(12)

R & D STATUS REPORT
NAVAL OCEAN RESEARCH & DEVELOPMENT ACTIVITY
(NORDA)

ARPA Order No. 4152,
Amendment 15

Contract No. N00014-85-C-0793

Contractor:

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A. DESCRIPTION OF PROGRESS

Current project status on a task by task basis is as follows:

TASKS 1 & 2:

1) Identify events detected and phases observed in MSS data:

All events visible on the unfiltered Gould and Teledyne MSS recordings have been identified for the short period channels SZ, SB, and SE, as discussed previously. Since last status report, the continuous MSS short-period data recorded on the bottom processing package which included MSS hydrophone data uncontaminated by the Challenger's depth transducer signals, have been filtered in an attempt to see high-frequency P_n, S_n, and T phases from teleseismic and regional events. MSS hydrophone data are currently being analyzed for comparison with waveforms from the borehole sensors. There are approximately 20 hours of MSS hydrophone data available. A water multiple stacking filter is being designed for hydrophone signal enhancement.

2) Cataloguing of pertinent MSS information and preliminary analyses:

Compilation of MSS information is currently being done. Problems encountered during data analysis have been listed in the 1985 report, as well as preliminary analyses by these authors and references of work done by others.

3) Comparison of MSS and OBS data and site characteristics:

As discussed in last status report, the S/N, observed phases, noise levels, and implied detection thresholds have been measured and compared for simultaneously recorded

earthquake and noise data for the MSS and OBSes at the South Pacific site. MSS site m_b bias calibrated to ISC and AFTAC magnitudes have been completed. Values of t* and Q from various phases observed in MSS data have been estimated. Signal enhancement and detection threshold improvement using an optimal band-pass filter and a simple polarization filter for regional and teleseismic events on MSS and OBSes have been examined. Since orientations for several OBSes have recently been determined, application of a true polarization filter on these data are now possible and will be attempted. Currently, other signal enhancement techniques (such as stacking of water layer multiples) are being investigated for obtaining the best realistic detection thresholds on these instruments. Realization of this task will involve the use of various synthetic modeling techniques.

Since last reporting period, all possible OBS quiet data windows occurring during the refraction study deployment period have been filtered for teleseismic phases from 5 possible events. No phases were detected.

Sub-tasks not yet started include measurement of stability of phases across OBS array, calibration of MSS and OBS regional event magnitudes to P_n codas, and separation of near-source from near-receiver propagation effects.

TASK 3: SYSTEMS/SITES COMPARISON:

Analysis of the Wake Island hydrophone array data has begun for the period of time corresponding to the MSS South Pacific site recording period. Continuous Wake data are not available, only time windows surrounding expected or observed events (a total of ~ 70 "events"). The identification of P, P_n, S_n, and T phases, S/N measurements on spectra and time domain data, and noise levels are currently being

compiled. These data will be compared with results from MSS and OBS data from the South Pacific site.

2) Two tapes of OSS borehole seismometer data (Kamchatka 1982 site) have been received from Hawaii and are currently being analyzed for noise level, S/N, and detection level comparisons with MSS, OBS, and hydrophone data.

TASK 4: SNAP-D SYSTEMS EVALUATION:

Work for this task will be initiated upon completion of the above mentioned analyses for MSS-83 and OSS-82 borehole data, OBS data, and Wake Island and MSS-83 hydrophone data.

B. SUMMARY OF PRELIMINARY FINDINGS SINCE LAST STATUS REPORT:

1) Hi-pass filtering at 0.6 and 4.0 Hz of continuous short-period MSS borehole and hydrophone data from the BPP deployment period revealed, on the hydrophone but not on the vertical channel, only one new high-frequency P_n phase associated with a previously detected teleseismic P phase. No other additional teleseismic phases were discovered in the hi-passed data that had not previously been identified in unfiltered or polarize-filtered data. In view of the previously reported remarkable lack of teleseismic detections at the MSS site, and the rather high teleseismic event detection threshold of ~ 5.1 to 5.3 m_b, the lack of high-frequency teleseismic phases is not surprising in the borehole data. It was hoped that the hydrophone channel would be a good detector of P_n, S_n, and T phases given reports of such detections on the Wake Island array. However, very few teleseismic events at distances between 30 to 60 degrees occurred during MSS operation, and

only two teleseisms with m_b > 5.0 occurred during quiet MSS hydrophone windows.

2) The 4.0 Hz hi-pass filtered continuous short-period MSS BPP data did reveal numerous regional events with S/N < 1 which had gone undetected in the unfiltered data. During one 9-hour period, 20 additional small magnitude events with P_n and S_n phases were detected in the high-passed data, whereas previously only 10 events had been identified from the unfiltered plots. These newly-detected events will be an important data set for comparison of MSS hydrophone and borehole signal characteristics, determination of detection levels at regional distances, and comparison of relative signal enhancement techniques for small magnitude events.

3) Use of a simple water-multiple stacking filter on the largest events, both teleseismic and regional, recorded on the MSS hydrophone channel have not produced signal enhancement as high as that resulting from high-pass fltering to remove the microseismic noise band. We suspect that sediment arrivals may be causing loss of coherency, and are planning to model sediment and water multiples for hydrophone and OBS instruments at this site to assist in design of an optimal stacking filter.

4) Preliminary analyses of Wake Island hydrophone data have resulted in ~ 20 event detections, most of which occurred between 30 and 60 degrees epicentral distance. Unfortunately events from this distance range are lacking in the MSS data due to location of the site relative to active source regions. However, some events in the Wake data are coincidental with events on the MSS. P_n, S_n, and T phases with significant energy above ~ 10 Hz are most frequently observed in the Wake data set. P phases generally have energy centered around ~ 6 Hz. Comparisons of Wake hydrophone S/N, noise levels, and detection levels with MSS and OBS data sets will soon be available.

C. SUMMARY OF NEEDED DATA OR OTHER INFORMATION

1) Miscellaneous gain correction and instrument response functions are needed for Wake Hydrophone and OSS data. This will be arranged imminently with U. of Hawaii personnel.

2) Any additional time periods needed for the AFTAC catalogue will be requested through Al Ballard in the near future.

D. PROPERTY & EQUIPMENT ACQUIRED

None

E. PERSONNEL CHANGES

None

F. TRAVEL

None

G. PLANS FOR NEXT REPORTING PERIOD

1) Complete observational analyses of Wake Island hydrophone data, including application of beam-forming and water-multiple-stacking signal enhancement techniques.

2) Complete observational analyses and signal enhancement studies on OSS data.

3) Design multiple-stacking filter for MSS hydrophone and OBS data.

4) Application of a polarization filter to OBSes with known orientations.

H. RESEARCH TASKS FAILED OR TERMINATED

None

I. FISCAL STATEMENT

Of the total funds of $188,040 authorized for 12 months, approximately 30% of the work has been completed.

J. COST DATA

Cumulative Cost Data as of January 31, 1986:

Labor Elements	Planned Amount ($)	Actual Amount ($)
Scientist	$ 20,352	$ 25,876
Technical Support		
Total Labor	20,352	25,876
Other Expenses		
Material	-0-	208
Travel	2,160	497
Computer	8,400	5,844
Total Other Expenses	$ 10,560	$ 6,549
Overhead	$ 24,382	$ 29,124
G & A	$ 14,210	$ 13,244
Fee	$ 5,710	$ 6,146
GRAND TOTAL	$ 75,214	$ 80,939

K. PLANNING ESTIMATES

Revised Planning Estimate as of January 31, 1986
(Cumulative Costs)

	Reporting Period 1st*	2nd*	3rd	4th	5th
Planned Percentage of Technical Completion	20%	40%	60%	80%	100%
Labor Elements	$	$	$	$	$
Scientist	10,941	25,876	30,528	40,705	50,881
Technical Support					
Total Labor	10,941	25,876	30,528	40,705	50,881
Other Expenses					
Material	42	208	-0-	-0-	-0-
Travel	-0-	497	3,240	4,320	5,400
Computer	1,762	5,844	12,600	16,800	21,000
Total Other Expenses	1,804	6,549	15,840	21,120	26,400
Overhead	11,606	29,124	36,573	48,764	60,955
G & A	5,333	13,244	21,316	28,421	35,527
Fee	2,439	6,146	8,566	11,421	14,277
GRAND TOTAL	$32,123	$80,939	$112,823	$150,431	$188,040

(*Actual)