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T 115 P Part 13.

DIGITAL PROCESSING REPORT

T 15-P, T 16-P AND T 19-P

SEISMIC SURVEY

FOR

BRIDGE OIL LIMITED

MAY - JULY 1985



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Introduction

The processing of 1005.53 kms of seismic data for BRIDGE OIL LIMITED recorded offshore S.E Australia was conducted in the SINGAPORE DIGITAL CENTRE OF WESTERN GEOPHYSICAL COMPANY OF AMERICA during May-July 1985. The survey covered areas T 15-P, T 16-P and T 19-P. All data employed the same processing sequence except an additional process was included for T 19-P. A detailed description of the variation on processing sequence and parameters can be found under Appendix 4.

Following are the acquisition parameters used for the survey:

BOAT

Western Odyssey	Party 86
Navigation by	Maxirun
Map Location	Antenna Position

SOURCE

Air Gun Volume	1530 CC.
Air Gun Pressure	4600 PSI
Gun Depth	6 M
S.P Interval	26.67 M
POP Interval	26.67 M
Shooting Rate	37.5 POPS/KM
No of Guns	19

INSTRUMENTS

System	L.R.S 16
Format	SEG-D, 6250 bpi
Filters	12 hz - 375 hz
Filter slopes	12 hz - 72 db/oct
Record length	5 SECS
Sample rate	1 MS
Polarity	Compression negative (Normal SEG Convvention).

Cable

Streamer	3200 M
Groups	240
Group Interval	13.33 M
Lead in	125 m
Cable depth	12 m. average

Array Formed Specifications

Format	SEG-D, 6250 bpi
Traces	120 (Demultiplex)
Trace Interval	26.67 M
Filters	12 hz - 180 hz
Filter slopes	12 - 72 db/oct
Lead In	32 m
Sample rate	2 MS
Time Delay	10ms



1. Format Conversion

The 120 trace demultiplexed, array formed data, in SEG-D format, was converted to WGC Code 4 format and resampled from 2 ms to 4 ms sample interval. Full word, 32 bit floating point data at geophone amplitude was maintained.

Shot records, giving 100% coverage, and a single trace section were also displayed to aid in quality control.

The LRS 16 10ms time delay in the array formed data was removed in this step.

2. Signature Deconvolution

A synthetic air gun signature, including the LRS-16 array channel response was used for derivation of the signature deconvolution operator. (Figure 1). All data were convolved with the operator prior to the application of a conventional predictive deconvolution.

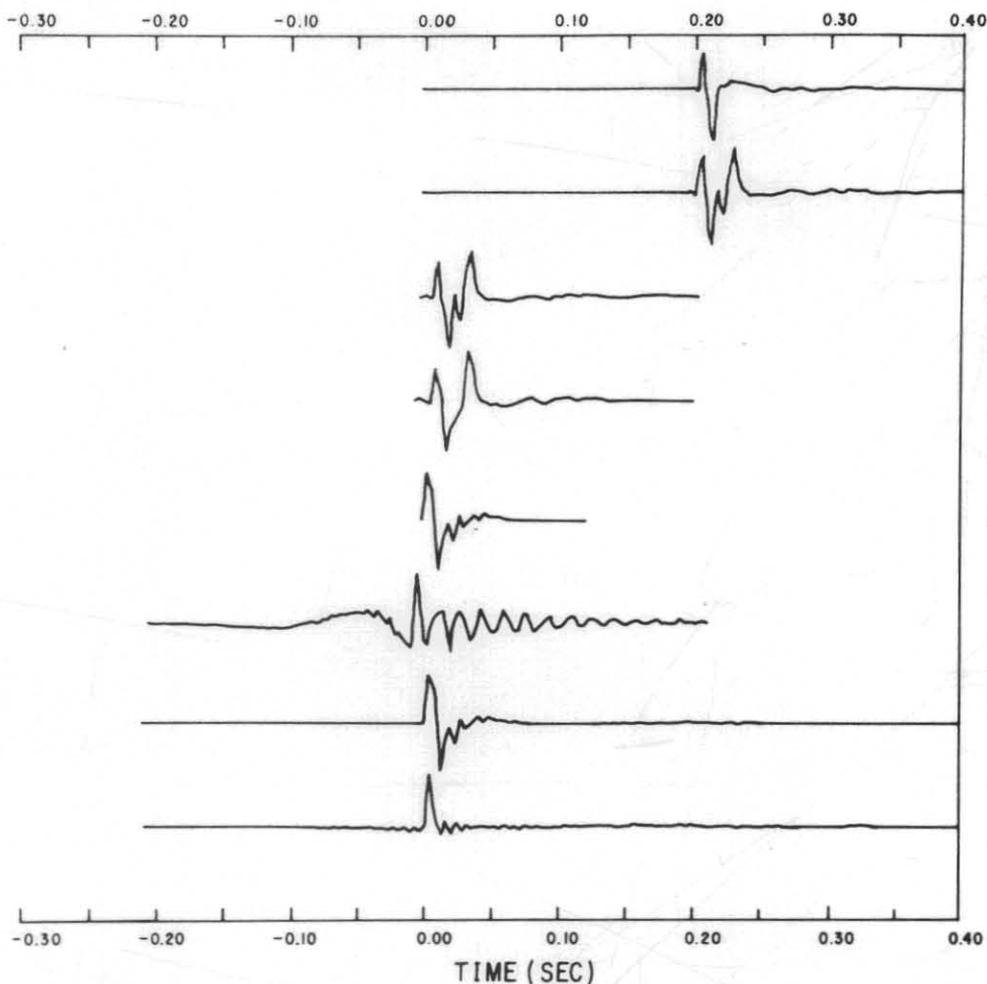
BRIDGE OIL SIGNATURE DECONVOLUTION OPERATOR DESIGN

232007

IDENT 10000

03 - 5 - 85 17.28.18

TRC	INPT	PROC	DSCR	OUTP
IUM	WVNM			WVNM
1		TPIN		SG
2	SG	GHST		SGG
3	SGG	SHFT		SGTS
4	SGTS	RSMP		SGTR
5	FILT	BPFL		MFIL
6	SGTR	SHAP	OPTR	OPRM
7	SGTR	SHAP	OUTP	OPM
8	OPM	DCON	OUTP	D004



- 1) INPUT SYNTHETIC AIR GUN SIGNATURE
- 2) ADD IN CABLE GHOST
- 3) TRIMMED AND TIME SHIFT TO ZERO
- 4) RESAMPLED TO 4 MS
- 5) 6-125 HZ MINIMUM PHASE IMPULSE
- 6) OPERATOR USED TO SHAPE (4) TO (5).
THIS WAS THE OPERATOR WHICH WAS APPLIED TO SEISMIC DATA
- 7) OUTPUT OF (4) AFTER (6) WAS APPLIED
- 8) AFTER 1ST SAMPLE PREDICTIVE DECON WAS APPLIED

FIG. 1

5 cm



WESTERN GEOPHYSICAL

3. Amplitude Recovery

To correct for spherical spreading, the inverse of the amplitude decay factor (A) was applied to the data where $A=1/TV^2$, T being 2 way time and V being RMS velocity. The velocity function used for the whole survey was :

<u>Time (ms)</u>	<u>Velocity (Metres/Sec)</u>
0000	1500
1000	2100
2000	2900
5000	4000

Deconvolution Before Stack

A Weiner-Levinson Least Squares Minimum Phase inverse filter was applied to all data.

Each trace was divided into 2 windows. Window 1 from 200 ms. below water bottom to 3000ms., and window 2 from 2500-5000 msec, giving an overlap of 500 ms.

A velocity of 2500 M/S was used for the stop time of the first window and the start time of the second.

A minimum prediction distance from the autocorrelation time lag of 12 ms and a maximum predictive distance of 240 msec was used for all data.

After deconvolution each trace was normalized to a value of 2000 RMS. The normalizer was stored in the trace headers.

Before and after deconvolution, autocorrelations were generated and displayed to monitor the deconvolution process. A deconvolved single near trace section was also output to assist in the subsequent picking of velocity analyses.

4. Velocity Analysis

Vertical RMS velocity analysis was performed in the VELAN program on the deconvolved trace sequential output. Two adjacent CDP families were used for each VELAN in this survey. Each trace in a CDP family was NMO corrected at a particular velocity, had first arrival energy muted, and was divided into 24 millisecond, gates. The corresponding gates for all combinations of traces of the CDP family were then correlated and the resulting product-sums summed for both CDP families to produce a correlation value for the centre time of the gate and the velocity used. A correlation trace for the centre time was produced by repeating the process for velocity starting at 1400 M/SEC and increasing by 84 M/SEC for 50 increments.

The graphic display was RMS velocity versus two-way time with the correlation traces normalized (maximum value in each gate plotted at uniform amplitude) and the normalising constant displayed as a 'relative maximum correlation' trace.

Analyses were identified by the shotpoint number of the near trace of the first CDP family.

In conjunction with each analysis, CDP gather and stack traces, NMO corrected to 5 pre-selected velocity functions were also displayed to assist interpretation.

5. F-K Multiple Attenuation (MAFK)

In the T-19P area, severe long period multiples were interfering with the primary reflections. To alleviate this problem, Multiple Attenuation Filter was employed after DBS.

MAFK involves three major steps.

Normal Moveout (NMO) correction is applied to the data using a velocity function that lies between the velocity of the multiples and the primaries. This results in primary reflections being over-corrected and the multiple reflection being under-corrected.

After NMO the data is transformed into F-K domain which results in the primary and the multiple dips being mapped on opposite sides of the zero wavenumber axis. A filter which zeros out that side of the F-K domain containing multiples is then applied. After filter application the data are transformed back into the T-X domain. Finally, inverse NMO is applied using the same velocity function as used in the NMO. This restores the primary events to their original positions for subsequent processing.

Velocity analysis was rerun and repicked after MAFK for better control in producing the final stacking velocity field.



6. Normal Moveout Application and CDP Stacking

The Normal Moveout Corrections for the final section were computed from the velocity functions generated for each line. The calculations were performed independently for each trace using a straight ray computation method.

After NMO corrections, muting was applied to remove first arrivals, early refracted energy and excessive stretch, following which, the traces in each CDP were horizontally stacked to produce the stack output.

Quality control of the velocity functions used was aided by the display of 'stack monitor sections'. These sections consisted of one moveout corrected, muted, common depth family from each 24th stack output trace. With each CDP family was displayed an 'applied velocity trace' which by means of large pips (500 m/s) and smaller pips (100 m/s or 50 M/S) showed the RMS velocity versus two-way time applied.

Using the preliminary stack section, stack monitor section, and picked velocity analyses the processing analyst was able to check the data for any necessary residual velocity adjustments before the final stack was run to verify the residual velocity corrections made.

7. Deconvolution After Stack

A Weiner-Levinson Least Squares Minimum Phase inverse filter was applied. A minimum predictive distance from the autocorrelation time zero of 12 ms with a maximum predictive distance of 240 ms was used for T 15-P and T 16-p.

A minimum predictive distance of 24 ms with a maximum predictive distance of 180 ms was used for T 19-P. Each trace was divided into 2 equal windows.

Before and after deconvolution, autocorrelations were generated and displayed periodically to monitor the deconvolution process.

8. RMS Gain

Root Mean Square gain was applied to the data. Each trace was divided into gates, the length of the first being 128 msec. Each gate thereafter is twice the length of the preceding gate until the maximum gate length of 1024 is reached. All succeeding gates have the maximum gate length until the entire trace is zoned. The amplitude of each sample in a gate is squared, a mean calculated and then the square root is taken (RMS 1).

The ratio of the desired RMS value (2000 RMS) to RMS 1 is the multiplier applied to the center of the gate. A straight line interpolation is then performed to derive multipliers for all samples between gate center-points.



9. Post Stack Coherent Noise Filter

Three lines in the survey were found to have very strong linear noise that required further special treatment prior to migration of the data.

F.K. Domain Filter

(Line BB85-04)

This process uses a two dimensional filter to pass/reject dipping events on seismic data. The filter is designed and applied in the frequency-wavenumber (F.K.) domain.

Reject fans of +3.5 to +8 ms/trace and -3.5 to -8 ms/trace with a taper of .5 ms/trace were applied to the data.

Multi Channel Coherent Noise Filter

(Lines BB85-08 and BB85 -12)

This program applies a multi-channel time domain filter to the seismic data to attenuate linear coherent noise. A fan defined by a minimum slope of 5 msec per trace and a maximum slope of 9 msec per trace was used. Rolloff frequency ie. that above which no data is attenuated was 40 hz.

The filter was designed using 17 traces.

10. Migration

Finite-Difference (FD) migration algorithm was used for the survey. Smoothed stacking velocities were input to the migration. Post migration gain and TVF are identical to those applied to the time sections.

However the finite difference algorithm is accurate for dips up to 25 degrees and the following lines were also migrated with F.K. steep dip algorithm to ensure accurate imaging of the maximum dip on these lines.

- 1) Line BB85-20
- 2) Line BB85-26
- 3) Line BB85-28

11. Band Pass Filtering

A filter pass band of 10 hz low cut and 90 hz hi cut with slopes of 18 db/octave and 36 db/octave respectively was applied to all final stacks and migrated stacks.



12. Final Display

The final output was displayed on film at a scale of 1:15748, (30 tr/in) horizontal and 3.75 in/sec vertical scale.

Shotpoint numbers are located at antenna position.

Display polarity was plotted with a negative number on tape represented by trough (ie. SEG normal).

Gun and cable corrections of 12 ms were applied during playback of the final display sections.

13. Tape Disposition

- | | | |
|--|---|-----|
| 1) Field tapes (120 channels array formed) | : | 181 |
| 2) No gain final stack tape (in SEG Y format) | : | 4 |
| 3) No gain migrated stack tape (in SEG Y format) | : | 4 |

The no gain final stack and no gain migrated stack tapes were concatenated and converted to SEG Y format.

All of the above tapes plus supporting data and all original picked velans were shipped to BRIDGE OIL in Sydney.

14 Pre-Production TestsFilter Test

Input : Line BB 85-26 shot record SP.120 before Dcon
: Line BB 85-26 shot record SP.120 after Dcon
: Line BB 85-60 shot record SP.330 before Dcon
: Line BB 85-60 shot record SP.330 after Dcon

Output Filter panels of input record

No filter

0 - 10 hz
7 - 14 hz
10 - 20 hz
14 - 28 hz
20 - 20 hz
28 - 56 hz
40 - 80 hz
56 - 112 hz
80 - 125 hz

FK Filter before stack

Input Line BB 85-26 (SP. 90-290) shot records at 4 ms S.R.
 Line BB 85-60 (SP. 100-290) shot records at 4 ms S.R.

Output Stack sections thru following processing sequence
 1. SEG D conversion/resample to 4 ms
 2. FK Filter
 3. DBS (Desig and 12-240 Predictive Dcon)
 4. Stack

It was decided not to run FK Filter in production.

Deconvolution Before Stack (DBS) Test

Input : Line BB 85-26 (90-290) preprocessed shot records
Line BB 85-26 (100-340) preprocessed shot records

Output : Stacks and auto-correlations displays of the following

- 1 No Decon
2. 4-240, 2 windows
3. 12-240, 2 windows
4. 16-240, 2 windows
5. 24-240, 2 windows
6. 32-240, 2 windows
7. Desig followed by 4-240, 2 windows
8. Desig followed by 12-240, 2 windows

No. 8 was chosen for all areas.



Mute Test

Input : Line BB 85-26 (SP.86-96 & SP 206-218)
Deconvolved CDF gathers
: Line BB 85-26 (SP.165-177 & SP 256-270)
Deconvolved CDF gathers

Output Limited offset panels of the following

1. Near 4 Traces
2. Near 8 Traces
3. Near 12 Traces
4. Near 16 Traces
5. Near 20 Traces
6. Near 30 Traces
7. Near 40 Traces
8. Near 50 Traces
9. Near 60 Traces
10. Near 70 Traces
11. Near 80 Traces
12. Near 90 Traces
13. Near 100 Traces
14. Near 120 Traces

Deconvolution after Stack (DAS) Test

Input : Line BB 85-26 (SP. 90-290) final stack
: Line BB 85-60 (SP. 100-340) final stack

Output Stack and A/C panels of the following DAS parameters

- 1 No Decon
2. 4-240, 1 window
3. 12-240, 1 window
4. 24-240, 1 window
5. 36-240, 1 window
6. 48-240, 1 window
7. 64-240, 1 window
8. 24-120, 1 window
9. 24-180, 1 window

No. 3 was chosen for area T-15P & T-16P

No. 9 was chosen for area T-19P

Migration Test

Input : Line BB 85-26 whole line final stack

Output : Migrated sections of following algorithms

1. F-K
2. Finite Difference
3. Kirchoff

No. 2 was chosen.

Multiple Attenuation Filter (MAF) before stack

Input : Line BB 85-60

Output : Stack section thru following processing sequence

1. SEG D conversion/resample to 4 ms
2. DBS (desig and 12-240 predictive DECON)
3. MAF
4. VELAN
5. STACK

MAF was chosen for area T-19P.

Stack Gain Test

Input : Line BB 85-26 (SP. 90-260) final stack
: Line BB 85-60 (SP. 100-340) final stack

Output : Stack sections with various gain routine

1. AGC 500 ms gate
2. AGC 800 ms gate
3. RMS gain (64-1024 ms gate)
4. Reflection Strength Gain

No. 3 was chosen for all areas.

Post Stack Filter Test

Input : Line BB 85-26 (SP. 90-260) gained final stack
: Line BB 85-60 (SP. 100-340) gained final stack

Output : Filter panels of final stack

No filter

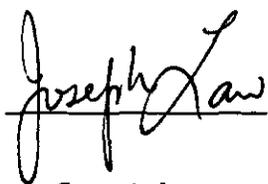
0- 10 hz
7- 14 hz
10- 20 hz
14- 28 hz
20- 40 hz
28- 56 hz
40- 86 hz
56- 112 hz
80- 125 hz
10- 50 hz
10- 60 hz
10- 70 hz
10- 80 hz
10- 90 hz
10- 100 hz
10- 125 hz

Band Pass Filter of 10-90 hz was chosen



Comments

Overall data quality was good for the whole survey, and no particular problems developed during the processing.



Joseph Law
(Geophysical Analyst)



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(Marine Processing Supervisor)



P. Nuttall
(Centre Manager)

Appendix 1Summary of lines processedArea : T-15/16-P

<u>Line</u>	<u>Shotpoint</u>	<u>Kms</u>
BB 85-1	1-543	14.48
BB 85-2	1-220	5.87
BB 85-2A	146A-604	12.27
BB 85-3	1-489	13.04
BB 85-4	1-908	24.21
BB 85-5	1-645	17.20
BB 85-5A	1-577	15.39
BB 85-6	1-942	25.12
BB 85-7	1-1012	26.99
BB 85-8	1-517	13.79
BB 85-9	1-599	15.97
BB 85-10	1-1255	34.47
BB 85-12	1-619	16.51
BB 85-14	1-190	5.07
BB 85-14A	115A-693	15.44
BB 85-16	1-493	13.15
BB 85-18	1-523	13.95
BB 85-20	1-896	23.89
BB 85-21	1-958	25.55
BB 85-22	1-647	17.25
BB 85-23	1-975	26.00
BB 85-24	1-180	4.8
BB 85-24A	110A-525	11.09
BB 85-26	1-760	20.27
BB 85-28	1-875	23.33
BB 85-30	1-630	16.80
BB 85-31	1-333A	8.88
BB 85-32	1-499	13.31
BB 85-33	1-315	8.40
BB 85-33A	241A-543	8.08
BB-85-34	1-508	13.55
BB 85-35	1-286A	7.63
BB 85-35A	1-235	6.27
BB 85-35B	161A-499	9.04
BB 85-36	1-535	14.27
BB 85-38	1-535	14.27
BB 85-40	1-695	18.53
BB 85-42	1-520	13.87
BB 85-44	1-505	13.47

Total km	601.47
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Area : Bass T-19-P

<u>Line</u>	<u>Shotpoint</u>	<u>Kms</u>
BB 85-51	35-1035	26.69
BB 85-52	35-422	10.35
BB 85-53	65-1200	30.29
BB 85-54	35-403	9.84
BB 85-55	35-460	11.36
BB 85-55A	385A-1293	24.24
BB 85-56	35-419	10.27
BB 85-57	35-999	25.73
BB 85-58	35-502	12.48
BB 85-60	35-560	14.03
BB 85-62	5-1221	32.45
BB 85-64	65-662	15.95
BB 85-66	35-617	15.55
BB 85-70	35-405	9.89
BB 85-71	70-704	16.93
BB 85-72	35-350	8.43
BB 85-73	65-691	16.72
BB 85-74	35-347	8.35
BB 85-76	35-639	16.13
BB 85-77	5-799	21.20
BB 85-78	35-1160	30.03
BB 85-78A	1085A-1366	7.52
BB 85-79	24-635	16.32
BB 85-80	35-533	13.31
	Total km	404.06

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Appendix 2Tape SummaryCLIENT : BRIDGE OILPROSPECT : T-15-P, T-16-P & T-19-PArray Data

<u>Box</u>	<u>L. No</u>	<u>F.S.P</u>	<u>L.S.P</u>	<u>F. Tape</u>	<u>L. Tape</u>
1	BB 85-20	1	896	UI64971	UI64974
1	BB 85-22	1	650	UI64975	UI64977
1	BB 85-24	1	180	UI64978	UI64978
1	BB 85-24A	110A	525	UI64979	UI64980
2	BB 85-28	1	875	UI64984	UI64987
2	BB 85-30	1	630	UI64988	UI64990
3	BB 85-23	1	975	UI64991	UI64994
3	BB 85-21	1	958	UI64995	UI64998
3	BB 85- 5	1	548	UI64999	UI65000
4	BB 85- 5	549	645	UI65001	UI65001
4	BB 85-5A	1	577	UI65002	UI65002
4	BB 85- 3	1	489	UI65005	UI65006
4	BB 85- 8	1	517	UI65007	UI65008
4	BB 85- 6	1	548	UI65009	UI65010
5	BB 85- 6	549	942	UI65011	UI65012
5	BB 85- 4	1	908	UI65013	UI65016
5	BB 85- 7	1	1012	UI65017	UI65020
6	BB 85- 9	1	599	UI65021	UI65023
6	BB 85-10	1	1255	UI65024	UI65030
7	BB 85-14	1	190	UI65031	UI65031
7	BB 85-14A	115A	693	UI65032	UI65037
7	BB 85- 2	1	220	UI65038	UI65038
7	BB 85-2A	146A	605	UI65039	UI65040
8	BB 85-18	1	523	UI65041	UI65043
8	BB 85-12	1	619	UI65044	UI65046
8	BB 85-16	1	493	UI65047	UI65048
8	BB 85- 1	1	429	UI65049	UI65050
9	BB 85- 1	430	543	UI65051	UI65055
9	BB 85-32	1	499	UI65056	UI65058
9	BB 85-36	1	535	UI65059	UI65060
10	BB 85-40	1	695	UI65061	UI65064
10	BB 85-44	1	505	UI65065	UI65066
10	BB 85-42	1	520	UI65067	UI65068
10	BB 85-38	1	535	UI65069	UI65070
11	BB 85-34	1	508	UI65071	UI65072
11	BB 85-35	1	286A	UI65073	UI65074
11	BB 85-35A	1	235	UI65075	UI65075
11	BB 85-35B	161A	499	UI65076	UI65077
11	BB 85-31	1	333A	UI65078	UI65079
11	BB 85-33	1	274	UI65080	UI65081
12	BB 85-33	275	315	UI65081	UI65081
12	BB 85-33A	241A	A43	UI65082	UI65083
12	BB 85-51	35	1035	UI65084	UI65087
12	BB 85-52	35	422	UI65089	UI65089

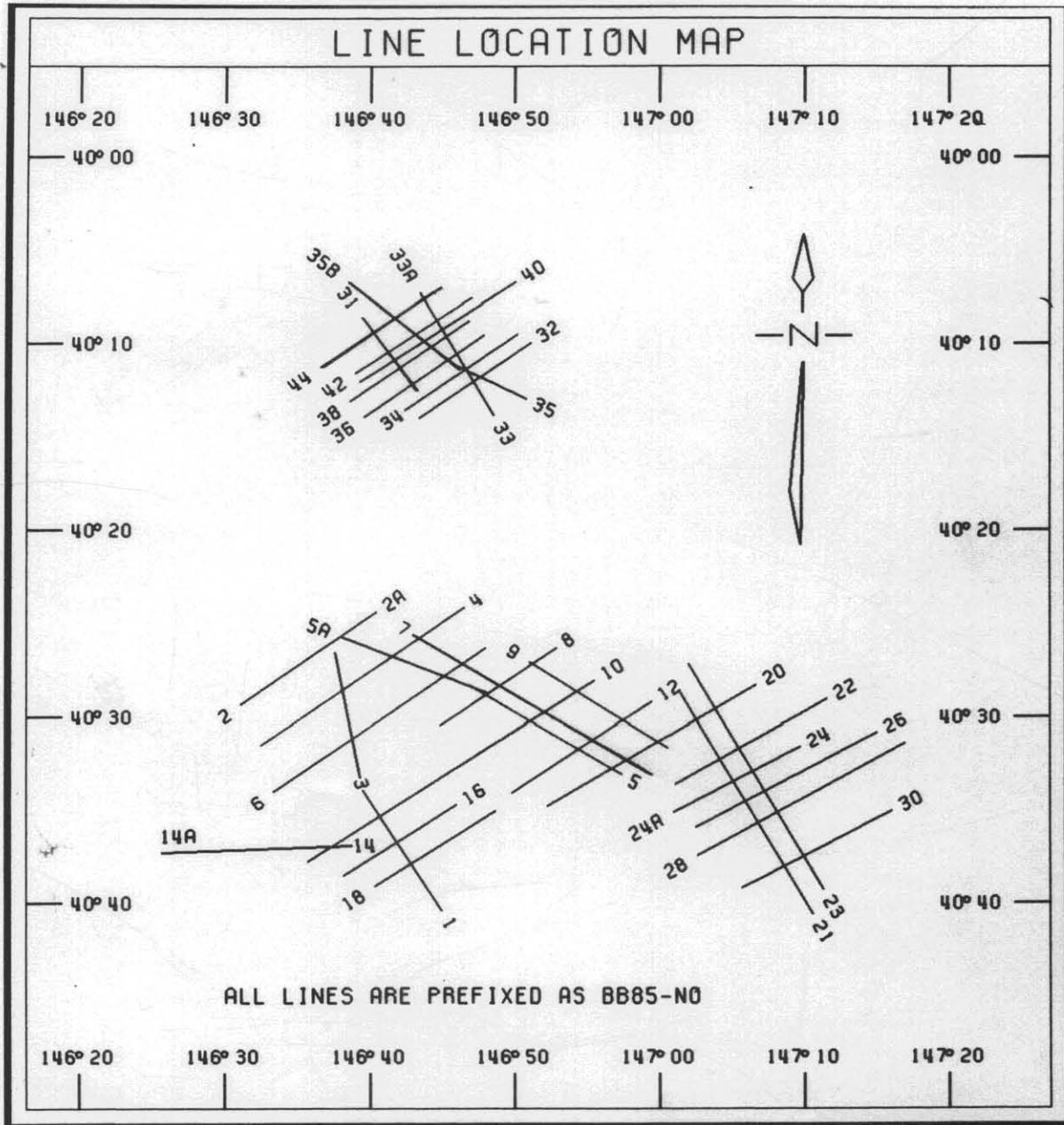


Litton

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<u>Box</u>	<u>L. No</u>	<u>F.S.P</u>	<u>L.S.P</u>	<u>F. Tape</u>	<u>L. Tape</u>
12	BB 85-54	35	307	UI65090	UI65090
13	BB 85-54	308	403	UI65091	UI65091
13	BB 85-56	35	419	UI65092	UI65093
13	BB 85-58	35	502	UI65094	UI65095
13	BB 85-60	35	560	UI65096	UI65097
13	BB 85-64	65	662	UI65098	UI65100
14	BB 85-77	5	799	UI65101	UI65103
14	BB 85-79	24	635	UI65104	UI65106
14	BB 85-66	35	617	UI65107	UI65109
14	BB 85-55	35	308	UI65110	UI65110
15	BB 85-55	309	460	UI65111	UI65111
15	BB 85-55A	305A	1293	UI65112	UI65115
15	BB 85-57	35	999	UI65116	UI65119
15	BB 85-53	65	340	UI65120	UI65120
16	BB 85-53	341	1200	UI65121	UI65124
16	BB 85-73	65	691	UI65125	UI65127
16	BB 85-62	5	827	UI65128	UI65130
17	BB 85-62	828	1221	UI65131	UI65132
17	BB 85-78	35	1230	UI65133	UI65137
17	BB 85-74	35	347	UI65138	UI65139
17	BB 85-72	35	307	UI65140	UI65140
18	BB 85-72	308	350	UI65141	UI65141
18	BB 85-70	35	405	UI65142	UI65143
18	BB 85-71	70	704	UI65144	UI65146
18	BB 85-80	35	533	UI65147	UI65148
18	BB 85-78A	1085A	1366	UI65149	UI65150
19	BB 85-76	35	639	UI65151	UI65153

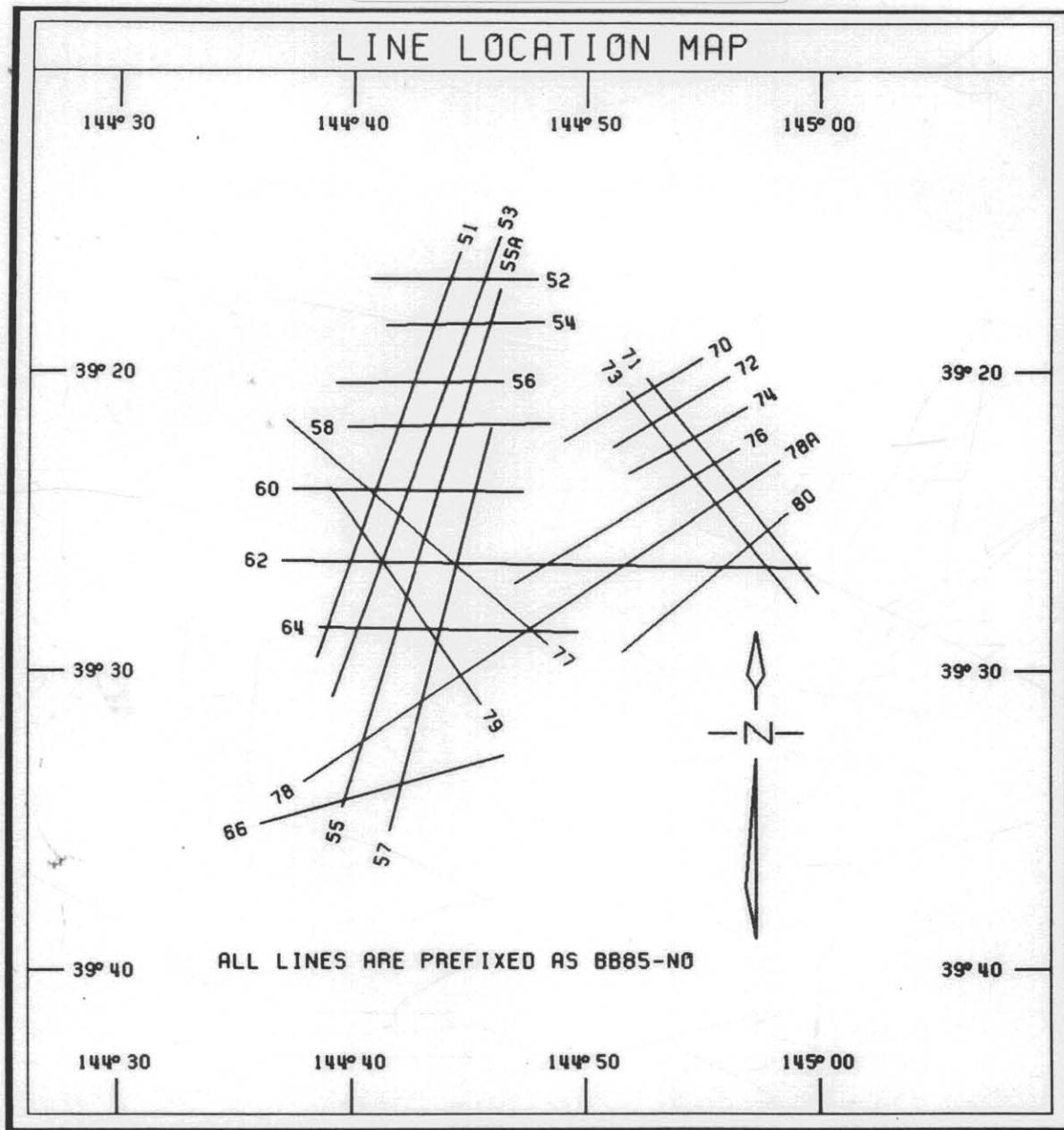
5 cm



LINE LOCATION MAP FOR T15-P & T16-P

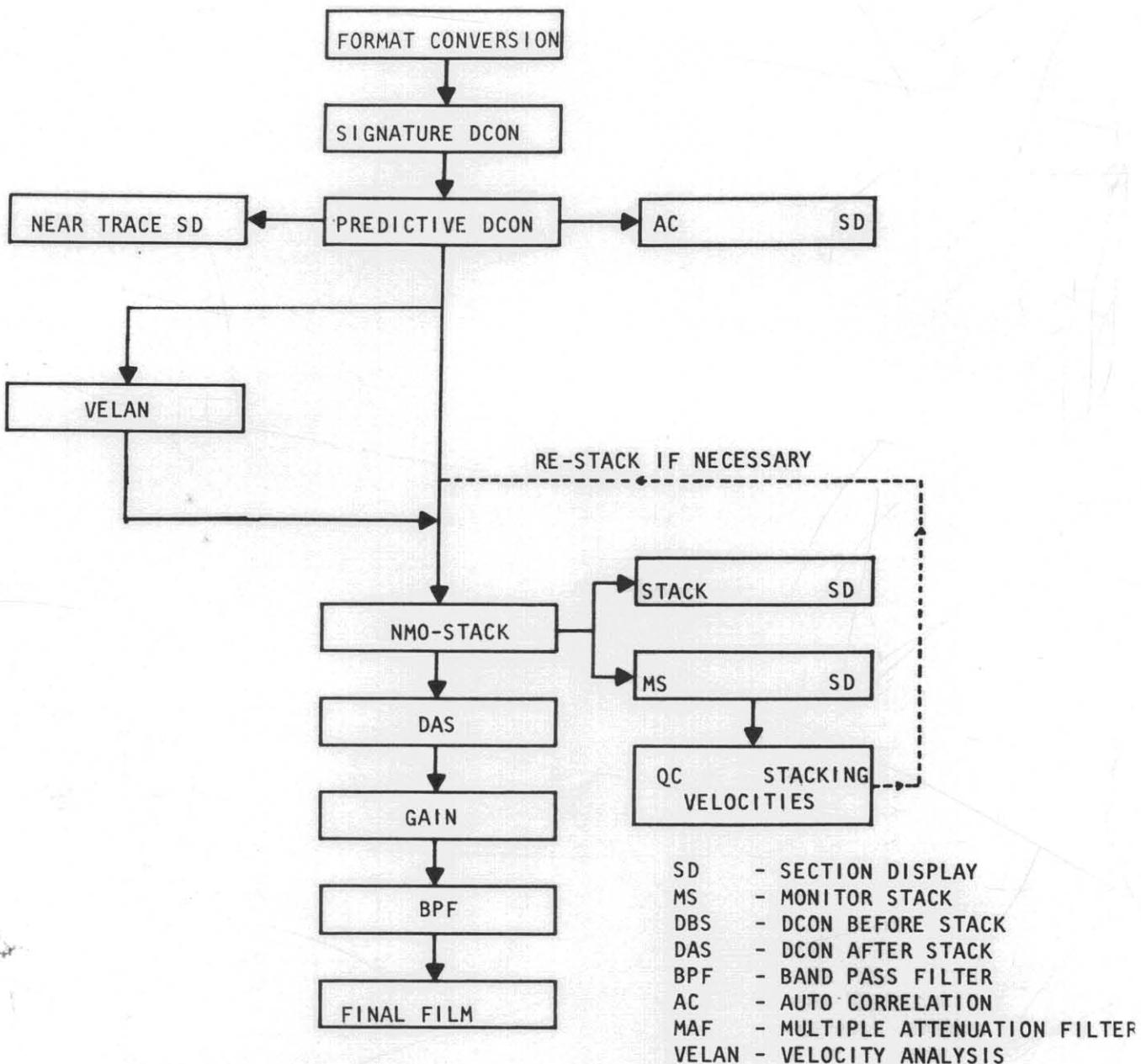


5 cm



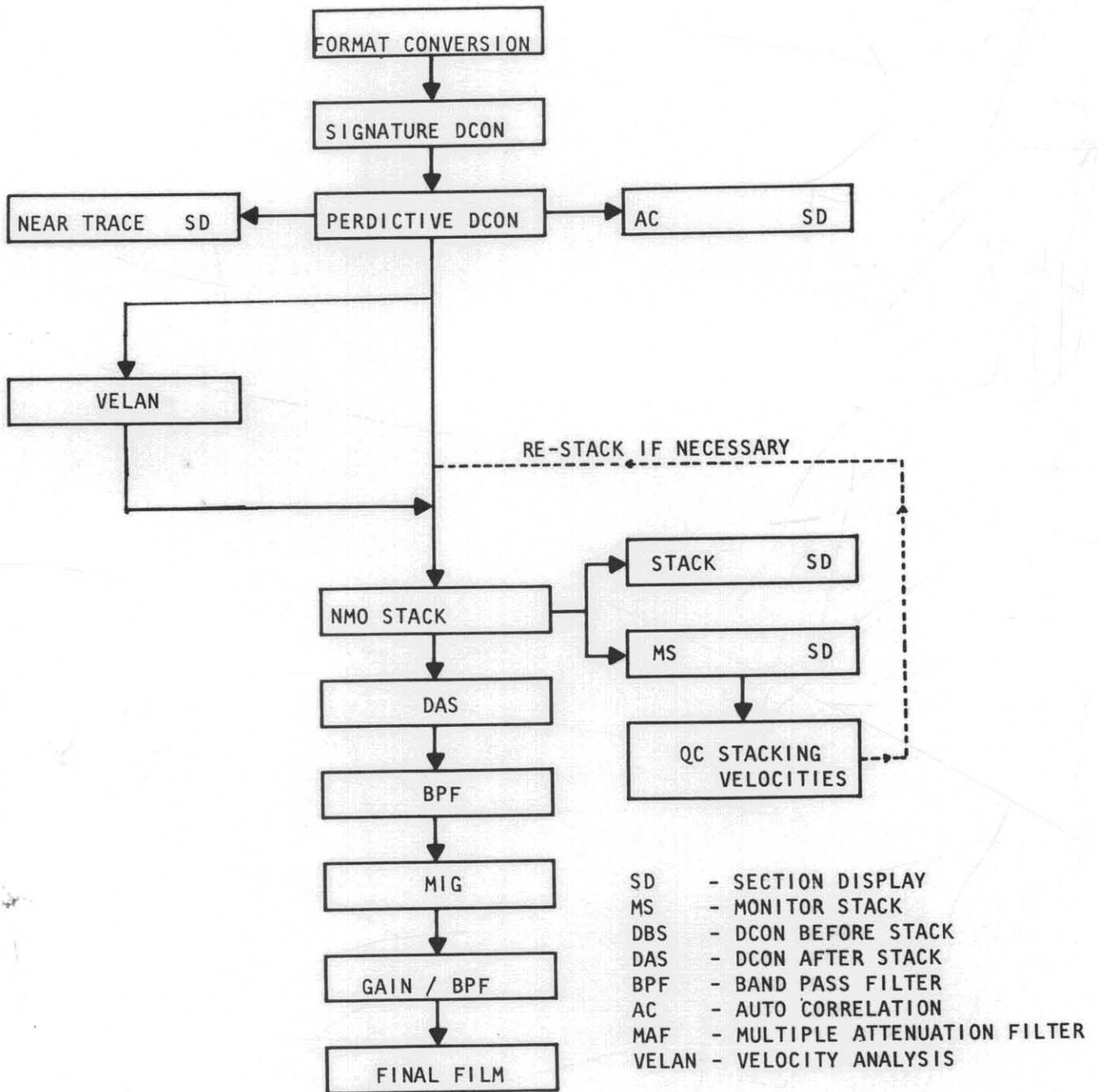
LINE LOCATION MAP FOR T19-P





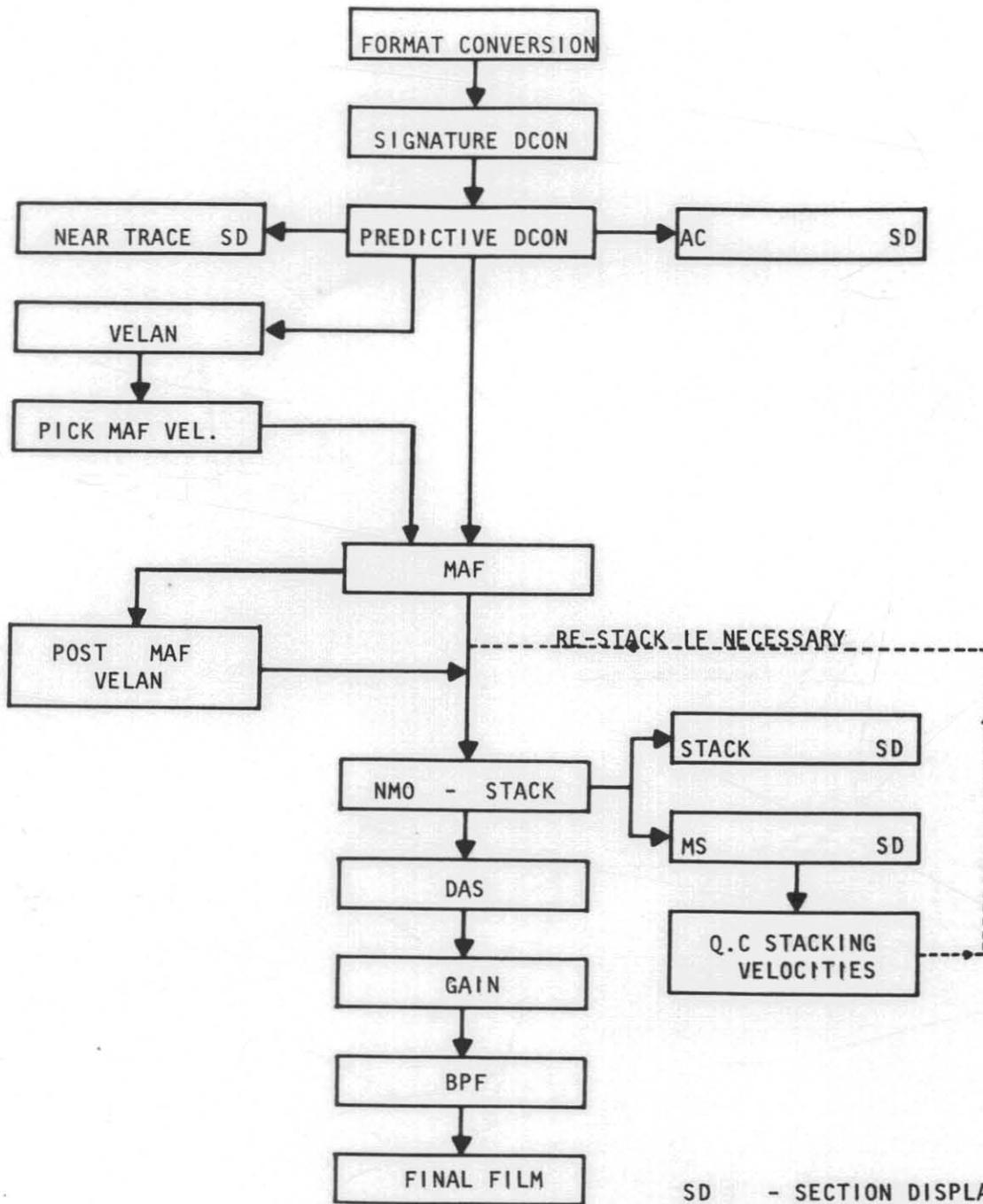
TIME SECTION PROCESSING FLOW CHART FOR T15-P, T16-P





MIGRATED SECTION PROCESSING FLOW CHART FOR
T15-P & T16-P

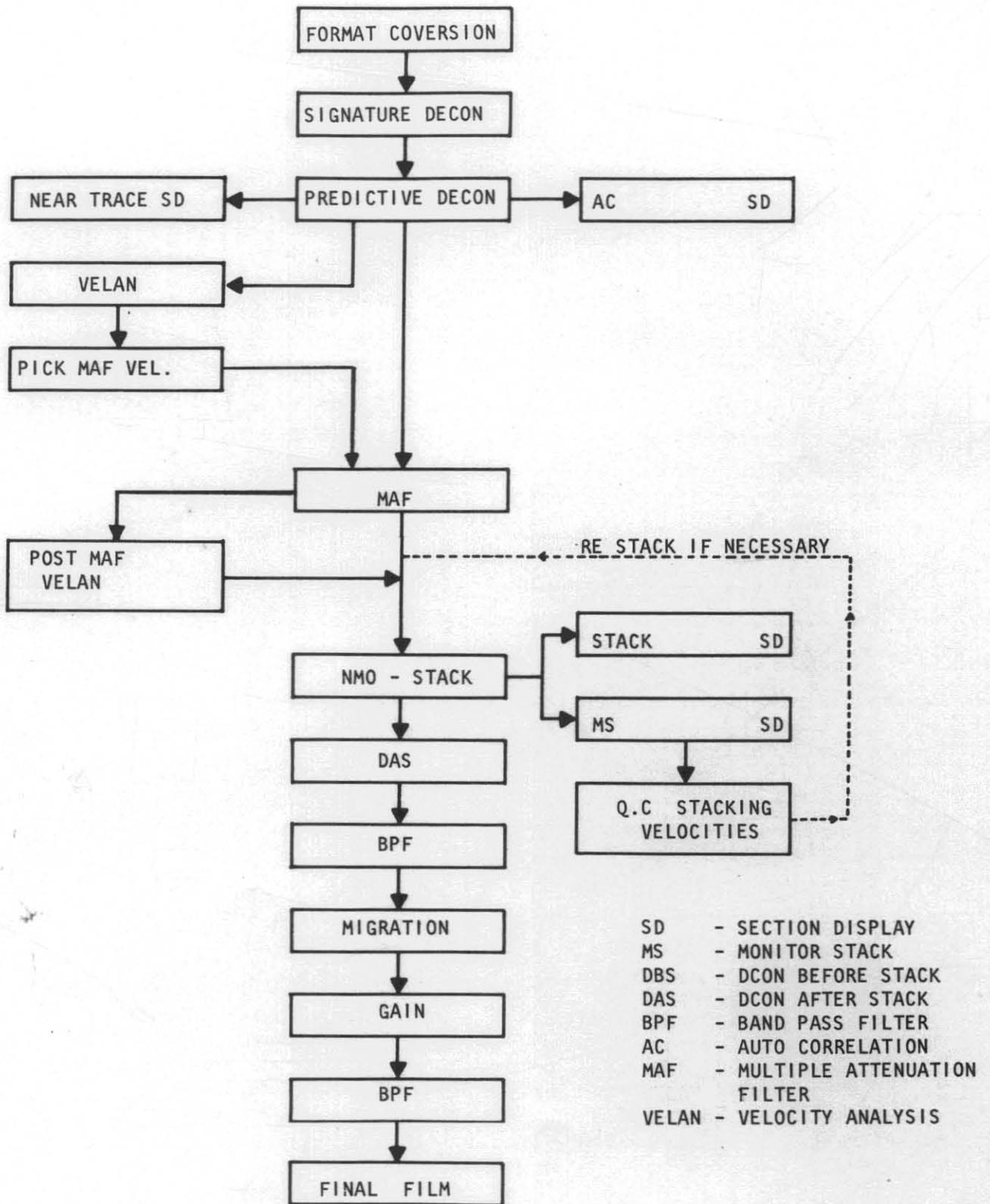




- SD - SECTION DISPLAY
- MS - MONITOR STACK
- DBS - DCON BEFORE STACK
- DAS - DCON AFTER STACK
- BPF - BAND PASS FILTER
- AC - AUTO-CORRELATION
- MAF - MULTIPLE ATTENUATION FILTER
- VELAN - VELOCITY ANALYSIS

TIME SECTION/PROCESSING FLOW CHART FOR T19-P





MIGRATED SECTION PROCESSING FLOW CHART FOR T19-P



APPENDIX 5Processing Format

<u>Process</u>	<u>FORMAT</u>		<u>SAMPLE RATE (msec)</u>			
	<u>In</u>	<u>Process</u>	<u>Out</u>	<u>In</u>	<u>Process</u>	<u>Out</u>
Conversion	SEG-D	FL	WGC 4 FL	2	4	4
D.B.S	WGC 4 FL	FL	WGC 4 FL	4	4	4
M.A F	WGC 4 FL	FL	WGC 4 FL	4	4	4
Stack	WGC 4 FL	FL	WGC 4 FL	4	4	4
Gain	WGC 4 FL	FL	WGC 4 FX	4	4	4
D.A.S	WGC 4 FL	FL	WGC 4 FX	4	4	4
Migration	WGC-4 FX	FL	WGC-4 FX	4	4	4
Gain	WGC 4 FX	FL	WGC 4 FX	4	4	4
BPF	WGC 4 FX	FL	WGC 4 FX	4	4	4

Final stack section playback at 4 ms sample rate

Final migrated section playback at 4 ms sample rate

FL : 32 bit - floating

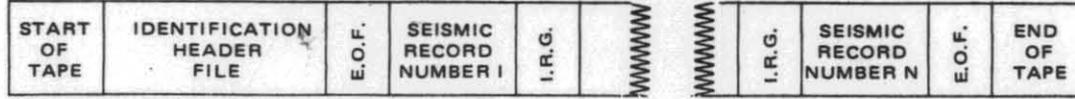
FX : 16 bit - fixed point

WGC 4 : Western Geophysical Intermediate Tape format

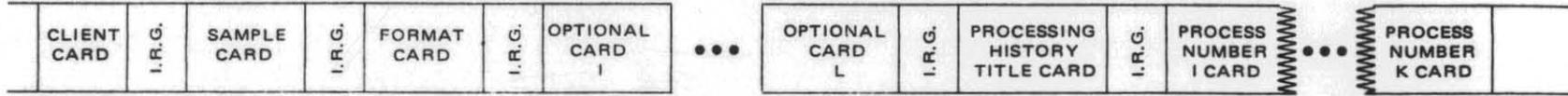


WESTERN GEOPHYSICAL SEISMIC INTERMEDIATE TAPE FORMAT

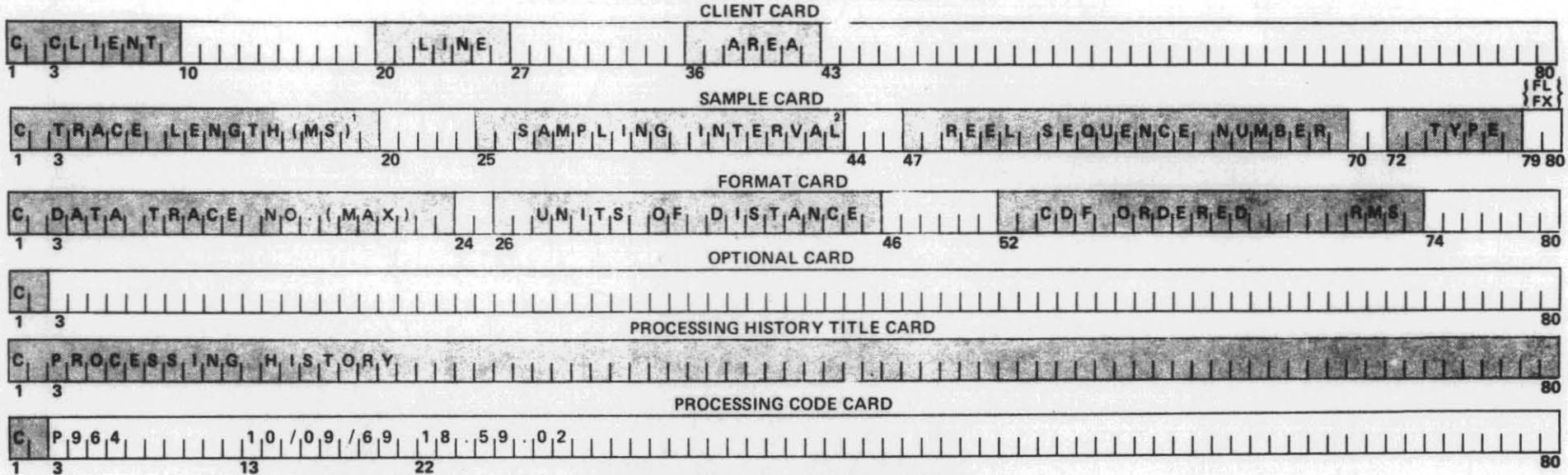
←
TAPE
MOTION



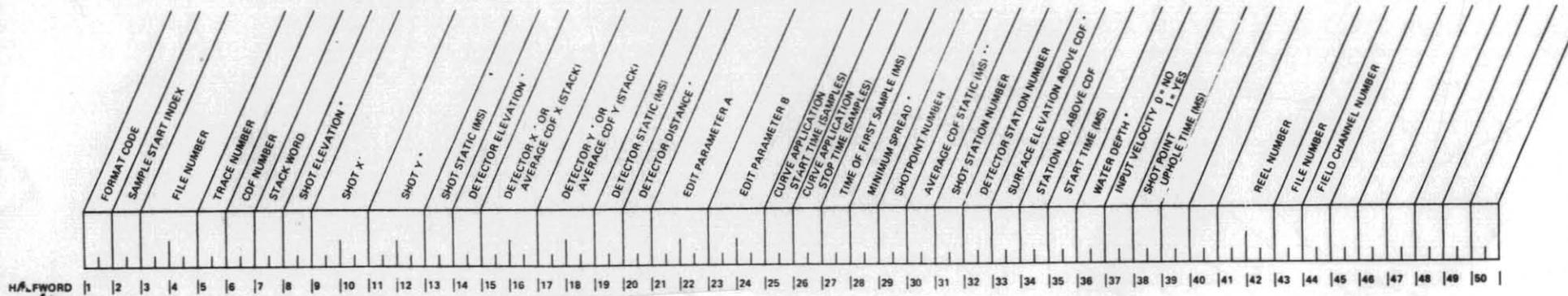
IDENTIFICATION
HEADER
FILE



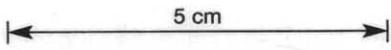
IDENTIFICATION HEADER CARD IMAGE DESCRIPTION



CODE 4 SEISMIC TRACE IDENTIFICATION

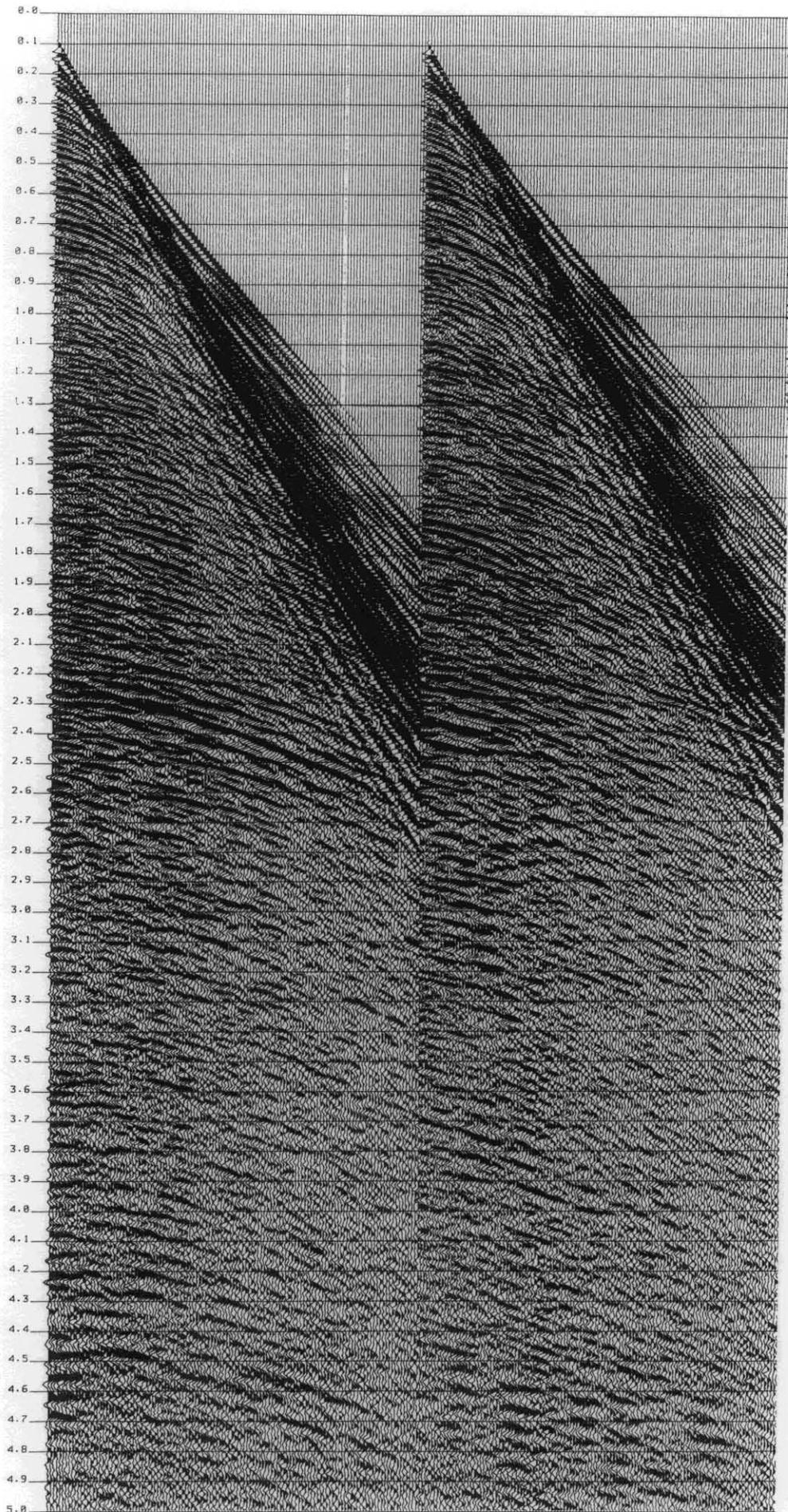


5 cm



SP.1

SP.60



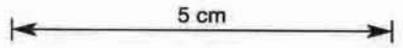
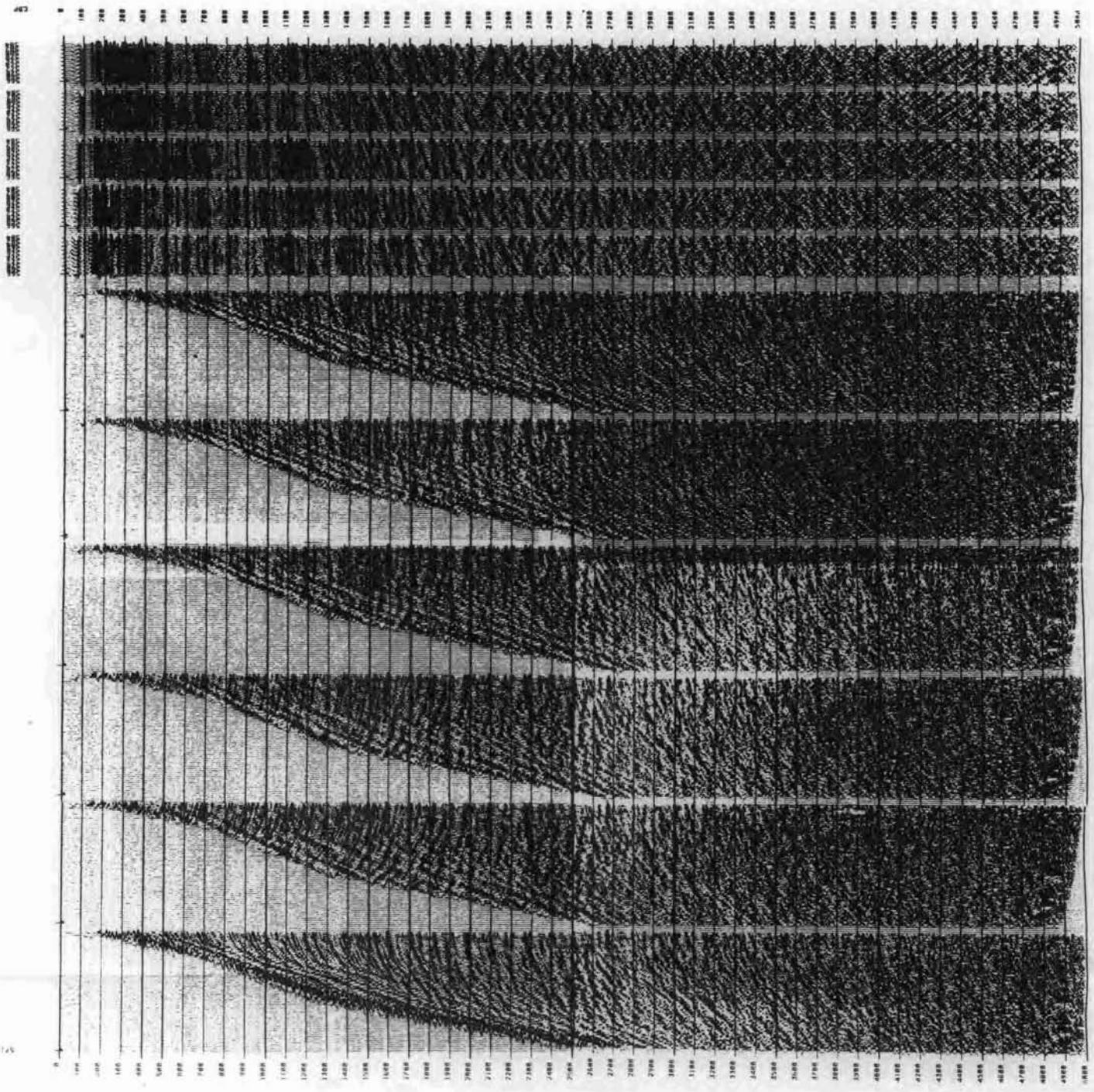
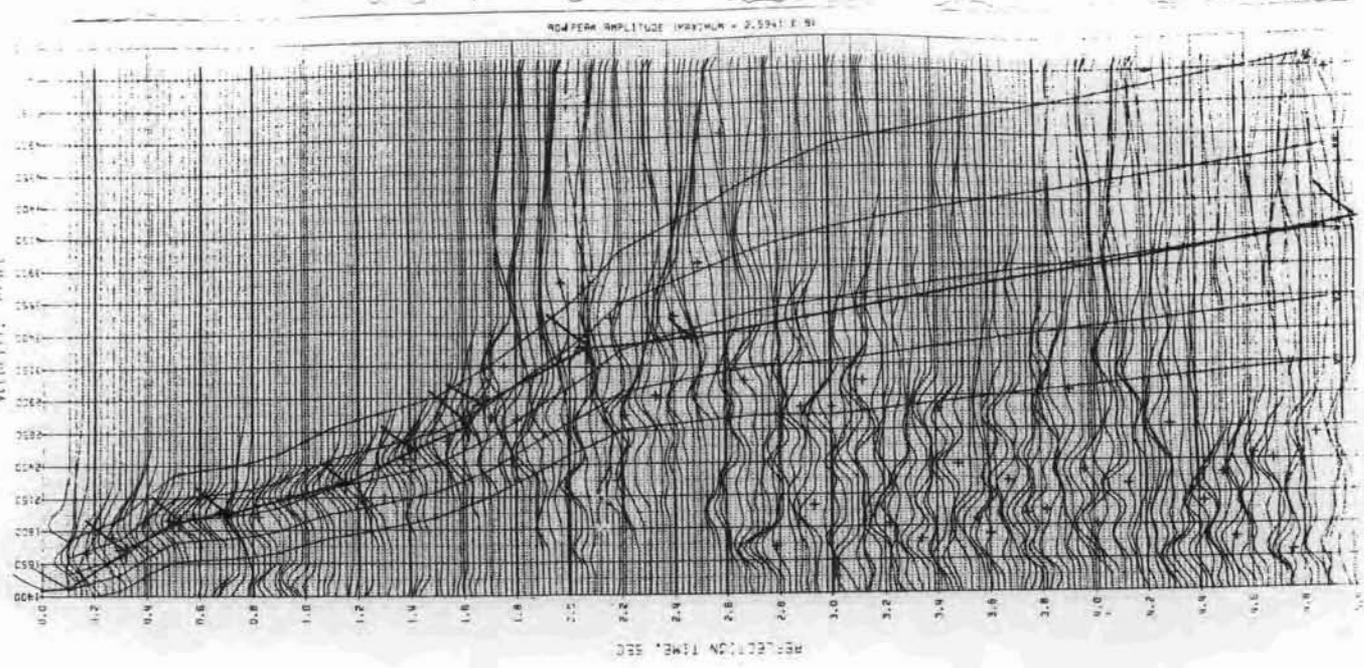


FIGURE 2 VELOCITY ANALYSIS OF LINE BB85-26

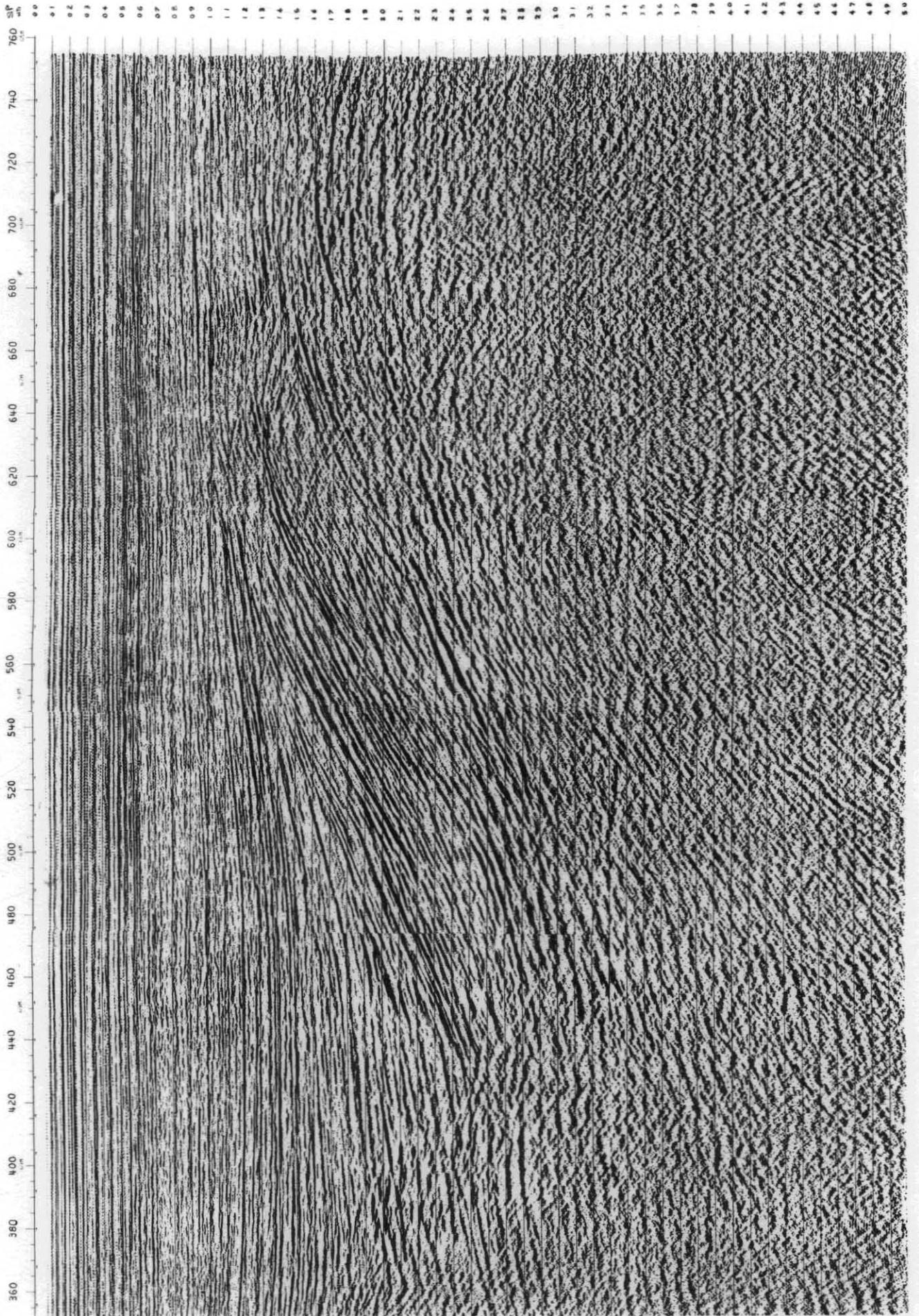
232042

W. S. H. 1000000
C. L. H. 1000000
C. H. H. 1000000
S. H. H. 1000000
T. H. H. 1000000
M. H. H. 1000000
W. S. H. 1000000
C. L. H. 1000000
C. H. H. 1000000
S. H. H. 1000000
T. H. H. 1000000
M. H. H. 1000000



APPENDIX 7 DISPLAYS ON T15P & T16P
FIGURE 3 FINAL STACK OF LINE BB85-26

5 cm



232043

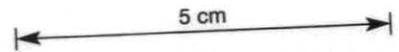
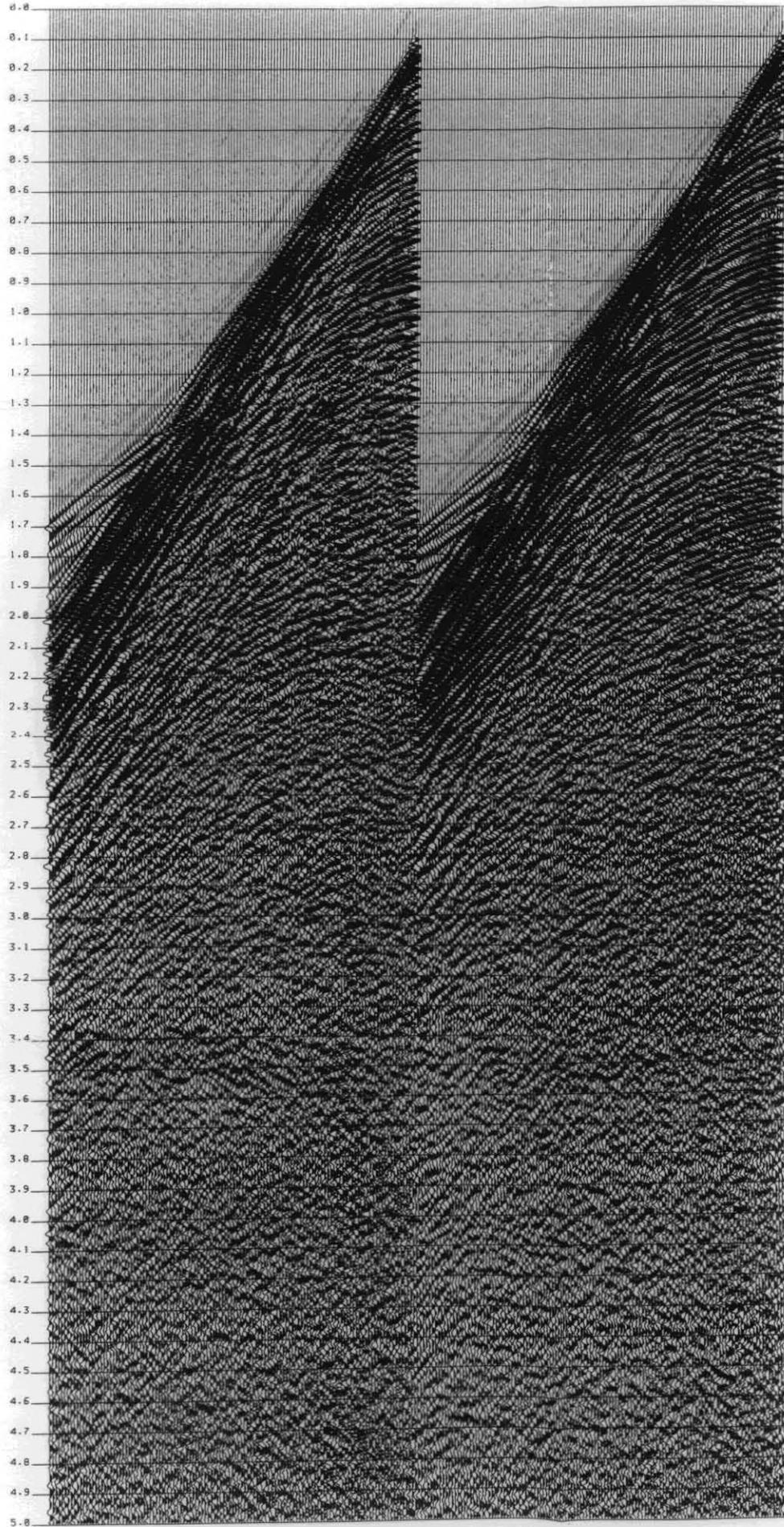


FIGURE 1 100% RECORDS OF LINE BB85-60

232044

SP.35

SP.95



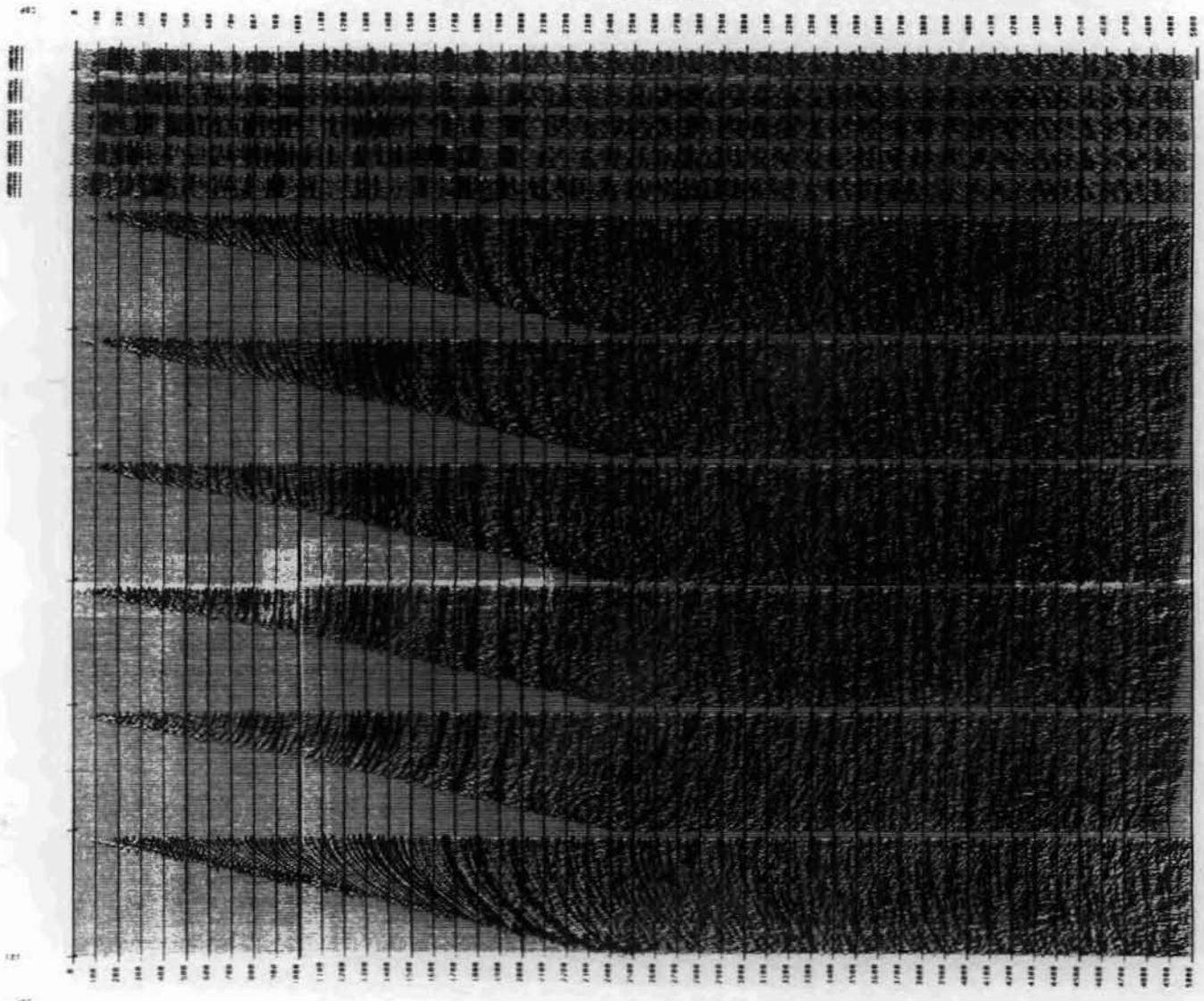
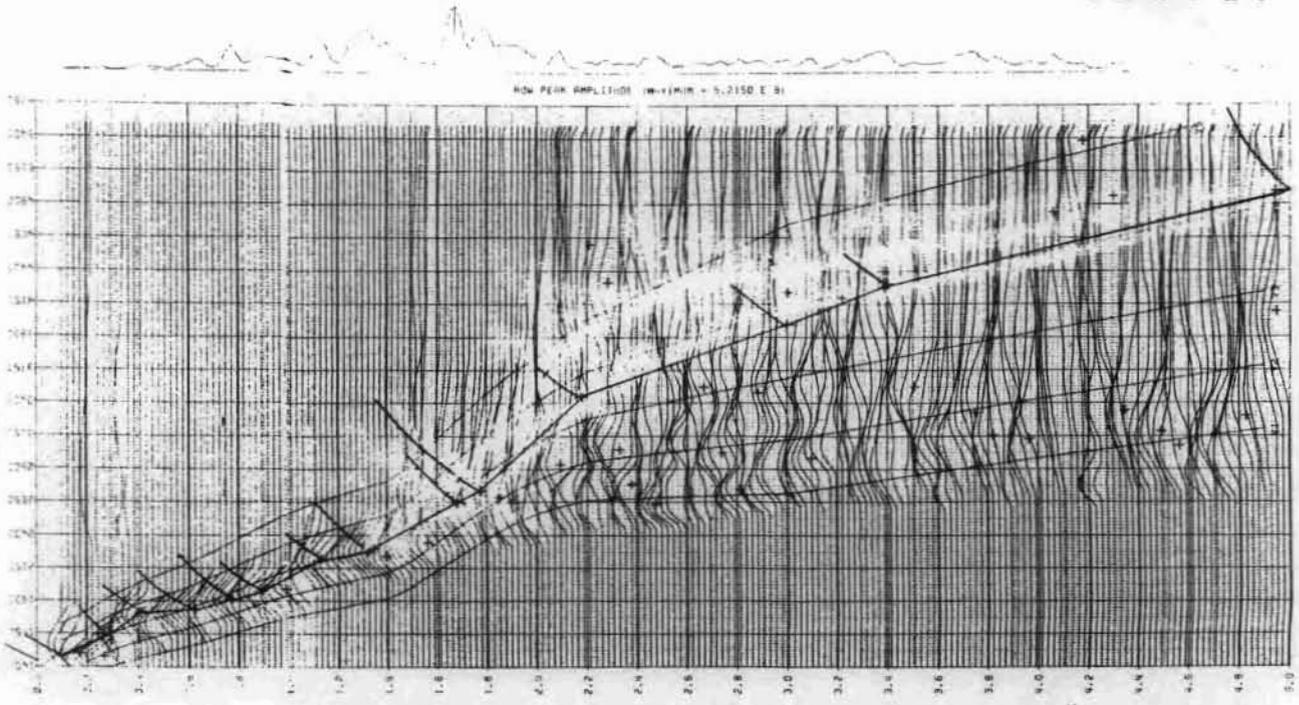
5 cm

APPENDIX 8 DISPLAYS ON T19P

FIGURE 2 VELOCITY ANALYSIS OF LINE BB85-60

232045

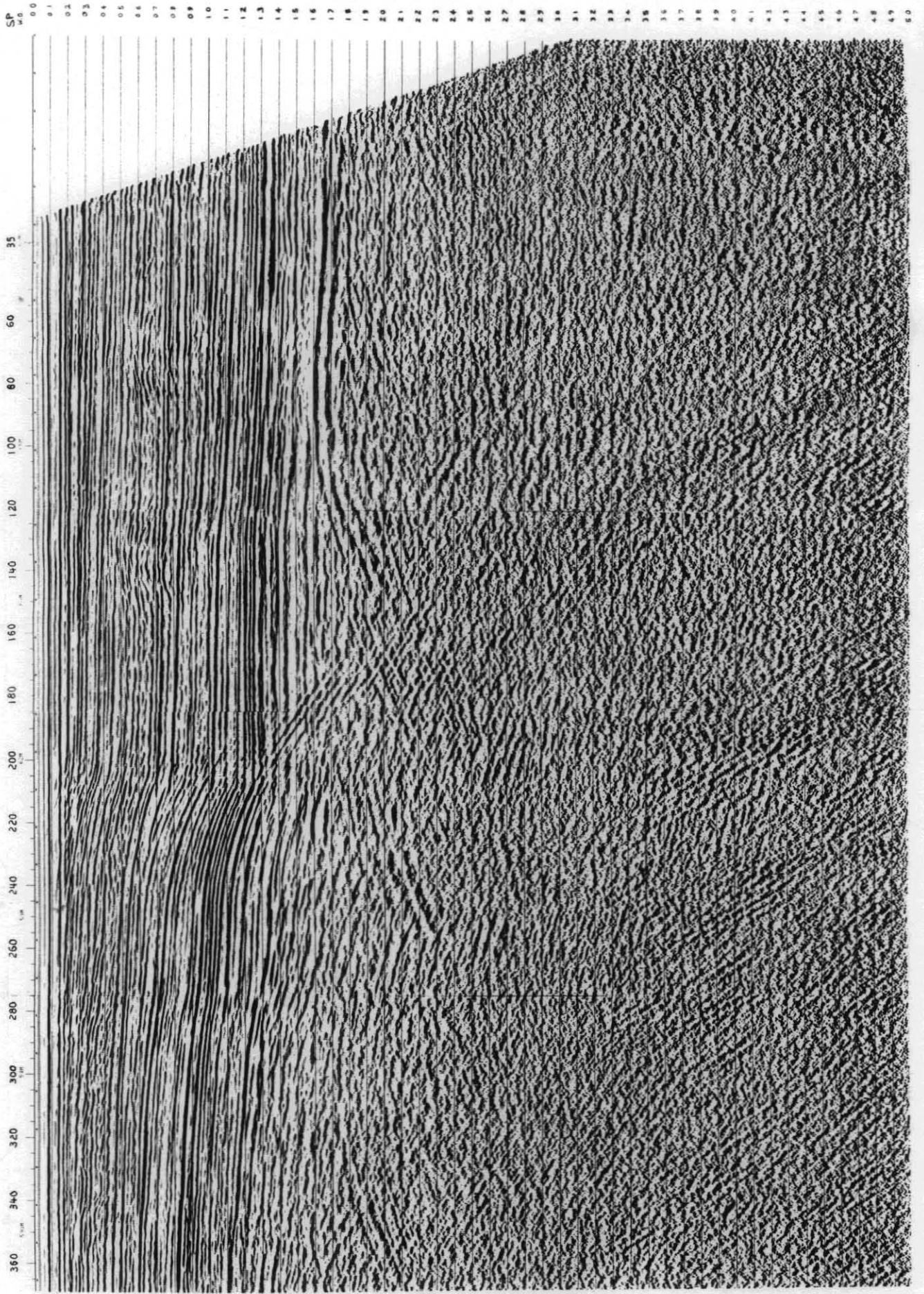
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SP 498
SP 499
SP 500



APPENDIX 8 DISPLAYS ON T19P
FIGURE 3 FINAL STACK OF LINE BB85-60

5 cm

232046



232047

DIGITAL PROCESSING REPORT

T 19-P, PHASE II

SEISMIC SURVEY

FOR

BRIDGE OIL LIMITED

DECEMBER 1985 - JANUARY 1986

TPR

OR_0216 (VOL 2/2)



WESTERN GEOPHYSICAL

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INTRODUCTION

The processing of 668.97 kms of seismic data for BRIDGE OIL LIMITED recorded offshore S.E Australia was conducted in the Singapore Digital Centre of WESTERN GEOPHYSICAL COMPANY OF AMERICA during December 1985 - January 1986. The survey was an extension of the PHASE I data shot earlier in May 1985. The procedure and programs utilized in processing the data are described in the following pages in the order in which they were applied. Final processing parameters were confirmed by personnel from BRIDGE OIL after studying tests, comparisons and recommendations submitted to them.



Following are the acquisition parameters used for the survey:

BOAT

McDermott II	Party 2931
Navigation by	ARGO
Map Location	Central Navigation Point

SOURCE

Air Gun Volume	4075 CC.
Air Gun Pressure	1900 PSI
Gun Depth	7 m
S.P Interval	30 m
POP Interval	30 m
Shooting Rate	33.3 pops/km

INSTRUMENTS

System	TSR
Format	SEG-D, 6250 bpi, demultiplexed
Filters	8 hz - 128 hz
Filter slopes	18 - 72 db/oct
Record length	6 secs
Sample rate	2 ms

CABLE

Streamer	2800 m
Groups	192
Group Interval	15 m
Lead in	194 m
Cable depth	10 m. average

FORMAT CONVERSION

The 192 trace demultiplexed, array formed data, in SEG-D format, was converted to WGC Code 4 format and resampled from 2 ms to 4 ms sample interval. Full word, 32 bit floating point data at geophone amplitude was maintained. The 52 ms TIGER delay was removed in this step, and record length was truncated to 5 seconds.

Shot records, giving 100% coverage, and a single trace section were also displayed to aid in quality control.

ADJACENT TRACE SUMMING

The 192 trace demultiplexed files were adjacent trace summed to 96 trace files.

Differential moveout was applied before summing using an average area velocity function as follows:

<u>Time (sec)</u>	<u>Velocity (m/sec)</u>
0.004	1500
1.000	2100
2.000	2900
5.100	4000



SIGNATURE DECONVOLUTION

A farfield air gun signature was provided for derivation of the signature deconvolution operator (see figure 1). All data were convolved with the operator prior to the application of a conventional predictive deconvolution.



BRIDGE OIL T19P PHASE II 1985 SURVEY

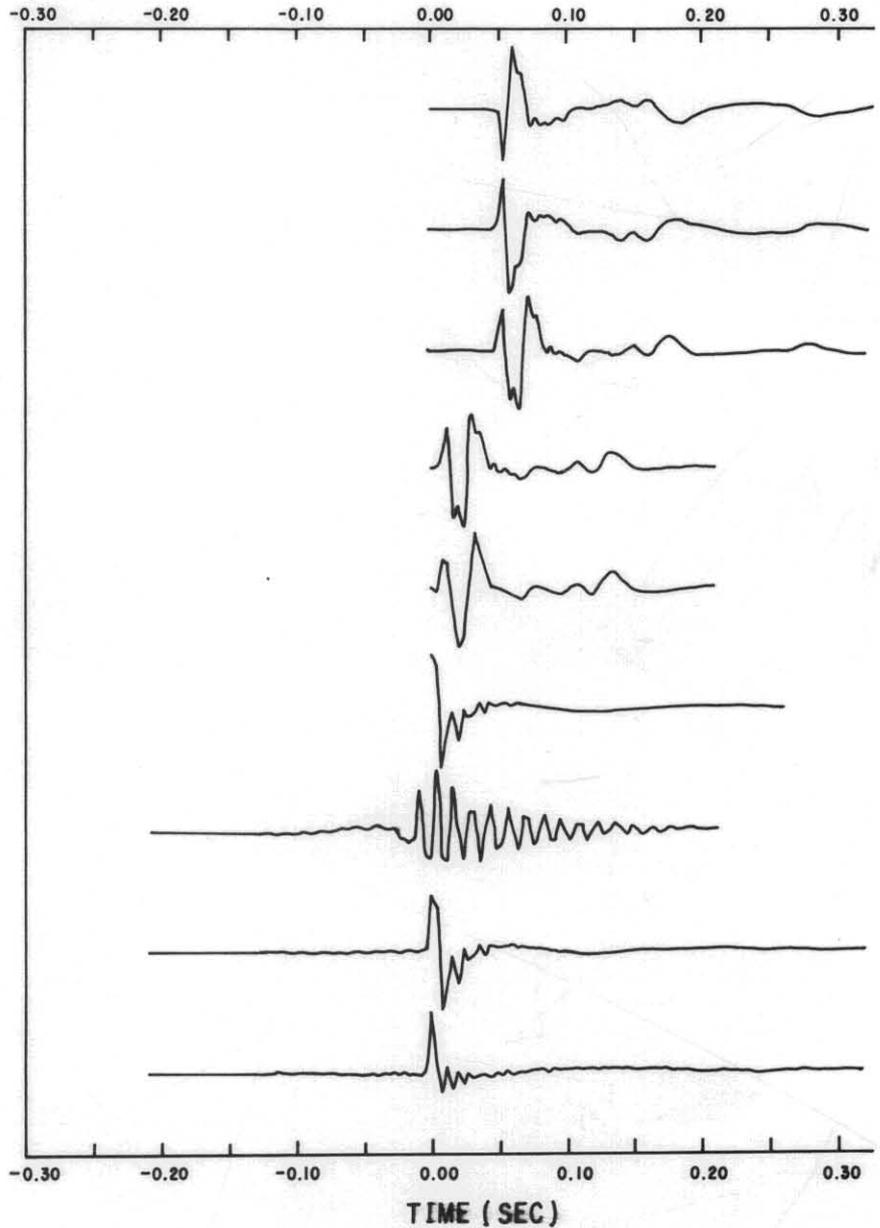
232054

IDENT 10000

16-1-86 10.45.07

TRC INPT PROC DSCR OUTP
NUM WVNM WVNM

1	CDIN	SG
2	SG SCAL	SGS
3	SGS GHST	SGG
4	SGGT SHFT	SGTS
5	SGTS RSMP	SGTR
6	FILT BPFL MFIL	
7	SGTR SHAP OPTR OPRM	
8	SGTR SHAP OUTP OPM	
9	OPM DCON OUTP D004	



- 1) INPUT AIR GUN SIGNATURE .
- 2) REVERSE POLARITY .
- 3) ADD IN CABLE GHOST .
- 4) TRIMMED AND TIME SHIFT TO ZERO .
- 5) RESAMPLED TO 4MS .
- 6) 8 - 128HZ MINIMUM PHASE IMPULSE .
- 7) OPERATOR USED TO SHAPE THE WAVELET (5) TO THE MINIMUM PHASE IMPULSE (6). THIS WAS THE OPERATOR WHICH WAS APPLIED TO SEISMIC DATA .
- 8) OUTPUT OF APPLYING THE OPERATOR (7) TO THE WAVELET (5) .
- 9) AFTER 1ST SAMPLE PREDICTIVE DECON WAS APPLIED .

SIGNATURE DECONVOLUTION OPERATOR DESIGN

FIG. 1

AMPLITUDE RECOVERY

To correct for spherical spreading, the inverse of the amplitude decay factor (A) was applied to the data where $A=1/TV^2$, T being 2 way time and V being RMS velocity. The velocity function used for the whole survey was :

<u>Time (ms)</u>	<u>Velocity (metres/sec)</u>
0000	1500
1000	2100
2000	2900
5000	4000

[7]

DECONVOLUTION BEFORE STACK

A Weiner-Levinson Least Squares Minimum Phase inverse filter was applied to all data. Each trace was divided into 2 windows. Window 1 from 200 ms. below water bottom to 3000ms., and window 2 from 2500-5000 msec, giving an overlap of 500 ms. A velocity of 2500 m/s was used for the stop time of the first window and the start time of the second. A minimum prediction distance from the autocorrelation time lag of 12 ms and a maximum predictive distance of 240 msec was applied.

After deconvolution each trace was normalized to a value of 2000 RMS. The normalizer was stored in the trace headers. Before and after deconvolution, autocorrelations were generated and displayed to monitor the deconvolution process. A deconvolved single near trace section was also output to assist in the subsequent picking of velocity analyses.

COMMON DEPTH POINT SORT

The 96 trace deconvolved records were then sorted into 48 trace common depth point families to facilitate further processing.

F-K MULTIPLE ATTENUATION (MAFK)

Primary reflections in this area were interfered with by severe long period multiples. To alleviate this problem, Multiple Attenuation Filter was employed after DBS.

MAFK involves three major steps.

Normal Moveout (NMO) correction is applied to the data using a velocity function that lies between the velocity of the multiples and the primaries. This results in primary reflections being over-corrected and the multiple reflection being under-corrected.

After NMO the data is transformed into F-K domain which results in the primary and the multiple dips being mapped on opposite sides of the zero wavenumber axis. A filter which zeros out that side of the F-K domain containing multiples is then applied. After filter application the data are transformed back into the T-X domain. Finally, inverse NMO is applied using the same velocity function as used in the NMO. This restores the primary events to their original positions for subsequent processing.

Velocity analysis was rerun and repicked after MAFK for better control in producing the final stacking velocity field.

VELOCITY ANALYSIS

Vertical RMS velocity analysis was performed in the VELAN program on the multiple attenuation filtered output. Two adjacent CDP families were used for each VELAN in this survey. Each trace in a CDP family was NMO corrected at a particular velocity, had first arrival energy muted, and was divided into 24 millisecond gates. The corresponding gates for all combinations of traces of the CDP family were then correlated and the resulting product-sums summed for both CDP families to produce a correlation value for the centre time of the gate and the velocity used. A correlation trace for the centre time was produced by repeating the process for velocity starting at 1400 M/SEC and increasing by 84 M/SEC for 50 increments.

The graphic display was RMS velocity versus two-way time with the correlation traces normalized (maximum value in each gate plotted at uniform amplitude) and the normalising constant displayed as a 'relative maximum correlation' trace.

Analyses were identified by the shotpoint number of the near trace of the first CDP family.

In conjunction with each analysis, CDP gather and stack traces, NMO corrected to 5 pre-selected velocity functions were also displayed to assist interpretation.

NORMAL MOVEOUT APPLICATION AND CDP STACKING

The Normal Moveout Corrections for the final section were computed from the velocity functions generated for each line. The calculations were performed independently for each trace using a straight ray computation method.

After NMO corrections, muting was applied to remove first arrivals, early refracted energy and excessive stretch, following which, the traces in each CDP were horizontally stacked to produce the stack output.

Quality control of the velocity functions used was aided by the display of 'stack monitor sections'. These sections consisted of one moveout corrected, muted, common depth family from each 24th stack output trace. With each CDP family was displayed an 'applied velocity trace' which by means of large pips (500 m/s) and smaller pips (100 m/s or 50 m/s) showed the RMS velocity versus two-way time applied.

Using the preliminary stack section, stack monitor section, and picked velocity analyses the Processing Analyst was able to check the data for any necessary residual velocity adjustments before the final stack was run to verify the residual velocity corrections made.



POST STACK GAIN

Automatic Gain Control (AGC) with time variant gates were applied to the data. A starting gain computation zone of 100ms was linearly expanded to 800ms and thereafter the zone was kept constant. An average absolute amplitude was computed for the zone, this value divided into the desired averaged amplitude and the result was used as a multiplier. The multiplier was applied at the midpoint of the gain zone.

The zone was then moved down the trace, one sample at a time and the computation repeated so as to produce and apply a multiplier for each sample.

From the first multiplier point back to the start of data and the multiplier in the last full length zone to end of data, a constant value was applied.

TIME VARIANT FILTERING

Zero Phase, Time Variant Digital Filtering was applied to the deconvolved data. The filter pass-band were selected on the basis of harmonic analysis run on data from several points in the survey.

Band pass filter of 10-60 hz was applied to data at the Northwestern part of the prospect (ie. lines 101 - 109 & line 111). At the South Eastern part of the prospect (ie. lines 110 & lines 112-157) time variant filter with filter times tracking the unconformity was applied. The filter pass bands and times of application used on line 135 were

<u>Time (ms)</u>	<u>Low Cut</u>	<u>High Cut</u>
0	15	70
1300	15	70
2100	10	50
5000	10	50

Low and high slopes of 18 and 36 db per octave respectively were used in all filter applications.

MIGRATION

Finite-Difference (FD) migration algorithm was used for the survey. Stacking velocities smoothed over 192 CDFs were input to the migration. Post migration gain and TVF were identical to those applied to the time sections.

FINAL DISPLAY

The final output was displayed on film at a scale of 1:17716, (30 tr/in) horizontal and 3.75 in/sec vertical scale.

Shotpoint numbers are located at central navigation point. Stepback of 135 was applied.

Display polarity was plotted with a positive number on tape represented by trough (ie. SEG reverse).

Gun and cable corrections of 12 ms were applied during playback of the final display sections.

TAPE DISPOSITION

- | | |
|--|-------|
| 1. Field tapes | : 162 |
| 2. No gain final stack tape (in SEG Y format) | : 3 |
| 3. No gain migrated stack tape (in SEG Y format) | : 3 |

The no gain final stack and no gain migrated stack tapes were concatenated and converted to SEG Y format.

All of the above tapes plus supporting data and all original picked VELANs were shipped to BRIDGE OIL in Sydney.

PRE-PRODUCTION TESTS

A comprehensive set of tests was undertaken prior to any production processing being started. All tests were performed on line BB85-135 unless otherwise specified.

1. Pre Stack Filtering

Following filter panels on shot records were generated :

No filter

0	- 10 hz
7	- 14 hz
10	- 20 hz
14	- 28 hz
20	- 20 hz
28	- 56 hz
40	- 80 hz
56	- 112 hz
80	- 125 hz

2. Adjacent Trace Sum (ATS) Test

Stack sections and 100% shot records before and after ATS were generated and displayed.

3. FK Filter Before Stack

Acceptance filters with the following parameter was tested on
ATS-ed 100% records

<u>Fan (msec/tr)</u>	<u>Tape (msec/tr)</u>
-3, +4	6, 8
-4, +6	8, 12
-6, +8	12, 16

4. Deconvolution Before Stack (DBS) Test

Stack sections and auto-correlations displays of the following were
generated. Input was ATS-ed and preprocessed shot records.

1. No Decon
2. 4-240, 2 windows
3. 12-240, 2 windows
4. 16-240, 2 windows
5. 24-240, 2 windows
6. 32-240, 2 windows
7. Desig followed by 4-240, 2 windows
8. Desig followed by 12-240, 2 windows

5. Mute Test

Limited offset panels of the following were penetrated.

1. Near 4 Traces
2. Near 8 Traces
3. Near 12 Traces
4. Near 16 Traces
5. Near 20 Traces
6. Near 30 Traces
7. Near 40 Traces
8. Near 50 Traces
9. Near 60 Traces
10. Near 70 Traces
11. Near 80 Traces
12. Near 96 Traces

6. Multiple Attenuation Filter (MAF) before stack

Stack section through following processing sequence was output.

1. SEG D conversion/resample to 4 ms
2. Adjacent trace sum
3. DBS (designature and 12-240 predictive Decon)
4. MAF
5. VELAN
6. Stack

7. Stack Gain Test

1. AGC 500 ms gate
2. AGC 100 - 800 ms gate
3. RMS gain (64-1024 ms gate)
4. Reflection Strength Gain

8. Deconvolution After Stack (DAS) Test

Stack and A/C panels of the following DAS parameters were generated.

1. No Decon
2. 4-240, 2 window
3. 12-240, 2 window
4. 24-240, 2 window
5. 36-240, 2 window
6. 48-240, 2 window
7. 64-240, 2 window
8. 24-240, 2 window
9. 36-240, 2 window

9. Post Stack FK Filter

FK Filter of ± 4 msec/trace and tapes of 8 ms/trace were applied to final stack and after migration of line BB85-11.

10. Post Stack Filter Test

Following filter panels of final stack were displayed.

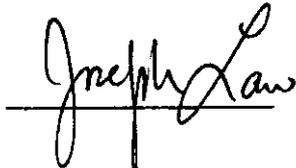
No filter

0 - 10 hz
7 - 14 hz
10 - 20 hz
14 - 28 hz
20 - 40 hz
28 - 56 hz
40 - 86 hz
56 - 112 hz
80 - 125 hz
10 - 50 hz
10 - 60 hz
10 - 70 hz
10 - 80 hz
10 - 90 hz
10 - 100 hz
10 - 125 hz

COMMENTS

Overall data quality was good for the whole survey, and no particular problems developed during the processing. The Multiple Attenuation Process (MAFK) significantly improved resolution through attenuation of long and medium period multiples.

When tying current Phase II Data, acquired by G.S.I., with Phase I, acquired by W.G.C. it appeared they were opposite polarities. On instructions from BRIDGE OIL the final sections for Phase II were displayed on film with negative number on tape being represented by a peak i.e polarity reversed.



Joseph Law
Geophysical Analyst



M.W. Brettell
Marine Processing Supervisor

Peter Nuttall
Manager, Data Processing



APPENDIX 1

232072

Summary Of Lines Processed

<u>Line</u>	<u>Shotpoint</u>	<u>Kms</u>
BB 85 101	1-259	7.77
BB 85 102	1-488	14.64
BB 85 103	2-750	22.50
BB 85 104	1-558	16.74
BB 85 105	1-629	18.87
BB 85 106	1-559	16.77
BB 85 107	1-459	13.77
BB 85 108	1-279	8.37
BB 85 109	1-418	12.54
BB 85 110	1-789	23.67
BB 85 111	1-389	11.67
BB 85 112	1-1208	36.24
BB 85 113	1-498	14.94
BB 85 114	1-1019	30.57
BB 85 115	1-489	14.67
BB 85 116	1-849	25.47
BB 85 117	1-489	14.67
BB 85 118	1-839	25.17
BB 85 119	1-459	13.77
BB 85 120	1-549	16.47
BB 85 121	1-489	14.67
BB 85 122	1-509	15.27
BB 85 123	1-459	13.77
BB 85 124	1-719	21.57
BB 85 125	1-399	11.97
BB 85 126	1-719	21.57
BB 85 127	1-439	13.17
BB 85 129	1-478	14.34
BB 85 131	1-509	15.27
BB 85 133	1-548	16.44
BB-85 135	1-659	19.77
BB 85 137	1-339	10.17
BB 85 139	1-339	10.17
BB 85 141	1-328	9.84
BB 85 143	1-389	11.67
BB 85 145	1-599	17.97
BB 85 147	1-599	17.97
BB 85 149	1-579	17.37
BB 85 151	1-329	9.87
BB 85 153	1-298	8.94
BB 85 155	1-288	8.64
BB 85 157	1-309	9.27

Total km 668.97



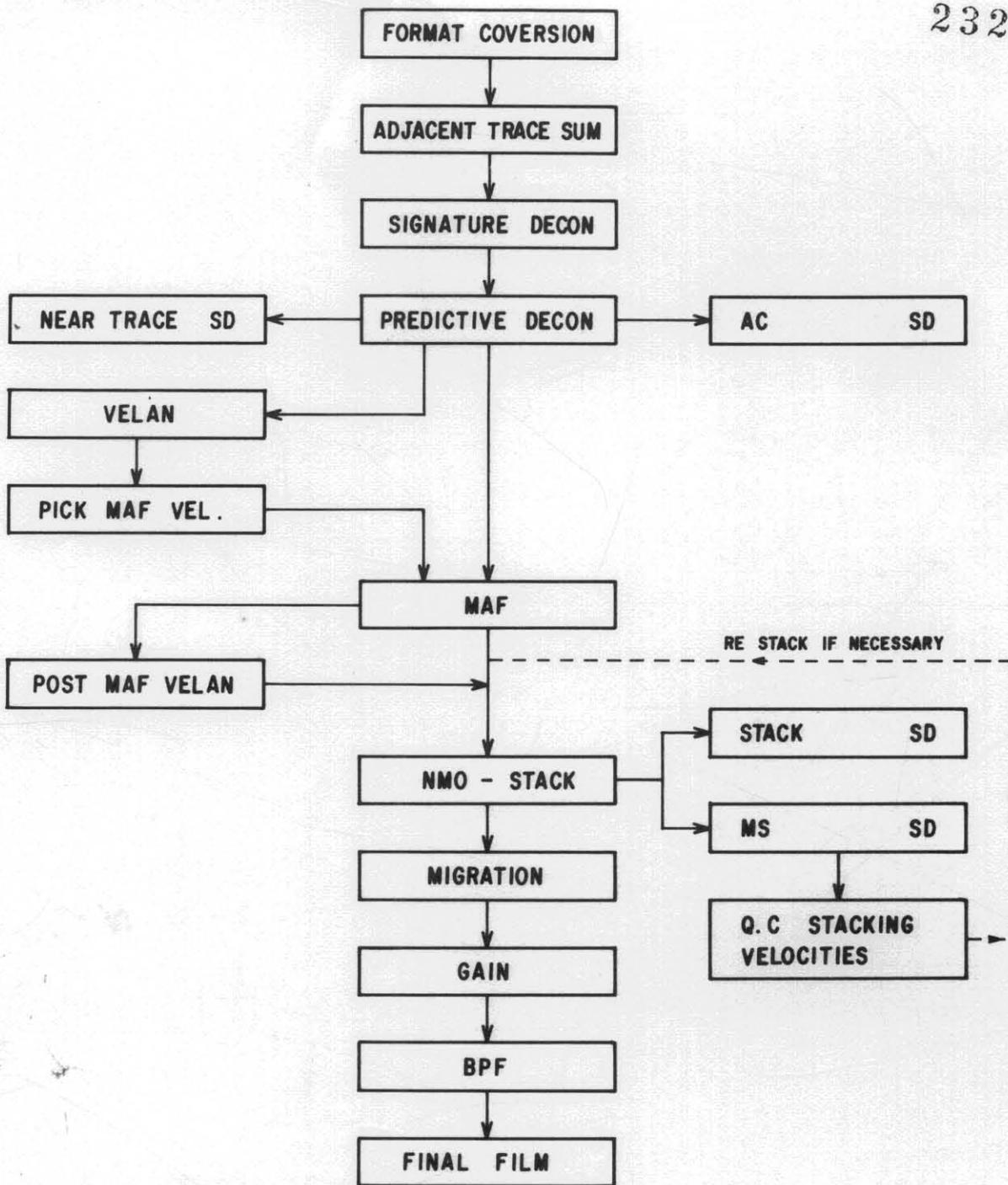
APPENDIX 2

Tape Summary

Array Data

<u>Box</u>	<u>L. No</u>	<u>F.S.P</u>	<u>L.S.P</u>	<u>F. Tape</u>	<u>L. Tape</u>
1091	BB 85 101	1	259	81 9812	81 9813
1090	BB 85 102	1	488	81 9798	81 9801
1091-1092	BB 85 103	1	750	81 9814	81 9818
1090	BB 85 104	1	558	81 9802	81 9805
1092	BB 85 105	1	629	81 9819	81 9822
1090-1091	BB 85 106	1	559	81 9806	81 9809
1092	BB 85 107	1	459	81 9823	81 9825
1091	BB 85 108	1	279	81 9810	81 9811
1092-1093	BB 85 109	1	418	81 9826	81 9828
770- 771	BB 85 110	1	789	81 9927	81 9931
1093	BB 85 111	1	389	81 9829	81 9831
771- 772	BB 85 112	1	1208	81 9932	81 9939
1093	BB 85 113	1	498	81 9832	81 9835
769- 770	BB 85 114	1	1019	81 9914	81 9920
1093-1094	BB 85 115	1	489	81 9836	81 9839
770	BB 85 116	1	849	81 9921	81 9926
1094	BB 85 117	1	489	81 9840	81 9843
1098	BB 85 118	1	839	81 9879	81 9885
1094	BB 85 119	1	459	81 9844	81 9846
1098-1099	BB 85 120	1	549	81 9886	81 9889
1094-1095	BB 85 121	1	489	81 9847	81 9850
1099	BB 85 122	1	509	81 9890	81 9893
1095	BB 85 123	1	459	81 9851	81 9853
1099- 768	BB 85 124	1	719	81 9894	81 9898
1095	BB 85 125	1	399	81 9854	81 9856
768	BB 85 126	1	719	81 9899	81 9903
1095-1096	BB 85 127	1	439	81 9857	81 9859
1096	BB 85 129	1	478	81 9860	81 9862
1096	BB 85 131	1	509	81 9863	81 9866
1096-1097	BB 85 133	1	548	81 9867	81 9870
1097	BB 85 135	1	659	81 9871	81 9875
1097-1098	BB 85 137	1	339	81 9876	81 9878
772	BB 85 139	1	339	81 9940	81 9942
772	BB 85 141	1	328	81 9943	81 9945
772- 767	BB 85 143	1	389	81 9946	81 9948
769	BB 85 145	1	599	81 9910	81 9913
767	BB 85 147	1	599	81 9949	81 9952
768- 769	BB 85 149	1	579	81 9906	81 9909
767	BB 85 151	1	329	81 9953	81 9955
768	BB 85 153	1	298	81 9904	81 9905
767	BB 85 155	1	288	81 9956	81 9957
767	BB 85 157	1	309	81 9958	81 9959

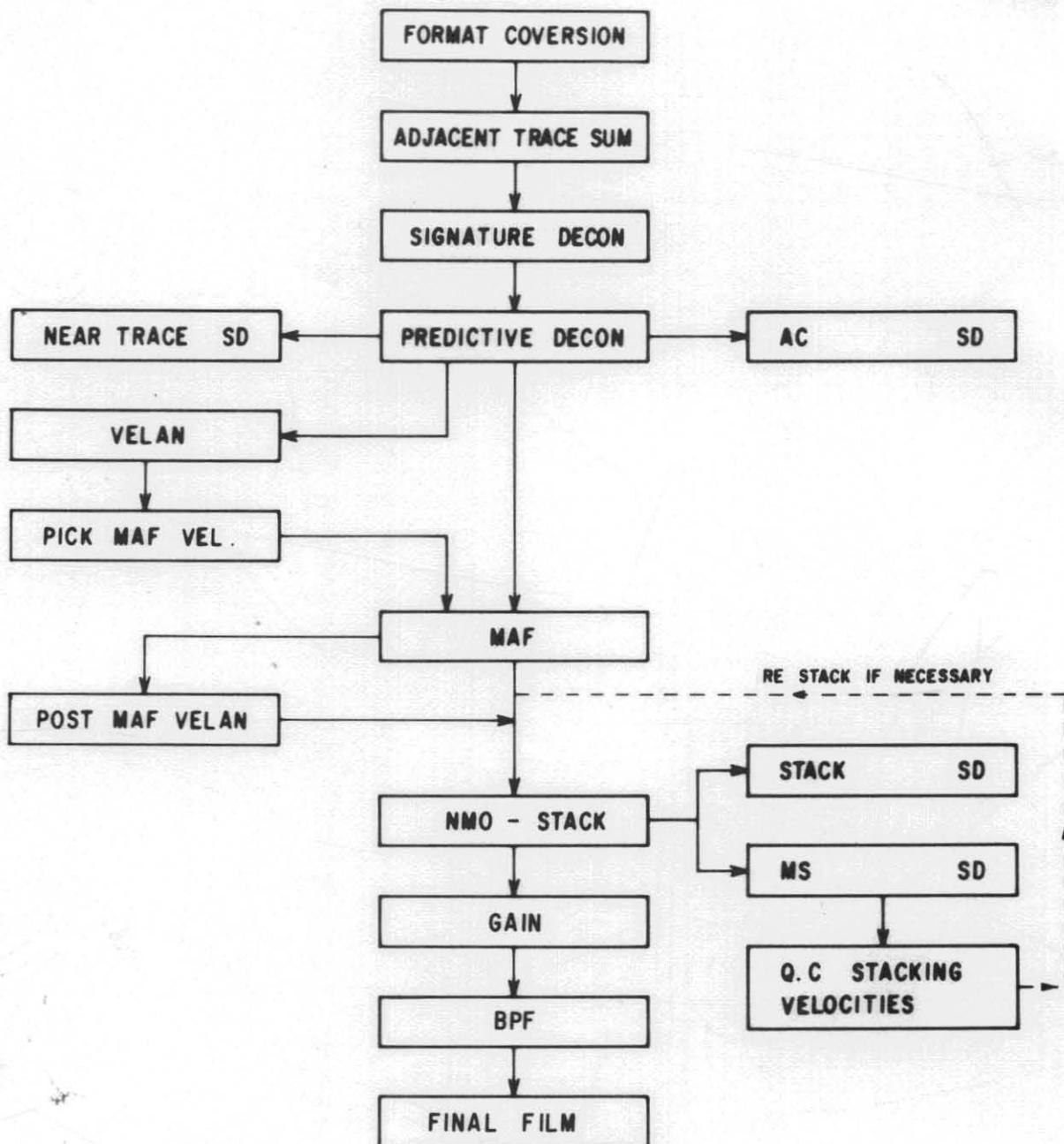
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- SD - SECTION DISPLAY
- MS - MONITOR STACK
- DBS - DECON BEFORE STACK
- TVF - TIME VARIANT FILTER
- AC - AUTO CORRELATION
- MAF - MULTIPLE ATTENUATION FILTER
- VELAN - VELOCITY ANALYSIS

MIGRATED SECTION PROCESSING FLOW CHART

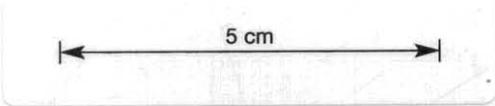
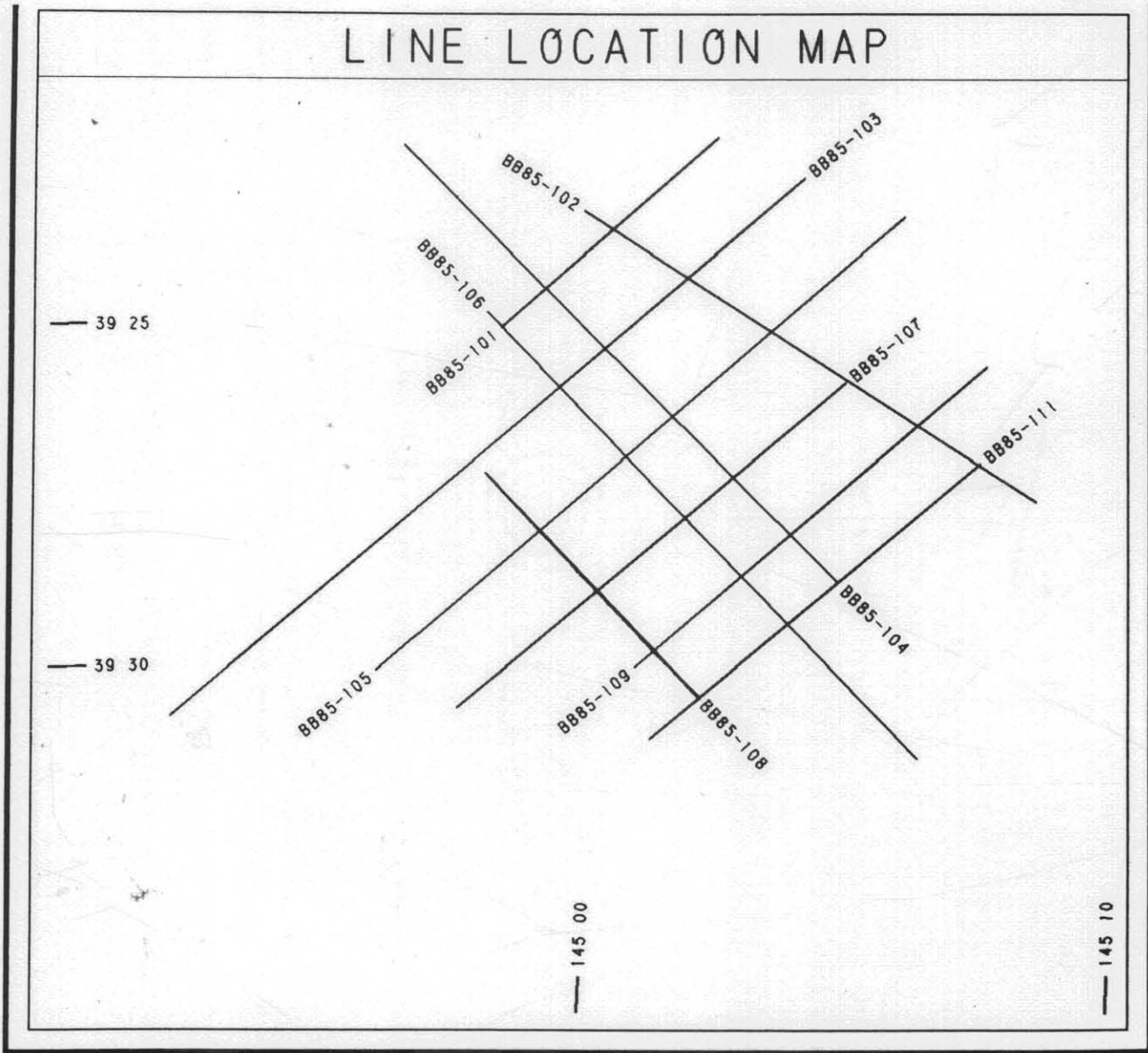




SD - SECTION DISPLAY
 MS - MONITOR STACK
 DBS - DECON BEFORE STACK
 TVF - TIME VARIANT FILTER
 AC - AUTO CORRELATION
 MAF - MULTIPLE ATTENUATION FILTER
 VELAN - VELOCITY ANALYSIS

TIME SECTION PROCESSING FLOW CHART

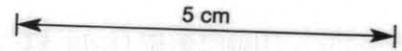
APPENDIX 5



LINE LOCATION MAP FOR T19P (PHASE 2)
MAP NO. 1

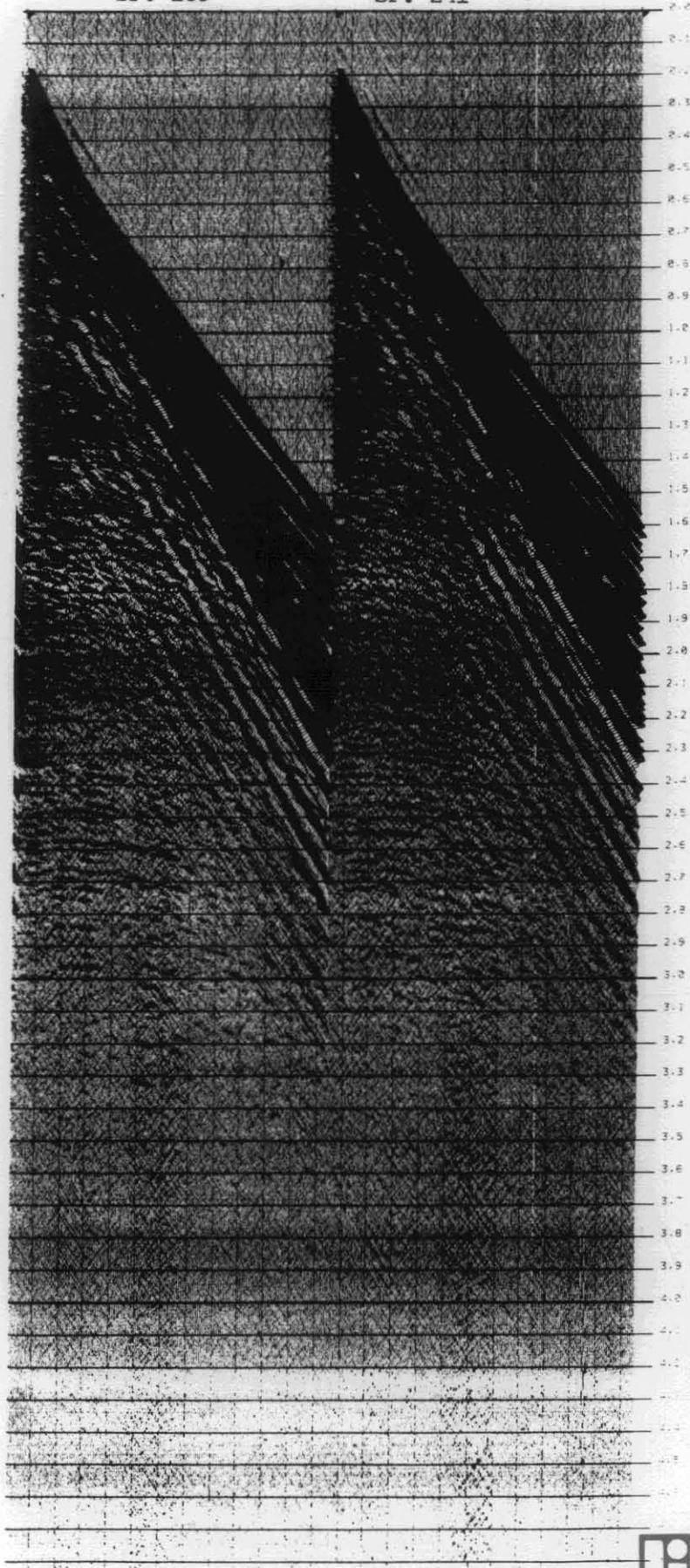


SHOT RECORDS OF LINE BB85135



SP. 289

SP. 241

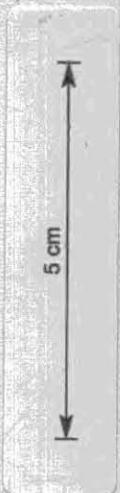
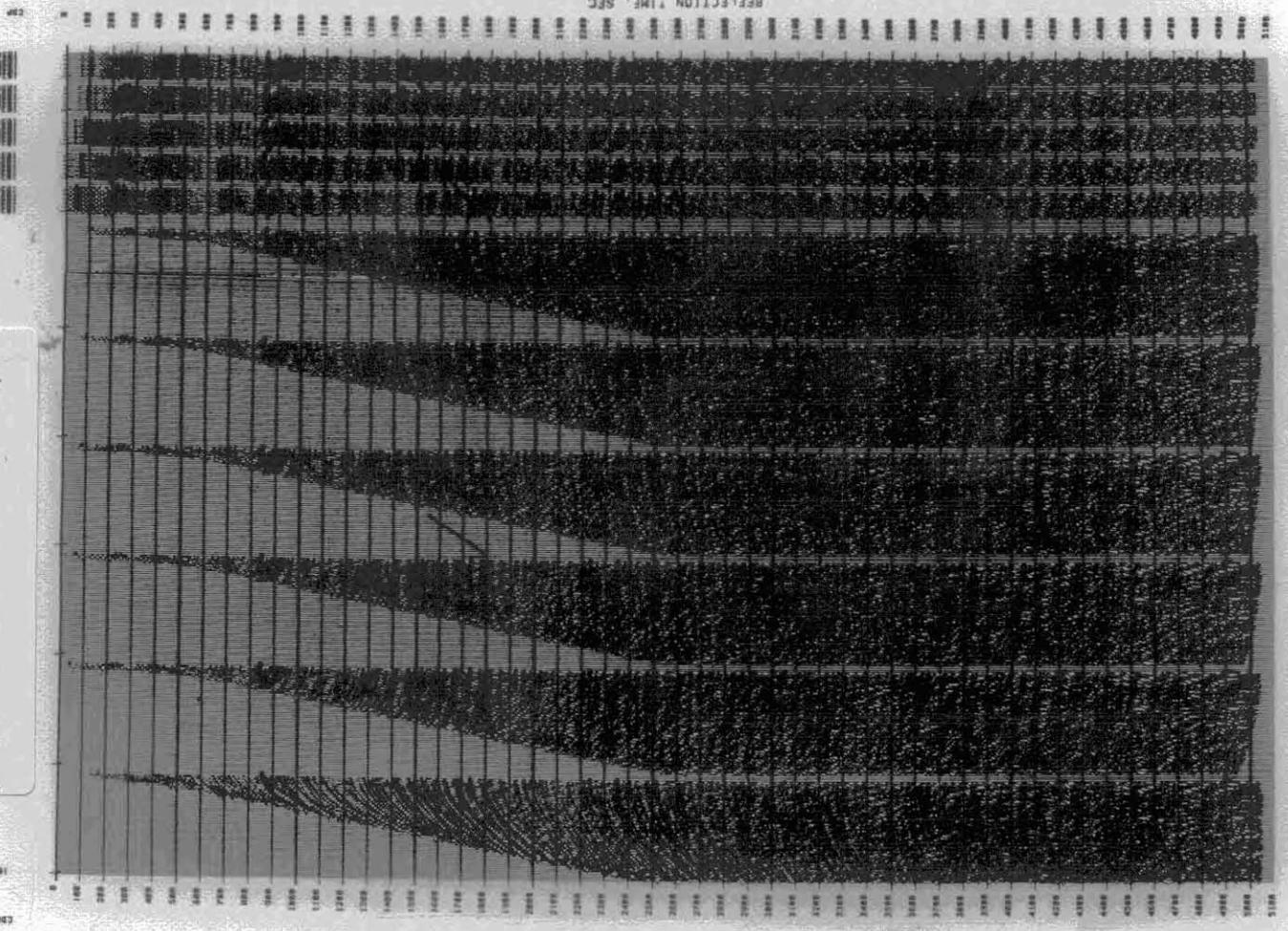
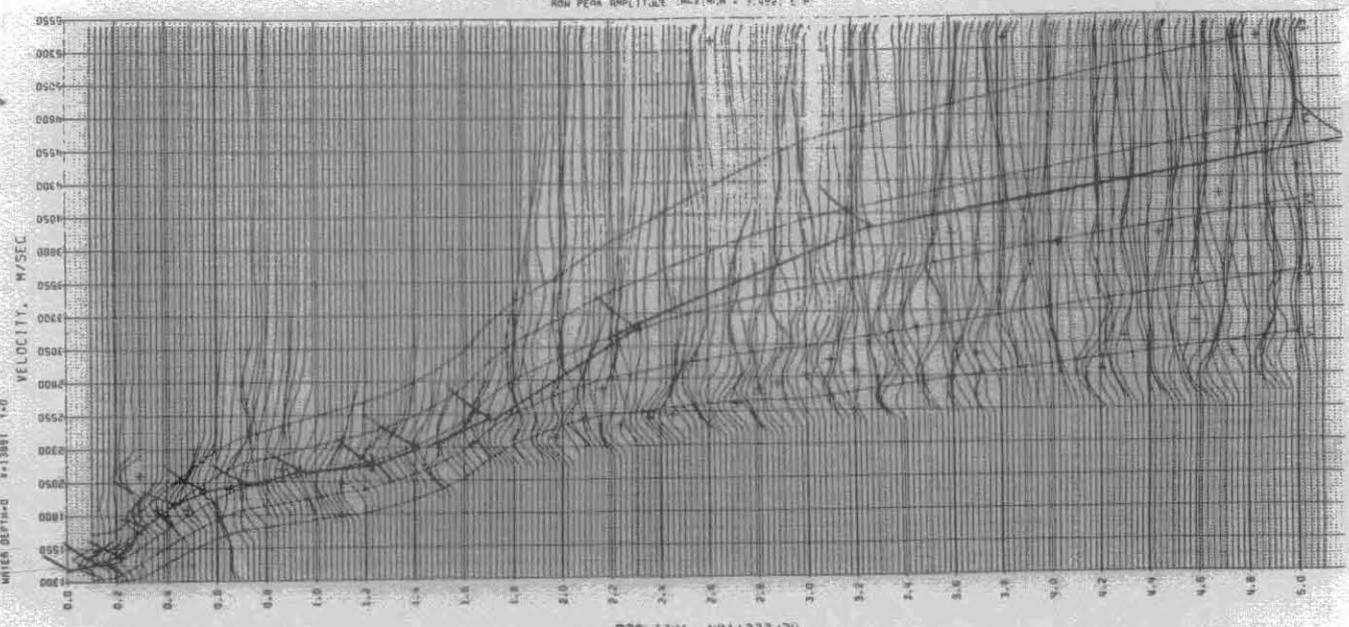


VELOCITY ANALYSIS OF LINE BB85135

LOCAL PEAKS TIME	VEL
0.020	1485.
0.032	2098.
0.354	1845.
0.430	1005.
0.484	2945.
0.555	1990.
0.659	2000.
0.724	2195.
0.880	2140.
0.940	2135.
1.108	2010.
1.270	2130.
1.390	2220.
1.447	2335.
1.616	2225.
1.708	2510.
1.800	2350.
1.972	2305.
2.082	2510.
2.164	2130.
2.230	2450.
2.300	2185.
2.355	2510.
2.552	2505.
2.620	2375.
2.715	1805.
2.812	2110.
2.880	2750.
3.000	2870.
3.100	2510.
3.176	2805.
3.262	2895.
3.472	2770.
3.570	3500.
3.701	2920.
3.822	2190.
4.054	2810.
4.270	2820.
4.300	3095.
4.444	3080.
4.588	3205.
4.680	3115.
4.732	2985.
4.852	3375.
4.886	3175.



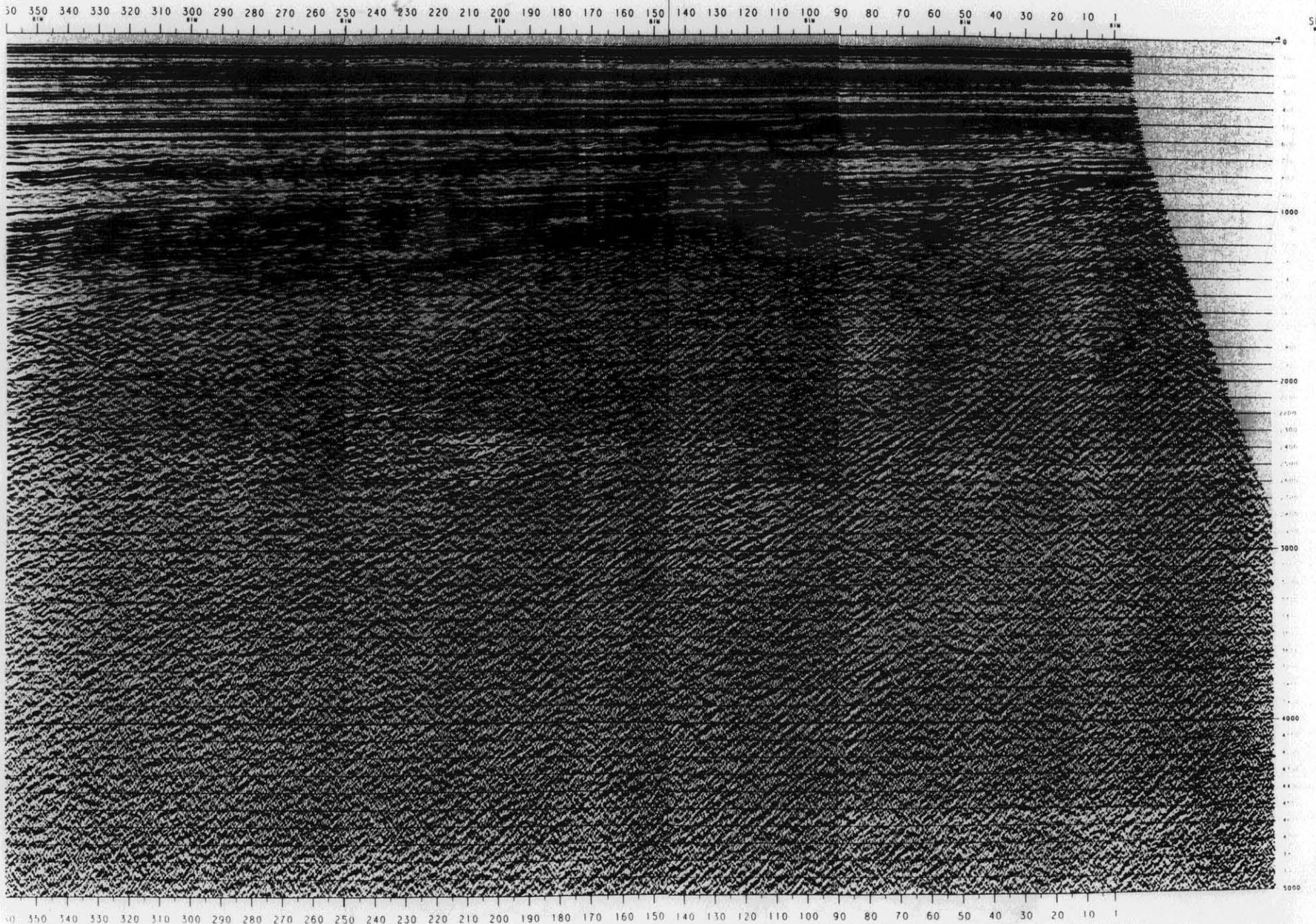
SP 413
 COP 1029 IND 81
 C CLIENT BRIDGE
 C LINE BB85-135
 C AREA BRSS
 SPAD-3000 Stream Meter Model 0-5-9-D
 1 INCHES DIA x 1.5 INCHES L
 MISCER BEST M-20 #13891 1-D



5 cm

FINAL STACK SECTION OF LINE BB85135

APPENDIX 9



WESTERN GEOPHYSICAL

232080