QUARTERLY TECHNICAL SUMMARY REPORT, JANUARY-MARCH 1973

Robert R. Blandford

Teledyne Geotech

Prepared for:

Advanced Research Projects Agency

18 April 1973

.....contributing to man's
understanding of the environment world

SEISMIC DATA LABORATORY QUARTERLY TECHNICAL SUMMARY REPORT JANUARY - MARCH 1973

R.R. BLANDFORD

18 APRIL 1973

Prepared for
AIR FORCE TECHNICAL APPLICATIONS CENTER

Under
Project VELA UNIFORM

Sponsored by
ADVANCED RESEARCH PROJECTS AGENCY
Nuclear Monitoring Research Office
ARPA Order No. 1714

TELEDYNE GEOTECH
ALEXANDRIA LABORATORIES

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1 ORIGINATING ACTIVITY (Corporate author) Teledyne Geotech Alexandria, Virginia	2a REPORT SECURITY CLASSIFICATION Unclassified 2b GROUP

3 REPORT TITLE

SEISMIC DATA LABORATORY QUARTERLY TECHNICAL SUMMARY REPORT
JANUARY-MARCH 1973

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)

Scientific

5 AUTHOR(S) (Last name, first name, initial)

Blandford, Robert R.

6 REPORT DATE 18 April 1973	7a TOTAL NO OF PAGES ~~22~~ 16	7b NO OF REFS
8a CONTRACT OR GRANT NO F33657-72-C-0009 b PROJECT NO VELA T/2706 c ARPA Order No. 1714 d ARPA Program Code No. 2F10	9a ORIGINATOR'S REPORT NUMBER(S) 9b OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	

10 AVAILABILITY/LIMITATION NOTICES

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

11 SUPPLEMENTARY NOTES	12 SPONSORING MILITARY ACTIVITY Advanced Research Projects Agency Nuclear Monitoring Research Office Washington, D.C.

13 ABSTRACT

This report summarizes the work done by the SDL during the period January through March 1973, and primarily concerns the seismic research activities related to the detection and identification of nuclear explosions and earthquakes. The report also contains brief discussions of the support tasks and data services which were performed for other government contractors and for participants in the VELA-UNIFORM and PRIME ARGUS projects.

14 KEY WORDS

Seismic Data Laboratory - Quarterly
Technical Summary
VELA-UNIFORM Project

Unclassified
Security Classification

SEISMIC DATA LABORATORY

QUARTERLY TECHNICAL SUMMARY REPORT

January - March 1973

AFTAC Project No.:	VELA T/2706
Project Title:	Seismic Data Laboratory
ARPA Order No.:	1714
ARPA Program Code No.:	2F-10
Name of Contractor:	TELEDYNE GEOTECH
Contract No.:	F33657-72-C-0009
Date of Contract:	01 July 1971
Amount of Contract:	$2,482,460
Contract Expiration Date:	30 June 1973
Project Manager	Robert R. Blandford
	(703) 836-3882

P.O. Box 334, Alexandria, Virginia 22313

TABLE OF CONTENTS

I. INTRODUCTION

This quarterly report summarizes the technical work, support effort, and data services completed during the period January through March 1973.

Reviews of technical reports completed during the reporting period are contained in Section II under descriptive headings. Section III is a summary of the support and service tasks performed for other government contractors for VELA-UNIFORM and PRIME ARGUS participants.

Volume I of the draft engineering study of seismic arrays has been delivered to VSC. Volume II will be delivered in the third week of April. Pursuant to instructions from VSC, several changes and additions are being compiled for Volume I. The changed pages will be forwarded to VSC for insertion in Volume I.

II. WORK COMPLETED

A. Investigation of the Signal Enhancement and Discrimination Capabilities of the Intermediate Period Strain-Pendulum Seismograph Combination at HNME (Houlton, Maine) - No. 294

The intermediate period strain-pendulum combination at HNME is shown to be very effective in

reducing 4 - 8 second microseisms and enhancing body phases. The spectra and the relative excitation of intermediate period P and S waves show good potential as discriminants between earthquakes and explosions. If, however, discrimination can be made using 1 and 20 second information, then standard instruments have a lower threshold.

The spectral behavior of body and surface waves is sensitive to the local structure, and knowledge of the local structure is needed for the refinement of signal processing methods for strain-pendulum combinations. If such knowledge is not available the best method is to design a processor on the basis of noise characteristics alone. Restricting the processor filter to be one-sided relative to zero lag time (physically realizable) degrades the filter performance relative to the two-sided filters but not significantly.

B. Network Multiple Station Discriminant Functions - No. 299

An extension has been made of linear discriminant analysis to the case where multiple station observations are available for each event. Multivariate regression was used to estimate the mean vectors and

covariance matrix in the multiple station discriminant function. The same stations need not be observed for all events as a separate discriminant vector can be derived for each station observation and only the discriminant functions available for each event are added. The identification curves for this multiple station discriminant were calculated for surface wave body wave pairs from a population of 20 earthquakes and 9 presumed explosions observed at various sub-combinations of six LRSM stations. The results obtained indicated that the multiple station discriminant function is superior to the usual method which treats the mean vector for each event as a single observation, a result of importance in the application of discriminants by a network of stations.

III. SUPPORT AND SERVICE TASKS

In addition to the research studies discussed above the SDL completed the following support and service tasks:

A. Data Cataloging, Classifying and Retrieval

The library consists of seismograph data from the LRSM sites, the observatories LASA, TFO, UBO, WMO, BMO, CPO and additional data from other sources. The corresponding operational logs are also included in the library.

At the end of March 1973, the library contained approximately:

34,737	analog magnetic tapes
21,092	digitized seismograms
5,710	digital magnetic tapes

The library also contains seismographic data on 16 mm and 35 mm film. Those are commonly from simultaneous recording of tape and film data at the observatories and the LRSM sites.

The following categories of digital tapes are in the library:

281	UBO multiplexed
1,199	LASA multiplexed
846	TFO long period (DGRADAS tapes)
601	TFO short period (ASDAS tapes)
2,045	Library tapes (A/D and D/D conversions)

826	Permanent save tapes
1,690	Operations tapes (scratch, save, etc.)

The analog tape library contains:

9,291	Compressed tapes
332	Composites
17,412	Tapes saved as recorded (not compressed)
7,669	Tapes scheduled for compression as time permits

B. Equipment Modifications

Minor modifications to the CALCOMP plotter interface were implemented without satisfactory checkout because the efforts of engineering personnel were directed toward the SDT system.

C. Maintain and Operate Equipment

The following hardware problems continue to exist on the PDP 15/50:

1. Intermittent failure of the VT15.
2. Loosening of hub locks on Magtape drives.
3. Magtape drives "dead" for short periods of time.
4. Too much bus length on PDP-15 negative bus.

D. Digital Programming

A portion of the coding completed on the A/D during February for the RSX version of ADS360 was re-done during March because of a misunderstanding of the use of the A/D handler link table. The recoding effort involved subroutine ADVERT. The new approach should enable us to accomplish A/D under the RSX operating system. Programming Note #4 was delivered to the project office.

Varian still has not exercised the maintenance and test routine, or delivered the DATAPLOT II software package, or an acceptable DOS compatible printer-plotter handler. We have requested but received no word as to when they will provide us with these items.

Coding has continued on the SWAP package and the Data Input Phase (DIP) skeleton coding has been done. Yet to be completed on this phase is the individual message routines but these should go rather quickly.

The following SWAP routines are finished and debugged:

1. KBDNT - user entry of ASCII to scope.
2. DECODS - decoding of ASCII from scope to internal use.
3. FREDSK - determine how much disk is available to SWAP.

4. COMINF - A Cal to provide information about system common areas to SWAP.

A meeting was held between DEC and Teledyne during which numerous problem areas were discussed. DEC intends to send support from Maynard to help resolve these problems. Specifically we discussed the following with DEC:

1. Inability to use Fortran .DAT slots over 7.
2. Inability to dynamically change the RSX A/D link tables.
3. Inconsistancy of using an array name vs. an array element when coding subroutine calls.
4. Inability to have Fortran arrays over 8K.
5. Incorrect sampling rates on DOS-15 A/D.
6. Determination of a hardware or software problem either in the Calcomp interface or in the software handler.
7. Problems in the MTI DOS Magtape handler.
8. A DOS logout problem wherein .DAT slot assignments are passed from one VIC to the next instead of reverting to default conditions.
9. LPO2KA will not print octal fields greater than 120 print positions on a 132 position line printer.

10. The TTY locks up the system during print of a load map under DOS.
11. The DOS loader uses one pass through the system library and under certain conditions cannot locate system routines.
12. RSX MCR sometimes determines that a task is both "active" and "inactive" simultaneously and therefore locks up the system.
13. RSX routine FSPFIL detects EOF records which are not on the tape.
14. The DOS Magtape handler has a bug which will not permit the sequence - Read, Rewind, Read.

A purchase order has been issued for the RASP-15 programming language. This system operates in conjunction with RSX Phase Two. The SWAP system will be implemented to make extensive use of this language. Receipt is scheduled for early April and installation and training in the use of RASP-15 should follow shortly.

A member of the staff visited Lincoln Laboratories and DEC in Maynard, Massachusetts, and Sterling Winthrop in Albany, New York. The purpose of the trip was to review the SWAP user specs, discuss the Bucode 9 track-tape drives, and gain some insight as to the power and use of RASP-15.

E. VELA and PRIME ARGUS DATA Copies

During the past year SDL supplied data or computer services to the following:

ACDA, Department of State, Washington, D. C.

Air Force Cambridge Research Laboratory

Air Force Office of Scientific Research

Commonwealth of Australia, Dept. of Natl. Development

Dept. of Energy, Mines, and Resources, Ottawa, Canada

General Atronics Corporation

IBM

Institute of Geological Sciences, Great Britain

Lawrence Livermore Laboratories

Los Alamos Scientific Laboratory

MIT, Lincoln Laboratory

Naval Research Laboratory, Washington, D. C.

National Park Service

Royal Norwegian Council for Scientific and Industrial Research

Texas Instruments

Teledyne Geotech, Garland, Texas

U. S. Dept. of Commerce, National Oceanic and Atmospheric Administration

U. S. Dept. of Interior, Geological Survey

Brown University

California Institute of Technology

Columbia University, Lamont-Dougherty Observatory

Georgia Institute of Technology

Institute of Geophysics, Victoria University

MIT, Lincoln Laboratory

New Mexico Institute of Mining and Technology

Oregon State University

Pennsylvania State University

St. Louis University

Southern Methodist University

University of Alaska

University of California, Berkeley

University of California, San Diego

University of Edinburgh

University of Hawaii

Universitie Louis Pasteur

University of Minnesota

University of Oklahoma

University of Texas at Dallas

University of Utrecht

University of Washington at Seattle

University of Wisconsin

F. Analog Field Tape Supply

As a result of compression 623 tapes are available to be shipped for field use. A limited amount of compression was done in March.

G. Array Data Service

During March, 9 samples of NORSAR short period data were requested, none were received. As of the end of March the SAAC/LASA weekly summary was being mailed to 28 recipients.