Integrated Services in
Petroleum Exploration and Production

Processing Report

For

Amity Oil N.L.

Gippsland Basin

Block: Vic/P38 Reprocessing

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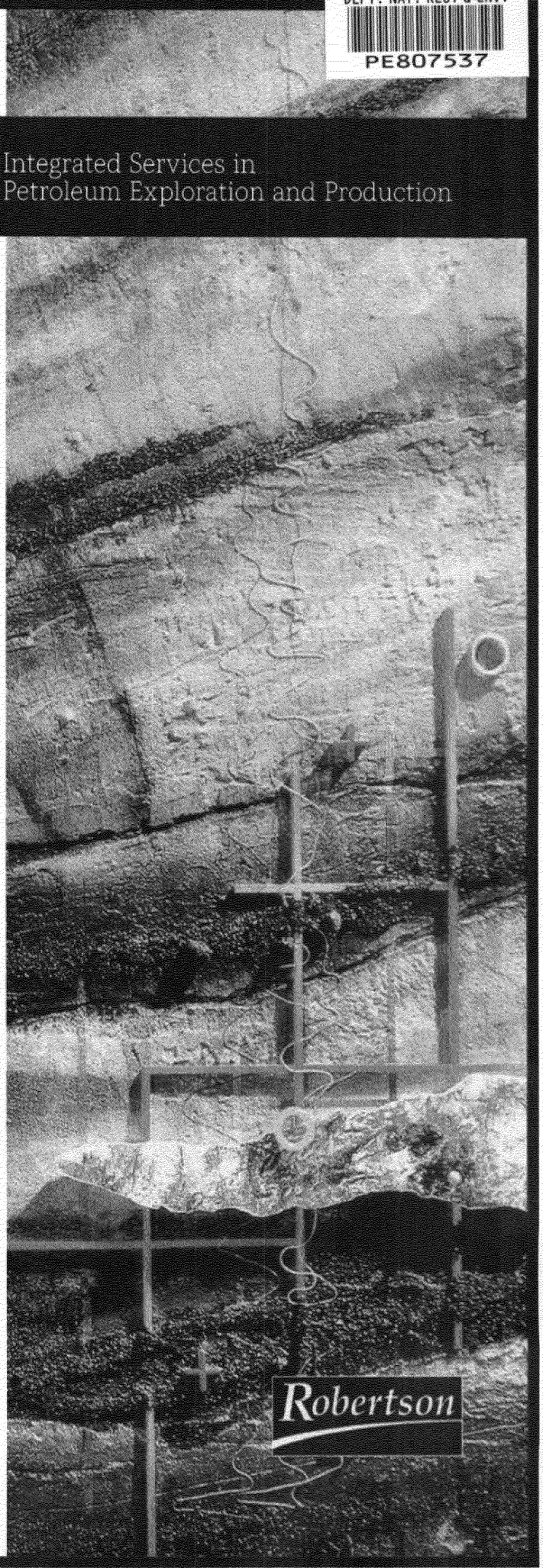

PROCESSING REPORT

FOR

AMITY OIL N.L

GIPPSLAND BASIN

BLOCK: VIC/P38 REPRO

ROBERTSON RESEARCH
(AUSTRALIA) PTY. LTD.
PERTH WESTERN AUSTRALIA

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1.0 INTRODUCTION

Reprocessing of '79-'82 vintage data is performed to improve mapping of block VIC/P38. Main events/targets are the Latrobe Group, Lakes Entrance Formation and Strzelecki Group. The permit is north of the Sunfish, Remora and Turrum oilfields.

Three vintages are included in the data set

GB79A- 96 channel
GB81- 72 channel
GH82A- 72 channel

SEE FIGURE 1.0 FOR complete line list

Processing is designed to be consistent across all data sets as far as possible. The GB79 vintage was recorded on "GSI" field tape, approximately 98% recoverable. The GB81 and GH82A were recorded on "Davis Extraseis" type field tapes which are known to deteriorate over time. Tapes were baked (heated for a period of about 24 hours), and then copied to intermediate tapes. Resulting in about 90% of the field data was recoverable, a good result for this type of tape/vintage. It is suggested that this is due to good storage (Dept. Mines Victoria)

Generally even though the GB81 and GH82A vintage datasets is 72 channel and was recorded on "Davis Extraseis" type field tapes the data is of superior data quality.

Principle aim of the processing is to image the Latrobe group and structure above and below. Also to improve the result compared to the original "GSI" processing.

LINE	FSP	LSP	KMS	CUM.KMS
GB79A-120	485	045	11.00	11.00
GB79A-121	253	045	5.20	16.20
GB79A-122	400	956	13.90	30.10
GB79A-124	DNP	DNP	0.00	30.10
GB79A-124a	420	973	13.83	43.93
GB79A-134b	101	297	4.90	48.83
GB79A-134	186	501	7.88	56.70
GB79A-135	101	580	11.98	68.68
GB79A-136	660	045	15.38	84.05
GB79A-137b	101	551	11.25	95.30
GB79A-138b	DNP	DNP	0.00	95.30
GB79A-139	101	400	7.48	102.78
GB79A-145	DNP	DNP	0.00	102.78
GB79A-146	101	484	9.58	112.35
GB79A-147	101	620	12.98	125.33
GB79A-148	101	653	13.80	139.13
GB79A-148a	DNP	DNP	0.00	139.13
GB79A-150	749	045	17.60	156.73
GB79A-152	101	650	13.73	170.45
GB79A-154	500	045	11.38	181.83
GB79A-156	101	550	11.23	193.05
GB81-017	001	235	5.85	198.90
GB81-018	001	255	6.35	205.25
GB81-019	140	546	10.15	215.40
GB81-020	DNP	DNP	0.00	215.40
GB81-021	001	301	7.50	222.90
GB81-022	001	301	7.50	230.40
GB81-023	001	296	7.38	237.78
GB81-024	001	389	9.70	247.47
GB81-025	001	587	14.65	262.12
GH82A-25a	200	1100	22.50	284.62
GH82A-027	001	904	22.58	307.20
GH82A-044	009	440	10.78	317.97
GH82A-045	147	715	14.20	332.17
GH82A-046	001	621	15.50	347.67
GH82A-047	001	400	9.98	357.65
GH82A-051	001	600	14.98	372.62
GH82A-052	001	451	11.25	383.88
GH82A-053	001	389	9.70	393.57
GH82A-22a	DNP	DNP	0.00	393.57
GH82A-23a	DNP	DNP	0.00	393.57
GL88-001	DNP	DNP	0.00	393.57
G92A-3017	DNP	DNP	0.00	393.57

Figure 1.0: Complete Line List

2.0 FIELD PARAMETERS

GB79 vintage

DESCRIPTION	*DETAILS*
Data recorded by:	G.S.I
Date recorded:	1980
Vessel:	M/V EUGENE MCDERMOTT II
Seismic source:-	Airgun
Pressure/Volume:	2000 p.s.i./2376 cu.in.
Depth:	7 metres average
Shot interval:	25 metres
Gun Delay	0 ms
Recording system:-	DFS 5
Format:	SEGD
Record length:	4 seconds
Sample interval:	2 milliseconds
Filters	Low : 8 Hz at 18dB/Octave
	High : 120 Hz at 70 dB/Octave
Receivers:-	
Streamer length:	2375 metres
Streamer depth:	12 metres average
Number of groups:	96
Near group number:	1
Group interval:	25 metres
Near group offsets:	255m or 332m

GB81 vintage

DESCRIPTION	*DETAILS*
Data recorded by:	Western Geophysical
Date recorded:	1981
Vessel:	M/V WESTERN ODYSSEY
Seismic source:-	Airgun
Pressure/Volume:	555cu in per gun
Depth:	6 metres average
Shot interval:	25 metres
Gun Delay	0 ms
Recording system:-	DFS 5
Format:	SEGD
Record length:	3 seconds
Sample interval:	2 milliseconds
Filters	Low : 8 Hz at 18dB/Octave
	High : 120 Hz at 72dB/Octave
Receivers:-	
Streamer length:	1775 metres
Streamer depth:	12 metres average
Number of groups:	72
Near group number:	1
Group interval:	25 metres
Near group offsets:	201m

GH82A vintage

DESCRIPTION	*DETAILS*
Data recorded by:	Western Geophysical
Date recorded:	1982
Vessel:	M/V WESTERN ODYSSEY
Seismic source:-	Airgun
Pressure/Volume:	4500 p.s.i./760 cu.in per gun
Depth:	6 metres average
Shot interval:	25 metres
Gun Delay	0 ms
Recording system:-	DFS 5
Format:	SEGD
Record length:	4 seconds
Sample interval:	2 milliseconds
Filters	Low : OUT
	High : 128 Hz at 70 dB/Octave
Receivers:-	
Streamer length:	1775 metres
Streamer depth:	12 metres average
Number of groups:	72
Near group number:	1
Group interval:	25 metres
Near group offsets:	114m

3.0 TESTING AND PROCESSING FLOW

3.1 TAPE TRANSCRIPTION

All data sets were recorded on SEGB reels. The '81 and '82 vintages were "Davis Extraseis" type field tapes. These are known to deteriorate over time. The tape tends to "fuse" together over time and thus the oxide coating delaminates when trying to read the tapes. Preheating the tapes minimizes this problem. A surprising result (about 90% recovered) was obtained when "baking" the tapes. The '79 vintage data set was all demultiplexed conventionally successfully.

3.2 GAIN RECOVERY

A exponential gain correction function is applied to raw records. Exponential gain: 12db/sec to 3000ms. The data is then saved as internal horizon format (16bit) as raw records.

3.3 INSTRUMENT DEPHASE

All data sets use DFS5 recording filters for which Robertson has standard dephase filters. A filter is designed to convert the instrument response of the DFS-5 recording systems with the appropriate filter setting to the minimum phase equivalent.

3.4 FX INTERPOLATION

Shot interpolation is done on shot records. The spatial interpolation is based on the forward backward linear prediction [FBLP] theory (cf., Tufts and Kumaresan, 1982; Spitz, 1991). Every shot has double the amount of traces output. Interpolation is done to improve the FK filter result and avoid spatial aliasing.

3.5 FK FILTER

Full cosine taper from k=0 to specified velocity of 1750 m/s. A 300 ms AGC is applied to the shots prior and removed post FK filtering.

3.6 MIXBACK UNFILTERED DATA (0-400ms) REMOVE INTERPOLATED TRACE

0-200ms is FK-unfiltered to retain the water bottom. 200-400ms ramp between full-unfiltered and full-filtered. Interpolated trace after FK filtering is removed.

3.5 SIGNATURE DECONVOLUTION 240MS OPERATOR (WAVELET DERIVATION)

Signature deconvolution based on Taner's method (ie; minimum phase signature derived from a mixed phase wavelet) is performed on each shot (shot dependent). A design window is given over which a wavelet via autocorrelation is estimated. Note that a single wavelet is derived for all offsets (averaged). In derivation the exponential gain is removed to keep the derivation stable (min phase). The derivation window can be repeated to improve the autocorrelation statistics.

In testing, the parameters are optimized to obtain the largest bandwidth output and the stability of the derived wavelet.

DESIGN WINDOW:			
	GB79	**GB81**	**GH82A**
near offset:	300-2500ms	300-2500ms	300-2500ms
far offset:	2000-3000ms	1700-2700ms	1500-2500ms
operator length:	240ms		
length of autocorrelation window:	500ms		
no of repeated of derivation:	3, shift design window down 100ms 2nd and 3rd time		
Taper:	50ms front end, 100ms back end		

3.8 DESIGNATURE

Desired output wavelet: 8/18-80/32 (Hz/Db/Oct)
Minimum Phase Spectrum
Butterworth Shaping
White Noise: 1%

3.9 GATHER

3.10 1ST PASS VELOCITIES ANALYSIS EVERY 1KM

Picked on screen using Robertson interactive velocity tool (fiva). Water depth is approximately 50m across all lines.

3.11 RADON DEMULTIPLE (FK DEMULTIPLE SHALLOW 0-500ms)

Radon demultiple is used from 500-4000msec and Fk demultiple 0-700msec (200msec ramp).

Data is transformed to Parabolic Radon domain after being NMO overcorrected. A total of 180 P-values were used to map the data in the delta-T range of -1500 to 4000ms. Data with delta-T ranges of 0 to 4000ms were modeled (assumed to be essentially multiple energy) and subtracted from the overall radon transform leaving essentially primary data. The data is then transformed back to X-T domain and the slowed first pass velocity functions removed.

over correction:	time	% of primary velocity applied
	0	95
	1000	94
	2000	94
	4000	92

removable agc: 200ms

Similarly with FK demultiple the data is over-corrected using 1st pass velocities and passed through an FK filter that passes only negative wave number data. Two CMPS are merged to one before input to the radon transform to double the fold and improve modeling.

3.12 DECON BEFORE STACK 2WIN 200/16 (OPER(MS)/GAP(MS)

Conventional decon tests were completed. Trace sequential gapped deconvolution using an operator of 200ms and a gap of 16ms was chosen. Because of the limited offset range available a 1 window design gate is chosen.

Operator Length/Gap (1 win)	120/16		
DESIGN WINDOW:			
	GB79	**GB81**	**GH82A**
near offset:	400-2700ms	400-2200ms	400-2200ms
far offset:	2000-3000ms	1900-2800ms	1700-3000ms
APPLY WINDOW:			
near offset:	0ms		
far offset:	0ms		
White noise	1%		

3.13 DMO

The DMO program applies 2D convolution operators to map the data accurately from non-zero offset in the manner described by Deregowski and Rocca (1981). The convolution is implemented by the summation method, applied to traces in common offset order. This procedure also achieves the desirable partial migration, whereby traces with common mid-points, but different source-receiver offsets, relate to the same sub-surface locations after DMO, for all dips. After DMO all reflection events appear, for the purposes of normal moveout correction, to have originated from horizontal reflectors. Therefore, optimum stack response for all reflector dips can be obtained from conventional moveout corrections based on velocity functions undistorted by reflector dip.
The velocity functions derived from analysis of data processed through DMO are essentially independent of structure.

removable agc: 300ms

3.14 PRE STACK MIGRATION CONSTANT VELOCITY 1500M/S

Pre Stack Migration is performed on common offset sections in the frequency wave number domain, using Stolt's F-K method. The data is migrated at a constant velocity of 1500m/s.

Dip Limited: 9msec/trace

3.15 SECOND PASS VELOCITIES ANALYSIS EVERY 0.5 KM

Picked on screen using Robertson interactive velocity tool (fiva).

2ndpassvelsall_westernformat on floppy disc (APPENDIX A1)

3.16 NMO & PRE-STACK SCALING & MUTE

Base Level Scaling (window designed) is used to scale gathers.

Window design length	1500ms
Start time 100m offset	500ms
End time 2700m offset	1500ms

Prestack scaling design window is applicable for all vintages. Similarly the mute is applicable for all vintages

MUTE (OFFSET/TIME) nearoff+100m, 0, nearoff+150m, 250, 655, 572, 2700, 2000

3.17 CDP STACK & GUN/CABLE STATIC CORRECTION

Stack, amplitude compensation by 1 over Root N. Gun and Cable static compensation is vintage variant.

See APPENDIX A2 for Gun and Cable depths (work sheet)

3.18 MINIMUM TO ZERO PHASE CONVERSION

Spectral estimate made using the Thompson multiplier method. A separate minimum to zero phase conversion operator is designed for the separate vintages. Operators were designed on representative lines for each vintage.

3.19 WAVE EQUATION MIGRATION (RESIDUAL) DEPTH STEP 20MS

Residual Wave-equation migration on stacked data using a finite difference solution in the X-T domain.

A Second order solution (65 degree) is used because of image requirements of faulting and structure.

Depth Step	20 ms
Velocities	Residual(2nd pass minus 1500ms),Smoothed (50%) slowed (100%shallow 80%deep)
Data Scaling	front-back end to full fold scaled down to avoid edge effects

3.20 PHASE MATCH TO SPERMWHALE-1 & SUNFISH-2

G92A-3017 intersects SPERMWHALE-1 & SUNFISH-2, this line was phase matched then tied to the rest of the grid. The reflectivity series of the wells is derived for the sonic and density logs) is cross-correlated with the seismic data to derive a cross-correlation wavelet. The resulting cross-correlation wavelet was analysed and the phase spectrum reduced to a constant phase shift (intercept) and constant time shift (gradient) by linear regression. The method is described by white, R.E., 1980, Partial coherence matching of synthetic seismograms with seismic traces. Geophysical Prospecting, 28, 333-358.

GB79A phase rotation = 0deg (to zero phase seg -ve)
GB81 phase rotation = 30deg (to zero phase seg -ve)
GH82A phase rotation = 80deg (to zero phase seg -ve)

Note phase rotation are <90degrees indicating that the data was recorded as seg -ve.

3.21 TWO TRACE MIX

0,1,1 mix

3.22 TIME VARIANT FILTER

TIME VARIANT FILTER

time (ms)	filter (Butterworth)
500	18, 18, 75, 72 (db/oct, Hz, Hz, db/oct)
1000	18,8,65,64 (db/oct, Hz, Hz, db/oct)
2000	18,5,50,48 (db/oct, Hz, Hz, db/oct)
3000	18,5,40,36 (db/oct, Hz, Hz, db/oct)

3.23 TWO WINDOW (400/1000MS) AGC

long window:	1000ms apply across whole section
short window:	400ms apply 0-1500
Percentage equalization:	70%

4.0 RESULTS

Significant improvements were archived in data quality, compared to the original G.S.I sections processed in the early '80s. Principally the data was higher resolution with better event continuity. Most improvement was in data zone 0-2000ms.

4.1 PHASEMATCHING

For phasematching diagrams see Appendix 2 & 3

4.2 EXAMPLE PROCESSING OF LINE GB81-017

Figure 4.21 brute stack – fk, designature
Figure 4.22 radon stack – fk demultiple (shallow)/radon demultiple (deep)
Figure 4.23 dmo stack – dbs/dmo
Figure 4.24 pstm stack – pstm stack 1500m/s
Figure 4.25 vel2 stack – 2nd pass vels, new mute base level scaling
Figure 4.26 mig – residual migraton
Figure 4.27 pmfm – phasematched, filtered, scaled migration

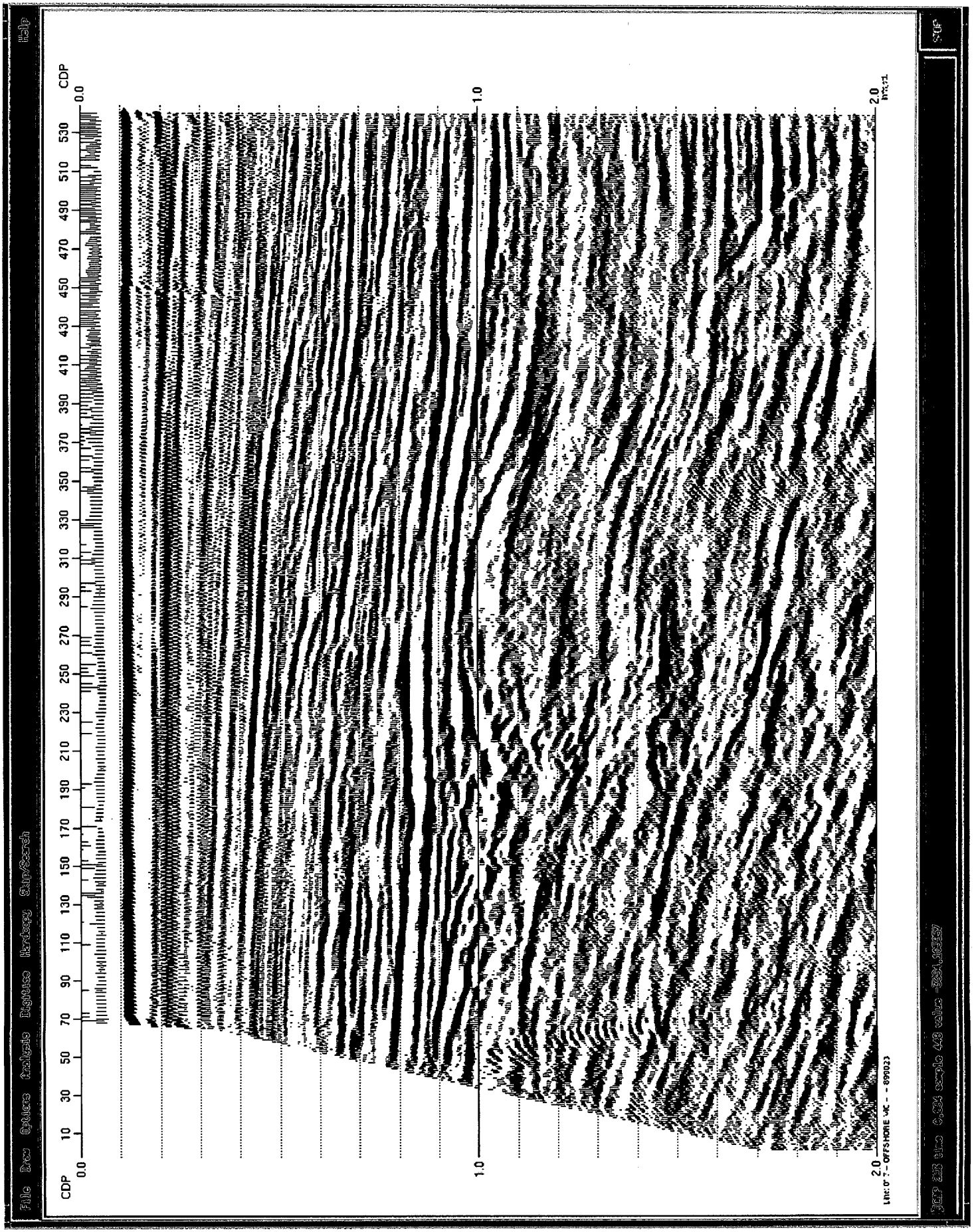

Figure 4.21 Brute stack- fk,designature

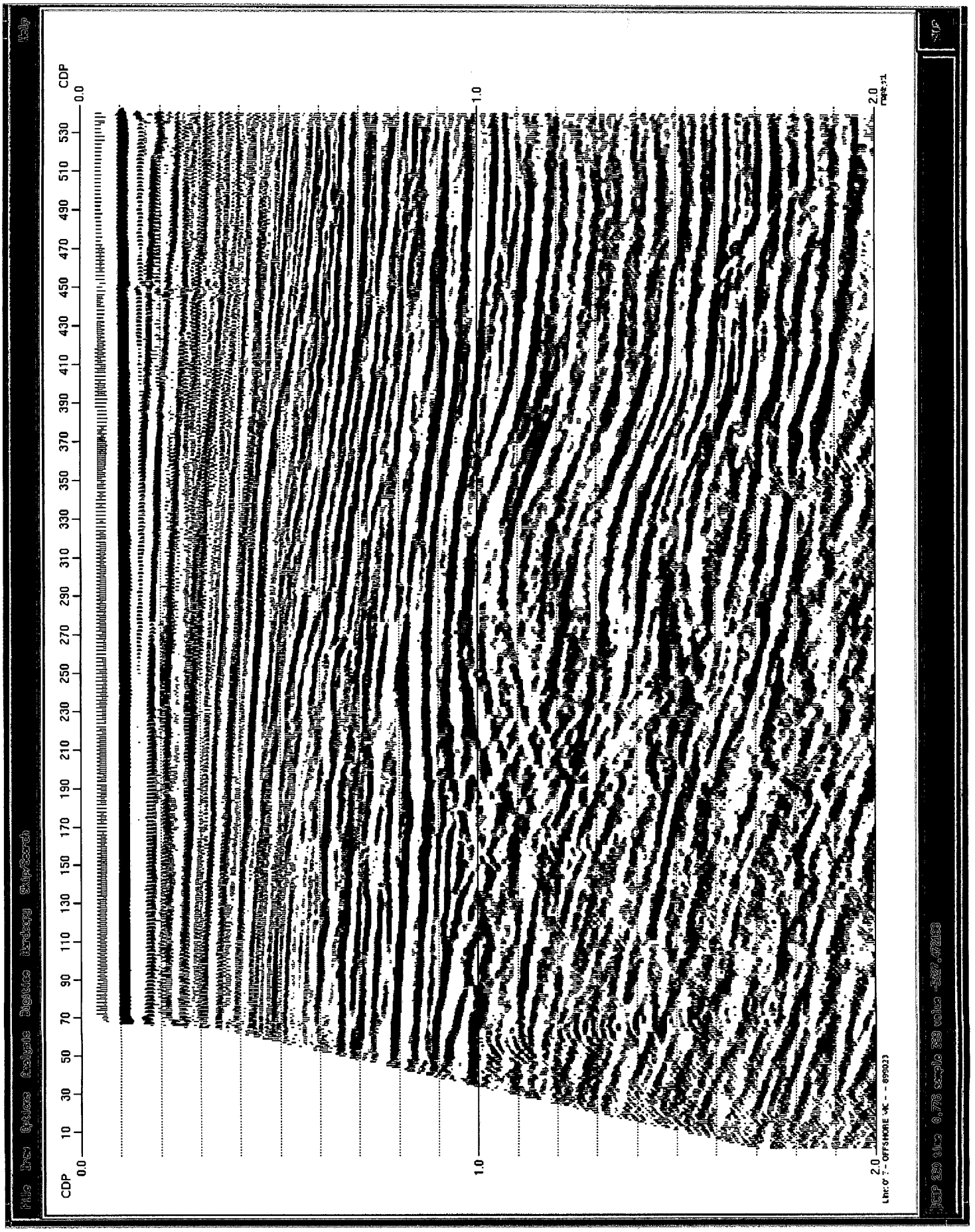

Figure 4.22 Radon stack- fkdemul shallow/radondemul deep

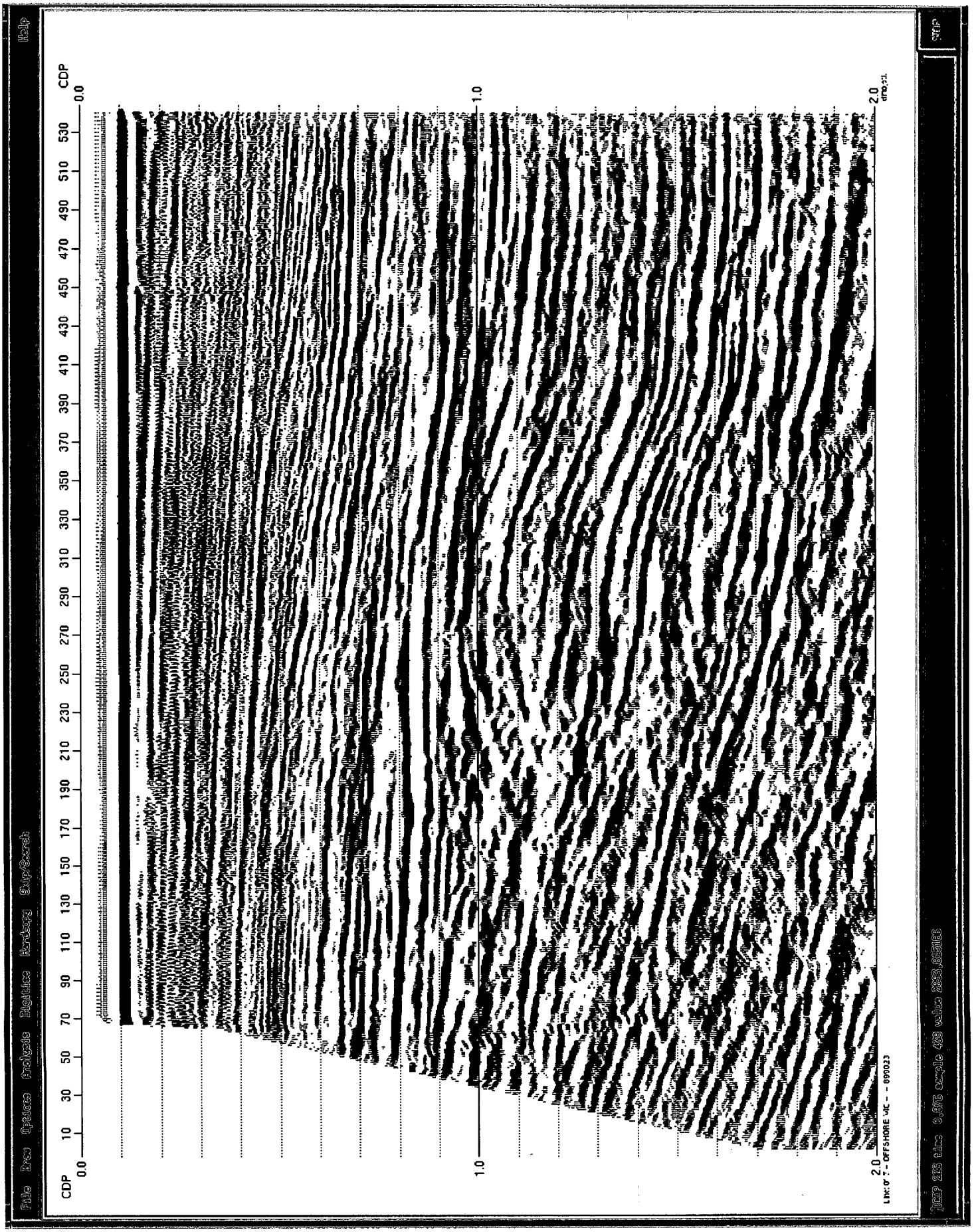

Figure 4.23 Dmo stack - dbs,dmo

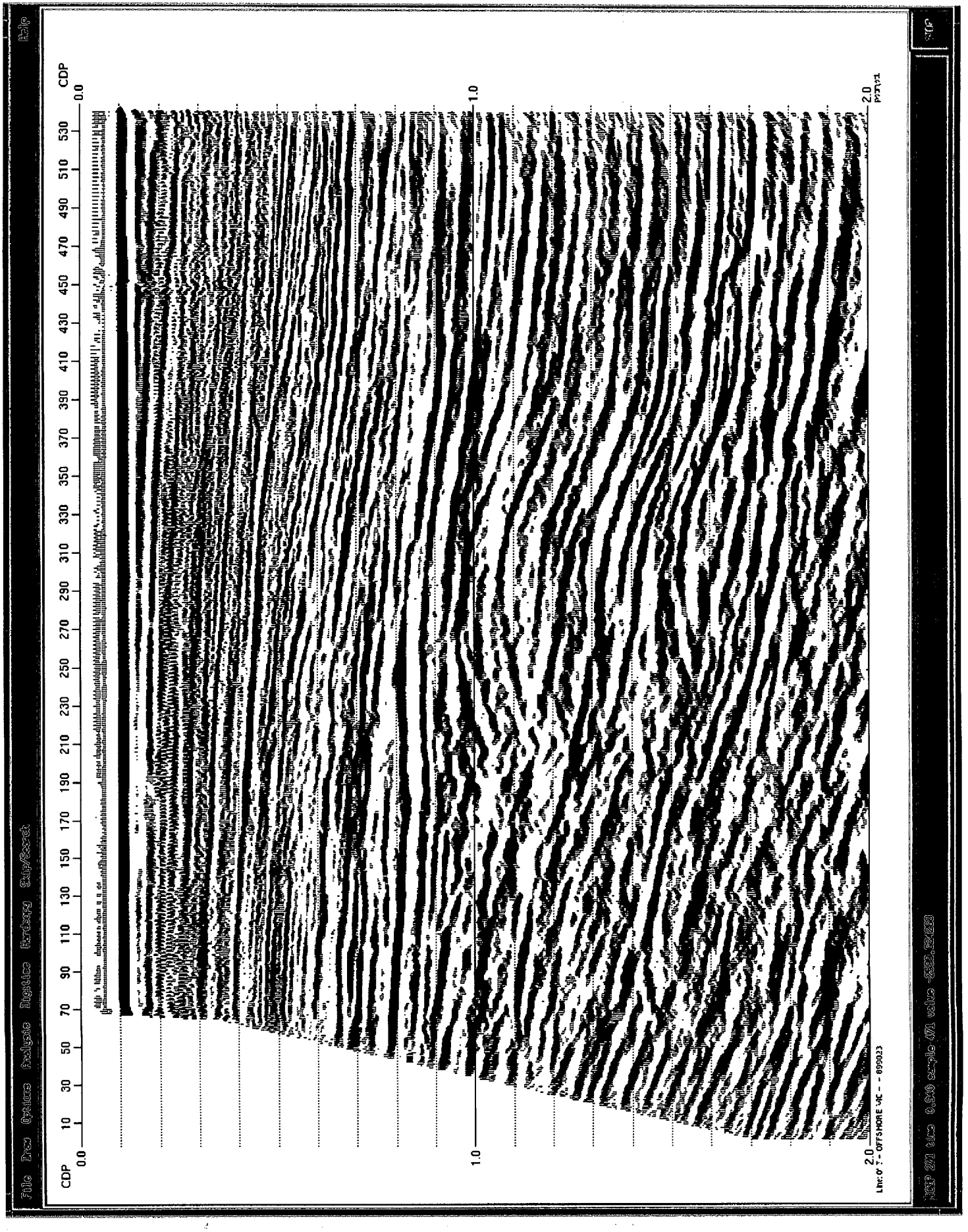

Figure 4.24 Pstm stack - pstm, 1500m/s single function

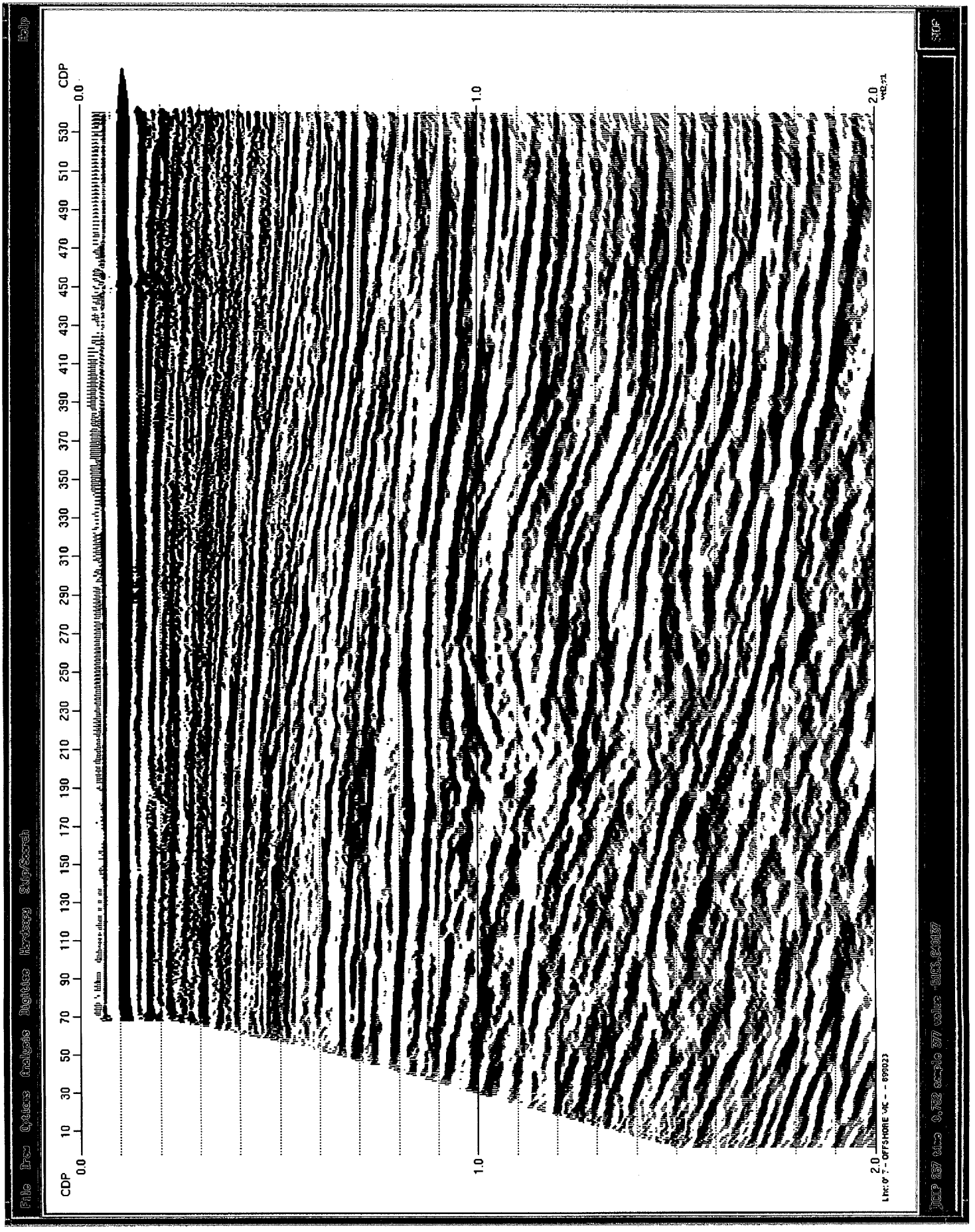

Figure 4.25 Vel2 stack - 2nd pass vels, newmute, base level scaling

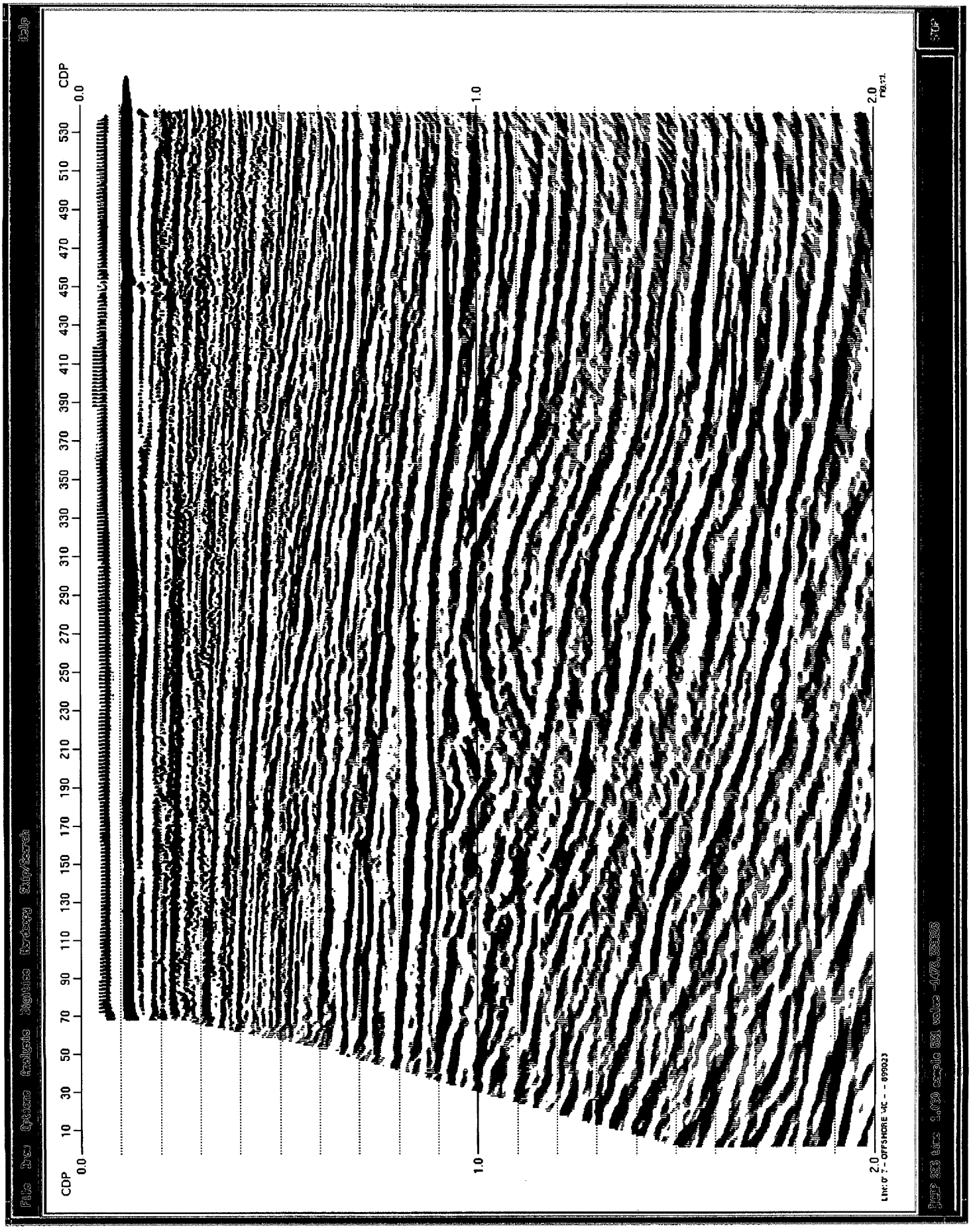

Figure 4.26 Mig-residual migration

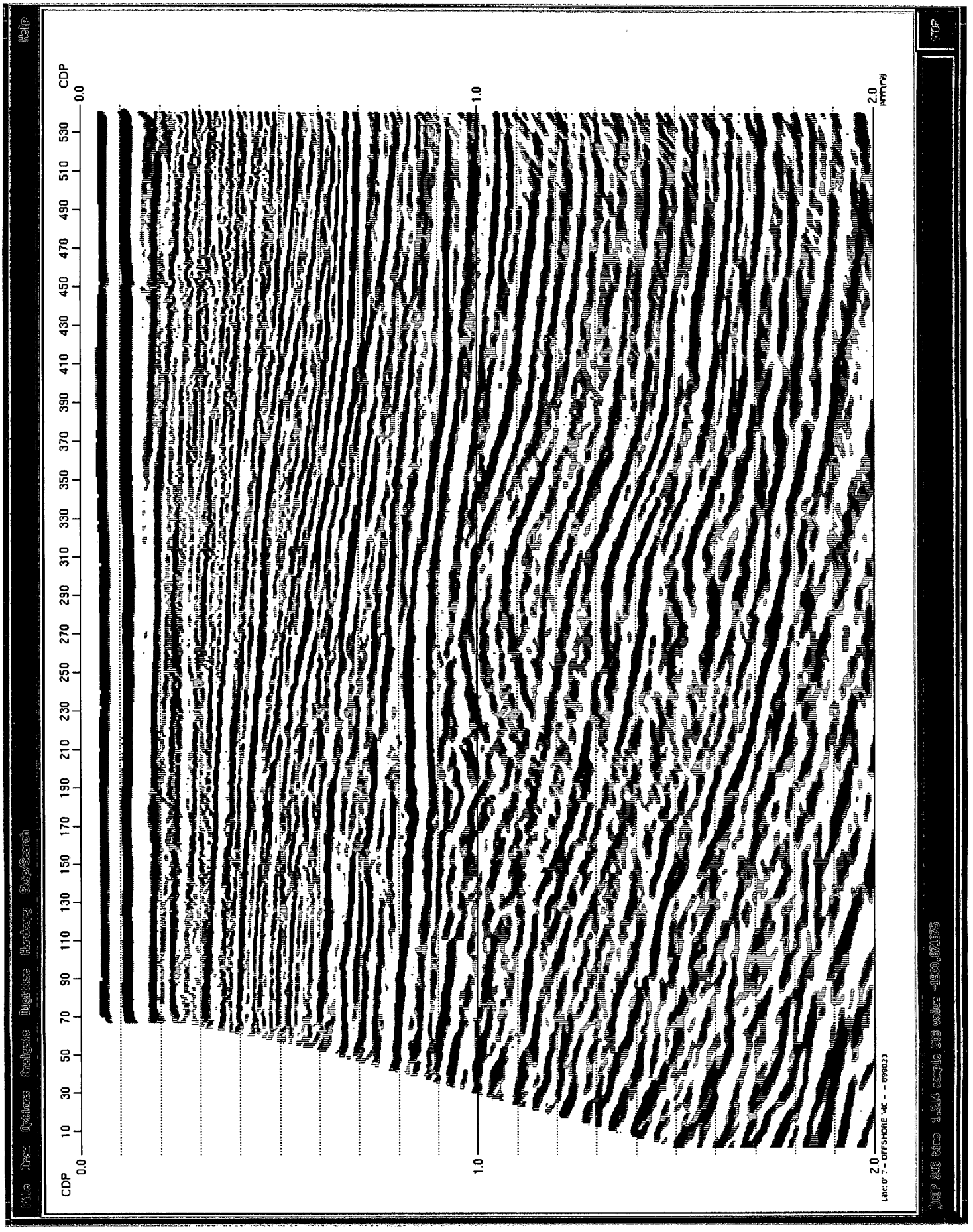

Figure 4.27 PMFM mig - phasematched, filtered, scaled

5.0 CONCLUSIONS

Even though "Davis Extraseis" type field tapes were used on the 'GB81 and GH82A' vintage datasets (19 years since acquisition) sufficient data was obtained for processing. The result is superior to the original G.S.I processing (approx 1982), principally in that the data is higher resolution with better event continuity.

Significant improvements were obtained by using trace interpolation prior to fk filtering. This was most noticeable in the shallow, especially given that the data (Water Bottom < 50m) is dominated by direct arrival and guided wave energy. Because of significant structure/variation in velocity, partial pre-stack migration and post-stack residual migration is superior to just post stack migration.

6.0 ARCHIVES AND DISPLAYS

1. Final Migration for 34 lines archived to exabyte (SEGY)
   Final Stacks for 34 lines archived to exabyte (SEGY)

2. Final Migration paper plots for 34 lines and 1 exabyte containing final migration in CGM+ format.

7.0 APPENDIX

A.1 2nd Pass Velocities
A.2 work sheet
A.3 phase match SUNFISH-1
A.4 phase match SPEARMWHALE-1

LINE	FFILE	LFLE	FSP	LSP	FCDP	LCDP	NOFF	NCH	DLE	DIR	C	G
GB79A-120	1	441	485	045	1	976	255	96	4	0	12	7
GB79A-121	1	206	253	045	1	512	255	96	4	0	12	7
GB79A-122	1	853	400	956	1	1208	332	96	4	90	12	7
GB79A-124	1	352	DNP	DNP								
GB79A-124a	1	585	420	973	1	1202	259	96	4	90	12	7
GB79A-134b	1	1	101	297	1	726	255	96	4	45	12	7
GB79A-134	1	1	186	501	1	488	225	96	4	225	12	7
GB79A-135	1	616	101	580	1	1054	255	96	4	45	12	7
GB79A-136	1	697	660	045	1	1326	255	96	4	225	12	7
GB79A-137b	1	450	101	551	1	996	255	96	4	45	12	7
GB79A-138b	371	610	DNP	DNP								
GB79A-139	1	315	101	400	1	694	254	96	4	45	12	7
GB79A-145	1	240	DNP	DNP								
GB79A-146	1	384	101	484	1	862	255	96	4	135	12	7
GB79A-147	1	556	101	620	1	1134	332	96	4	135	12	7
GB79A-148	1	591	101	653	1	1200	254	96	4	135	12	7
GB79A-148a	1	320	DNP	DNP								
GB79A-150	1	705	749	045	1	1504	257	96	4	315	12	7
GB79A-152	1	550	101	650	1	1194	263	96	4	135	12	7
GB79A-154	296	785	500	045	1	1006	256	96	4	315	12	7
GB79A-156	1	450	101	550	1	994	254	96	4	135	12	7
GB81-017	11	245	001	235	1	540	201	72	3	238	12	6
GB81-018	11	265	001	255	1	580	201	72	3	67	12	6
GB81-019	11	559	140	546	1	884	201	72	3	238	12	6
GB81-020	11	309	DNP	DNP								
GB81-021	11	311	001	301	1	672	201	72	3	328	12	6
GB81-022	11	311	001	301	1	672	201	72	3	328	12	6
GB81-023	11	306	001	296	1	662	201	72	3	157	12	6
GB81-024	11	399	001	389	1	848	201	72	3	328	12	6
GB81-025	11	600	001	587	1	1244	201	72	3	112	12	6
GH82A-25a	210	111	0 200	1100	1	1872	114	72	4	270	12	6
GH82A-027	11	914	001	904	1	1878	114	72	4	90	12	6
GH82A-044	19	450	009	440	1	934	114	72	4	0	12	6
GH82A-045	157	725	147	715	1	1208	114	72	4	90	12	6
GH82A-046	11	631	001	621	1	1312	114	72	4	180	12	6
GH82A-047	11	410	001	400	1	870	114	72	4	0	12	6
GH82A-051	11	611	001	600	1	1270	114	72	4	135	12	6
GH82A-052	11	461	001	451	1	972	114	72	4	225	12	6
GH82A-053	11	399	001	389	1	848	114	72	4	90	12	6
GH82A-22a	11	246	DNP	DNP								
GH82A-23a	11	232	DNP	DNP								
GL88-001	1	339	DNP	DNP								
G92A-3017			**Tie line for phase matching									

DNP=do not process
NOFF=near offset(m)
NCH=no. of channels
DLE=data length(s)
C=cable depth(m)
G=gun depth(m)

APPENDIX A.2

PE807538

This is an enclosure indicator page.
The enclosure PE807538 is enclosed within the container PE807537 at this location in this document.

The enclosure PE807538 has the following characteristics:

ITEM_BARCODE	PE807538
CONTAINER_BARCODE	PE807537
NAME	Phase match for Sunfish-1
BASIN	GIPPSLAND
ONSHORE?	N
DATA_TYPE	SEISMIC
DATA_SUB_TYPE	SECTION
DESCRIPTION	Phase match for Sunfish-1. Appendix A.3. By Robertson Research Australia Pty. Ltd. for Amity Oil N.L. 1999
REMARKS	
DATE_WRITTEN	
DATE_PROCESSED	
DATE_RECEIVED	17-DEC-1999
RECEIVED_FROM	Amity Oil NL
WELL_NAME	Sunfish-1
CONTRACTOR	
AUTHOR	
ORIGINATOR	
TOP_DEPTH	
BOTTOM_DEPTH	
ROW_CREATED_BY	DH00_SW

(Inserted by DNRE - Vic Govt Mines Dept)

PE807539

This is an enclosure indicator page.
The enclosure PE807539 is enclosed within the container PE807537 at this location in this document.

The enclosure PE807539 has the following characteristics:

ITEM_BARCODE	PE807539
CONTAINER_BARCODE	PE807537
NAME	Phase match for Spermwhale-1
BASIN	GIPPSLAND
ONSHORE?	N
DATA_TYPE	SEISMIC
DATA_SUB_TYPE	SECTION
DESCRIPTION	Phase match for Spermwhale-1. Appendix A.4. By Robertson Research Australia Pty. Ltd. for Amity Oil N.L. 1999.
REMARKS	
DATE_WRITTEN	
DATE_PROCESSED	
DATE_RECEIVED	
RECEIVED_FROM	Amity Oil NL
WELL_NAME	Spermwhale-1
CONTRACTOR	
AUTHOR	
ORIGINATOR	
TOP_DEPTH	
BOTTOM_DEPTH	
ROW_CREATED_BY	DH00_SW

(Inserted by DNRE - Vic Govt Mines Dept)