

Annual Report for Period: 05/2009 - 04/2010

Submitted on: 04/13/2010

Principal Investigator: McGill, Paul R.

Award ID: 0648122

Organization: MBARI

Submitted By:

McGill, Paul - Principal Investigator

Title:

Collaborative Proposal: Development of a Prototype Multi-Sensor Ocean Floor Observatory on the MARS Cable

Project Participants

Senior Personnel

Name: McGill, Paul

Worked for more than 160 Hours: Yes

Contribution to Project:

Post-doc

Graduate Student

Undergraduate Student

Technician, Programmer

Other Participant

Research Experience for Undergraduates

Organizational Partners

University of California-Berkeley

UCB is providing the computer software for connecting the seismometer to the MARS cable in Monterey Bay, as well as analyzing and archiving the data streams. MBARI is designing the ocean equipment and operates the ships and ROVs needed to install and maintain the system.

Other Collaborators or Contacts

Activities and Findings

Research and Education Activities:

Project activities in the latter half of 2008 concentrated on final design and construction of the MARS (Monterey Accelerated Research System) Extension Cable and the refurbished MOBB (Monterey Ocean Bottom Broadband) interface electronics. Early 2009 was dedicated to extensive testing of the completed system, followed by successful installation at sea and commencement of operation on February 25th and 26th, 2009. The system ran well for almost a year, delivering high-quality seismic, current, and pressure data to the

Berkeley Seismological Laboratory in real time. However in February of 2010 the Extension Cable was severed by commercial fishing operations and has ceased operations until a replacement cable can be installed.

The final design of the MOBB interface closely matches that described in the project proposal, and meets all of the original functional and design specifications. One of the greatest challenges was in sending the MARS 1 pulse-per-second timing signal over the 3.6 km Extension Cable to the MOBB electronics. The installed circuitry performed well and provided accurate timing to both the Guralp CMG-1T Broadband Seismometer and the Quanterra Q330 digitizer. Some occasional inconsistencies in the 1 PPS signal from MARS were observed and their cause is being analyzed. The power and data connections were working well, providing much more capacity than required by MOBB as may be required by future applications.

The MOBB backup power system is different from that described in the original project proposal. Instead of single-use lithium batteries, the final design utilizes a large capacitor bank to provide power if power from the MARS cable is interrupted. The capacitors can maintain operation of the MOBB system for more than two hours, thus preventing any loss of data for short power outages. Unlike lithium batteries, the capacitors can recharge when power is restored and have an essentially unlimited lifetime.

The backup power system was tested when the MARS PMACS (Power Monitoring and Control System) indicated a fault in the Extension Cable on April 5th, 2009, five and a half weeks after the system was activated. PMACS was indicating a ground fault, i.e. an unintentional connection to seawater from the 375 VDC power carried by the Extension Cable. To isolate the fault, power to MOBB was interrupted twice and the system continued to operate as designed with no loss of data. The PMACS tests indicated possible damage to the cable, and visual inspection by the ROV Ventana on April 13th revealed that the Extension Cable had been snagged by an unknown fishing vessel and was pulled tight near the MARS node. Three subsequent ROV dives were used to reposition the cable and relieve the tension. The MOBB system continued to operate even with the ground fault, but a supplementary funding request was submitted and granted in order to replace the damaged cable.

On September 28th, 2009 an ROV dive near the MARS node revealed that the MOBB Extension Cable had been trawled a second time. Once again, the system continued to operate despite additional damage to the cable. This second incident, however, indicated that trawling incidents are not rare occurrences despite the issuance of clear marine advisories warning fishermen to avoid the areas where research equipment is deployed. A decision was made to better protect the replacement cable by burying it 20 to 30 cm deep in the ocean-bottom sediment. The Monterey Bay National Marine Sanctuary approved a request to perform the cable burial operations.

The design of an ROV cable-burial plow commenced in early 2010. Based on lessons learned from the first deployment, the cable itself was redesigned with steel strength members to increase stiffness and improved electrical properties on the signal-carrying wires. The cable is being custom built and is expected to be delivered in late summer of 2010.

On February 11th, 2010 the power monitoring system on MARS indicated that the MOBB Extension Cable had drawn too much current and was automatically shut down. Attempts to restart MOBB were unsuccessful. An ROV dive on March 25th, 2010 revealed that the MOBB site itself, and not just the cable, had been trawled. Extensive damage was done, including the destruction of the current meter, a severing of the Extension Cable near the SIIM (Science Instrument Interface Module), and moderate damage to the frame holding the system electronics. All equipment was recovered, with the exception of the severed Extension Cable as its end could not be located; it will have to be recovered from the

MARS end on a subsequent dive. The extent of the damage to the equipment is still being evaluated, but it is expected that everything can be repaired or replaced with funds remaining in the project budget.

Findings:

The cabled undersea observatory funded by this grant ran well for almost a year, meeting all design goals as described in the original project proposal. Fishing trawlers caused major damage to the observatory, but a more trawl-resistant cable will be installed in late summer of 2010 to restore the MOBB system to operation.

Training and Development:

Outreach Activities:

Journal Publications

Romanowicz, B; McGill, P; Neuhauser, D; Dolenc, D, "Acquiring Real Time Data from the Broadband Ocean Bottom Seismic Observatory at Monterey Bay (MOBB)", SEISMOLOGICAL RESEARCH LETTERS, p. 197, vol. 80, (2009). Published, 10.1785/gssrl.80.2.19

Books or Other One-time Publications

McGill, P., D. Neuhauser, and B. Romanowicz, "Connecting an Ocean-Bottom Broadband Seismometer to a Seafloor Cabled Observatory: A Prototype System in Monterey Bay", (2008). Poster at AGU Fall meeting, Published Bibliography: EOS. Trans. AGU, 89(53), Fall Meet. Suppl., Abstract OS51C-1264.

Romanowicz, B., T. Taira, D. Dolenc, P. McGill, D. Neuhauser, "Exploiting Real Time Data from the Monterey Ocean Floor Broadband Observatory", (2009). Talk at Fall AGU meeting, Published Bibliography: Eos Trans. AGU, 90(52), Fall Meet. Suppl., Abstract S51D-04

Web/Internet Site

URL(s):

<http://www.mbari.org/mars/general/MOBB>

Description:

Other Specific Products

Product Type:

Instruments or equipment developed

Product Description:

This grant has funded the development of an ocean-bottom seismic observatory connected to shore by a subsea cable.

Sharing Information:

The interface developed by this grant is not specific to the instruments currently connected to the observatory. This same design could be used by other investigators to connect a wide variety of instruments to subsea cables.

Contributions

Contributions within Discipline:

Contributions to Other Disciplines:

Contributions to Human Resource Development:

Contributions to Resources for Research and Education:

Contributions Beyond Science and Engineering:

Conference Proceedings

Special Requirements

Special reporting requirements: None

Change in Objectives or Scope: None

Animal, Human Subjects, Biohazards: None

Categories for which nothing is reported:

Activities and Findings: Any Training and Development

Activities and Findings: Any Outreach Activities

Contributions: To Any within Discipline

Contributions: To Any Other Disciplines

Contributions: To Any Human Resource Development

Contributions: To Any Resources for Research and Education

Contributions: To Any Beyond Science and Engineering

Any Conference