150,622	6,637
WHOI	41,607	17,721
Indirect Costs	96,895	-
Total	1,087,615	66,385

MILESTONE STATUS

Milestones identified in the Project Management Plan are discussed below and related to their status.

Milestone 1: ***Complete the baseline characterization of the subsurface at the Observatory site, MC118 for presentation to the panelists at the DOE Merit Review.*** *Complete Seismic Analysis of data from MC118 including defining features that relate to the occurrence of gas hydrates.*

Baseline character of the Observatory site at MC118, as revealed in several seismic data sets is complete. Three different resolution datasets have been evaluated and integrated. Jumbo piston cores, heat-flow data, and polarity-preserving chirp data have been recovered and are being integrated and evaluated. We have yet to complete the hydrate vessels for collection from the SSD and we have yet to complete the biostratigraphic analysis of the cores, but we definitely have a much clearer view of the surface and subsurface at MC118 than we did in 2010 when this proposal was tendered. We have, at last, recovered a photo survey of the western craters of the Woolsey Mound in order to complete our surface structures and benthic faunal analyses. We have also acquired a high resolution multibeam and polarity-preserving chirp survey of Woolsey Mound and vicinity and are working on the processing possibilities and interpretation. Chemical surveying has added valuable information to the site baseline characterization and we now have a student analyzing the BBLA seafloor array data.

Milestone 2: Recover instruments from the seafloor and analyze data for baseline geochemistry and microbiology for the model (Task 9).

All landers have been recovered. CMRET began analyses of the BBLA data in the summer of 2012 and now has a Visiting Scholar dedicated to the completion of this task.

Milestone 3: Deploy horizontal line arrays, connect them to the data recovery system and collect test data from the data-logger. *All components of the deployment have been tested successfully.* Deployment strategy has been redesigned to include a lander for delivery of the arrays, one-at-a-time to the seafloor. This will likely not occur until fall, 2013.

Milestone 4: Complete installation of all Observatory components and collect geophysical data for input into model (Task 9). Due to deployment logistics, this milestone will necessarily follow the deployment of the horizontal arrays. However, time-series geochemical data from the BBLA and CSA are now being processed and evaluated. Heat-flow, pore-fluid and JPC have been made available to modeling efforts.

Milestone 5: Complete additional surveys – SSDR, Mass spectrometer (STRC-funded), multibeam (NIUST-funded) to provide important updated baseline seismic data prior to the commencement of true monitoring. The multibeam and mass spectrometer surveys are complete. We have received a complementary update in the multibeam from the Navy C&C along with very high resolution side-scan sonar data from MC118. We will use our 2005 survey to calibrate a new AUV they are testing for the Navy. The hydrophone array – necessary for the SSDR survey with the AUV-borne receiver - in Phase 2 of development by NOAA has been tabled for the moment, until the NOAA-NIUST budget is reinstated.

Milestone 6: **Complete 4C survey and analyze data for new software:** This dataset has been collected and delivered to subcontractors for analyses. UM has taken the lead in evaluating the active-source data and together with Lookout Geophysical Company,

has completed the task.

Milestone 7: Establish a "final" model of the observatory site, from which changes can be determined and monitoring established. The initial phases of the modeling effort are complete. Real data are now being incorporated into the final model. Unfortunately, funds are exhausted so this project remains incomplete though SAIC researchers are seeking additional funds to enable them to complete it. If funds sufficient to complete the model are not secured, the approximation of the base of hydrate stability, determined in this reporting period, can surely serve until additional funds are found.

New Milestones – and status - from FY10 Program Management Plan

Milestone 5: Collect and evaluate giant piston cores from the MC118 Sea Floor Observatory. This Phase 4 milestone is tied to Task 2 and is estimated to be complete in July, 2013. This task is essentially complete. The cores have been collected, logged and described and a report of their lithostratigraphy completed (APPENDIX A, previous report, 42877R24). We hope to get a complete biostratigraphic analysis by the end of July, 2013.

Milestone 6: Collect heat-flow data from MC118. This Phase 4 milestone is tied to tasks 2 and 3 and is estimated to be complete by March, 2012. This task is complete. A paper has been submitted to the Journal of Geophysical Research – Solid Earth.

Milestone 7: Collect and evaluate additional gravity cores to complete sedimentation model, support geochemical and geophysical (structural) characterization of MC118. This Phase 4 milestone is tied to Tasks 2, 3 and 4 and is estimated to be complete by July, 2014. This task has slid as two cruises had to be cancelled in light of certification issues with the vessel and failure of our equipment. We have rescheduled to coordinate coring with speed of sound probe testing. This cruise is now anticipated to occur in July, 2014. Although the project will be over, this task will go forward.

Milestone 8: Integrate geophysical datasets with geochemical and biological data. This Phase 4 milestone is tied to tasks 2 and 3 and is partly complete but ongoing. This task is in progress and results thus far have contributed significantly to numerous evaluations of MC118, most significantly the selection of sites for both the JPC and heat-flow cruises as well as our gravity coring cruise. An updated habitat map, tentatively tied to the shallow high resolution seismic and acoustic data was presented at the 2011 International AAPG in Milan and was awarded a "top ten" poster status for the entire meeting. A continuation of the approach is the subject of a paper for the Journal of Marine and Petroleum Geology, with one of our 2012-13 Visiting Scholars as lead author.

Milestone 9: Purchase and learn to operate an Infrared camera for the purpose of distinguishing hydrates in unopened cores. This Phase 4 milestone is tied to task 2 and is estimated to be complete by April, 2011. This task is complete. The camera was used on the JPC cruise. Initial results were very promising and significant work has been done to improve the carriage and scale display. The goal is to use it on our coring cruise to identify which cores and sections are likeliest to contain hydrates and/or exhibit gas expansion.

Milestone 10: Collect and analyze hydrate and "slime"(= protective ? biofilm) at hydrate outcrops in an effort to explain the existence and persistence of hydrate in seawater undersaturated for methane. This Phase 4 milestone is tied to tasks 2 and

4 and is estimated to be complete by September, 2013. Pressure chambers have been designed and built with this goal in mind but not installed on a vehicle, either the SSD or the I-SPIDER.

Milestone 11: Recover additional pore-fluid time-series via additional instrument (PFAs, osmolander, peepers) deployments and recoveries. This Phase 4 milestone is tied to task 4 and is estimated to be complete by October, 2012. We have deployed several systems of pore-fluid collection. Peepers were collected via the ROVARD. Analyses counterindicate this collection technique as the collection bags leaked. However, series of pore-fluids have been collected via cores and a variety of instruments. Although we will continue to try to retrieve the osmoboxes that remain, this task is complete. The technology won a spot as an ECOGIG PI for Dr. Lapham

Milestone 12: Deploy the ABCMS lander in upgraded configuration including video, lights reduced-size mass spectrometer, and altimeter. This Phase 4 milestone is tied to task 5 and is estimated to be complete by July, 2013. This milestone was achieved in October, 2011, with the exception of the mass spectrometer functions. Its scheduled participation - with a new MIMS unit - in the Consortium cruise to MC118 had to be changed from September, 2012, when the cable failed, to April, 2013. When this cruise was cancelled due to unworkable sea states, it was rescheduled for July, 2013.

ACCOMPLISHMENTS

Major accomplishments of this reporting period include:

Major progress of two Visiting Scholars from the University of Rome on CMRET and NIUST projects;

Journal papers published;

Design and construction of two instrument landers for the ECOGIG GRI-I project;

Successful use of the I-SPIDER on three successive cruises both surveying and deploying instruments;

Servicing of seafloor lander with the SSD and the I-SPIDER including several new operations;

With the NIUST AUV team, recovery of multibeam and sub-bottom chirp data from multiple sites and from multiple depths;

Consolidation of electronics for at-sea operations into a single “topside system” for increased efficiency;

Installation of Ultra-short Baseline (USBL) transponders in the hull of the R/V *Pelican* to enhance exceptional navigation/locating capabilities at sea and to eliminate the need to calibrate our system for each cruise;

Establishing a processing protocol for the new polarity-preserving chirp data;

Production of images from OBS data from MC118;

Planned, contracted for and executed a research cruise to MC118, site of the GOM-HRC MS/SFO, during which time we successfully performed a variety of lander operations.

PROBLEMS/DELAYS

The majority of delays in the program derive from challenges presented by weather, working at 900m water depth and/or shortage of funds and personnel. We acknowledge, however, that these difficulties do not appear to be near being resolved, so we are resolved to a future of working in extremely challenging environments.

Both the cruises we contributed to and the one we ran we conducted this reporting period, were extremely successful. Landers have been recovered and are being reconfigured to accommodate a different configuration of instruments. A cancelled cruise was rescheduled and though all projects have not bee tested at sea, the subcontractors have fulfilled their obligations and we will continue to try to find at-sea opportunities for these completed but untested systems. We have taken on, for pay, other marine research work, particularly lander work, in order to keep our capabilities moving forward. We continue to pursue additional opportunities in both competitions and contract work.

A major difficulty for the CMRET is loss of personnel. Due to lack of funding into the future, we are unable to replace our senior personnel. Remaining researchers are tasked with additional work often including jobs for which we were not trained. Our shop has been cooperating with the NIUST shop as both groups are short-handed and we benefit from complementary expertise, but we have not replaced the two experienced personnel lost from the shop in the last two years.

PRODUCTS

Important products of this reporting period are:

1. Successful at-sea performances of multiple landers,
2. Multiple datasets from AUVs;
3. Data-processing protocol for Polarity-preserved chirp data,
4. Student projects (to lead to completed MS theses),
5. Working I-SPIDER ROV (for surveying and deployment);
6. Consolidated top-side at-sea electronics equipment/capabilities;
7. Transponders in the Pelican’s hull,
8. Progress Report from July - December, 2012,
9. Publications in peer-reviewed Journals,
10. New capabilities and projects shared with other researchers and institutions.

RECENT PUBLICATIONS BY CONSORTIUM MEMBERS:

2013

*Carrière, Olivier and Peter Gerstoft, 2012, Deepwater subseafloor imaging using active seismic interferometry, Geophysics, submitted.

*Macelloni, Leonardo, Charlotte Brunner, Simona Caruso, Carol Lutken, Marco D'Emidio, Laura Lapham, 2013, Spatial distribution of seafloor biogeological and geochemical processes as proxies of fluid flux regime and evolution of a carbonate/hydrates mound, northern Gulf of Mexico, Deep Sea Research, Part 1, Manuscript Number: DSR1-D-12-00118R1.

*Simonetti, Antonello, James H. Knapp, Kenneth Sleeper, Carol B. Lutken, Leonardo Macelloni, Camelia C. Knapp, 2013, Spatial Distribution of Gas Hydrates from High-Resolution Seismic and Core Data, Woolsey Mound, Northern Gulf of Mexico, Marine and Petroleum Geology 44 (2013) 21-33.

In Press:
Lutken, Carol B., Marco D'Emidio, Leonardo Macelloni, Michela Ingrassia, Martina Pierdomenico, Vernon Asper, Arne Diercks, Max U. Woolsey, Roy Jarnagin, 2013, Challenges in imaging the deep seabed: examples from Gulf of Mexico cold seeps, Transactions of the GCAGS, New Orleans, 2013.

Submitted:
Olivier Carriere, Peter Gerstoft, William S. Hodgkiss, Planar arrays and spatial filtering in ambient noise interferometry, J Acoust. Soc. Am.

Macelloni, L., Lutken, C. B., Garg, S., Simonetti, A., D'Emidio, M., Wilson, R.M., Sleeper, K., Lapham, L., Lewis, T., Pizzi, M., Knapp, J., Knapp, C., Brooks, J. and McGee T.M., *Heat-flow regimes and the hydrate stability zone of Woolsey mound (northern Gulf of Mexico): a transient, thermogenic, fault-controlled hydrate system,* submitted to the Journal of Geophysical Research - Solid Earth.

Wilson, Rachel, Leonardo Macelloni, Antonello Simonetti, Jeffrey Chanton, Jim Knapp, Laura Lapham, Carol Lutken, Ken Sleeper, Charlotte Brunner, Chris Martens, Marco D'Emidio, Integrating geochemical profiles with seismic surveys to identify subsurface methane sources and migration pathways across a gas hydrate mound, submitted to Geochemistry, Geophysics, Geosystems.

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