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AD-A247 733



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Test of the New ONR Ocean Bottom Seismographs on the Juan de Fuca Ridge

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*Final Report to the Office of Naval Research
Grant N00014-90-J-1881 for the
Period 05-01-90 - 09-30-91*

MPL-U-10/92
January 1992

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92 3 13 030

92-06625



REPORT DOCUMENTATION PAGEForm Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. Agency Use Only (Leave Blank).		2. Report Date. January 1992	3. Report Type and Dates Covered. Final Report	
4. Title and Subtitle. Test of the New ONR Ocean Bottom Seismographs on the Juan de Fuca Ridge			5. Funding Numbers. N00014-90-J-1881 Project No. Task No.	
6. Author(s). Leroy M. Dorman and John A. Hildebrand				
7. Performing Monitoring Agency Name(s) and Address(es). University of California, San Diego Marine Physical Laboratory Scripps Institution of Oceanography San Diego, California 92152			8. Performing Organization Report Number. MPL-U-10/92	
9. Sponsoring/Monitoring Agency Name(s) and Address(es). Office of Naval Research Department of the Navy 800 North Quincy Street Arlington, VA 22217-5000 Code 1125GG			10. Sponsoring/Monitoring Agency Report Number.	
11. Supplementary Notes.				
12a. Distribution/Availability Statement. Approved for public release; distribution is unlimited.			12b. Distribution Code.	
13. Abstract (Maximum 200 words). Sea tests are vital to debug the ONR OBS performance, especially if the instruments are to perform reliably during the early ONR funded ULF/VLF experiments. These instruments were tested in a realistic deep-sea deployment under conditions where there was little experimental risk. The SERA Expedition (Seismic Experiments on the Rise Axis) was an ideal setting for testing these instruments since the EPR Natural Laboratory provided both local and distant earthquakes as well as airgun sources from the R/V Washington. The instruments recorded seismic data continuously during a four day deployment. This experiment provided an excellent variety of signals upon which to refine the instruments.				
14. Subject Terms. seafloor instrumentation ocean bottom seismographs			15. Number of Pages. 3	
			16. Price Code.	
17. Security Classification of Report. Unclassified	18. Security Classification of This Page. Unclassified	19. Security Classification of Abstract. Unclassified		20. Limitation of Abstract. None

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Accession For	
DTIC Grant	
DTIC Tab	
Availability Codes	
Justification	
By	
Distribution	
Availability Codes	
Level and/or	
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Abstract

Sea tests are vital to debug the ONR ocean bottom seismographs (OBS) performance, especially if the instruments are to perform reliably during the early ONR funded ULF/VLF experiments. These instruments were tested in a realistic deep-sea deployment under conditions where there was little experimental risk. The SERA Expedition (Seismic Experiments on the Rise Axis) was an ideal setting for testing these instruments since the EPR Natural Laboratory provided both local and distant earthquakes, as well as airgun sources from the *R/V Thomas Washington*. The instruments recorded seismic data continuously during a four-day deployment. This experiment provided an excellent variety of signals upon which to refine the instruments.

Introduction

The Marine Geology and Geophysics and Ocean Acoustics branches of the Office of Naval Research sponsored an Accelerated Research Initiative to investigate the ULF/VLF noise, in part in response to improved quieting of modern submarines and in part to advance the science in that area. At that time it was recognized that the available instrument pool was inadequate to support experiments of major scale and ONR sought proposals to construct a fleet of identical instruments of modern design. From the

Objectives

responses to their request, ONR formed a consortium of academic institutions consisting of the Woods Hole Oceanographic Institution (G. M. Purdy), the Scripps Institution of Oceanography (L. M. Dorman and J. A. Hildebrand), the Massachusetts Institute of Technology (S. C. Solomon), and the University of Washington (A. Schultz). The mission of this consortium was to create an ocean bottom seismograph (OBS) of improved design that would help answer scientific issues concerning seafloor noise generation and propagation in the ULF/VLF frequency band. Contracts were issued for a one-year instrument development phase followed by a one-year construction phase, currently occupying the major portion of our efforts.

Objectives

The objectives of this cruise were several. Primary support was from ONR for measurement of crustal compliance to the forcing of low-frequency ocean waves by simultaneous measurement of water pressure at the seafloor using a Cox-Webb differential pressure gauge and measurement of the seafloor motion using a Lacoste-Romberg accelerometer. Auxiliary funding was available from ONR for test deployments of newly-constructed ocean bottom seismographs and from the RIDGE program of NSF for a reconnaissance seismicity survey of the East Pacific Rise near 9° N where D. Fornari and R. Haymon reported evidence supporting recent tectonic activity.

The new instruments, which were in a raw and minimally tested state at the outset, have been used in one small field experiment and one major one. The instruments returned data from both experiments. The data from the first, Seismic Experiments on the Ridge Axis (SERA), was of minimal quality but produced the seismograms in the EOS article (Jacobson et al. 1991).

Sea tests

Sea tests are vital to debug the ONR OBS performance, especially if the instruments are to perform reliably during the early ONR funded ULF/VLF experiments. We tested these instruments in a realistic deep-sea deployment under conditions where there was little experimental risk. The first field tests of the new instruments were supported by ONR as an add-on to a proposed cruise on the Juan de Fuca ridge aboard the NOAA ship *DISCOVERER*. Because of the minimal funding of that cruise and the timing of instrument development, the sea-tests were delayed. The next opportunity arose when the RIDGE "rapid response" program pointed out the opportunity for seismic reconnaissance of the East Pacific Rise around 9°50'N (the ONR Natural Laboratory) where R. Haymon and D. Fornari, during submersible dives, observed visual evidence of recent volcanism. This motivated the slight relocation of a previously scheduled EPR cruise of Drs. Hildebrand and Webb to allow work at this area. The augmentation of ship funding allowed time for OBS operations.

References

The SERA Expedition (Seismic Experiments on the Rise Axis) was an ideal setting for testing these instruments since the EPR Natural Laboratory provided both local and distant earthquakes as well as airgun sources from the *R/V Washington*. A logistic description of the SERA expedition is presented in Dorman and Sauter (1991). Details of the cruise operations are in the cruise report and in a scientific report to the RIDGE management, now published in the "grey" journal RIDGE EVENTS (Hildebrand, Webb and Dorman, 1991).

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