

OPERATIONS REPORT
ON A VIBROSEIS SEISMIC SURVEY
CONDUCTED IN
DAVIS COUNTY, UTAH

HILL AIR FORCE BASE PROSPECT

FOR

UNIVERSITY OF UTAH RESEARCH INSTITUTE
SALT LAKE CITY, UTAH



Seismograph Service Corporation
A SUBSIDIARY OF RAYTHEON COMPANY
P.O. BOX 1580 TULSA, OKLAHOMA

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INTRODUCTION

A seismic survey utilizing the VIBROSEIS* method was conducted in the vicinity of Hill Air Force Base, Utah, during the period of May 16 to June 12, 1979, for the University of Utah Research Institute.

The objective of the survey was to define subsurface geologic structures in and below the Tertiary section, particularly deep-seated faulting.

Because of the anticipated high noise levels (traffic & airplane), the prolificity of man-made structures, - houses, buried sewer-electric-water pipes, underground storage reservoirs, water wells - and because of its inherent flexibility, the VIBROSEIS* system was selected as the energy source of choice.

The prospect consisted of two east-west lines and one north-south tie line totalling 14.91 miles of surface traverse.

*Trademark of Continental Oil Company



GENERAL DISCUSSION

Production field recording was preceded by an experimental program (Appendix III) from which optimum field recording parameters were selected and which confirmed the feasibility of using reflection seismology to obtain the geological objectives required. It must be stated that the recording parameters selected were designed primarily to penetrate to depths of 8,000 feet or less.

Field operations were frequently interrupted by heavy traffic, aircraft movement and security fences. Data quality noticeably deteriorated as a function of this noise, however the multiple raypaths and power of cross-correlation inherent in the use of the VIBROSEIS* system enabled the acquisition of fair to good quality data.

2400% Common Depth-Point production data were digitally recorded using S.S.C. manufactured tractor mounted vibrators as the synchronized, swept frequency energy source. (Appendix VI) The recorded field data were summed and cross-correlated and quality controlled by an on-site, trailer-mounted PHOENIX 704 mini-computer system which also output preliminary processed data for initial viewing.

Final processing and display of the data were performed on a PHOENIX "I" system at SEISMOGRAPH SERVICE CORPORATION regional office in Denver, Colorado. (Appendix VII)

*Trademark of Continental Oil Company



CONCLUSIONS & RECOMMENDATIONS

The results obtained from the seismic survey show that the Tertiary objectives were well achieved. Data objectives below the Tertiary section, if the boundry can be established, were fair quality, with many fault associated events evident. The Tertiary data were of good quality, delinitating many interbedded horizons. Shallow sub-surface structures may be directly related to deeper than Tertiary events. Well control should resolve any questions as to the depth of the Tertiary section.

If future seismic surveys are to be run in the general area, Seismograph Service Corporation would recommend the following changes or implementations. The VIBROSEIS* source should be used, utilizing larger vibrator trucks with more mass, therefore inducing more signal power into the ground. It should be noted that more power may be undesireable near buildings, homes, and underground reservoirs.

Since noise appeared to be the largest problem in obtaining good data results, the survey could be conducted in the evening-night time hours, when traffic is at a minimum. Seismograph Service Corporation, due to insurance regulations, could not vibrate during these hours.

No final interpretation is submitted.

Respectfully submitted,

SEISMOGRAPH SERVICE CORPORATION

By: J.E. Smatla, Supervisor

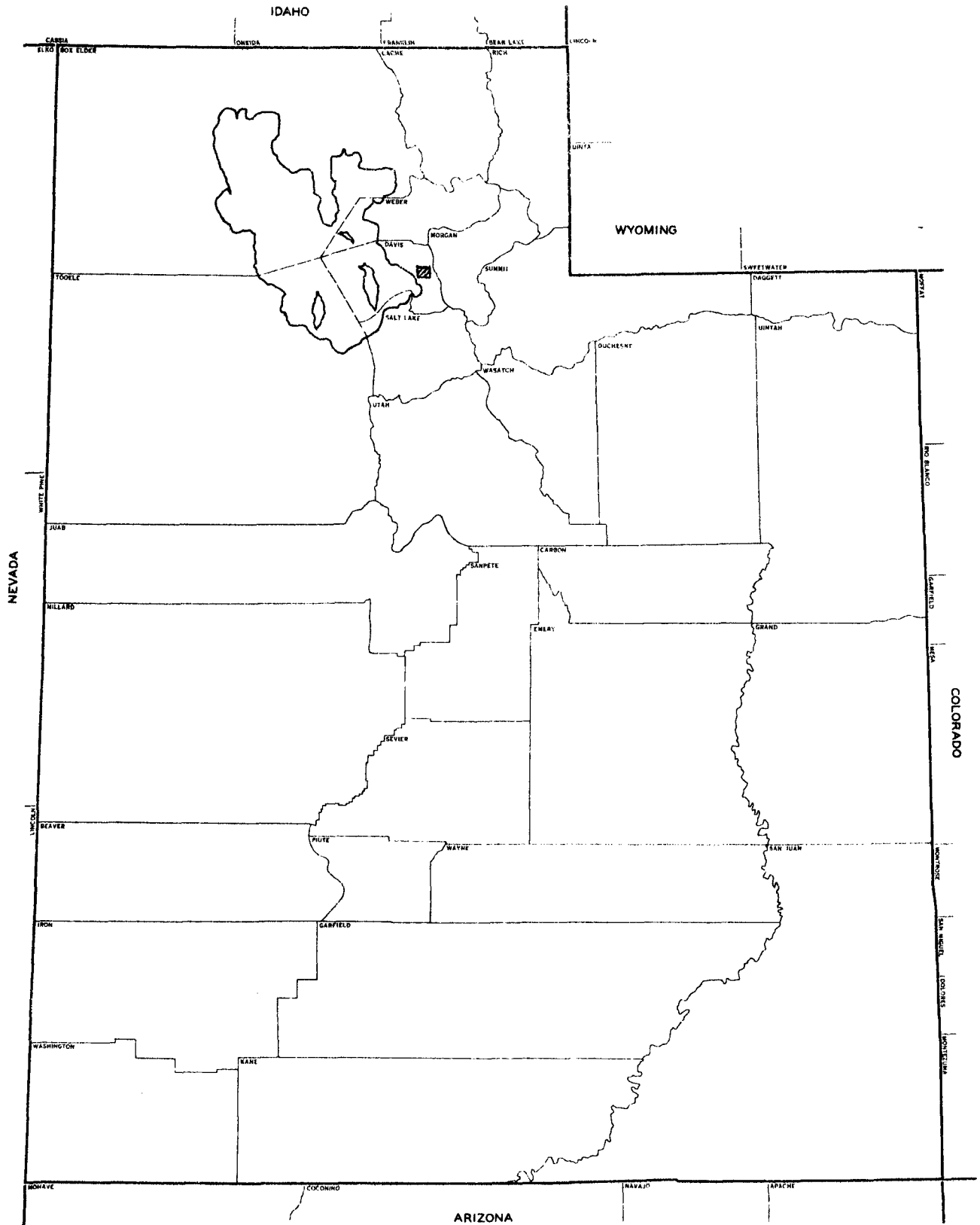
By: D.R. Seifert, Area Manager

/js
August 8, 1979

*Trademark of Continental Oil Company



APPENDIX I
INDEX MAP OF UTAH



Area Surveyed

APPENDIX II

PHYSIOGRAPHY

Topography:	Flat, partially river bisected
Population:	Densely populated
Culture:	55% airforce Base, 35% Highway, 10% ranchland
Drainage:	Well drained. Weber river drains westward at north boundary of the prospect
Soil:	Sand - gravel
Weather:	Hot, some afternoon rain, little wind
Roads:	50% highways - access roads, 50% none
Access to area from headquarters:	All lines within 5 miles of the headquarters
Traverse difficulties:	Caused by: Heavy highway traffic, Air Force Base security areas, many fences, drainage ditches



APPENDIX III

EXPERIMENTAL

Noise spread
Geophone pattern
Source pattern
Sweep comparisons

Object:

Three parallel spreads utilizing 16 stations each were layed out with 110 foot station intervals. On one spread a 110 foot inline geophone pattern was used. The second spread used a 220 foot geophone inline pattern. The third spread consisted of 24 phones bunched in a two foot circle about each recording station for noise analysis.

Sweeps of 56-14 Hz and 15-80 Hz were used, recording both 2 & 4 milliseconds with the 15-80 Hz sweep. These sweeps were vibrated from distances of 440, 2200, and 3960 feet into these spreads utilizing 110 feet, 220 feet, and stacked vibrator patterns, 16 sweeps per vibrator and three vibrators.

Results:

The results of these comparisons were adequate to determine the parameters to be used for field recording and these are indicated under "Operation Methods".



Experimental

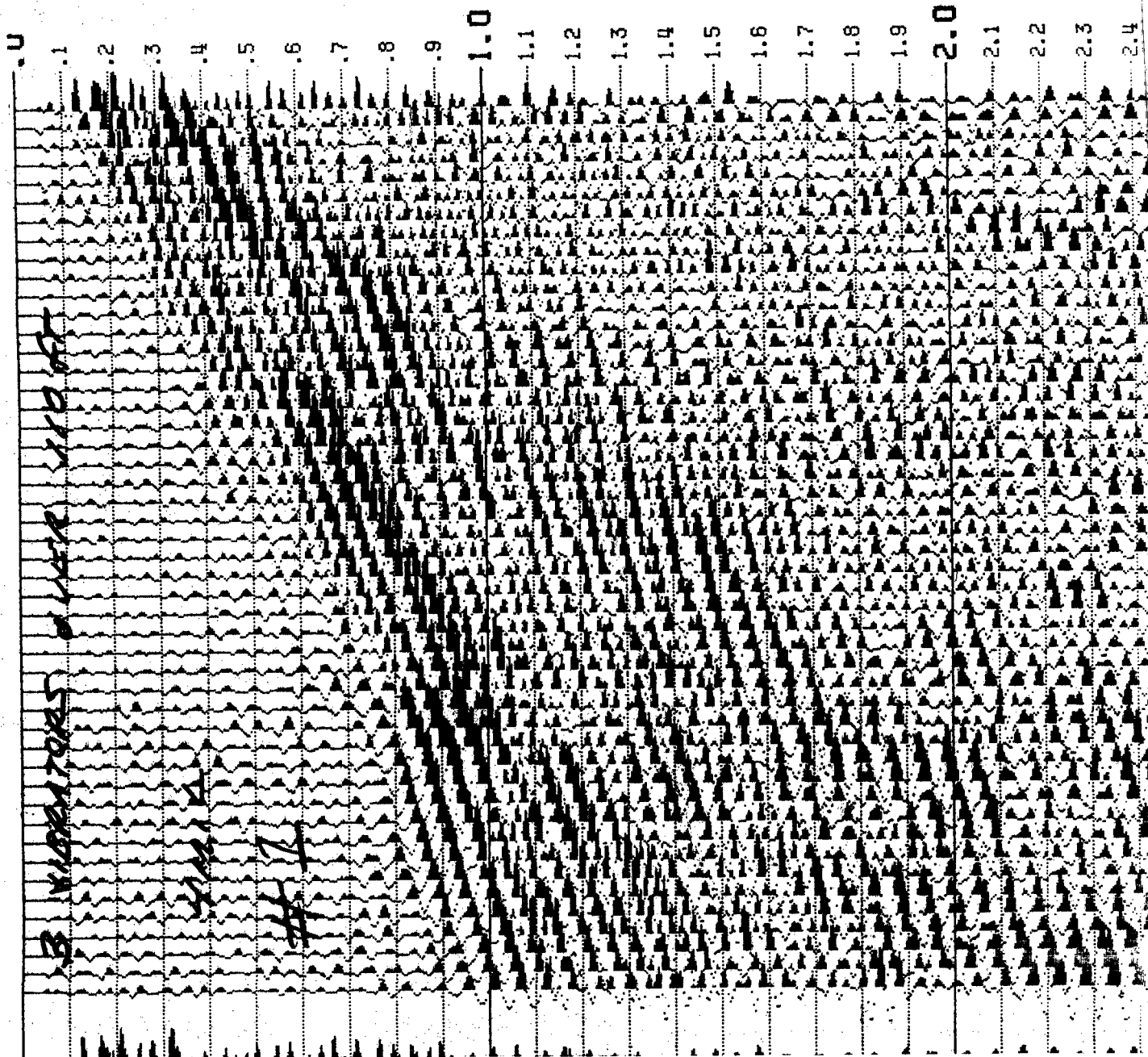
24 phones over 110 feet

Record B = 3 Vib
over 220 feet

56-14 Hz Sweep 4 ms

Record A = 3 Vib
over 110 feet

A



B

Experimental

24 phones over 220'

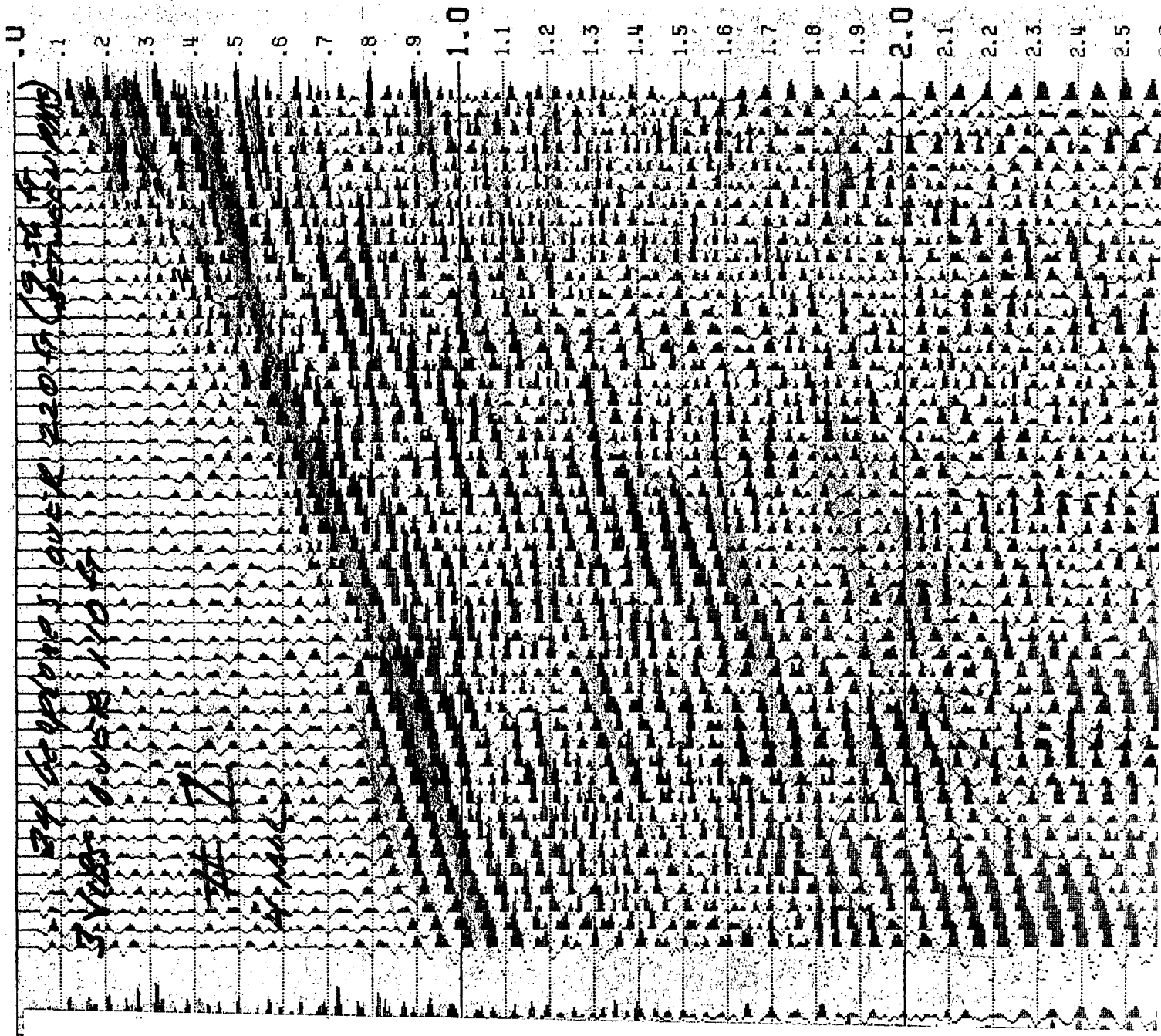
Record B = 3 Vib
over 220 feet

56-14 Hz Sweep 4 ms

Record A = 3 Vib
over 110 feet

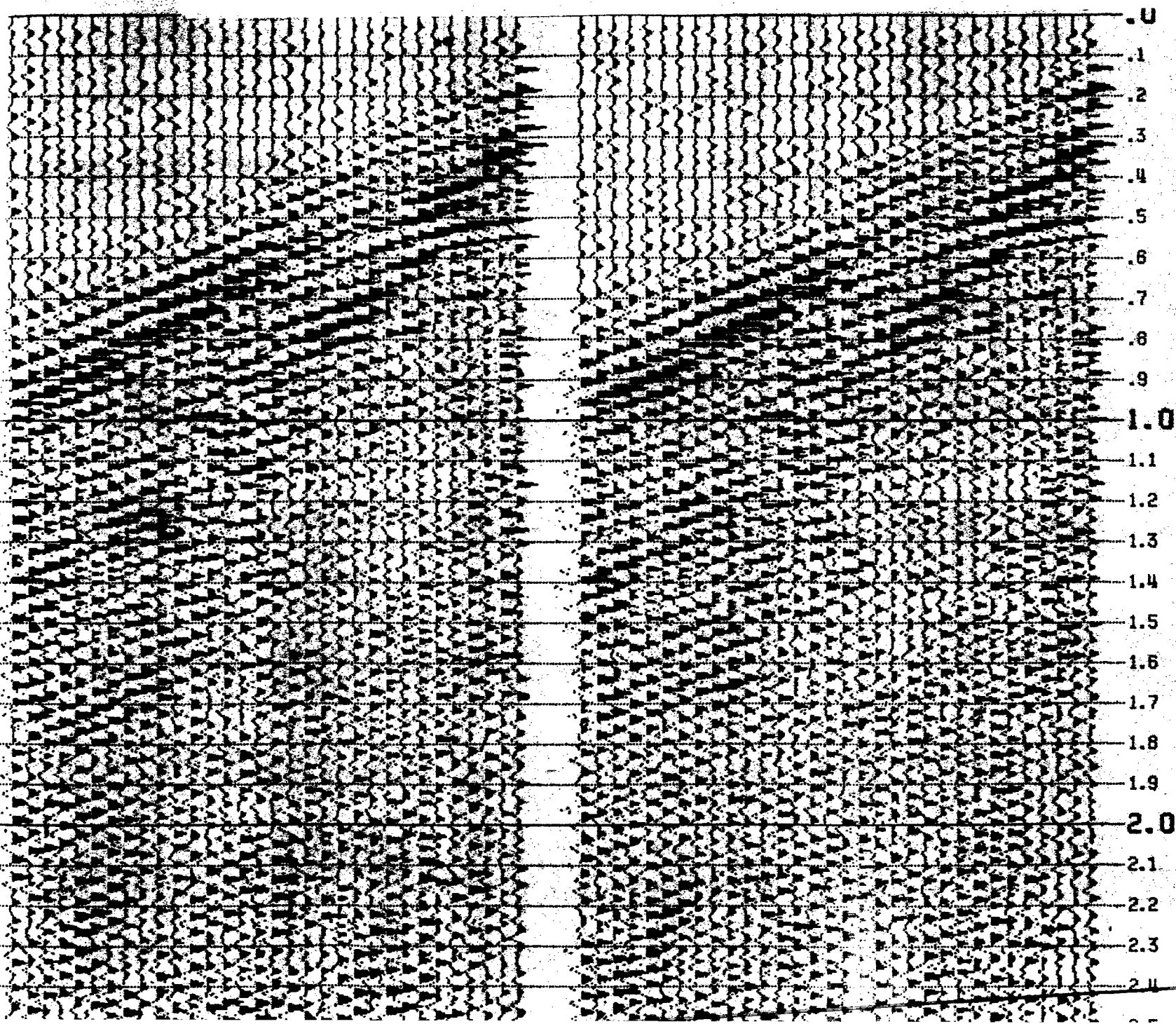
A

B



B

A



0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.0
2.1
2.2
2.3
2.4

Experimental

15-80 Hz Sweep 2 ms

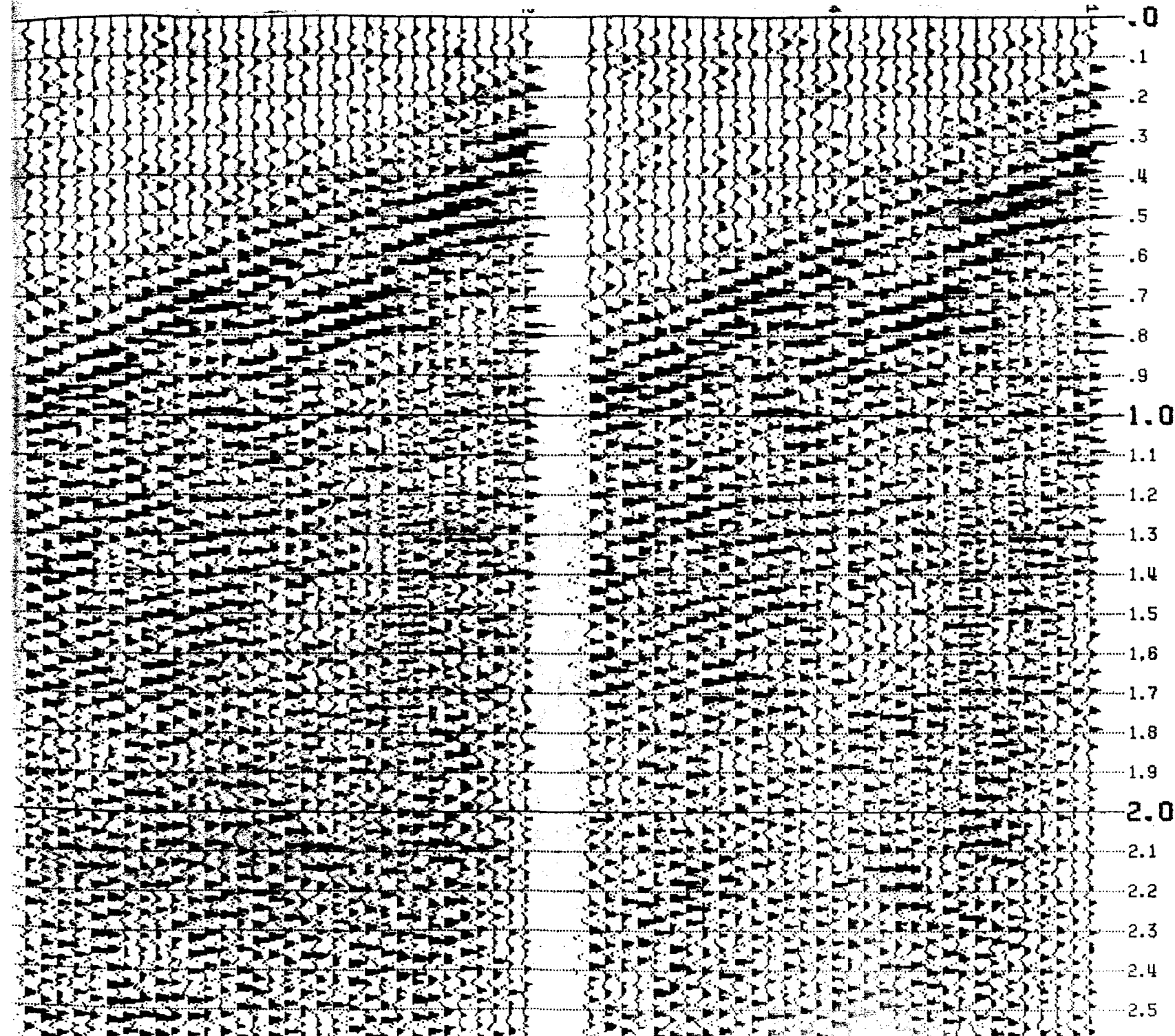
3 Vibrs over 110' pattern
Record A

24 phones over 110 feet

3 Vibrs over 220' pattern
Record B

B

A



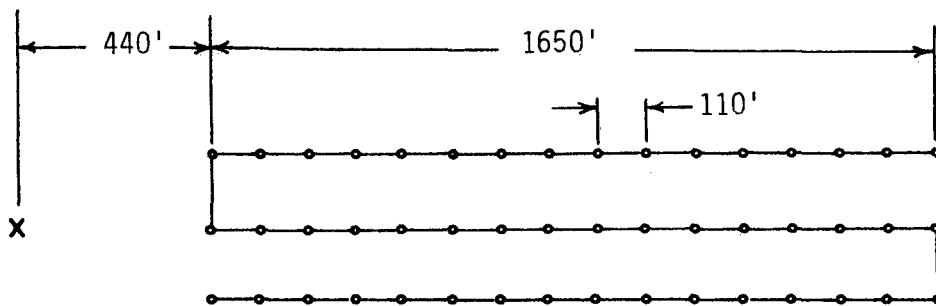
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.0
2.1
2.2
2.3
2.4
2.5

Experimental
15-80 Hz Sweep 2 ms
3 Vib over 220' pattern
Record B
24 phones over 220 feet
3 Vib over 110' pattern
Record A

EXPERIMENTAL PROGRAM

GEOPHONE SPREAD LAYOUT

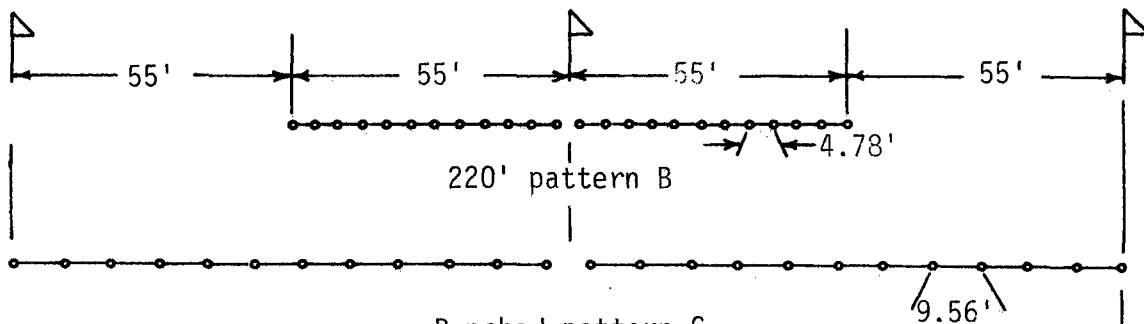
Vibrators vibrated at distances of 440', 2200', and 3960' from the spread.



A
B
C

GEOPHONE PATTERNS

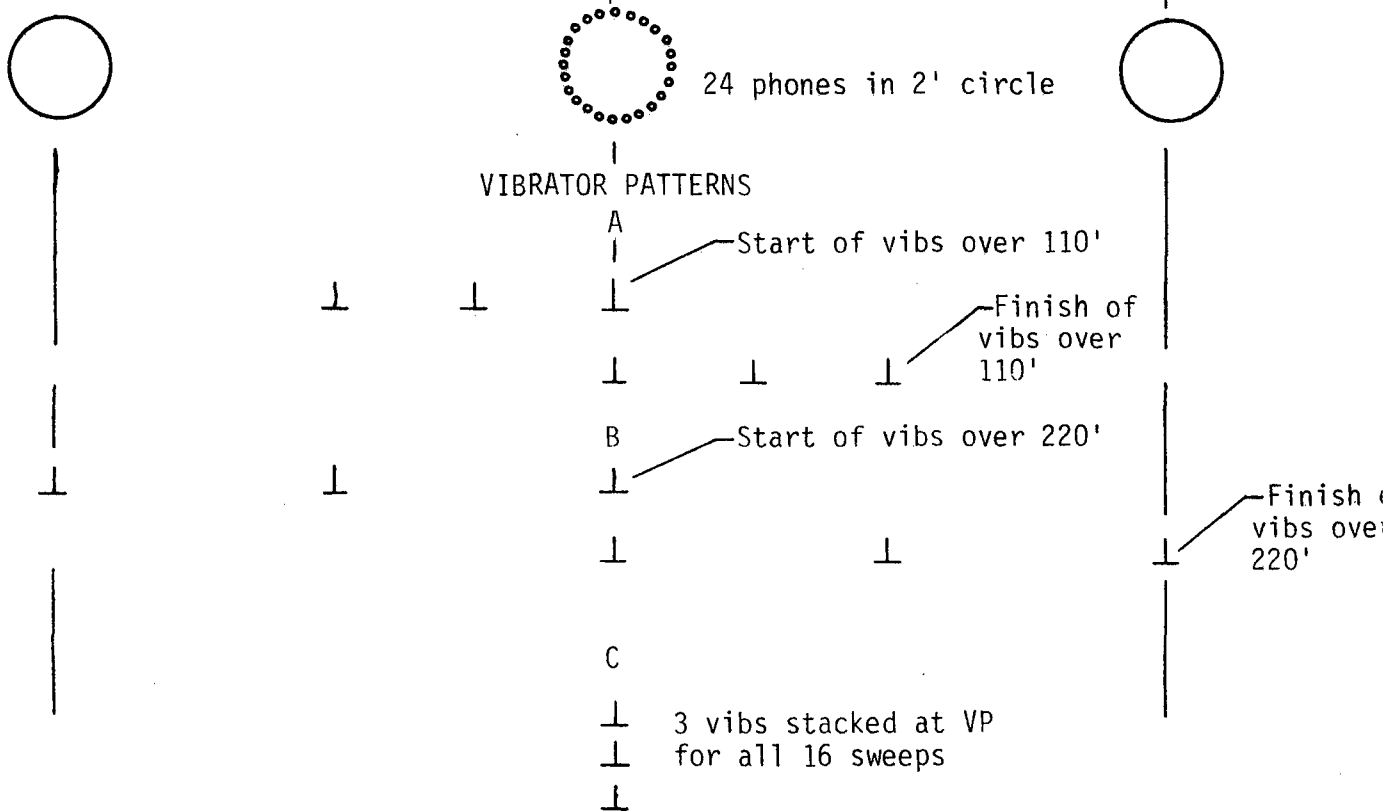
110' pattern A



Bunched pattern C



VIBRATOR PATTERNS



APPENDIX IV

OPERATING STATISTICS

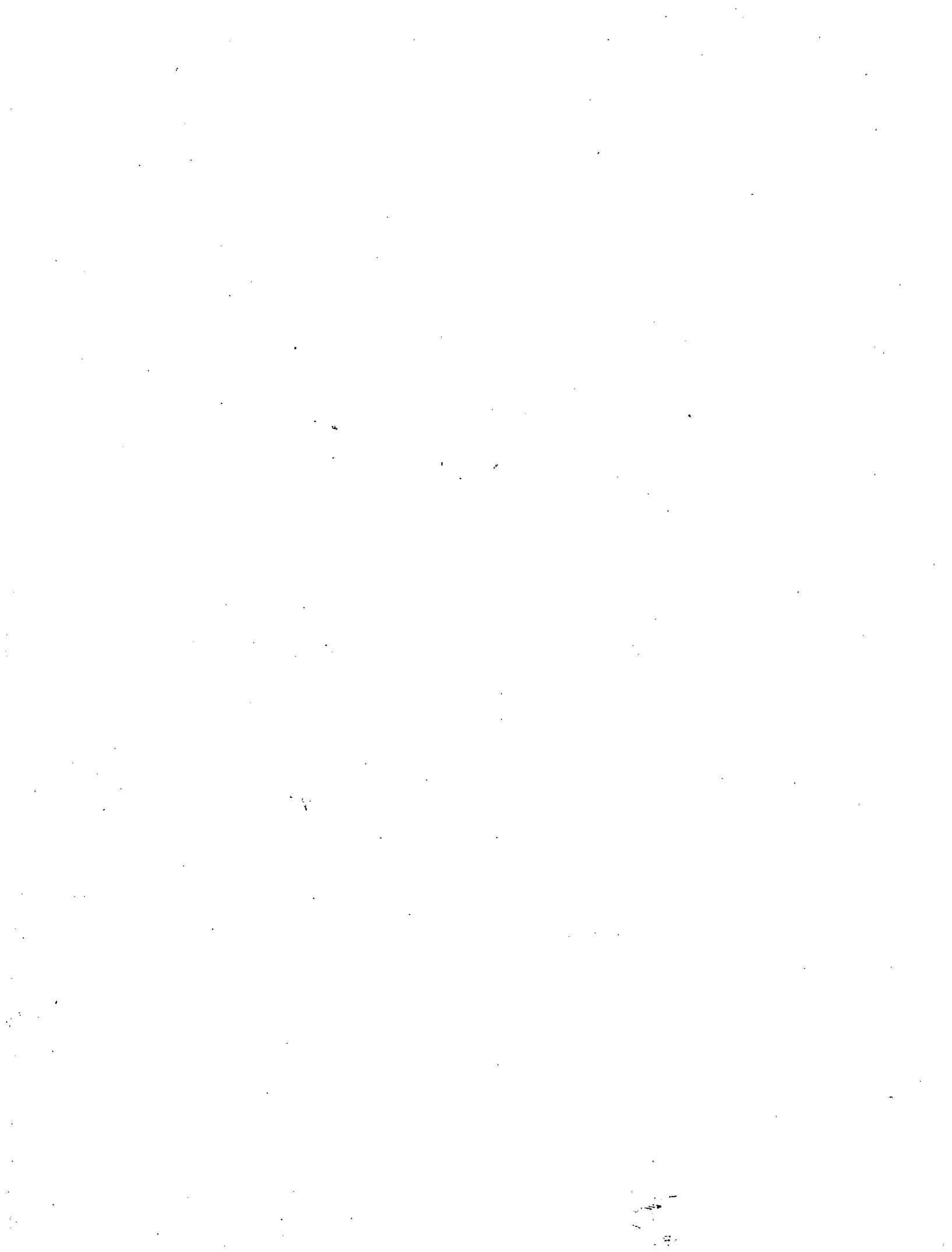
Crew Headquarters:	Clearfield, Utah South Gate - Hill Air Force Base
Starting Date:	May 16, 1979 (Experimental)
Completion Date:	June 12, 1979 (Line 3)
Work Days:	22 days
Total Hours:	266.5
Profiles Completed:	629
Linear Miles	14.91
Length Line 1	5.08 miles
" " 2	6.08 miles
" " 3	3.75 miles



PERSONNEL AND EQUIPMENT

Instrument Truck Number:	2951
Observers:	R.K. Fain and G. Lucero
Vibrator Mechanic:	D.G. Varner
SSC Tractor Vibrator number:	3141
SSC Tractor Vibrator number:	3142
SSC Tractor Vibrator number:	3143
SSC Tractor Vibrator number:	3144
Permit Agent:	R.O. Markham
Surveyors:	E.K. Phelps and R. Strang
Rodman:	L.A. Haddaway and M.O. MacConnel
Party Manager:	T.H. Vernon
Seismologist/Phoenix Operator:	G. Flechtner
Supervisor:	J.E. Smatla





APPENDIX VI

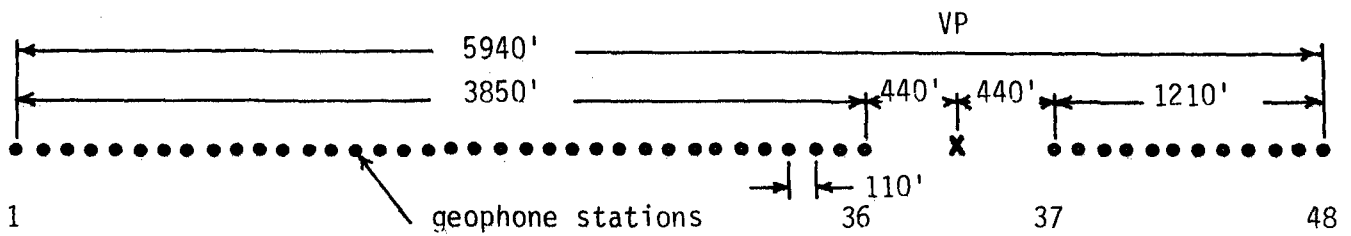
OPERATION METHODS

Method used:	24 fold common depth point
Recording spread used:	Inline asymmetrical (36 traces west, 12 traces east)
Offset distance: (source center to nest center)	440 feet - near traces (36,37) - 4920 feet - far trace
Station spacing:	110 feet
Geophone interval:	9.56 feet between phones - centered on the recording station with first phone 4.78 feet from station flag. Total pattern length of 220 feet by 0 feet wide. 2 strings of 12 phones connected in series - parallel giving 24 phones per nest.
Geophone type:	EV-22, 8 Hz phones
VP Interval:	220 feet
Vibrator pattern:	3 or 4 vibrators inline for total pattern length of 220 feet. 55 feet spacing when using 3 vibrators, approximately 37 feet spacing when using 4 vibrators
Number of sweeps per vibrator per trace:	16 over 220 feet
Sweep:	56-14 Hz / 14 sec duration
Equipment: Type vibrators:	Center mount, SSC-VIBK Tractor mounted. (Appendix V)

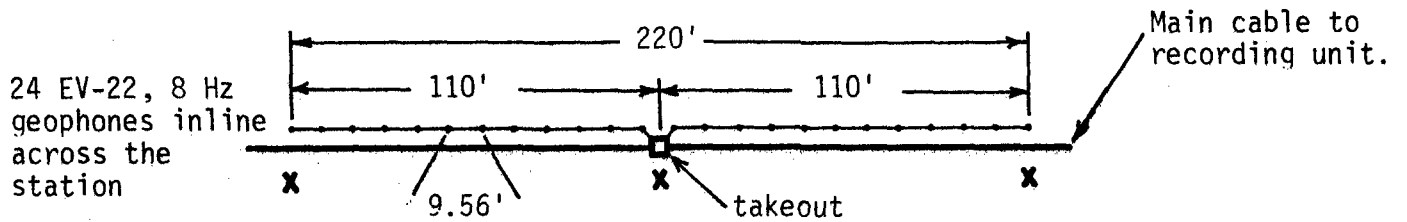
A diagram illustrating the geophone arrangement & vibrator pattern is shown on page 18.



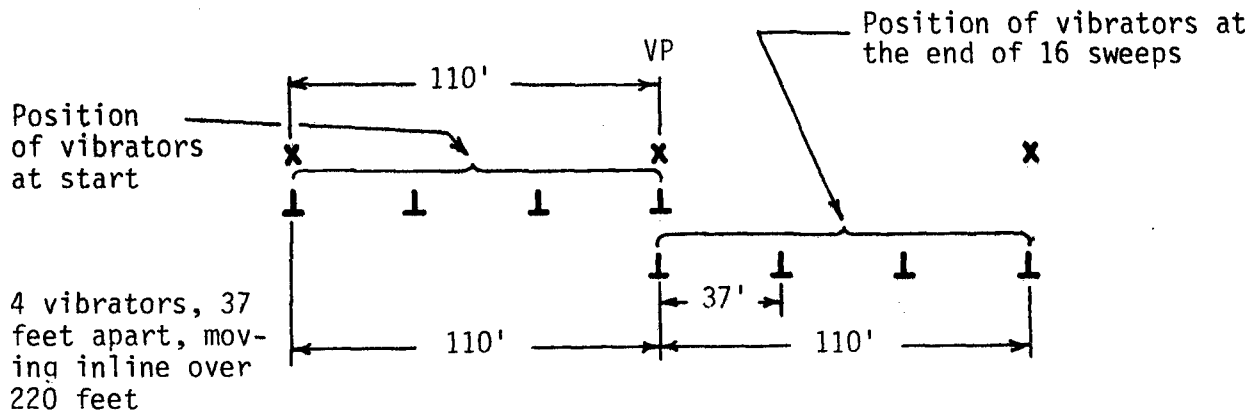
GENERALIZED FIELD LAYOUT



DETAIL OF GEOPHONE ARRANGEMENT



DETAIL OF VIBRATOR PATTERN



3 vibrators, 55 feet apart, moving inline over 220 feet

16 sweeps per vibrator

Sweep frequency: 56-14 Hz

Contract #2882
Hill Air Force Base Prospec
Davis County, Utah



APPENDIX VI (Contd.)

OPERATION METHODS (Contd.)

Instrumentation:

Amplifier recorder system

DFS IV

Number of channels used

48

Field filter:

12 Hz lowcut, 62 Hz Hicut, 60 cycle notch filter in

Tape:

.5 inch, 9 track

Format:

SEG-B, 800 BPI

Summing and correlation:

In trailer-mounted PHOENIX 704 mini-computer system

Sample rate:

Recorded/processed at 4 ms



APPENDIX VII

PRE-STACK CORRECTIONS

Seismic datum: 4800 feet
Correctional Velocity: 5000 feet per second

REPLAY PROCESSING

Filter: 15-18-55-60 Hz 0-1.5 sec
13-15-40-50 Hz 1.5-4.0 sec
Trace muting: 90ms at 0 distance
1300ms at 4920 feet
Sample rate: 4 ms
Deconvolution: 28 ms predictive
Statics: Automatic CDP alignments
Automatic Gain Control: Time variant
Migration: Wave equation
Final Presentations: Film display
24 fold common depth point
Migration of line

