WesternGeco

FINAL PROCESSING REPORT

For the

VIC/P42 3D
MARINE SEISMIC SURVEY

GIPPSLAND BASIN
AREA: VIC/P42

CONTRACT: GBA02B

For

BASS STRAIT OIL COMPANY LTD.
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MELBOURNE, 3000
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By

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January 2003
Project Number: J2643

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1 INTRODUCTION

This report details the data processing of the VIC/P42 (Gippsland Basin) 3D Marine Seismic Survey carried out by WesternGeco (WG). The project was conducted in Bass Strait - Australia under the Contract Number GBA02B for Bass Strait Oil Company Ltd (BSOC).

The project consisted of approximately 9640 line kilometres of data in permit VIC/P42.
(see figure 1).

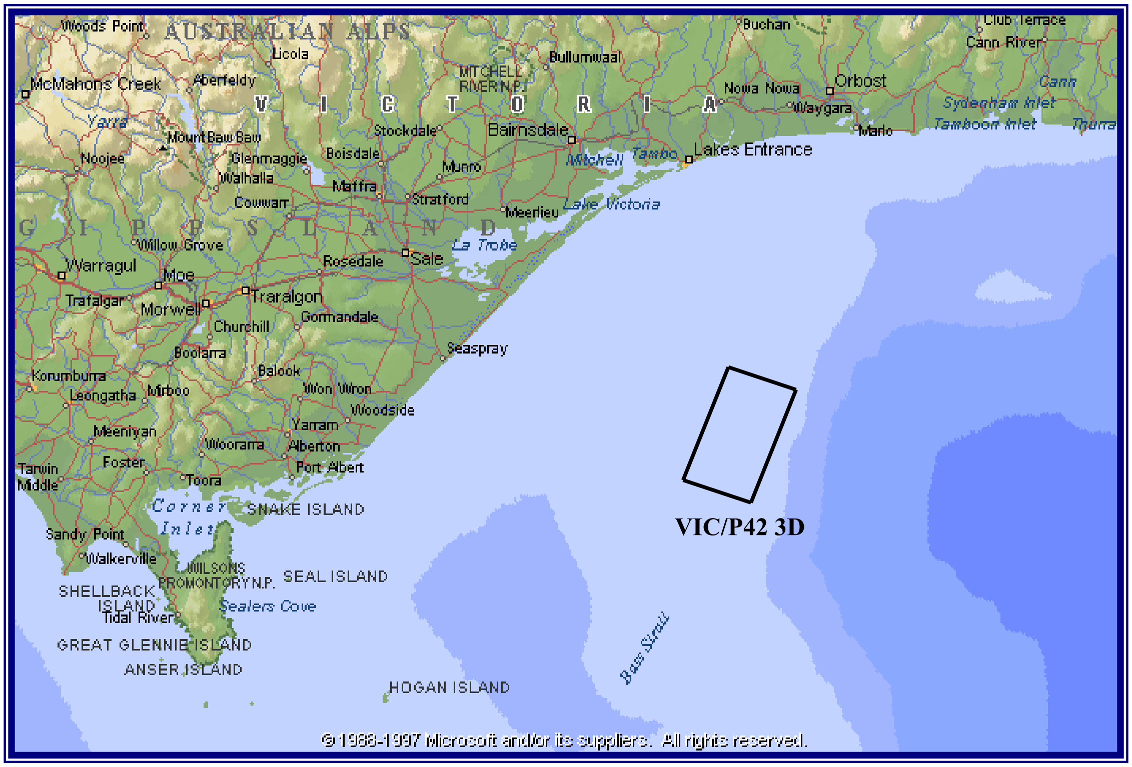
The data was recorded by WesternGeco's vessel M/V Geco Beta in late July to early August 2002. The data processing was conducted between mid August and the end of November 2002.

The project was co-ordinated and processed from the Melbourne Processing Centre. Computing facilities in Perth, Western Australia were linked to the Melbourne geophysical staff using Frame Relay Technology with a burst capacity of 256 Kbit/sec. This enabled all of the main processing to be performed in the Perth supercomputer facility, using Western's Omega® Seismic Processing system software.

Tests were performed to determine processing parameters between August and November 2002.

The project was co-ordinated for Bass Strait Oil by Mr. Ian Reid. The data processing at WesternGeco was managed by Mr. Peter Griffin.

Figure 1: Locality Map



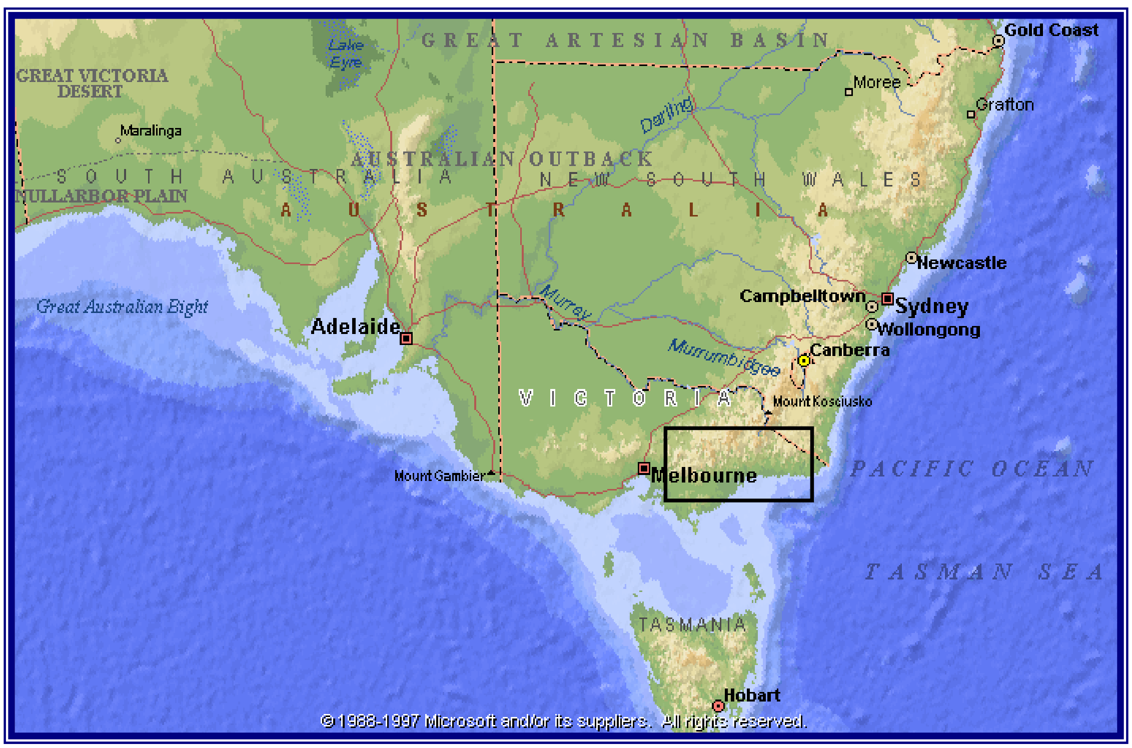


Figure 2: Prospect Location / Grid Definition

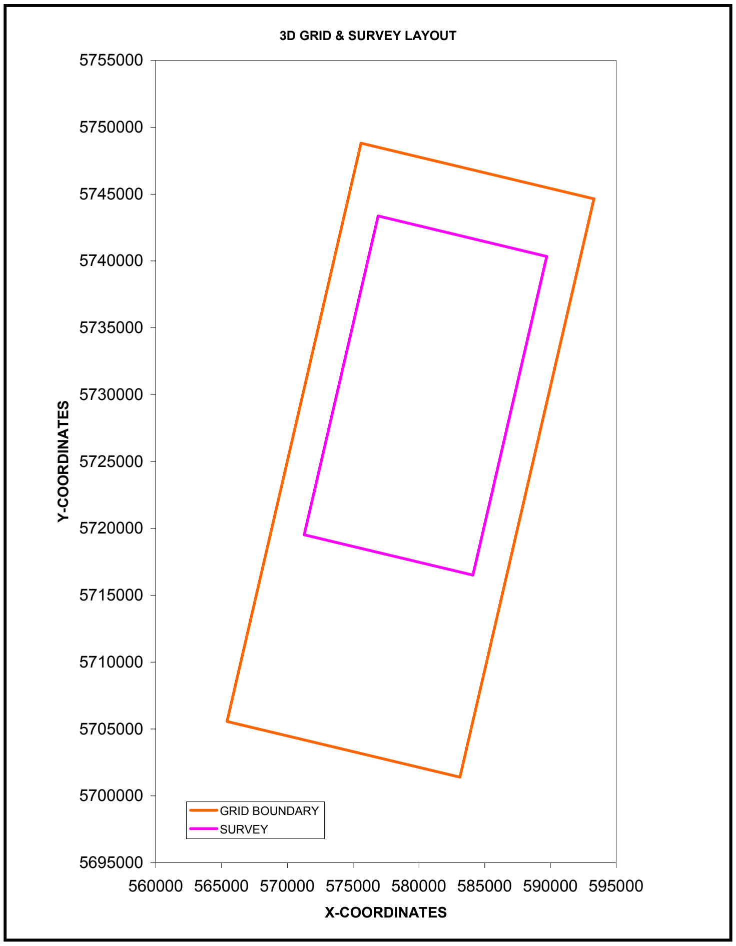
Projection Type:	UTM (South)
Projection Zone:	55 S
Central Meridian:	147 Degrees East
Spheroid:	Australian National
Survey Datum:	AGD 84
Crossline Spacing:	12.5 metres
Crossline Increment:	1.0
Acquisition Line Spacing:	25.0 metres
Line Increment:	1.0
Prospect Angle:	193.254 Degrees

Grid Boundary

		25m x 12.5m		12.5m x 12.5m	
X-Coordinates	**Y-Coordinates**	**Inline (inc 1)**	**Crossline**	**Post-interp Inline(inc1)**	**Post-interp Crossline**
593295.588269	5744640.523595	901	601	1802	601
583110.343698	5701398.860606	901	4155	1802	4155
575604.710952	5748807.475088	1628	601	3256	601
565419.466381	5705565.812099	1628	4155	3256	4155

Survey Boundary

X-Coordinates	**Y-Coordinates**	**Inline (inc 1)**	**Crossline**	**Post-interp Inline(inc1)**	**Post-interp Crossline**
589715.838571	5740346.878046	1001	1001	2002	1001
584101.630886	5716511.645127	1001	2960	2002	2960
576891.777572	5743367.488000	1528	1001	3056	1001
571277.569887	5719532.255081	1528	2960	3056	2960



1.1 PROJECT AIMS AND OBJECTIVES

BSOC's geophysical requirements for this project were as follows:

1. Process a Pre Stack Time Migration (PSTM) volume.
2. On completion of processing, the following data volumes would be required:

- Final Stack Migrations –Filtered / Scaled
- Final Stack Migrations – Unfiltered / Unscaled
- Angle Stack Migrations (Near) – Unfiltered / Unscaled
- Angle Stack Migrations (Mid) – Unfiltered / Unscaled
- Angle Stack Migrations (Far) – Unfiltered / Unscaled
- Near Trace Gather Volume – Unfiltered / Unscaled / NMO Corrected
- 3D CDP sorted DBS Gathers– Unfiltered / Unscaled

3. A CD-ROM containing the following 3D velocity files in WGC format:

- BSOC supplied velocities from previous surveys
- First Pass Velocities (800 x 800 m grid)
- Second Pass Velocities (800 x 800 m grid)
- Third Pass Velocities (400 x 400 m grid)
- High Density Velocity Analysis Velocities (200 x 100 m grid)

2 ACQUISITION SUMMARY

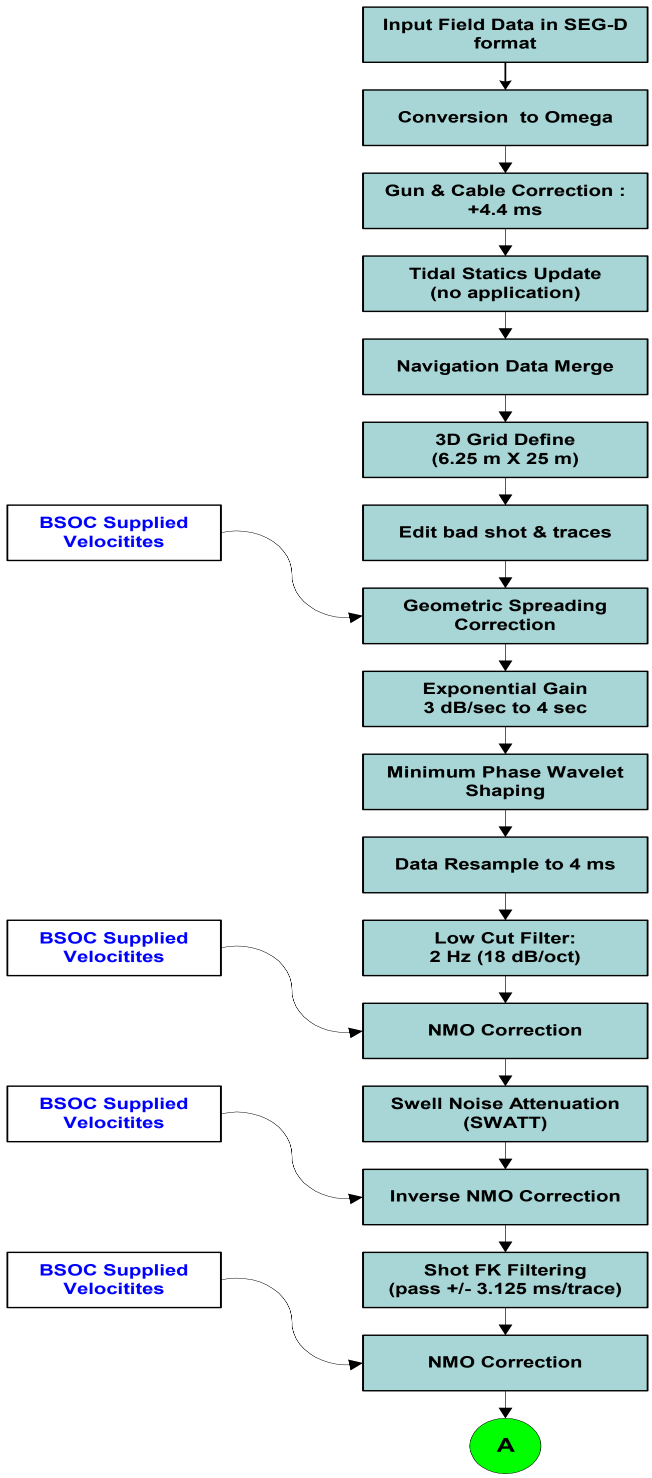
The VIC/P42 (Gippsland Basin 3D) field data was collected during July and August 2002 by WesternGeco using the *M/V Geco Beta* with a conventional towed streamer technique. The following parameters were utilised for data collection:

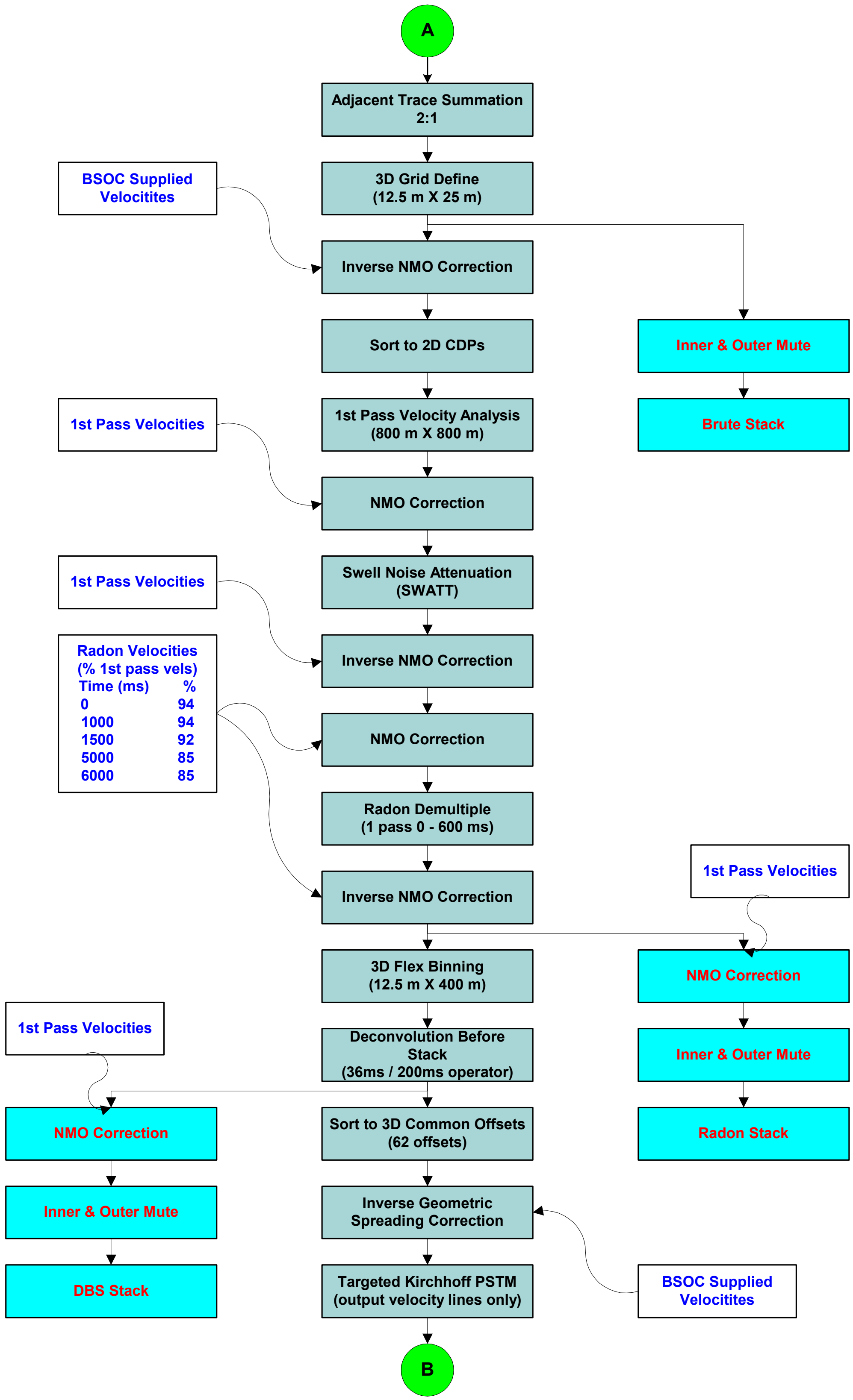
Streamers	
▪ Type:	NAP-4 (Fjord Instruments Nessie 4)
▪ Length	8 x 4600 metres
▪ Number of Groups:	2944 (368 per streamer)
▪ Depth	8 metres
▪ Streamer Separation:	100 metres
▪ Group Interval:	12.5 metres
Energy Source	
▪ Array Type:	Dual arrays, flip-flop
▪ Gun Type:	Bolt air guns
▪ Gun Separation:	50 metres
▪ Total Volume:	3542 cubic inches (single source)
▪ Operation Pressure:	2000 psi
▪ Depth:	7 metres
▪ Shotpoint Interval:	18.75 metres
▪ Offset distance:	150 metres (nominal center source to center first group)
Instrumentation	
▪ Recording System:	TRIACQ version 1.6c
▪ Recording Format:	SEG-D 8015 revision 2
▪ Recording Medium:	3590
▪ Low Cut Filter:	3 Hz (18 dB/Octave)
▪ High Cut Filter:	180 Hz (72 dB/Octave)
▪ Sample Interval:	2 ms
▪ Record Length:	6000 ms
▪ Filter Delay:	5.6 ms

	Recording System	
	Chan 1 – 368:	Streamer 1
	Chan 369 – 736:	Streamer 2
	Chan 737 – 1104:	Streamer 3
	Chan 1105 – 1472:	Streamer 4
	Chan 1473 – 1840:	Streamer 5
	Chan 1841 – 2208:	Streamer 6
	Chan 2209 – 2576:	Streamer 7
	Chan 2577 – 2944:	Streamer 8
Navigation Systems		
▪ Primary:	TRINAV GPS	
▪ Secondary:	Fugro Starfix	
Data Sampling		
▪ Nominal Fold:	61	

3 DATA PROCESSING SUMMARY

Figure 3: Production Processing Flow Diagram




A
Adjacent Trace Summation 2:1
3D Grid Define (12.5 m X 25 m)
BSOC Supplied Velocitites
Inverse NMO Correction
Sort to 2D CDPs
Inner & Outer Mute
Brute Stack
1st Pass Velocity Analysis (800 m X 800 m)
1st Pass Velocities
NMO Correction
Swell Noise Attenuation (SWATT)
1st Pass Velocities
Inverse NMO Correction
Radon Velocities
(% 1st pass vels)
Time (ms) %
0 94
1000 94
1500 92
5000 85
6000 85
NMO Correction
Radon Demultiple (1 pass 0 - 600 ms)
Inverse NMO Correction
1st Pass Velocities
NMO Correction
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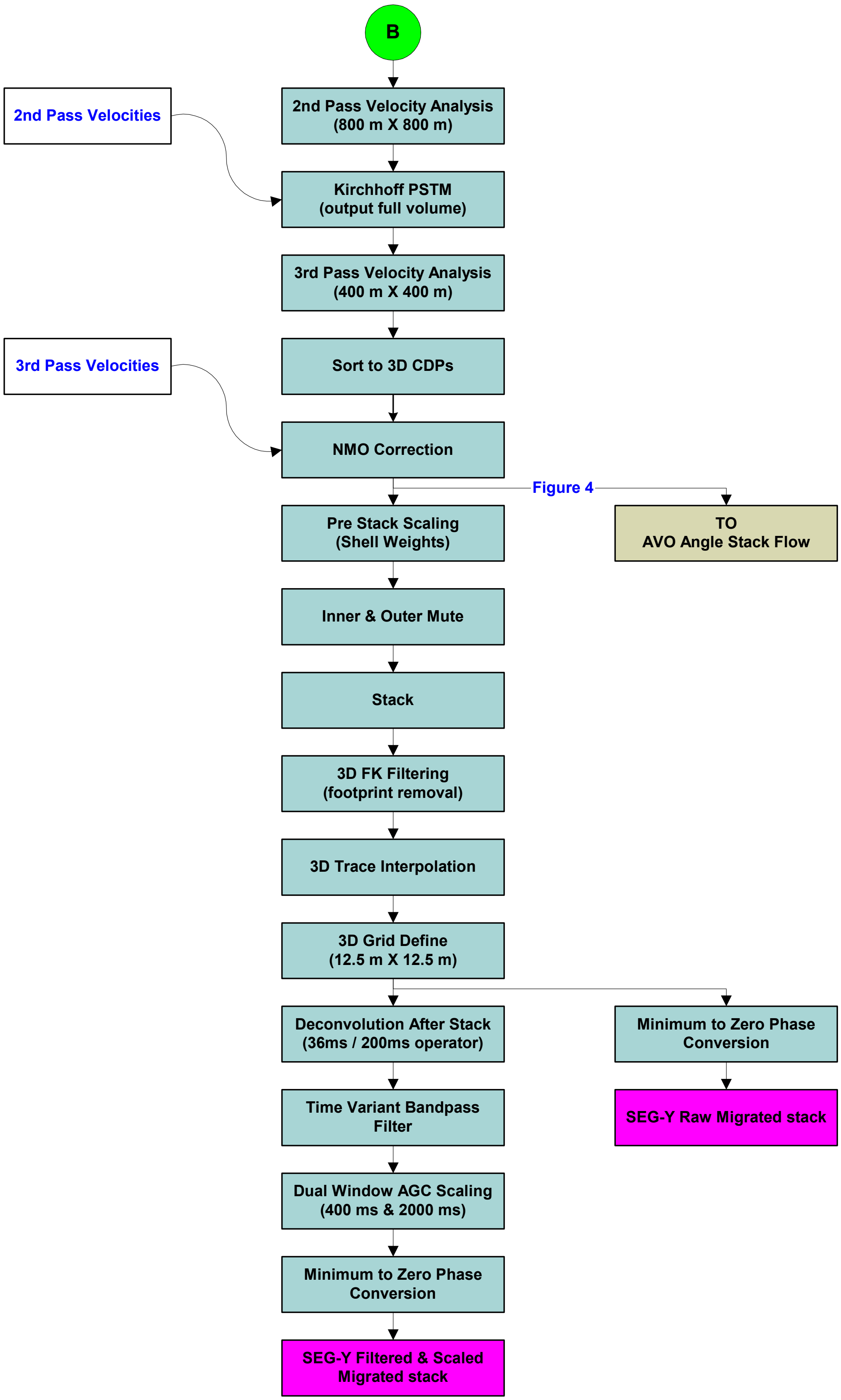
Inner & Outer Mute
1st Pass Velocities
NMO Correction
Sort to 3D Common Offsets (62 offsets)
Radon Stack
Inner & Outer Mute
Inverse Geometric Spreading Correction
DBS Stack
Targeted Kirchhoff PSTM (output velocity lines only)
BSOC Supplied Velocitites
B


B
2nd Pass Velocities
2nd Pass Velocity Analysis (800 m X 800 m)
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Dual Window AGC Scaling (400 ms & 2000 ms)
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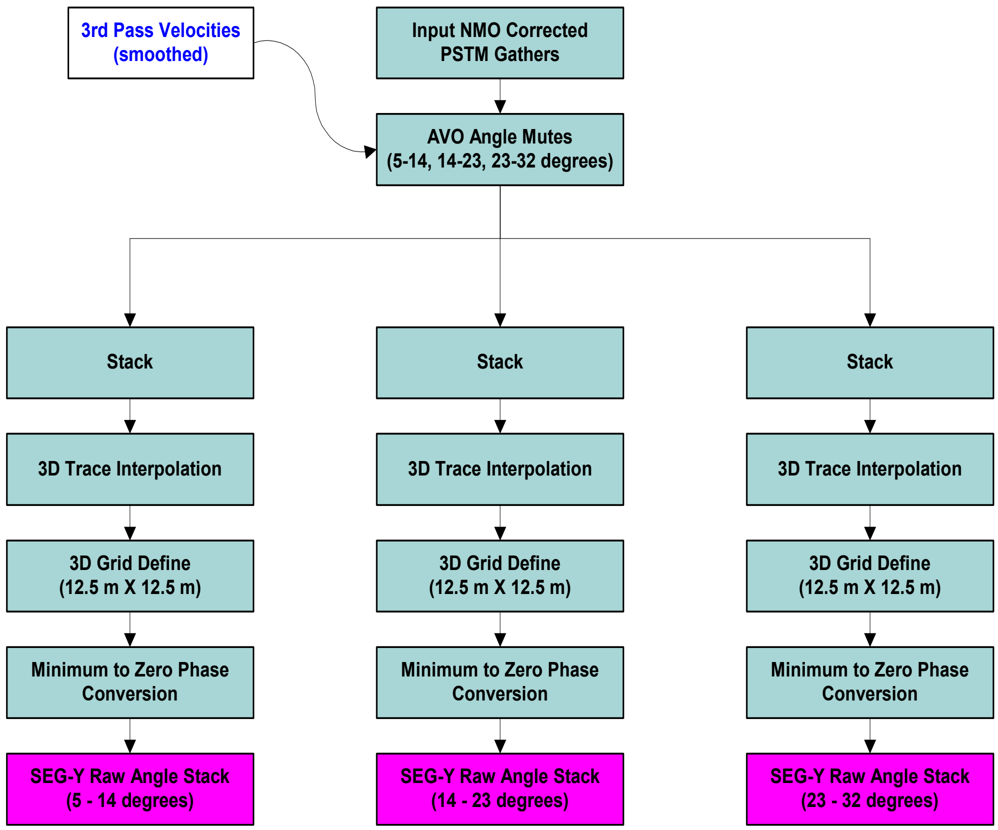
SEG-Y Filtered & Scaled Migrated stack

Figure 4: Production Processing Flow Diagram (Angle Stacks)



4 PERSONNEL AND EQUIPMENT

4.1 GEOPHYSICAL STAFFING AND ORGANISATION

WESTERNGECO

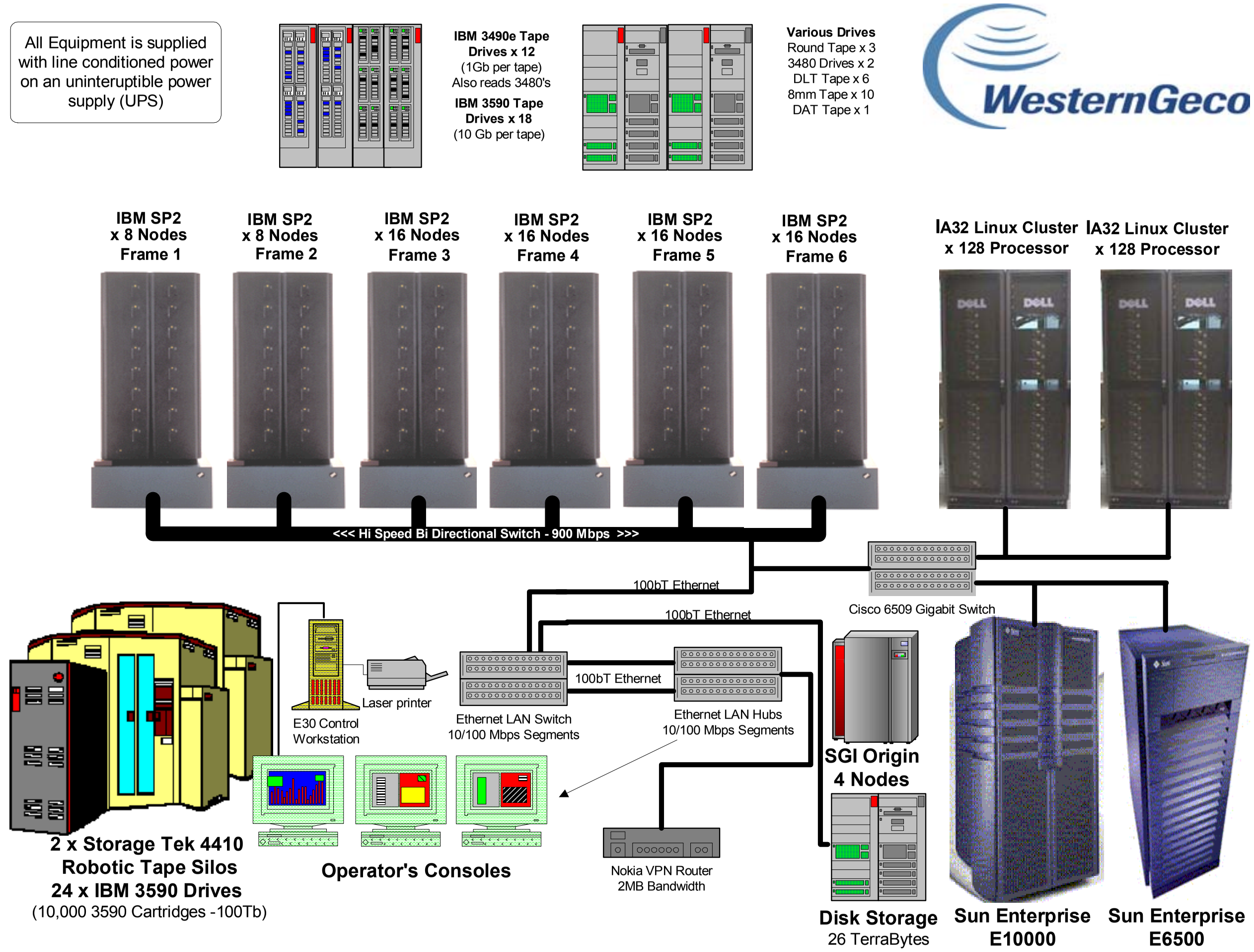
Mr. Michael Hartley	Data Processing Manager Melbourne	Allocation of resources in the Melbourne Data Processing Centre. Contract administration.
Mr. Peter Griffin	Senior Geophysicist	Client liaison in testing and parameters.
Mr. Paul Bellofiore	Senior Geophysicist	Client liaison in testing and parameters.

BASS STRAIT OIL COMPANY LTD.

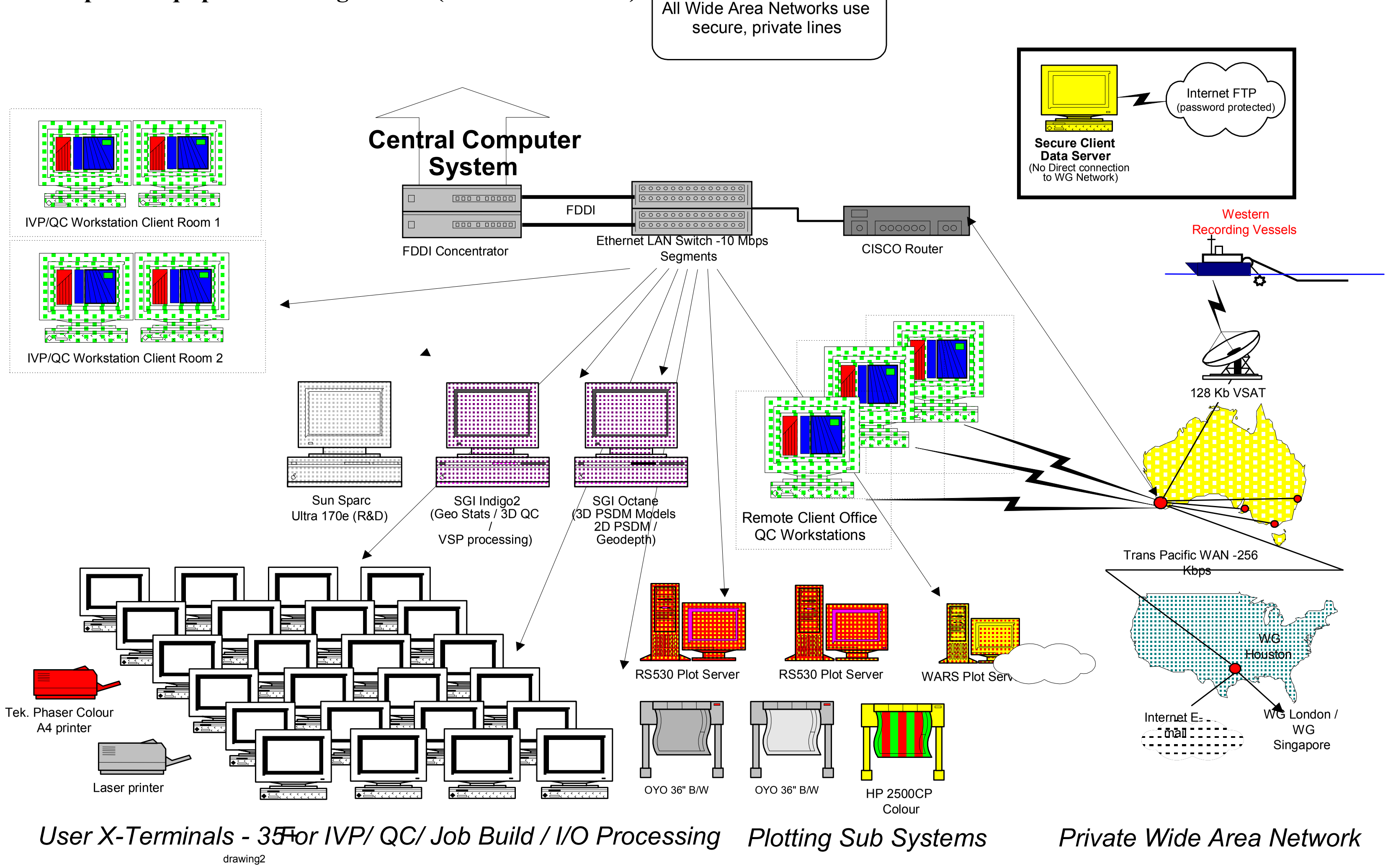
Mr. Ian Reid	General Manager, Exploration	Project Co-Ordination and Quality Control
Mr. Andrew Adams	Commercial Manager	Project Co-Ordination and Quality Control
Mr. Henry Askin	Technical Advisor	Technical and parameter Quality Control

4.2 EQUIPMENT

Figure 5: Computer Equipment Configuration (Perth)



Computer Equipment Configuration (Perth & environs)



5 PRODUCTION PROCESSING SEQUENCE

Details of the processing flow, in the order that they were applied, are described below.

5.1 POLARITY

Recording polarity was maintained throughout the processing sequence.

5.2 REFORMAT SEGD TO OMEGA

The basic function of the tape transcription process was to reformat field tape data to WG Omega format. The 2944 trace demultiplexed data, in SEG-D format, was converted to WG Omega format. Full word, 32 bit floating point data at hydrophone amplitude was maintained.

5.3 GUN & CABLE DATUM CORRECTION

A total +4.4ms bulk static was applied to the data to correct for the gun and cable datum correction (+10ms) and the filter delay (-5.6ms).

5.4 TIDAL STATICS UPDATE

Tidal height predictions table for the Vic/P42 location was supplied by the client. Static corrections were calculated from these tide prediction table with 1500 m/sec water velocity and were updated into the trace headers and applied later in the processing flow. The tidal static corrections for the survey were found to be less than 0.5ms.

5.5 SEISMIC/NAVIGATION MERGE

Header information provided by the source/receiver location UKOOA datasets were merged with the seismic data.

5.6 3D GRID DEFINE

A 6.25 m X 25 m grid is applied to the data using the navigation x-y coordinates

5.7 TRACE EDIT

Records and traces flagged as bad in the observer's logs were edited from the processing sequence

5.8 GEOMETRIC SPEADING

To correct for spherical spreading, the inverse of the amplitude factor (A) was applied to the data gathers where $A = 1(/T*(V^2))$, T being the two-way time and V being RMS velocity.
Velocities supplied by BSOC from previous nearby surveys were used for this correction.

5.9 EXPONENTIAL GAIN

An exponential gain of 3dB per second to 4 seconds was applied to the data gathers.

5.10 MINIMUM PHASE WAVELET SHAPING

A source signature was obtained from the acquisition vessel. This was then shaped to a minimum phase wavelet and the shaping operator is then applied to the data via wavelet convolution.

5.11 DATA RESAMPLE

The data was resampled from 2 ms to 4 ms. A zero phase anti-alias filter with a high cut of 93.75 Hz (3/4 Nyquist) with a slope of 36 dB/oct was applied prior to resample.

5.12 LOW CUT BANDPASS FILTER

A low cut filter of 2 Hz (18dB/oct) was applied to attenuate the low frequency bias from the data.

5.13 NORMAL MOVEOUT

NMO was applied using a velocity 3D field derived from previous nearby surveys supplied by BSOC.

5.14 SWELL NOISE ATTENUATION (SWATT)

During acquisition some lines showed significant noise, which was attributed to sea swell. This noise was attenuated with the use of SWATT. SWATT transforms the data into the frequency domain and then applies a median filter. Frequency bands that deviate from the median amplitude by a specified threshold are replaced with good frequency bands from a neighboring trace.

Frequency Bands	0-10Hz	Incrementing at 2Hz
Threshold	**Time**	**Percentage**
	0ms	400%
	6000ms	400%

5.15 INVERSE NORMAL MOVEOUT

The BSOC supplied 3D velocity function NMO was removed.

5.16 SHOT RECORD FK FILTERING

This process uses a two dimensional filter to pass specific segments of the shot gather data.
The filter is designed and applied in the frequency - wavenumber (F-K) domain.

Pass Fan:	+/- 3.125 ms/trace (+/- 4000 m/s)
Taper:	6.25 ms/trace Cosine Taper
Reversible AGC:	300 ms
Filter Start Time:	120 ms

5.17 NORMAL MOVEOUT

NMO was applied using a velocity 3D field derived from previous nearby surveys supplied by BSOC.

5.18 ADJACENT TRACE SUM

The 368 trace files from each shot/cable combination were 2:1 adjacent trace summed to form 186 trace files per shot /cable group. The group interval was effectively doubled to 25.0 m after adjacent trace summing.

5.19 3D GRID DEFINE

A 12.5 m X 25 m grid is applied to the data using the navigation x-y coordinates

5.20 2D CMP SORTING

The data volume was sorted from acquired source gathers to 2D common midpoint gathers.

5.21 BRUTE STACK

Selected acquisition inlines of the NMO corrected data were muted to remove first arrivals, early refracted energy, and excessive stretch before being stacked for client Brute Stack QC plots.

5.22 INVERSE NORMAL MOVEOUT

The BSOC supplied 3D velocity function NMO was removed.

5.23 FIRST PASS VELOCITIES

Velocity analyses were generated on a 800m by 800m grid using WesternGeco's Interactive Velocity Processing (IVP). The velocities were picked by WGC and qc'ed by BSOC.

5.24 3D STACK VELOCITY FIELD

3D interpolation of the first pass velocity functions were used to derive a full 3D field.

5.25 NORMAL MOVEOUT

NMO was applied using a velocity 3D field derived from the first pass velocity functions.

5.26 SWELL NOISE ATTENUATION (SWATT)

A second pass of SWATT was applied in the cmp domain to further attenuate noise attributed to sea swell. Due to the change to the cmp domain the noise remaining from the shot domain will become random and therefore easier to remove. SWATT can also be applied over all frequencies with a higher percentage threshold.

Frequency Bands	0-100Hz	Incrementing at 5Hz
Threshold	**Time**	**Percentage**
	0ms	800%
	6000ms	800%

5.27 INVERSE NORMAL MOVEOUT

The first pass 3D velocity function NMO was removed.

5.28 RADON MULTIPLE ATTENUATION

A single pass cascaded parabolic radon multiple attenuation method was selected to suppress multiples. The following parameters were used in the process on CDP gathers:

FPV Velocity Field Percentage:	0s+94%, 1.0s+94%, 1.5s+92%, 5s+85%, 6s+85%
Moveout Time Windows:	0 – 600 ms
Number of p-traces:	121
Maximum frequency:	100 Hz

5.29 RADON STACK

Selected acquisition inlines of the NMO corrected data were muted to remove first arrivals, early refracted energy, and excessive stretch before being stacked for client Radon Stack QC plots. In addition the complete radon stack volume was loaded into WesterGeco's OmegaVu software package for inhouse client QC.

5.30 3D FLEX BINNING

Nominal bin size was 25.0 m (inline) by 12.5 m (crossline), with duplicated trace offsets within any one cell discarded (i.e. the trace with its perpendicular offset nearest to the cell centre was retained). Rectangular bins were used in the flexicell binning process to maintain the nominal 62 fold multiplicity. The following offset bin expansion was used:

Offset (m)	**Crossline Bin Size (m)**	**Inline Bin Size (m)**
100	400	12.5
4750	400	12.5

5.31 DECONVOLUTION (DBS)

Predictive (gapped) deconvolution before stack (DBS) was performed using a single window autocorrelation analysis over the primary zone of interest. The predictive operator was applied on the 2D cmp gathers in a trace by trace process. The operator parameters are as follows:

Number of Windows:	1
Gap:	36 ms
Operator:	200 ms
Removable AGC:	120 ms

5.32 DBS STACK

Selected acquisition inlines of the NMO corrected data were muted to remove first arrivals, early refracted energy, and excessive stretch before being stacked for client DBS Stack QC plots. In addition the complete DBS stack volume was loaded into WesterGeco's OmegaVu software package for inhouse client QC.

5.33 3D COMMON OFFSET SORT

The 2D data volume was sorted to produce 62 common offset cubes.

5.34 INVERSE GEOMETRIC SPEADING

The Geometric Spreading applied in step 5.7 is remove with the inverse function derived from the same RMS velocities.

5.35 TARGETED KIRCHHOFF PRE STACK TIME MIGRATION (PSTM)

The data was pre stack migrated in the common offset domain with a Kirchhoff algorithm using the first pass 3D velocity field. The output from the migration was limited to preselected velocity inlines to enable a second pass velocity analysis on the migrated gathers.

Type of ray path computation:	Curved
Time aperture:	3500 ms
Maximum aperture radius:	4000 metres
Maximum migration dip:	45 degrees

5.36 SECOND PASS VELOCITIES

Velocity analyses were generated on a 800m by 800m grid using WesternGeco's Interactive Velocity Processing (IVP). The velocities were picked by WGC and qc'ed by BSOC.

5.37 3D STACK VELOCITY FIELD

3D interpolation of the second pass velocity functions were used to derive a full 3D field.

5.38 KIRCHHOFF PRE STACK TIME MIGRATION (PSTM)

A full volume Kirchhoff PSTM was performed on the offset gathers using the second pass 3D velocity field and the same parameters as in the targeted PSTM.

Type of ray path computation:	Curved
Time aperture:	3500 ms
Maximum aperture radius:	4000 metres
Maximum migration dip:	45 degrees

5.39 THIRD PASS VELOCITIES

Velocity analyses were generated on a 400m by 400m grid using WesternGeco's Interactive Velocity Processing (IVP). The velocities were picked by WGC and qc'ed by BSOC.

5.40 3D STACK VELOCITY FIELD

3D interpolation of the third pass velocity functions were used to derive a full 3D field.

5.41 3D CMP SORTING

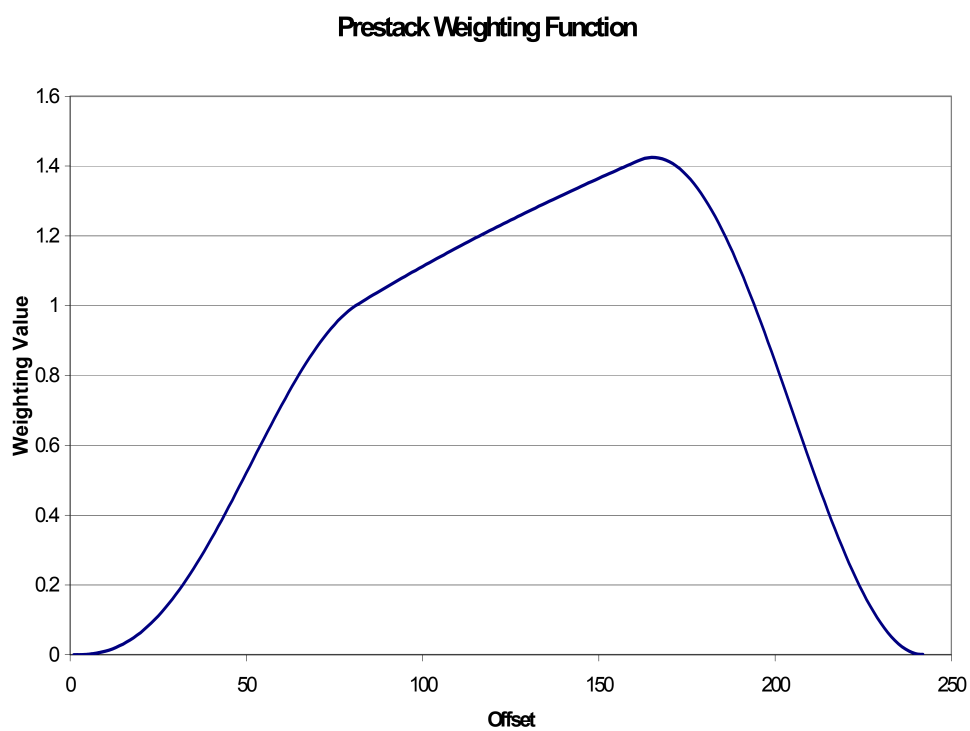
The data volume was sorted from common offset cubes to 3D common midpoint gathers.

5.42 NORMAL MOVEOUT

NMO was applied using a velocity 3D field derived from the third pass velocity functions.

5.43 PRE-STACK SCALING (FULL STACK VOLUME ONLY)

Prestack weighting was applied to the NMO corrected cmp gathers prior to final stacking. The weighting function is based on the standard weighting function illustrated below. The shape of the weighting function varies with time as it is stretched or compressed with the changing distance between the inside and outside mute functions.



5.44 MUTE AND STACKING

After NMO correction of the data muting was applied to remove first arrivals, early refracted energy, and excessive stretch before final stacking.

Mute for PSTM Flow

Outside Trace Mute:	Offset (m)	Time (ms)
	206	0
	281	259
	510	400
	1385	1000
	4606	3290
	4830	3500
	4985	4000
Inside Trace Mute:	**Offset (m)**	**Time (ms)**
	200	450
	285	500
	295	1500
	585	2200
	590	2900
	1300	3200
	1335	6000

In addition to the full stack volume a series of AVO stack volumes of predetermined near, mid and far angle ranges are created. These AVO stacks are created from unscaled (no Shell weighting) and unmuted PSTM gathers. They are archived with no 3D FK, DAS and no time variant filtering and scaling. The selected AVO angle ray paths are calculated using the Dix approximation:

Angle Stack Volume	AVO Angle
Near	5 to 14 degrees
Mid	14 to 23 degrees
Far	23 to 32 degrees

5.45 3D FK FILTERING (FULL STACK VOLUME ONLY)

This process helps suppress both incoherent and coherent noise such as the geometry footprint from the stack volume. The geometry footprint manifests itself as kx-ky (wavenumber) peaks within each temporal frequency slice. These peaks are removed from overlapping time-space windows via the application of a notch filter in the f-kx-ky domain. The windows are then merged before being output as a filtered stack volume. This process is only applied from 0 – 500 ms.

5.46 3D TRACE INTERPOLATION

Trace interpolation was performed on the entire stack data volume. Data was interpolated from 12.5m by 25m bins to 12.5m by 12.5m bins using a combination of f-kx-ky (frequency-wavenumber) transform up to the spatial aliasing frequency and a f-x-y (frequency-time) transform beyond the spatial aliasing frequency. The spatial aliasing frequency is determined by the maximum dip of interest. The inline and crossline numbering remains the same except that while the crossline increment is still 1 the inline increment changes from 1 to 0.5.

Stage	**Bin Size (m)** Crossline x Inline
Original	12.5m x 25m
Interpolated	12.5m x 12.5m
Maximum Dip	10 ms/trace

5.47 3D GRID DEFINE

A 12.5 m X 12.5 m grid is applied to the data using the navigation x-y coordinates

5.48 DECONVOLUTION (DAS) (FULL STACK VOLUME ONLY)

Predictive (gapped) deconvolution after stack (DAS) was performed using a single window autocorrelation analysis over the primary zone of interest. The predictive operator was applied on the 3D stack volume in a trace by trace process. The operator parameters are as follows:

Number of Windows:	1
Gap:	36 ms
Operator:	200 ms
Removable AGC:	120 ms

5.49 TIME VARIANT FILTER (FULL STACK VOLUME ONLY)

The following zero phase time variant filter was applied:

Time(ms)	Low Cut(Hz)	Slope(dB/octave)	High Cut(Hz)	Slope(dB/octave)
0	8	36	70	72
1000	8	36	70	72
2000	8	36	60	72
2500	6	36	55	72
3000	6	36	45	72
4000	5	36	40	72
5000	5	36	30	72
6000	5	36	30	72

5.50 TIME VARIANT SCALING (FULL STACK VOLUME ONLY)

The following dual window AGC was applied:

Window (ms)	Mixback
400	30%
2000	70%

5.51 ZERO PHASE CONVERSION

The desired output for the data was a zero phase wavelet. To achieve this, an operator was designed to convert the data from one inline from minimum to zero phase. This operator was then applied to the whole data volume.

5.52 ARCHIVE RENUMBER

Due to the interpolation of the stack volume the inlines and crosslines were renumbered using the following relationship:

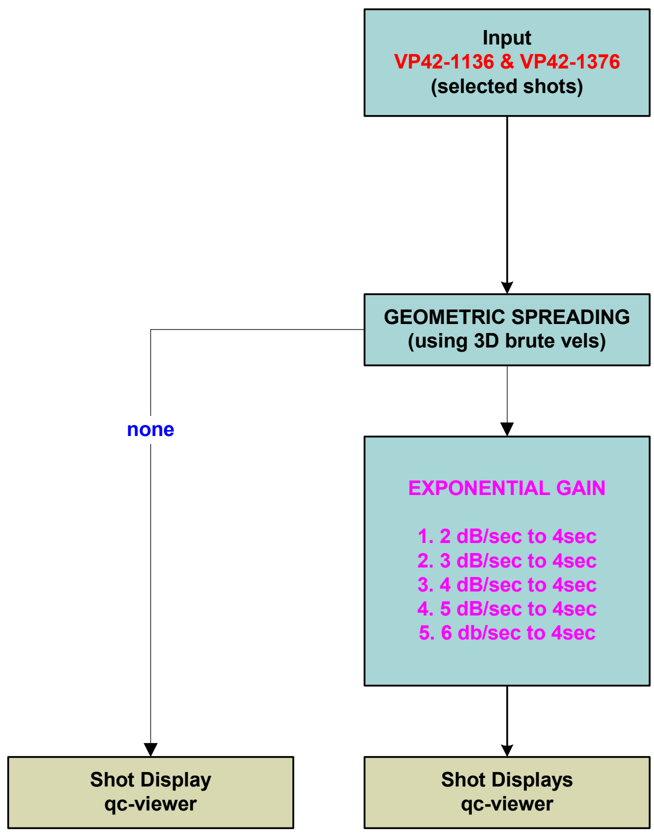
ARCHIVED INLINE = ACQUISITION INLINE *2
ARCHIVED CROSSLINE = ACQUISITION CROSSLINE

6 PARAMETER TESTING

Initial tests on the VIC/P42 3D dataset were performed on acquisition inline numbers 1008, 1136 and 1376.

6.1 EXPONENTIAL GAIN

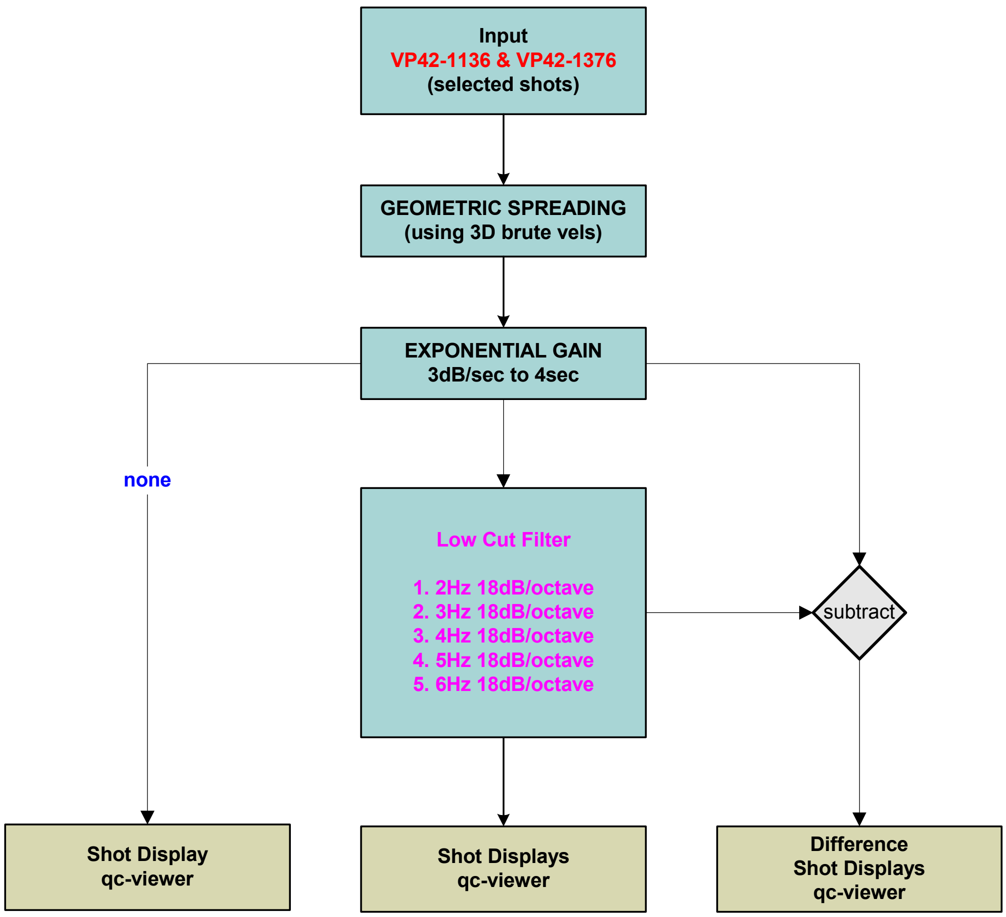
The testing of this parameter was performed on selected shot gathers from test lines.

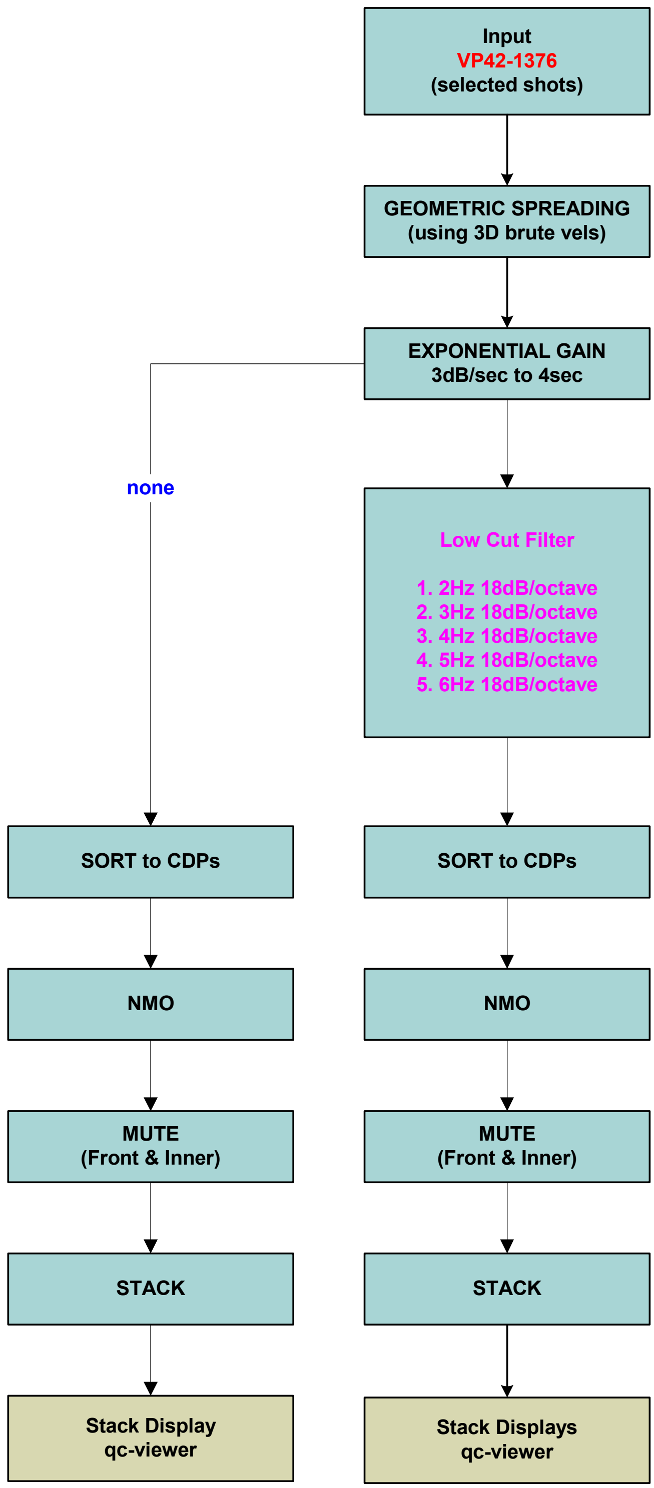


An exponential gain function of 3 dB/sec to 4 seconds was selected for production processing.

6.2 LOW CUT FILTER

The testing of this parameter was performed on both selected shot gathers and the entire stack range for test lines.





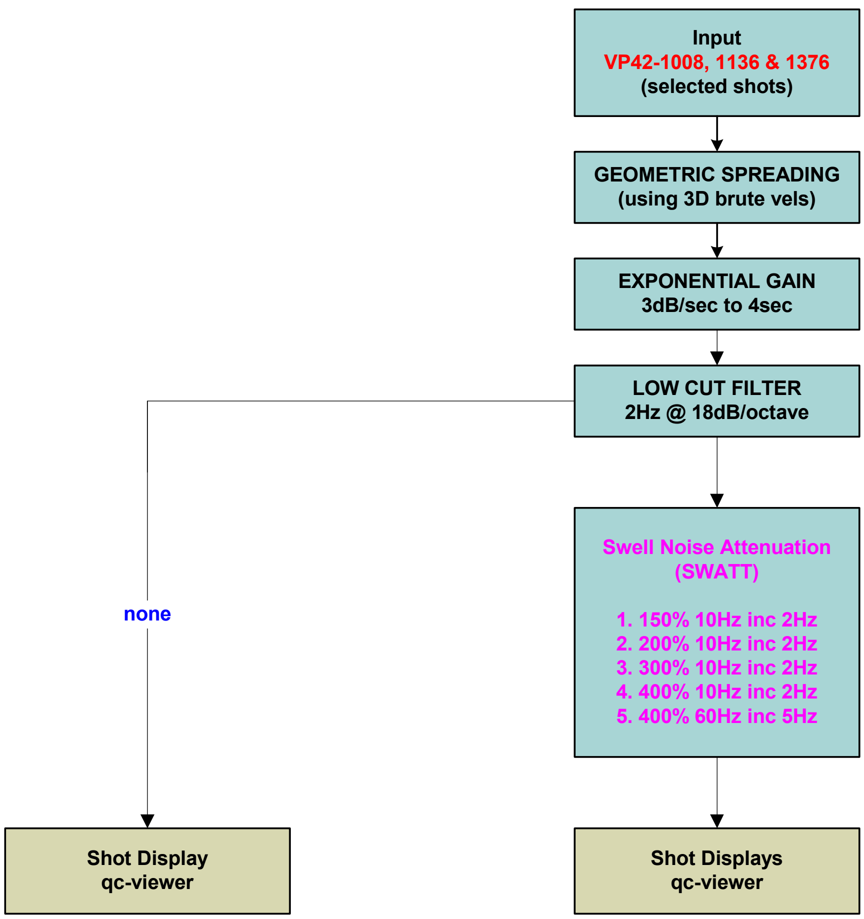
A low cut filter of 2Hz (18dB/octave) was chosen to be applied for production.

6.3 SWELL NOISE ATTENUATION

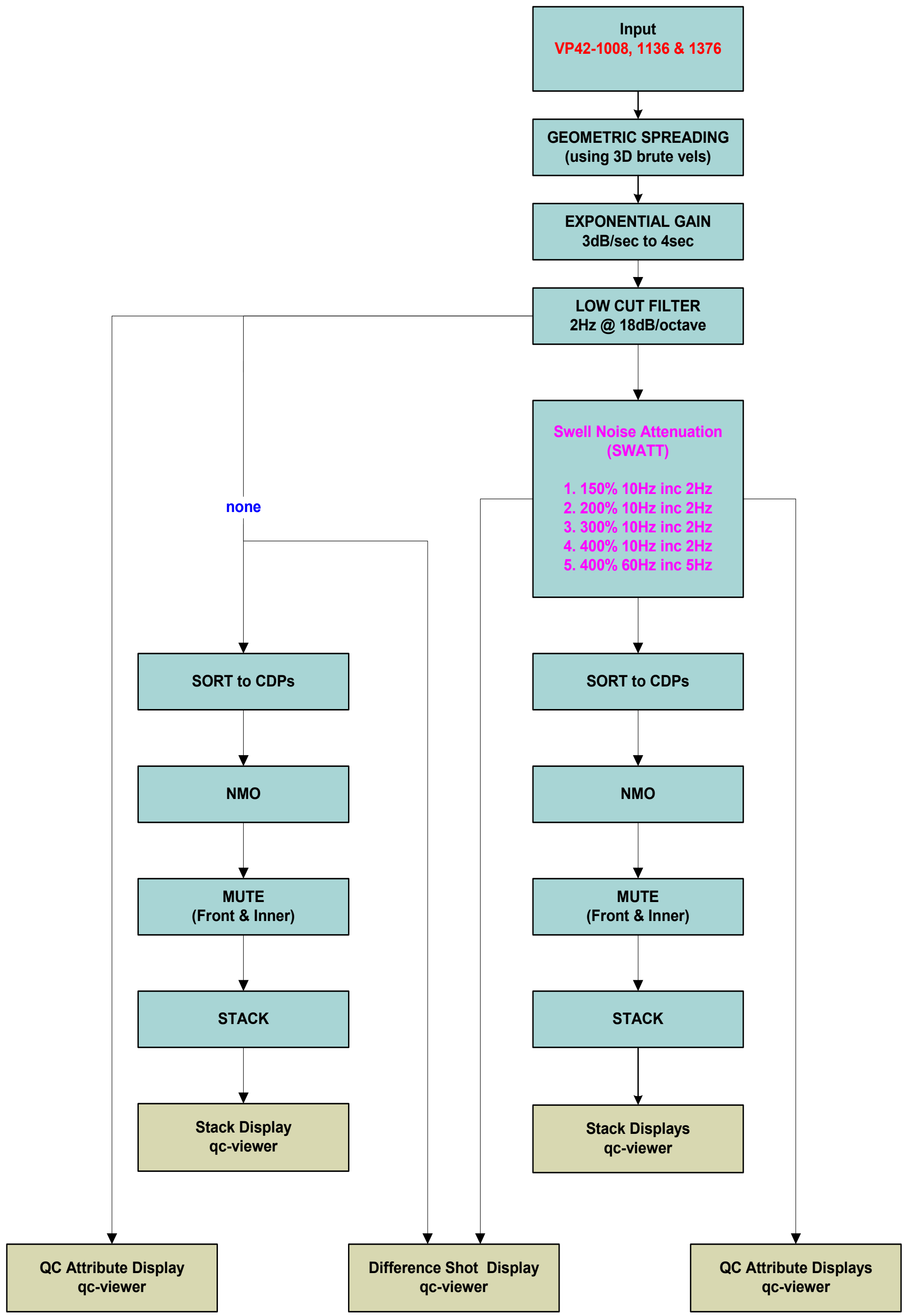
The SWATT processing module was imported from Geco Prakla (Seismos) software into OMEGA, and the following testing flow details attempts at noise attenuation using SWATT.

Initial testing consisted of selected shot gathers from the test lines being processed through SWATT. Various threshold values from 150 % to 400 % were tested (a threshold value of 400 % results in amplitudes greater than 4 times the window average are attenuated).

A the process was tested to a maximum frequency of 10 Hz so as not to cut into signal frequencies (swell noise is unlikely to exist above this frequency on the shot gathers).



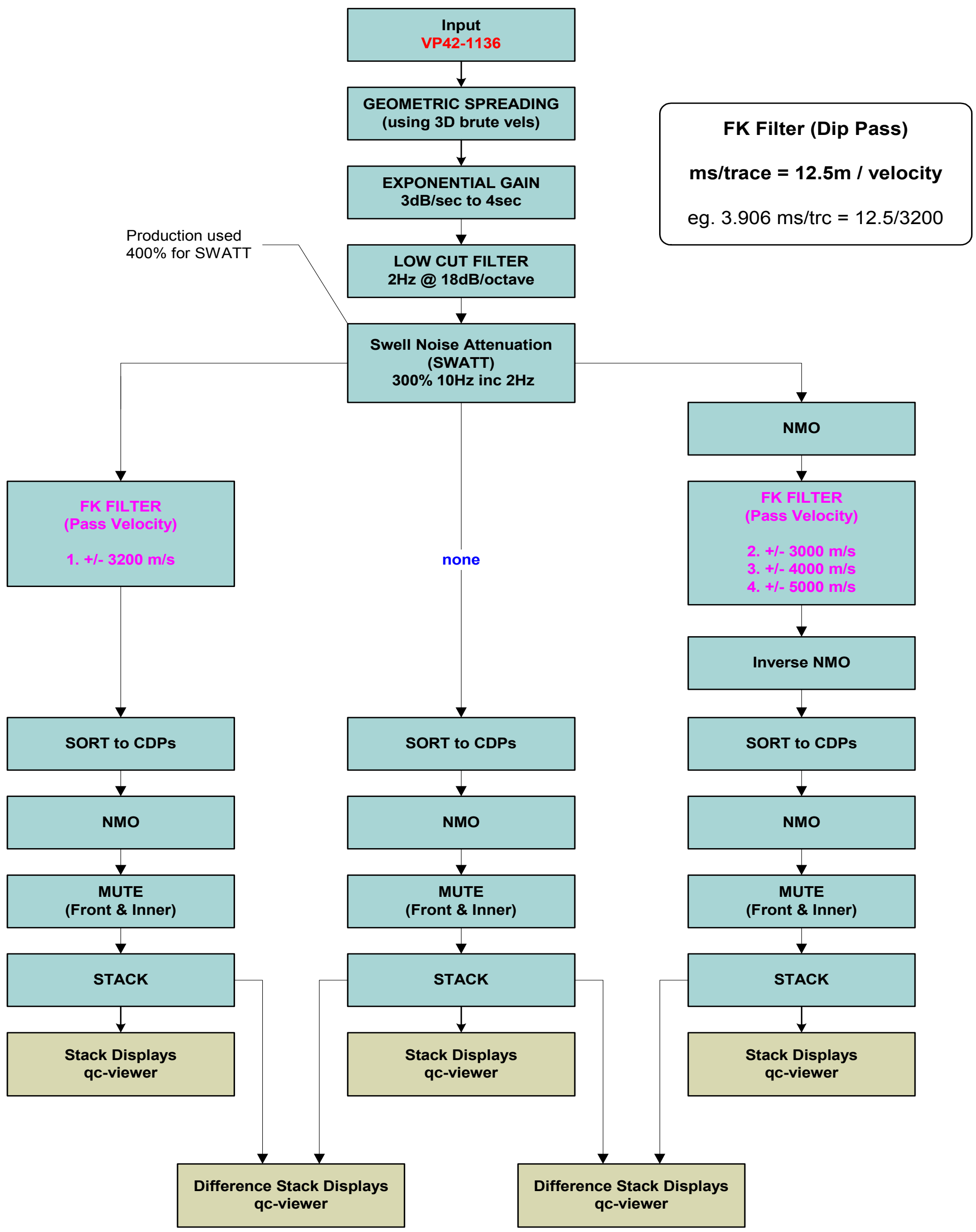
The tests were repeated over the entire shot record range for all test lines and a series of stack displays with accompanying difference plots and QC Attribute displays were produced.



A resulting threshold of 400% over the frequency range of 0 – 10 Hz at an increment of 2 Hz was selected for the production flow.

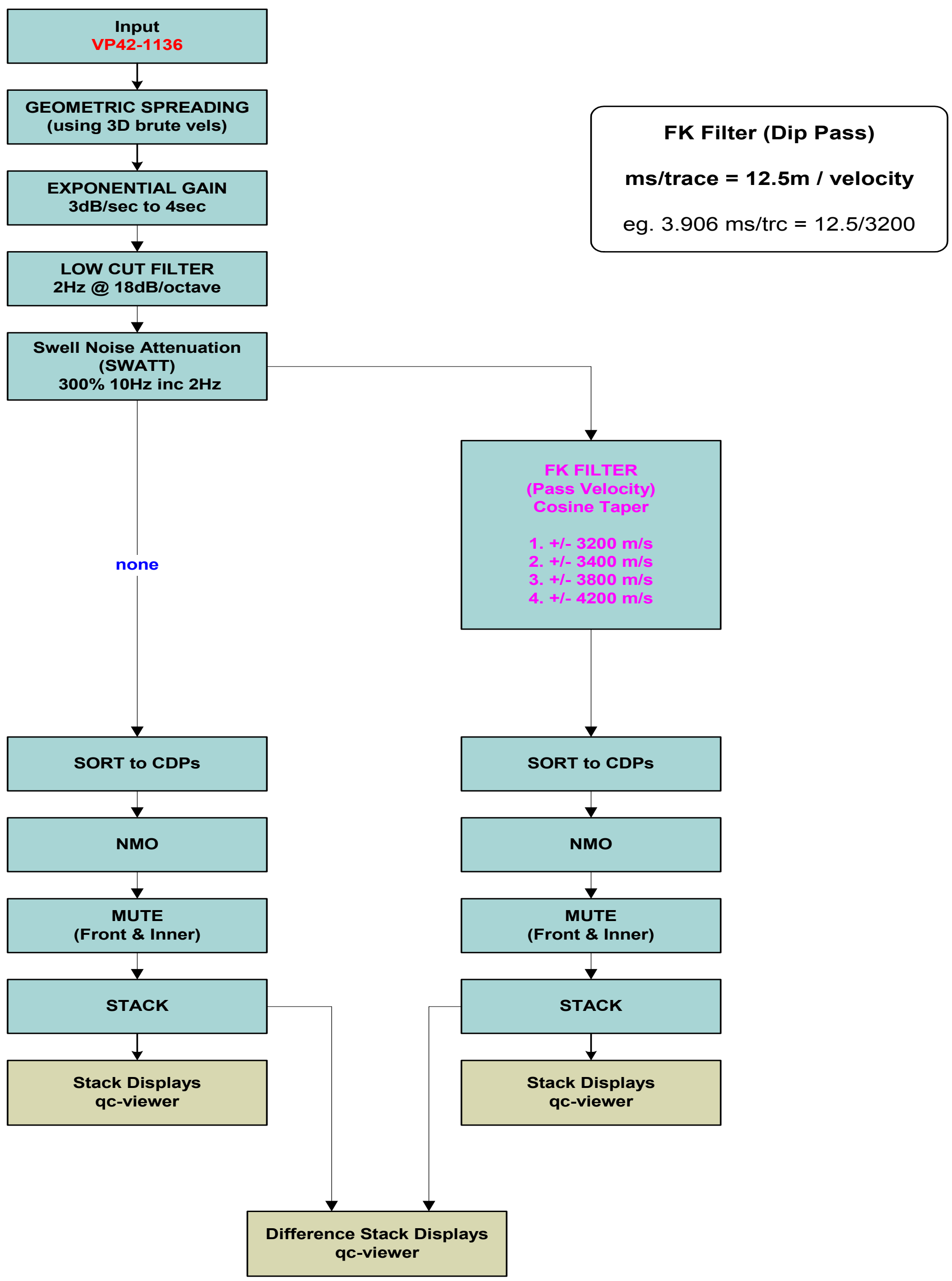
6.4 SHOT FK FILTER

Coherent linear noise is attenuated from the data by using a dip filter based on a pass zone being narrower than the dip of the offending noise. A series of stack displays testing a range of dips (or velocities) were produced for test line 1136.



The initial chosen Shot FK Filter consisted of +/- 3200 m/s with NMO correction from the BSOC supplied velocities.

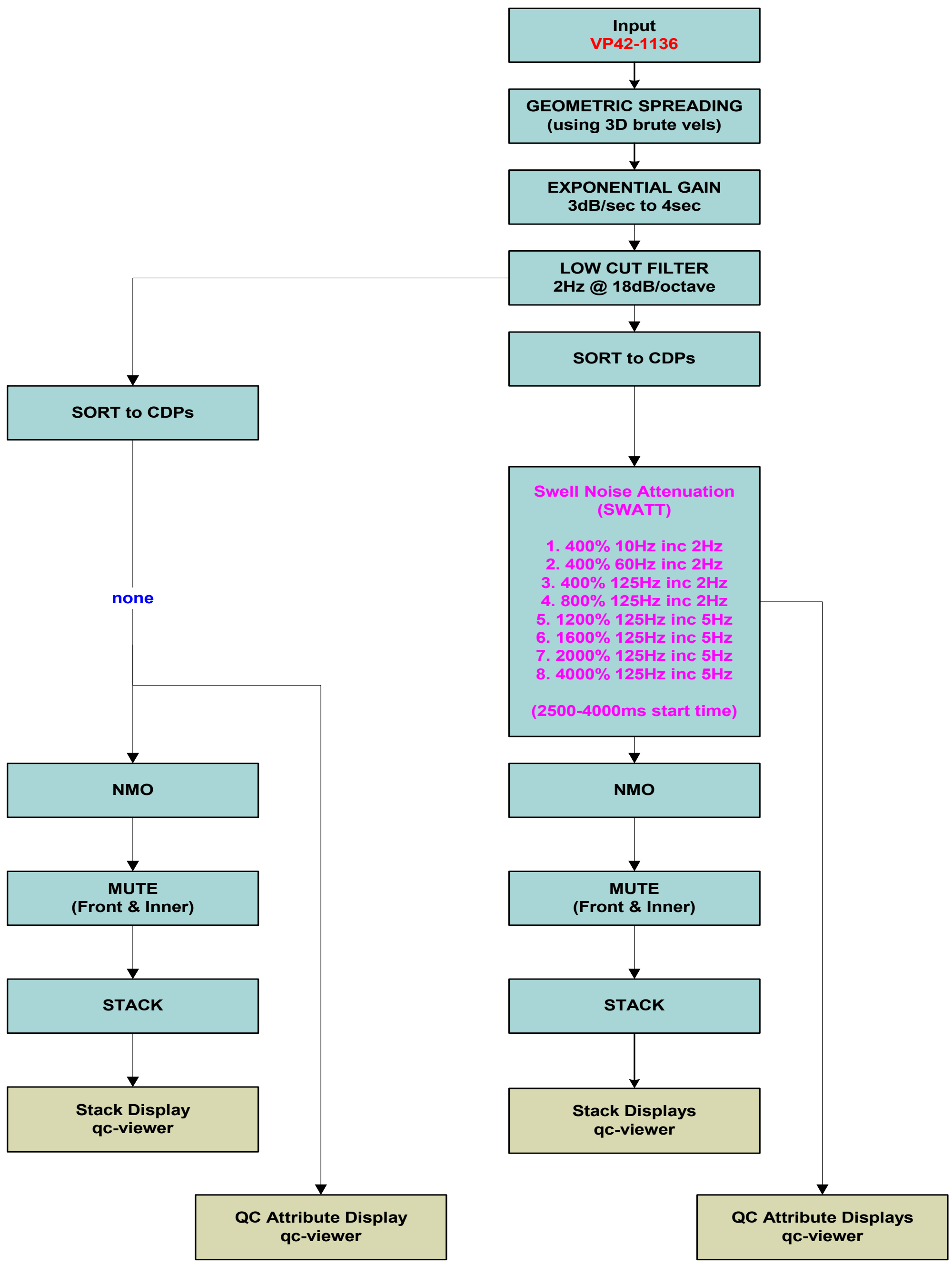
Shot FK Filter was revised due to a noise problem traced back to the NMO correction within the original Shot FK Filter stage.



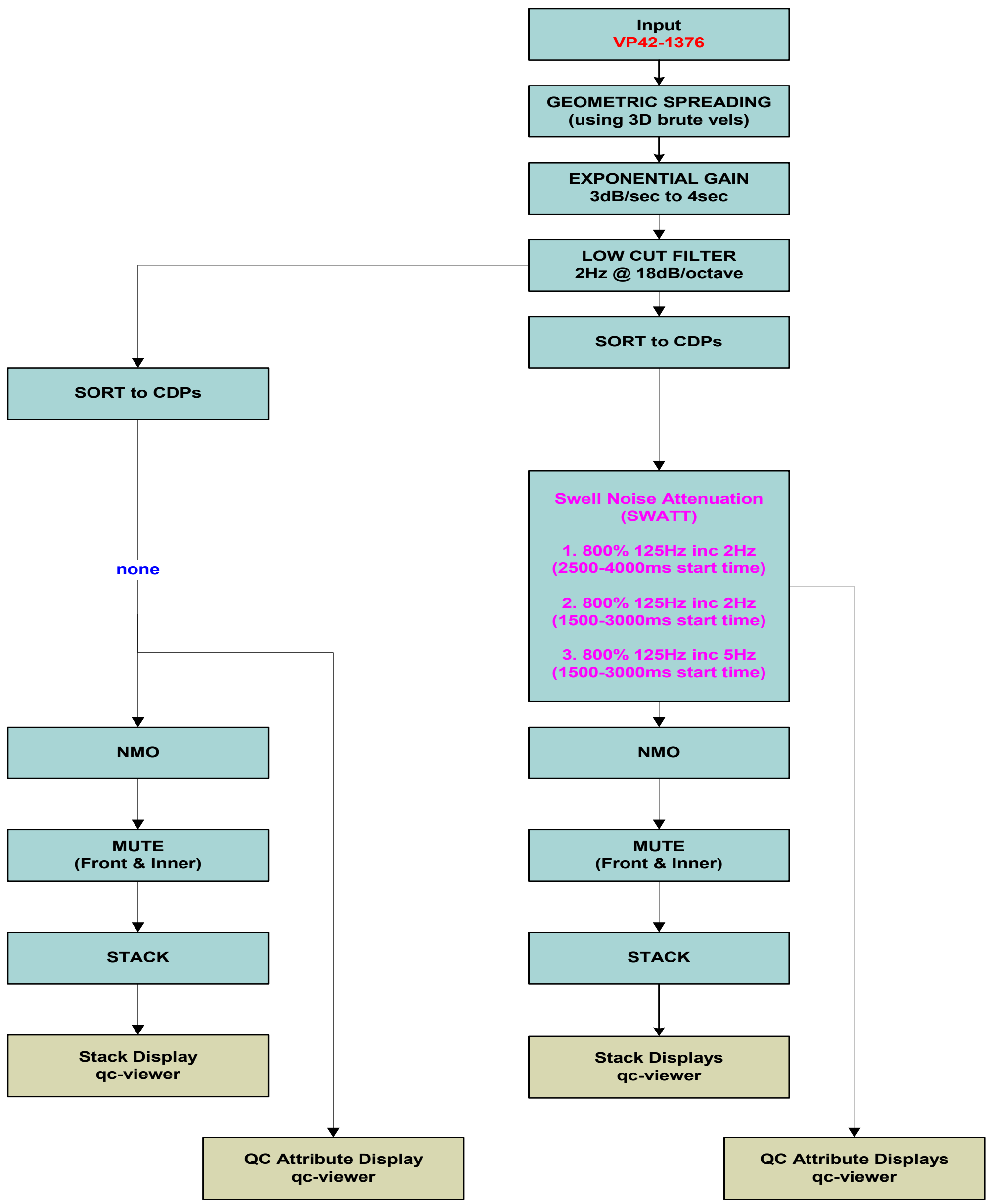
The revised Shot FK Filter consisted of +/- 4000 m/s with No NMO correction.

6.5 SWELL NOISE ATTENUATION (CMP DOMAIN)

When the data was sorted to 2D CMPs is was discovered that high amplitude coherent noise existed in the gathers. Consequently a second pass of SWATT in the CMP domain was tested to provide a solution and remove this noise.



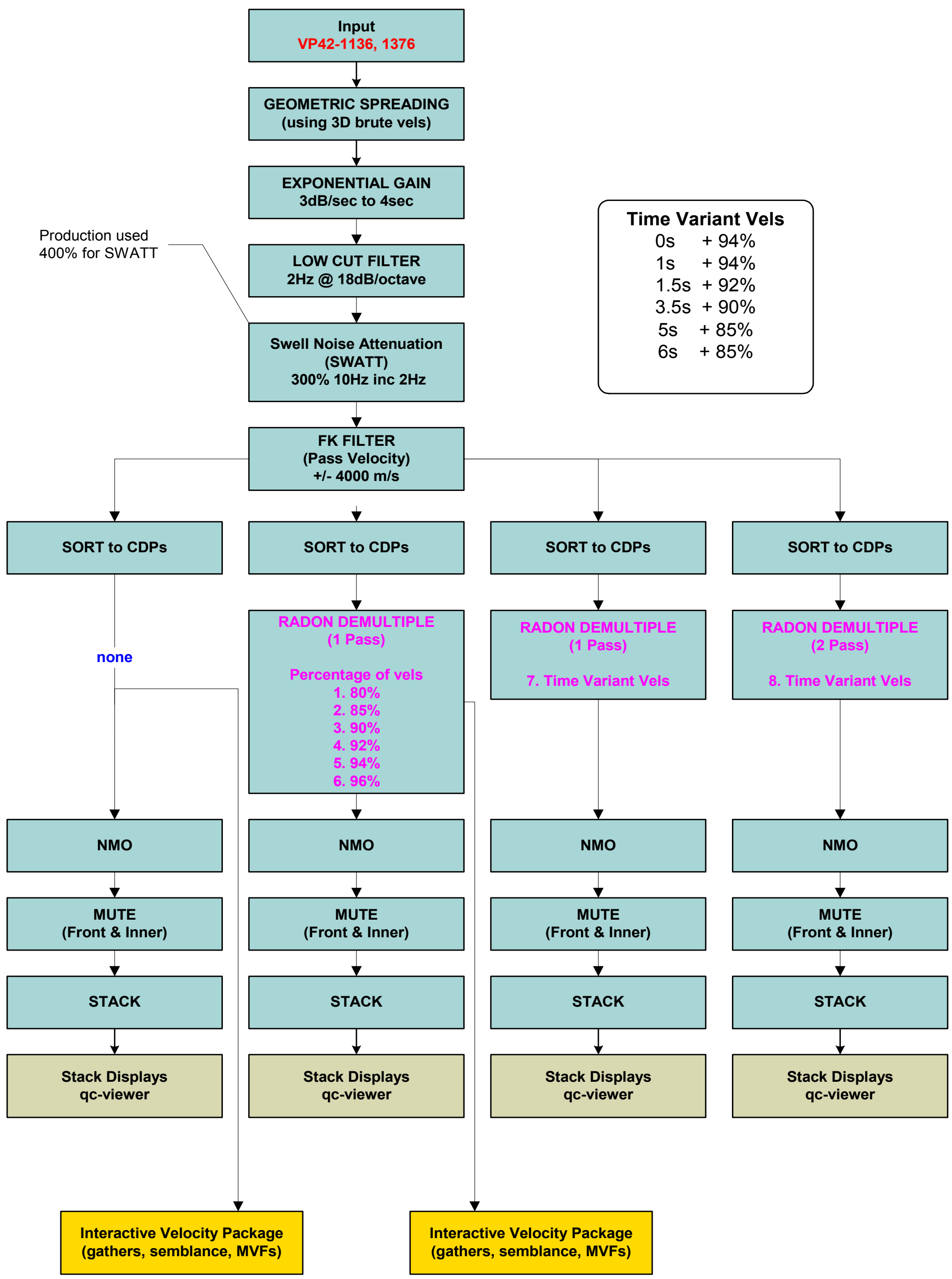
It was found that the threshold value could be increased to 10 times the value used in the Shot domain SWATT (400%) and still attenuated the noise. As a result the frequency range was extended out to Nyquist (125 Hz) so to ensure that all the noise was removed.



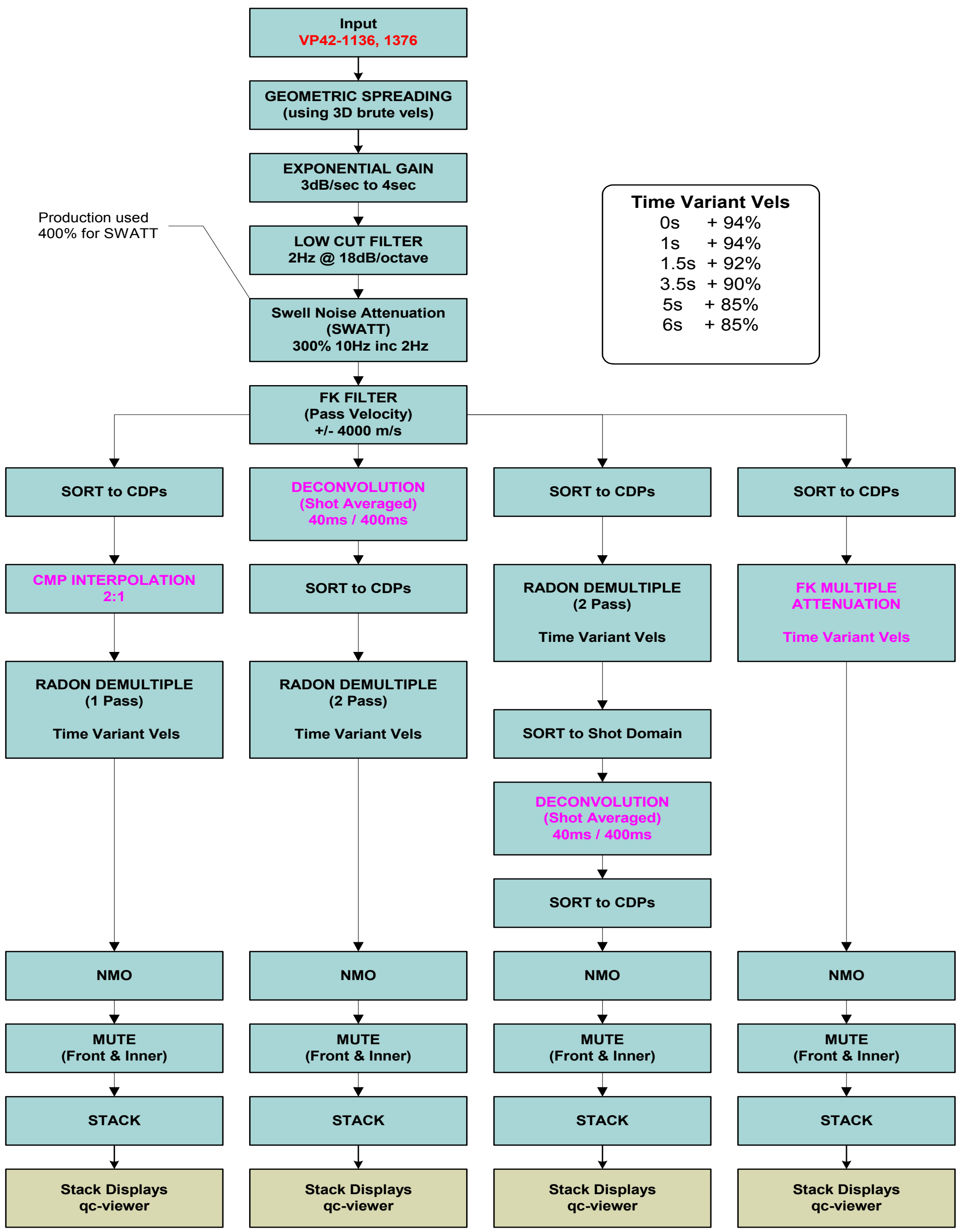
The start time of the SWATT was also adjusted to make sure first arrivals (which are high amplitude) are not attenuated. It was decided that a threshold of 800% over the frequency range of 0 – 100 Hz at an increment of 5 Hz would be selected for production.

6.6 RADON DEMULTIPLE

The initial stage of testing of radon demultiple is to select the percentage variation with time of the pre-radon velocities (first pass velocities). Stack displays are produced as well as loading the individual percentage functions into IVP for semblance analysis comparison of real and multiple events.

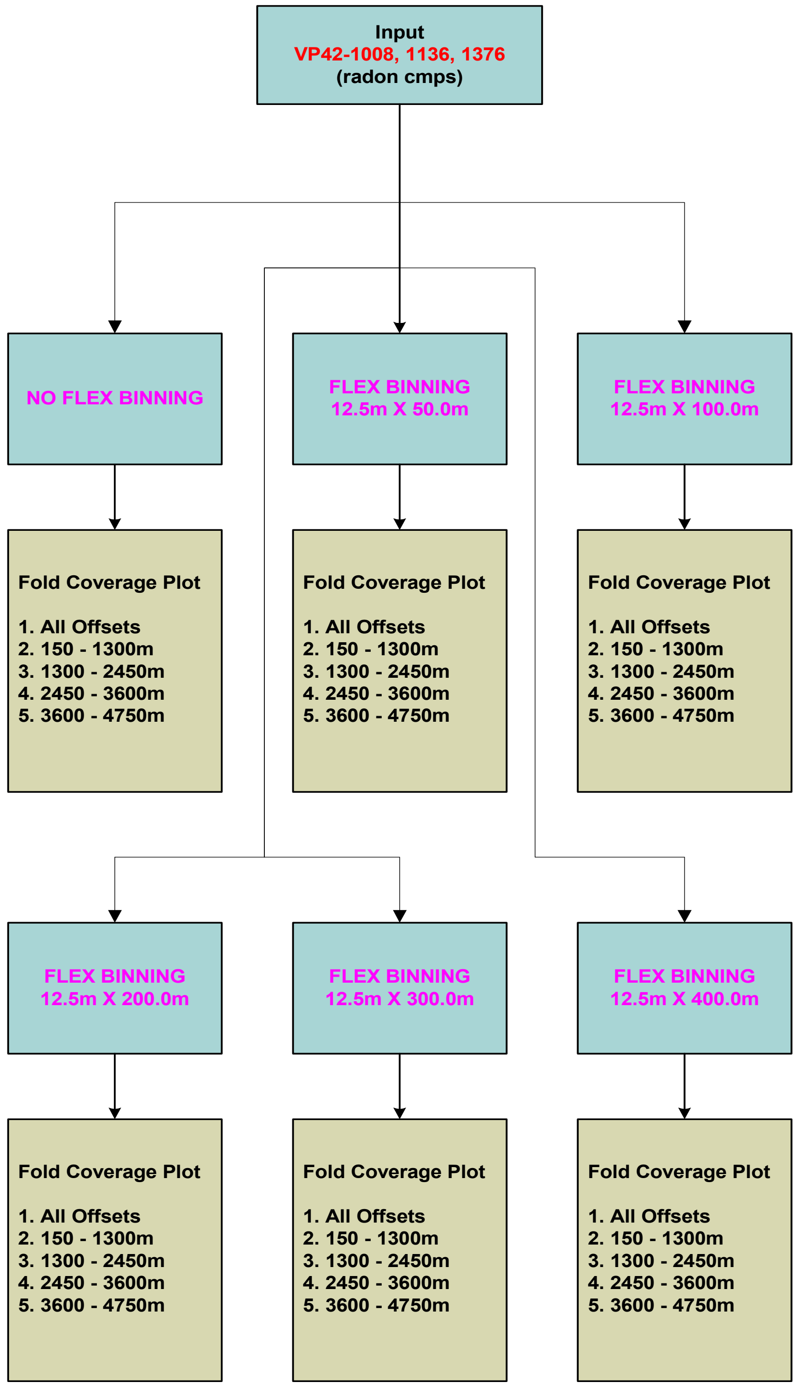


Once the percentage function has been established then the other demultiple parameters can be examined. Issues such as single versus multiple passes, inter-gather interpolation, FK demultiple and whether to run the demultiple process before or after predictive deconvolution.



It was decided to use a single pass of radon demultiple with the time variant percentage velocities to be run before predictive deconvolution.

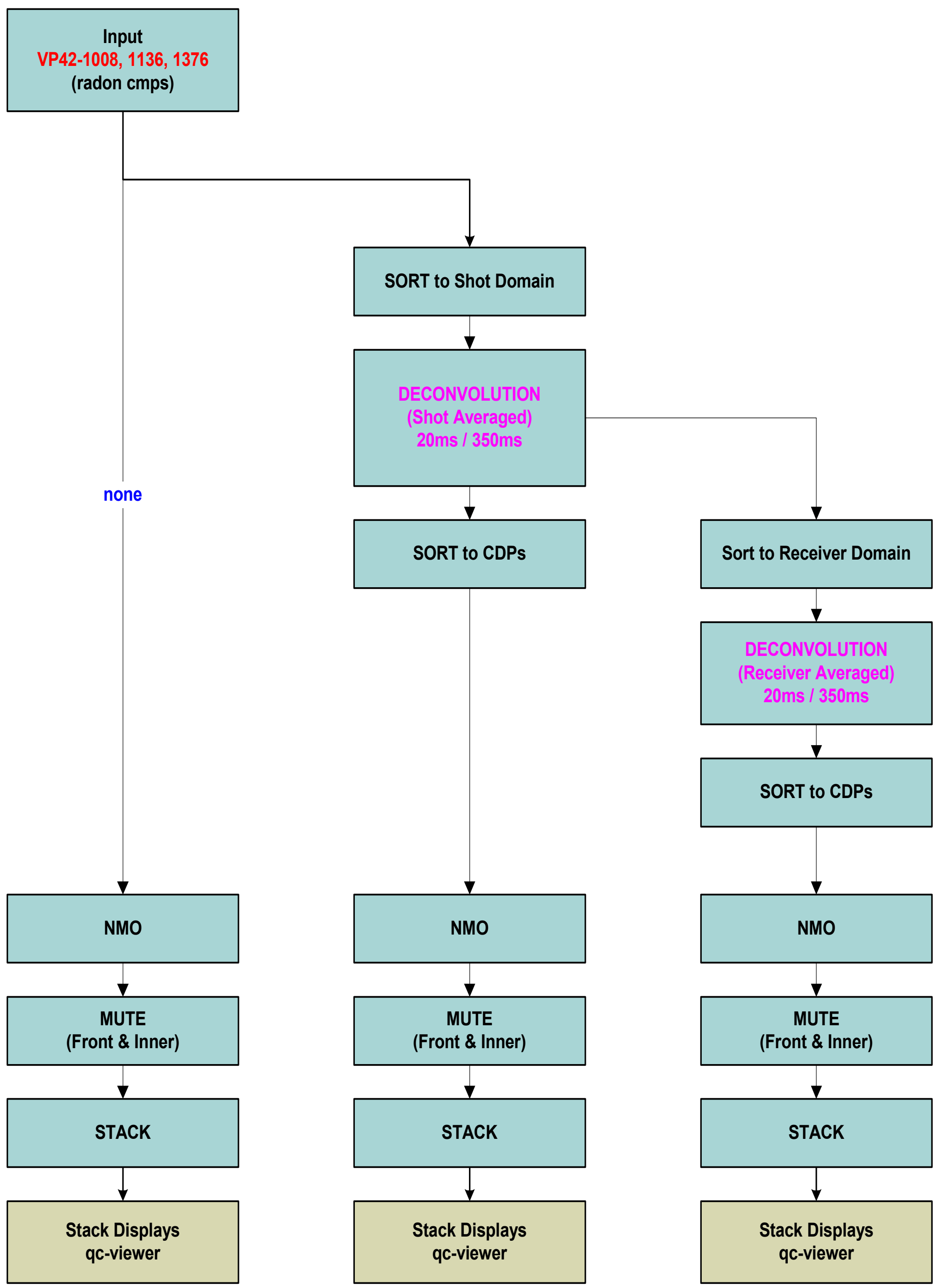
6.7 FLEX BINNING



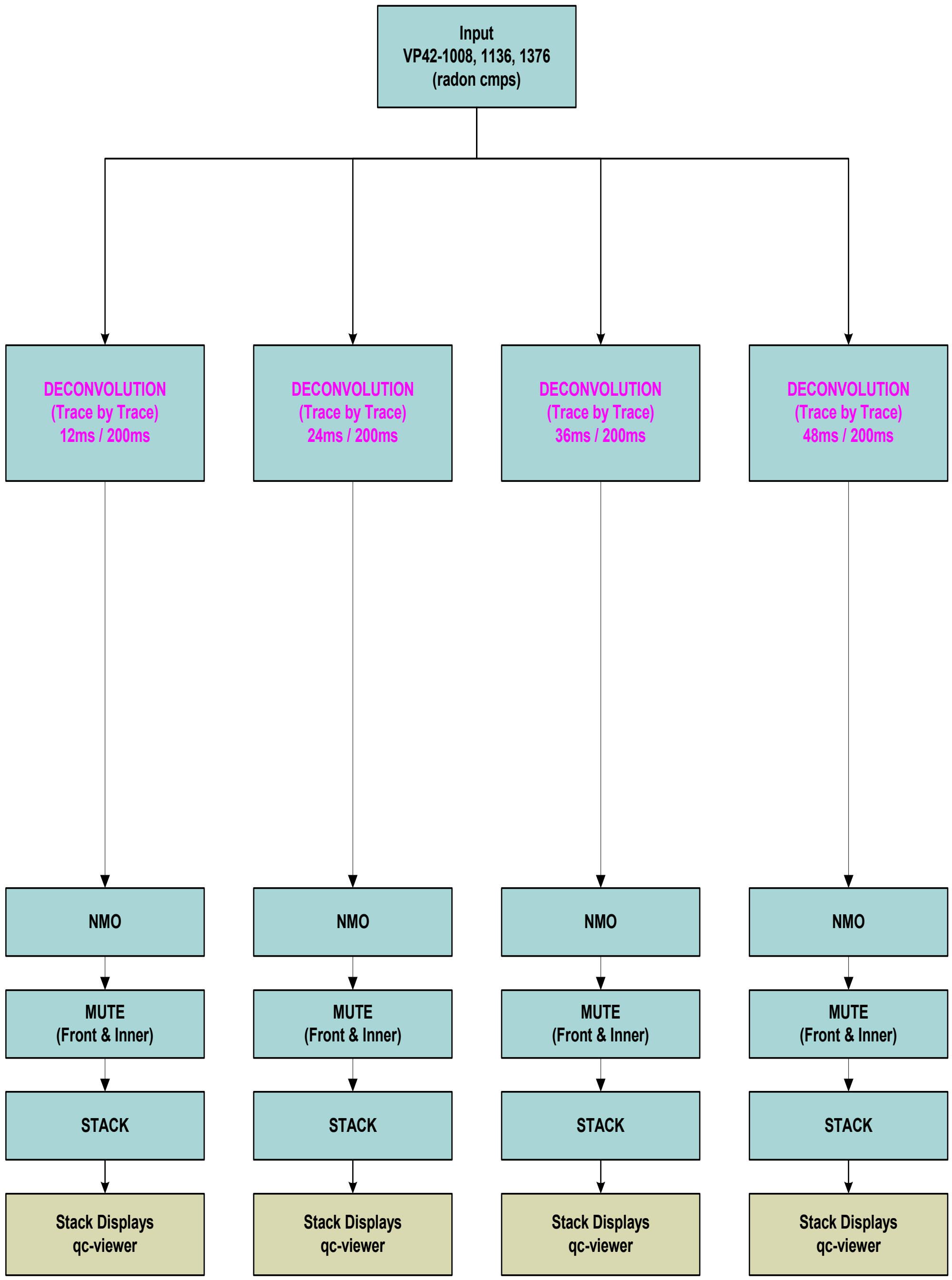
Flex Binning of 12.5m x 400m was selected for production.

6.8 DECONVOLUTION (DBS)

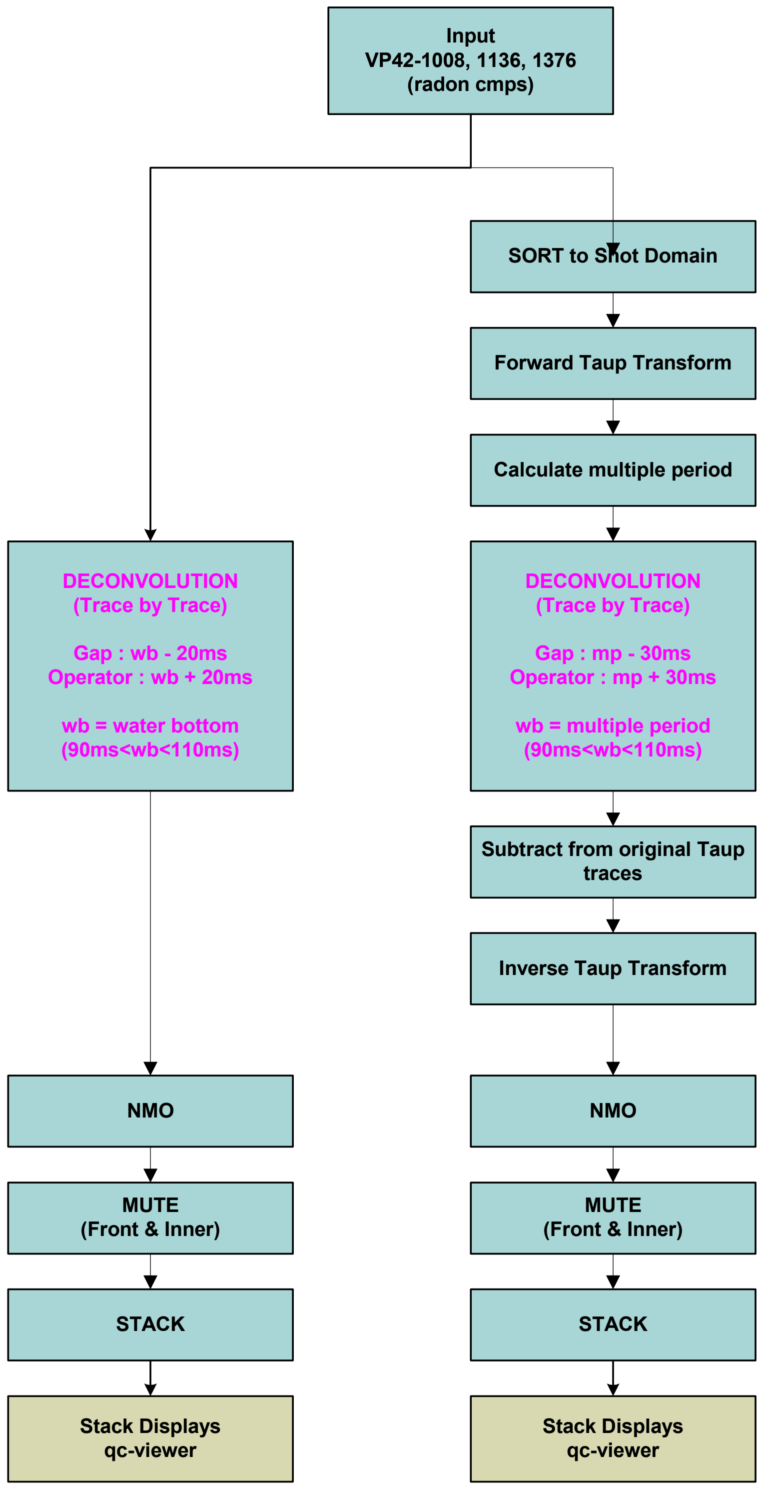
Using the radon CMPs for the test lines the following series of deconvolution stacks were produced. First were the gather averaged (panel) predictive deconvolution stacks.



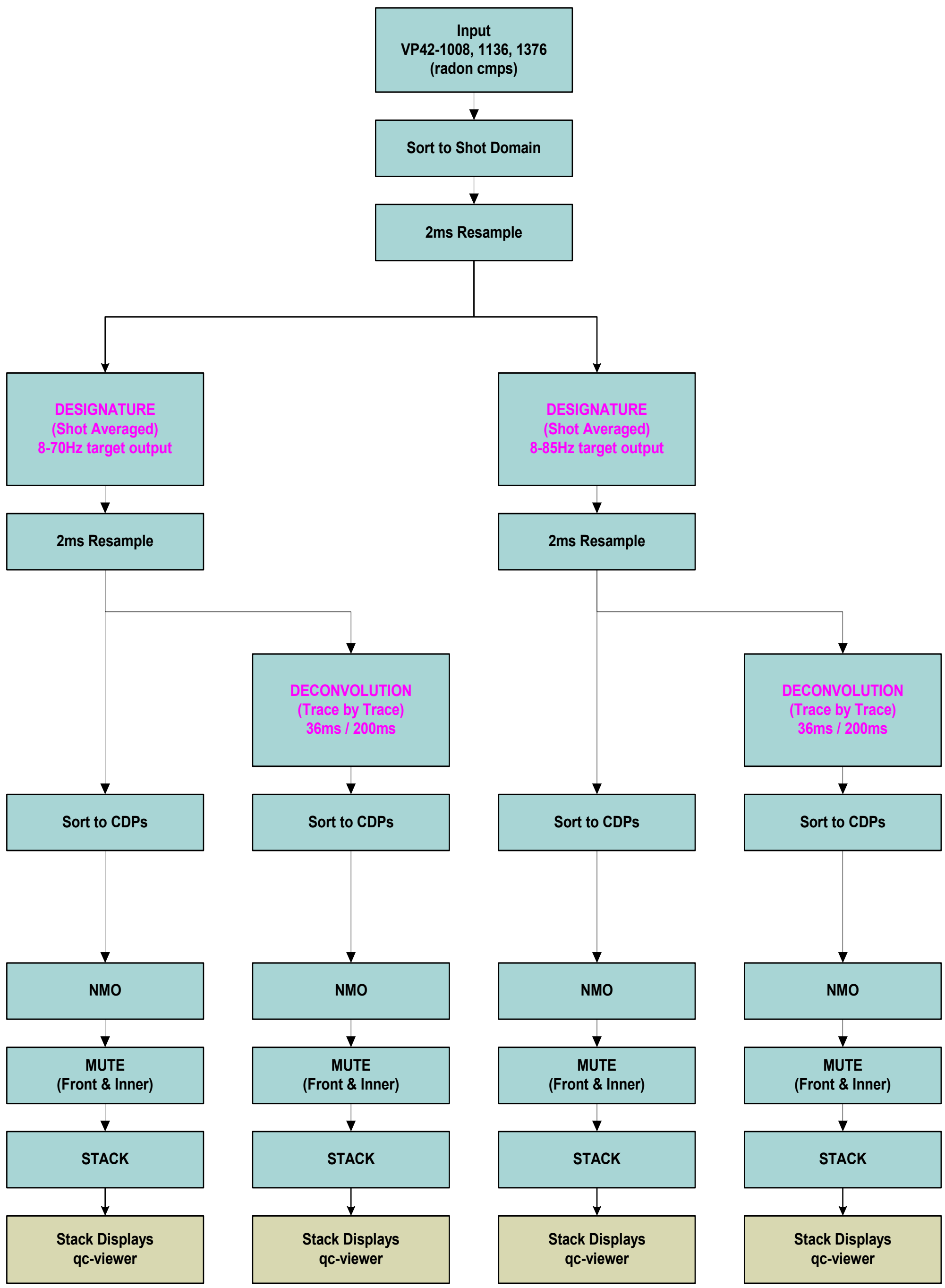
This is followed be the trace by trace predictive deconvolution stacks.



And finally the water bottom derived deconvolution stacks.

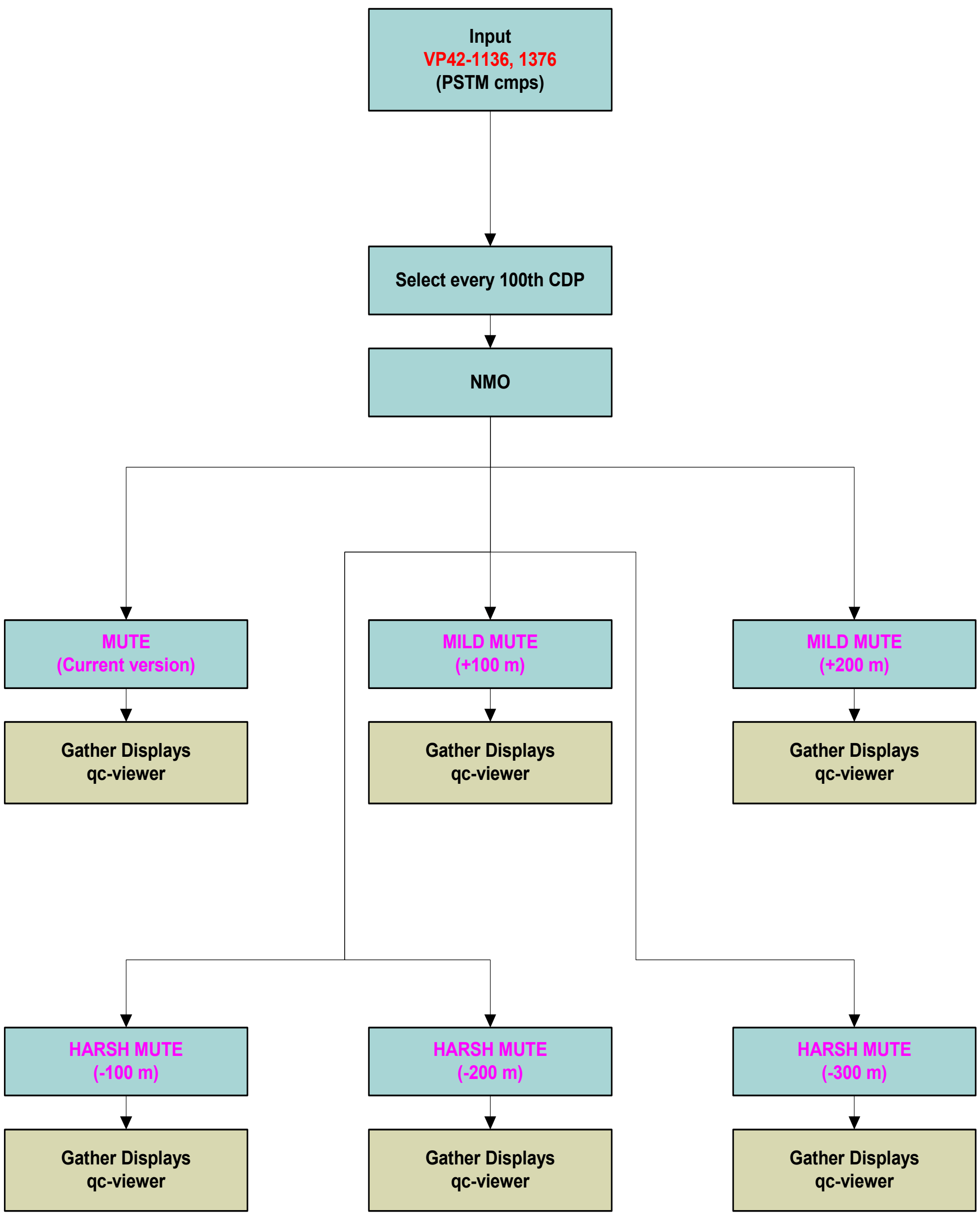


It was decided that a 36 ms gap and 200 ms operator trace by trace predictive deconvolution would by applied to the data. The chosen predictive deconvolution was then preceeded by a targeted signature deconvolution to boost the data spectrum. However this was rejected as an optional process for production as it was considered to introduce noise.

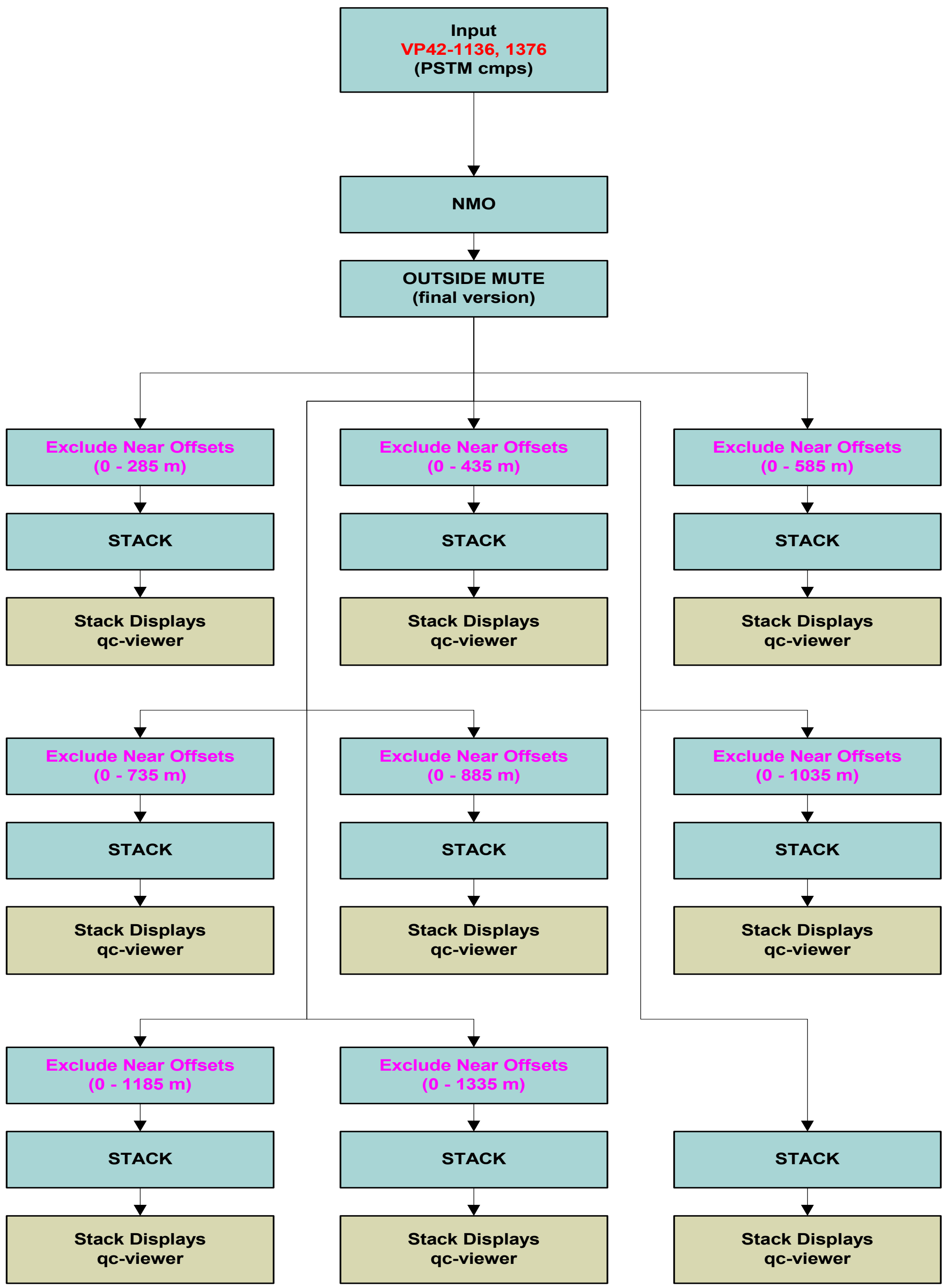


6.9 FINAL STACK MUTE

The current version outside mute function was displayed on the NMO corrected PSTM CMP gathers along with 2 milder and 3 harsher versions of itself. The mild versions were determined by increasing the offset of the function by 100 m increments. The hasher versions were determined by decreasing the offset of the function by 100 m increments. Stack displays were also produced of each mute variation. A final version of the outside mute function was then selected for production.



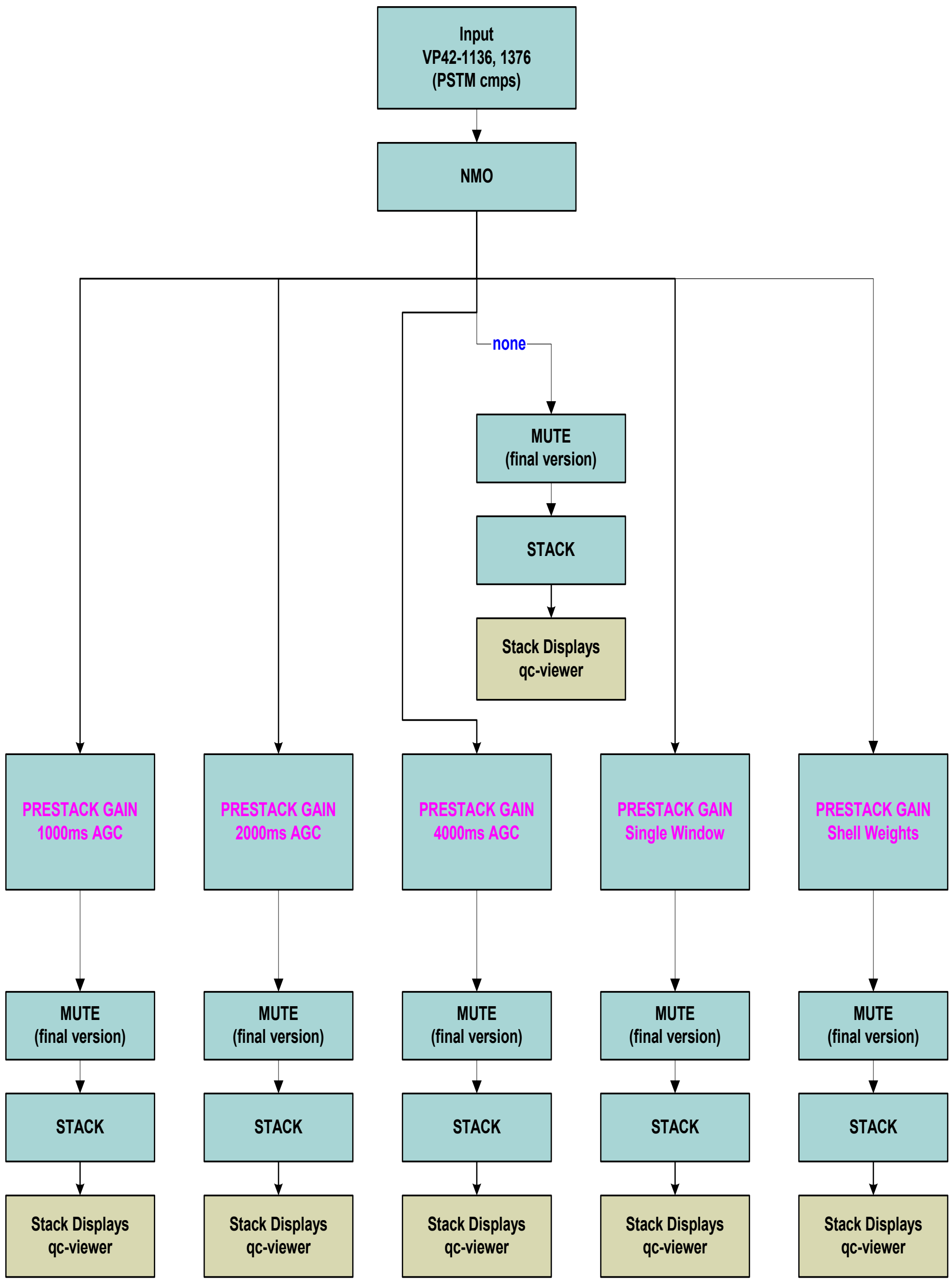
The inside mute function is obtained by creating a series of limited offset stacks where the nearest traces are excluded from the stack displays (using the final outside mute) at increments of 150 m out to approximately one third of the offset range. From these stacks an inside mute function was selected to remove unwanted data signal on the near traces.



Mute for Production

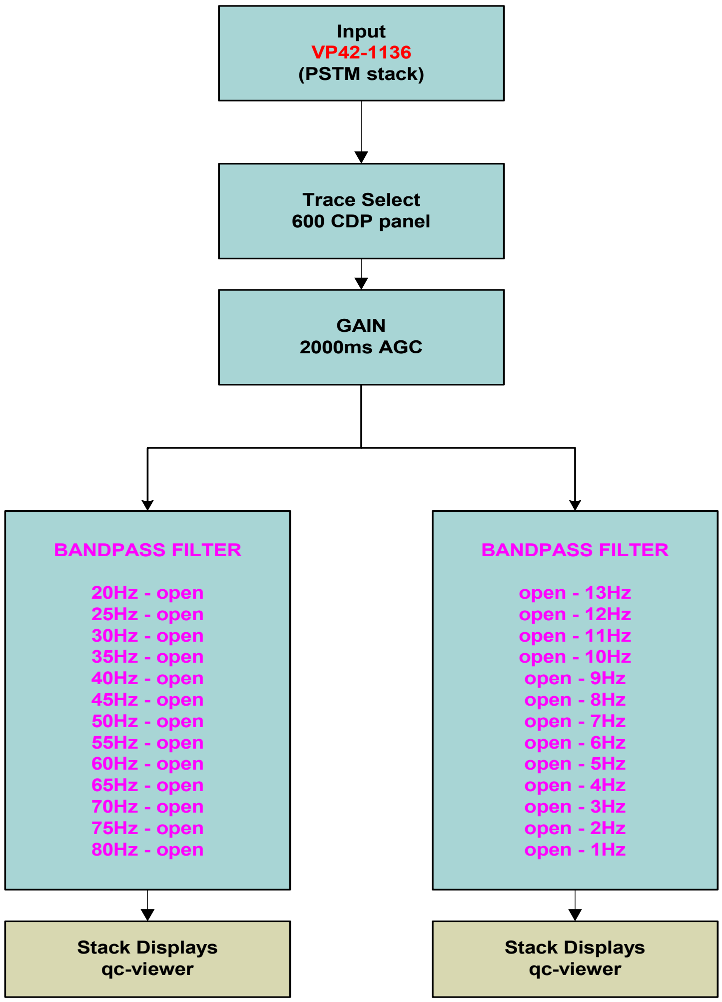
	Offset (m)	Time (ms)
Outside Trace Mute:	**Offset (m)**	**Time (ms)**
	206	0
	281	259
	510	400
	1385	1000
	4606	3290
	4830	3500
	4985	4000
Inside Trace Mute:	**Offset (m)**	**Time (ms)**
	200	450
	285	500
	295	1500
	585	2200
	590	2900
	1300	3200
	1335	6000

6.10 PRESTACK GAIN



The Shell Weights prestack gain option was selected for the production dataset.

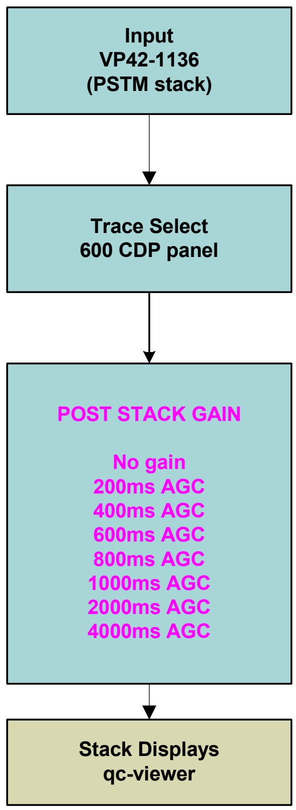
6.11 TIME VARIANT FILTER



Using the above filter panels the following time variant filter was applied:

Time(ms)	Low Cut(Hz)	Slope(dB/octave)	High Cut(Hz)	Slope(dB/octave)
0	8	36	70	72
1000	8	36	70	72
2000	8	36	60	72
2500	6	36	55	72
3000	6	36	45	72
4000	5	36	40	72
5000	5	36	30	72
6000	5	36	30	72

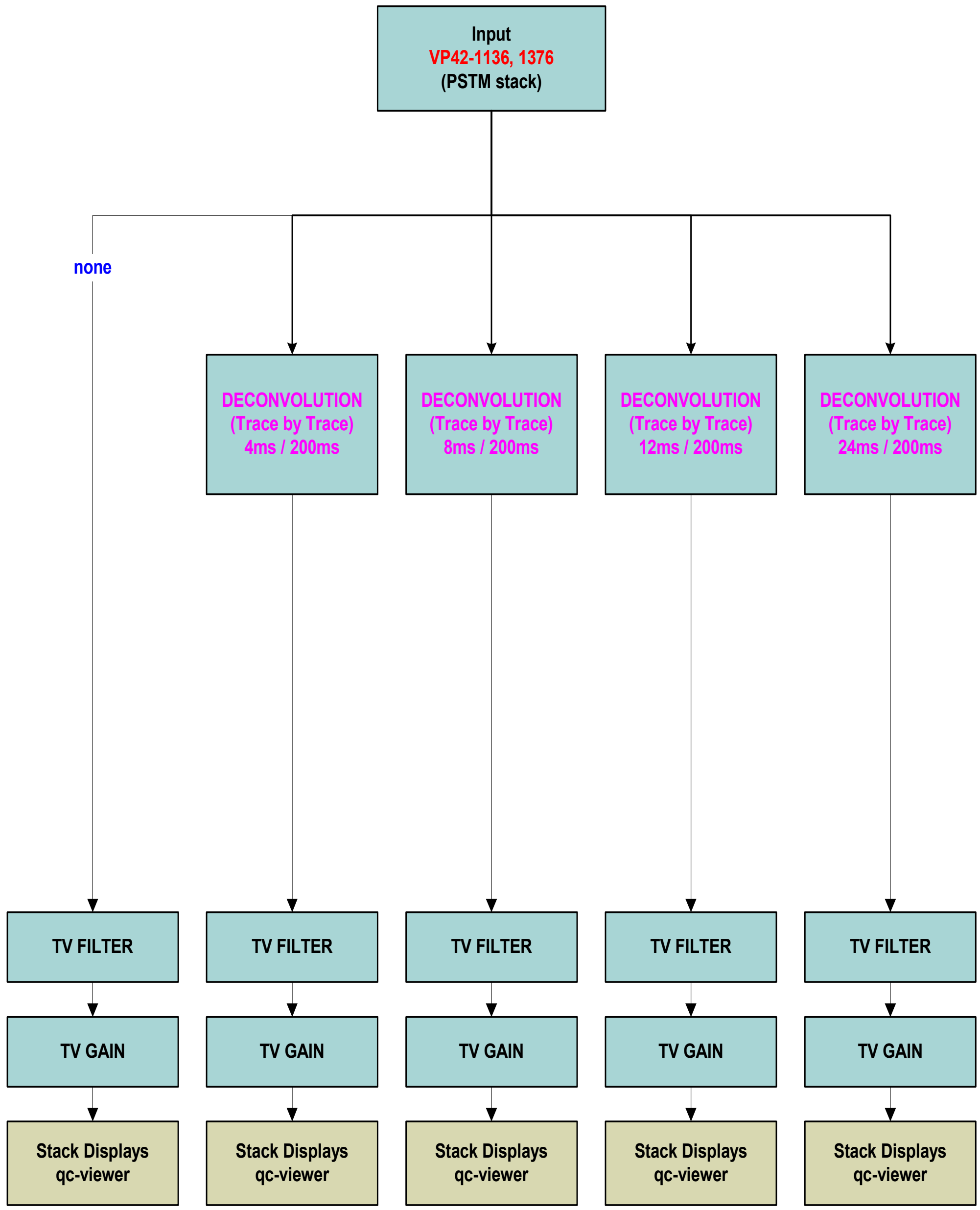
6.12 TIME VARIANT SCALING

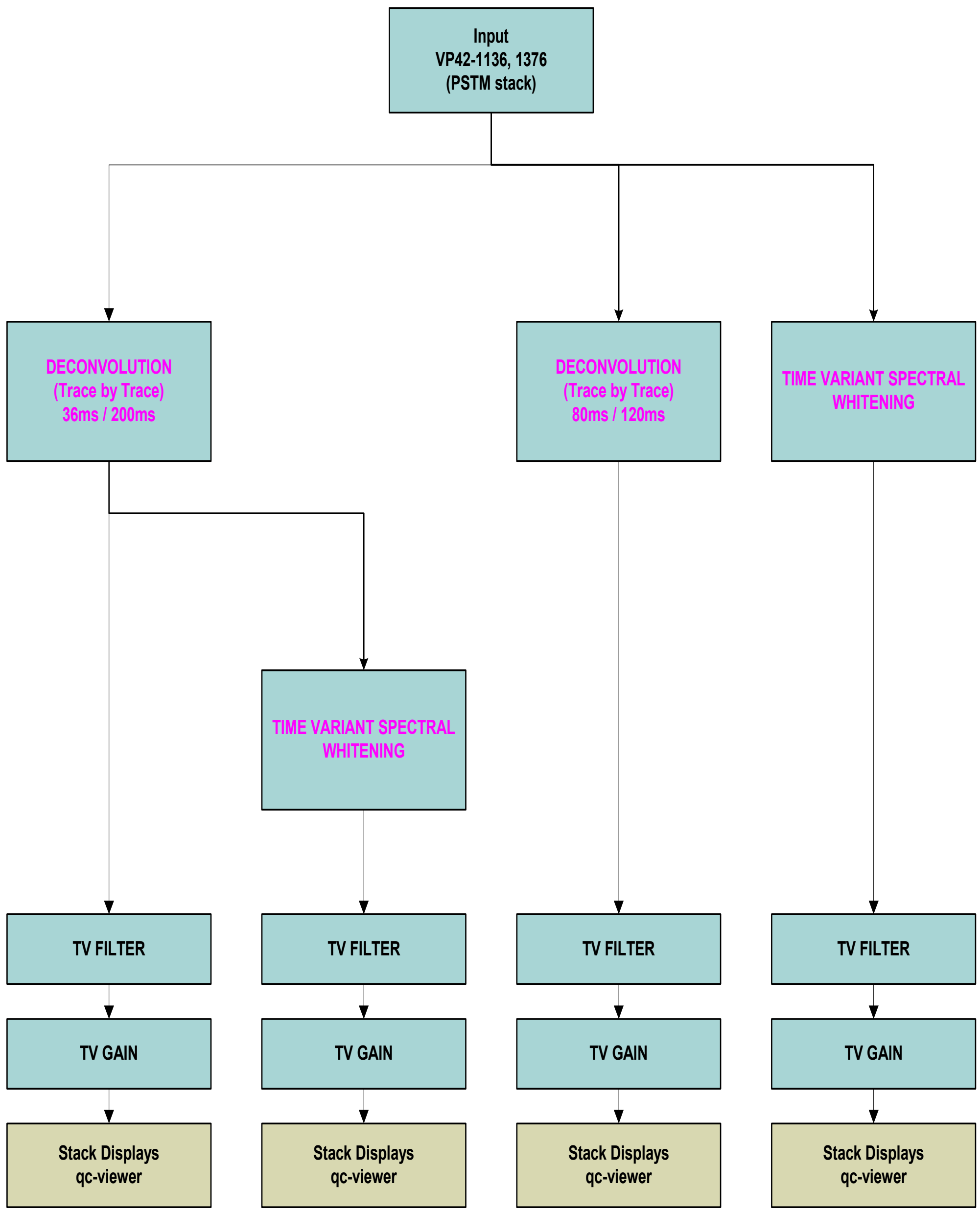


The following dual window AGC was applied:

Window (ms)	Mixback
400	30%
2000	70%

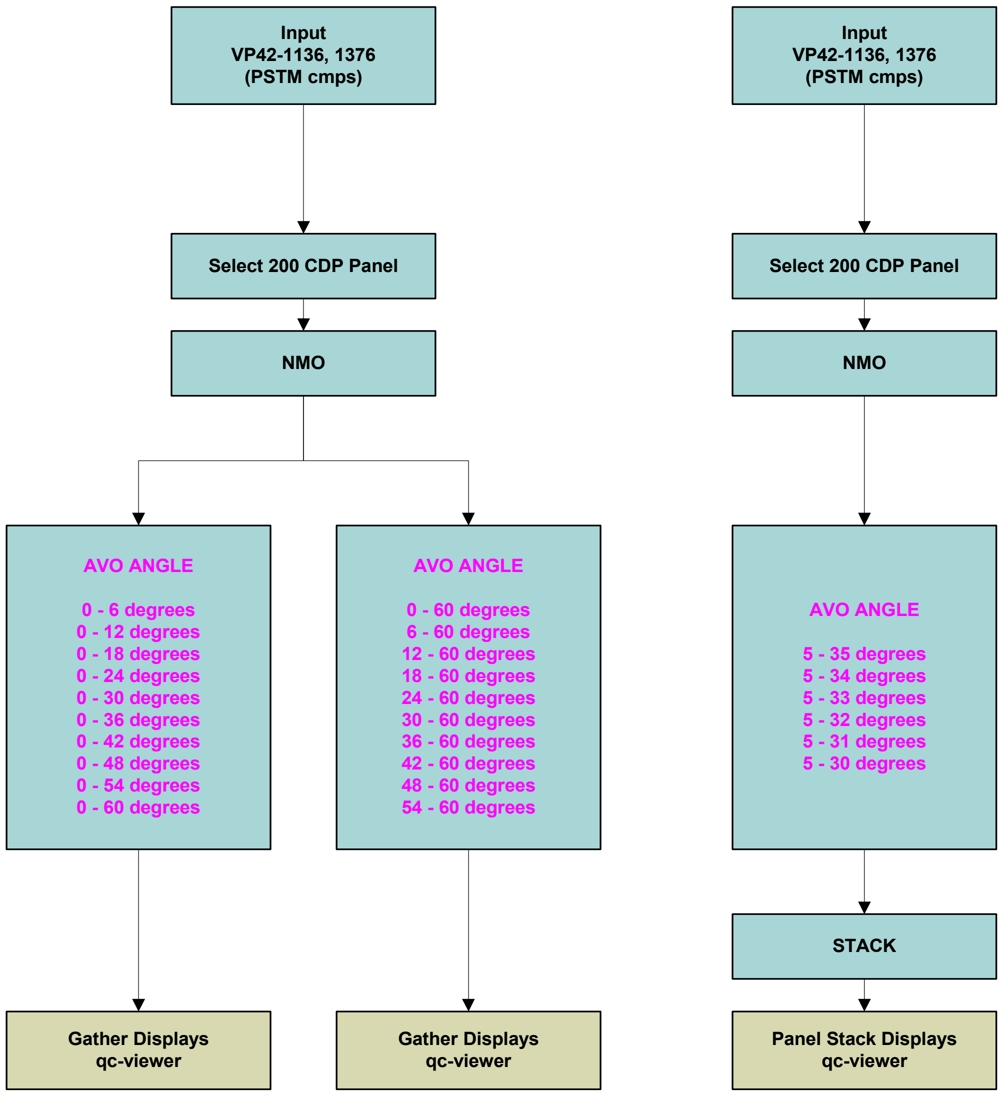
6.13 DECONVOLUTION (DAS)





It was decided that a 36 ms gap and 200 ms operator trace by trace predictive deconvolution would by applied to the data after stacking, due to its general ability to both enhance the signal response and attenuate reverberating signals such as water multiples. The result from the addition of Time Variant Spectral Whitening was promising but it was preferred that the data frequency spectrum remain unaltered.

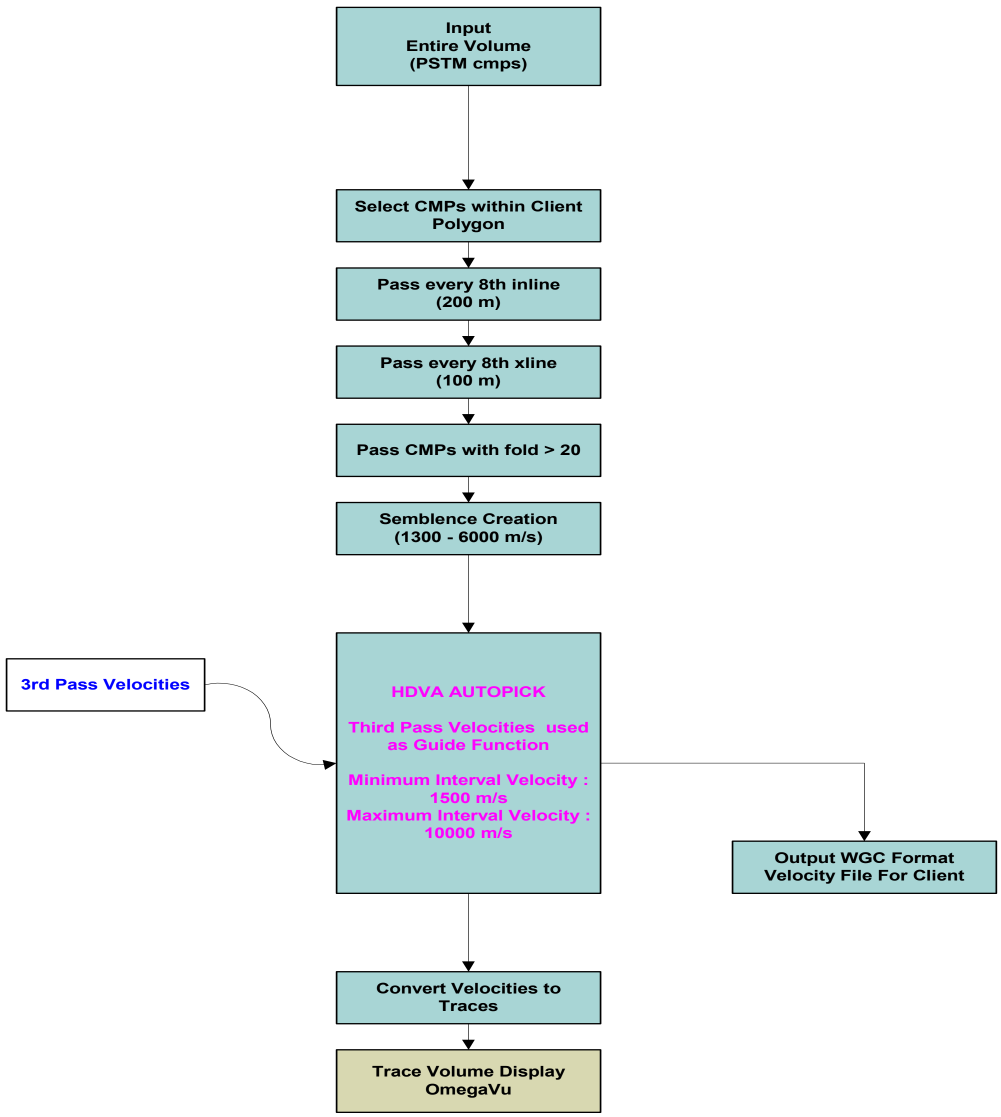
6.14 AVO ANGLE STACKS



The initial series of angle tests (gather displays) determined that the minimum and maximum AVO angles would be approximately 6 to 36 degrees. The panel stack displays then refined this range to between 5 and 32 degrees. Dividing this range evenly into near, mid and far extents gives the following AVO angle stack volumes.

Angle Stack Volume	AVO Angle
Near	5 to 14 degrees
Mid	14 to 23 degrees
Far	23 to 32 degrees

6.15 HIGH DENSITY VELOCITY ANALYSIS (HDVA)



A High Density Velocity Analysis (HDVA) was done on the north-eastern part of the survey area consisting of approximately 215 sqkm. This analysis involves about half of the entire data volume and so the agreed velocity spacing was set at 200 m in the inline direction and 100 m in the crossline direction (8 x 8 cmp bins). This is 8 times the resolution of the Third Pass velocities (400 x 400 m grid). The analysis was restricted to cmps with a fold greater than 20 and the total number of velocity functions output from the autopicker was 10708. The output functions were then converted to velocity traces and loaded into WesternGeco's OmegaVu software package for viewing by the client.

7 APPENDICES

7.1 FIELD TAPE LIST

SEQ	LINE	FSP	LSP	FIRST TAPE	LAST TAPE	No. Of TAPES
1	VP421216P001	2315	944	3	6	4
2	VP421008P002	1001	2960	7	11	5
3	VP421232P003	2807	949	12	16	5
4	VP421024P004	1007	1632	17	18	2
5	VP421248P005	2804	954	19	23	5
6	VP421024A006	1623	2957	24	27	4
7	VP421200P007	2811	939	28	32	5
8	VP421040P008	1012	2956	33	37	5
9	VP421184P009	2813	2501	38	38	1
10	VP421184A010	2180	934	39	41	3
11	VP421056P011	1017	2953	42	46	5
12	VP421168P012	2815	929	47	50	5
13	VP421072P013	1022	2647	51	55	4
14	VP421264P014	2802	959	56	60	5
15	VP421088P015	1027	2949	61	65	5
16	VP421280P016	2800	964	66	70	5
17	1VP42104P017	1032	2947	71	75	5
18	VP421296P018	2798	969	76	80	5
19	VP421120P019	1037	2945	81	85	5
20	VP421312P020	2796	974	86	90	5
21	VP421120J021	1037	2945	91	95	5
22	VP421328P022	2794	2036	96	97	2
23	VP421328A023	1780	979	98	99	2
24	VP421136P024	1042	2943	100	104	5
25	VP421344P025	2792	984	105	109	5
26	VP421152P026	1047	2940	110	114	5
27	VP421360P027	2789	989	115	119	5
28	VP421152J028	1047	2940	120	124	5
29	VP421216A029	2809	2306	125	126	2

30	VP421072A030	2638	2951	127	127	1
31	VP421184B031	2510	2171	128	128	1
32	VP421328B032	2045	1771	129	129	1
33	VP421520P033	1665	2891	130	132	3
34	VP421376P034	2787	994	133	137	5
35	VP421504P035	1660	2893	138	140	3
36	VP421376J036	2787	994	141	145	5
37	VP421488P037	1655	2895	146	148	3
38	VP421376K038	2787	994	149	153	5
39	VP421472P039	1650	2897	154	156	3
40	VP421392P040	2785	1502	157	160	4
41	VP421456P041	1645	2105	161	162	2
42	VP421408P042	2783	1507	163	165	3
43	VP421456A043	1645	2899	166	168	3
44	VP421424P044	2781	1512	169	171	3
45	VP421440P045	1640	2902	172	174	3

7.2 LINE SUMMARY

SEQ	LINE	Prime/ Infill/ Reshoot	FSP	LSP	FID	LID	LENGTH (KM)	DIR (DEG)
1	VP421216P001	PRIME	2315	944	2315	944	25.73	13
2	VP421008P002	PRIME	1001	2960	1001	2960	36.75	193
3	VP421232P003	PRIME	2807	949	2807	949	34.86	13
4	VP421024P004	PRIME	1007	1632	1007	1632	11.74	193
5	VP421248P005	PRIME	2804	954	2804	954	34.71	13
6	VP421024A006	PRIME	1623	2957	1623	2957	25.03	193
7	VP421200P007	PRIME	2811	939	2811	939	35.12	13
8	VP421040P008	PRIME	1012	2956	1012	2956	36.47	193
9	VP421184P009	PRIME	2813	2501	2813	2501	5.87	13
10	VP421184A010	RESHOOT	2180	934	2180	934	23.38	13
11	VP421056P011	PRIME	1017	2953	1017	2953	36.32	193
12	VP421168P012	PRIME	2815	929	2815	929	35.38	13
13	VP421072P013	PRIME	1022	2647	1022	2647	30.49	193
14	VP421264P014	PRIME	2802	959	2802	959	34.58	13
15	VP421088P015	PRIME	1027	2949	1027	2949	36.06	193

16	VP421280P016	PRIME	2800	964	2800	964	34.44	13
17	1VP42104P017	PRIME	1032	2947	1032	2947	35.93	193
18	VP421296P018	PRIME	2798	969	2798	969	34.31	13
19	VP421120P019	PRIME	1037	2945	1037	2945	35.79	193
20	VP421312P020	PRIME	2796	974	2796	974	34.18	13
21	VP421120J021	INFILL	1037	2945	1037	2945	35.79	193
22	VP421328P022	PRIME	2794	2036	2794	2036	14.23	13
23	VP421328A023	RESHOOT	1780	979	1780	979	15.04	13
24	VP421136P024	PRIME	1042	2943	1042	2943	35.66	193
25	VP421344P025	PRIME	2792	984	2792	984	33.92	13
26	VP421152P026	PRIME	1047	2940	1047	2940	35.51	193
27	VP421360P027	PRIME	2789	989	2789	989	33.77	13
28	VP421152J028	INFILL	1047	2940	1047	2940	35.51	193
29	VP421216A029	RESHOOT	2809	2306	2809	2306	9.45	13
30	VP421072A030	RESHOOT	2638	2951	2638	2951	5.89	193
31	VP421184B031	RESHOOT	2510	2171	2510	2171	6.38	13
32	VP421328B032	RESHOOT	2045	1771	2045	1771	5.16	13
33	VP421520P033	PRIME	1665	2891	1665	2891	23.01	193
34	VP421376P034	PRIME	2787	994	2787	994	33.64	13
35	VP421504P035	PRIME	1660	2893	1660	2893	23.14	193
36	VP421376J036	INFILL	2787	994	2787	994	33.64	13
37	VP421488P037	PRIME	1655	2895	1655	2895	23.27	193
38	VP421376K038	RESHOOT	2787	994	2787	994	33.64	13
39	VP421472P039	PRIME	1650	2897	1650	2897	23.40	193
40	VP421392P040	PRIME	2785	1502	2785	1502	24.08	13
41	VP421456P041	PRIME	1645	2105	1645	2105	8.64	193
42	VP421408P042	PRIME	2783	1507	2783	1507	23.94	13
43	VP421456A043	RESHOOT	1645	2899	1645	2899	23.53	193
44	VP421424P044	PRIME	2781	1512	2781	1512	23.81	13
45	VP421440P045	PRIME	1640	2902	1640	2902	23.68	193

7.3 ARCHIVE TAPES

The following archive products were produced for pre-stack data:

Number	Media / Format	Data
DBSFLEX GATHERS		
Q00737	3590 SEGY	PSTM CMP Gathers (Lines 978-990 inc 1)
Q00738	3590 SEGY	PSTM CMP Gathers (Lines 991-997 inc 1)
Q00739	3590 SEGY	PSTM CMP Gathers (Lines 998-1004 inc 1)
Q00740	3590 SEGY	PSTM CMP Gathers (Lines 1005-1011 inc 1)
Q00741	3590 SEGY	PSTM CMP Gathers (Lines 1012-1018 inc 1)
Q00742	3590 SEGY	PSTM CMP Gathers (Lines 1019-1025 inc 1)
Q00743	3590 SEGY	PSTM CMP Gathers (Lines 1026-1032 inc 1)
Q00744	3590 SEGY	PSTM CMP Gathers (Lines 1033-1039 inc 1)
Q00745	3590 SEGY	PSTM CMP Gathers (Lines 1040-1046 inc 1)
Q00746	3590 SEGY	PSTM CMP Gathers (Lines 1047-1053 inc 1)
Q00747	3590 SEGY	PSTM CMP Gathers (Lines 1054-1060 inc 1)
Q00748	3590 SEGY	PSTM CMP Gathers (Lines 1061-1067 inc 1)
Q00749	3590 SEGY	PSTM CMP Gathers (Lines 1068-1074 inc 1)
Q00750	3590 SEGY	PSTM CMP Gathers (Lines 1075-1081 inc 1)
Q00751	3590 SEGY	PSTM CMP Gathers (Lines 1082-1088 inc 1)
Q00752	3590 SEGY	PSTM CMP Gathers (Lines 1089-1095 inc 1)
Q00753	3590 SEGY	PSTM CMP Gathers (Lines 1096-1102 inc 1)
Q00754	3590 SEGY	PSTM CMP Gathers (Lines 1103-1109 inc 1)
Q00755	3590 SEGY	PSTM CMP Gathers (Lines 1110-1116 inc 1)
Q00756	3590 SEGY	PSTM CMP Gathers (Lines 1117-1123 inc 1)
Q00757	3590 SEGY	PSTM CMP Gathers (Lines 1124-1130 inc 1)
Q00758	3590 SEGY	PSTM CMP Gathers (Lines 1131-1137 inc 1)
Q00759	3590 SEGY	PSTM CMP Gathers (Lines 1138-1144 inc 1)
Q00760	3590 SEGY	PSTM CMP Gathers (Lines 1145-1151 inc 1)

Q00761	3590 SEGY	PSTM CMP Gathers (Lines 1152-1158 inc 1)
Q00762	3590 SEGY	PSTM CMP Gathers (Lines 1159-1165 inc 1)
Q00763	3590 SEGY	PSTM CMP Gathers (Lines 1166-1172 inc 1)
Q00764	3590 SEGY	PSTM CMP Gathers (Lines 1173-1179 inc 1)
Q00765	3590 SEGY	PSTM CMP Gathers (Lines 1180-1186 inc 1)
Q00766	3590 SEGY	PSTM CMP Gathers (Lines 1187-1193 inc 1)
Q00767	3590 SEGY	PSTM CMP Gathers (Lines 1194-1200 inc 1)
Q00768	3590 SEGY	PSTM CMP Gathers (Lines 1201-1207 inc 1)
Q00769	3590 SEGY	PSTM CMP Gathers (Lines 1208-1214 inc 1)
Q00770	3590 SEGY	PSTM CMP Gathers (Lines 1215-1221 inc 1)
Q00771	3590 SEGY	PSTM CMP Gathers (Lines 1222-1228 inc 1)
Q00772	3590 SEGY	PSTM CMP Gathers (Lines 1229-1235 inc 1)
Q00773	3590 SEGY	PSTM CMP Gathers (Lines 1236-1242 inc 1)
Q00774	3590 SEGY	PSTM CMP Gathers (Lines 1243-1249 inc 1)
Q00775	3590 SEGY	PSTM CMP Gathers (Lines 1250-1256 inc 1)
Q00776	3590 SEGY	PSTM CMP Gathers (Lines 1257-1263 inc 1)
Q00777	3590 SEGY	PSTM CMP Gathers (Lines 1264-1270 inc 1)
Q00778	3590 SEGY	PSTM CMP Gathers (Lines 1271-1277 inc 1)
Q00779	3590 SEGY	PSTM CMP Gathers (Lines 1278-1284 inc 1)
Q00780	3590 SEGY	PSTM CMP Gathers (Lines 1285-1291 inc 1)
Q00781	3590 SEGY	PSTM CMP Gathers (Lines 1292-1298 inc 1)
Q00820	3590 SEGY	PSTM CMP Gathers (Lines 1299-1305 inc 1)
Q00821	3590 SEGY	PSTM CMP Gathers (Lines 1306-1312 inc 1)
Q00822	3590 SEGY	PSTM CMP Gathers (Lines 1313-1319 inc 1)
Q00823	3590 SEGY	PSTM CMP Gathers (Lines 1320-1326 inc 1)
Q00824	3590 SEGY	PSTM CMP Gathers (Lines 1327-1333 inc 1)
Q00825	3590 SEGY	PSTM CMP Gathers (Lines 1334-1340 inc 1)
Q00826	3590 SEGY	PSTM CMP Gathers (Lines 1341-1347 inc 1)
Q00827	3590 SEGY	PSTM CMP Gathers (Lines 1348-1354 inc 1)

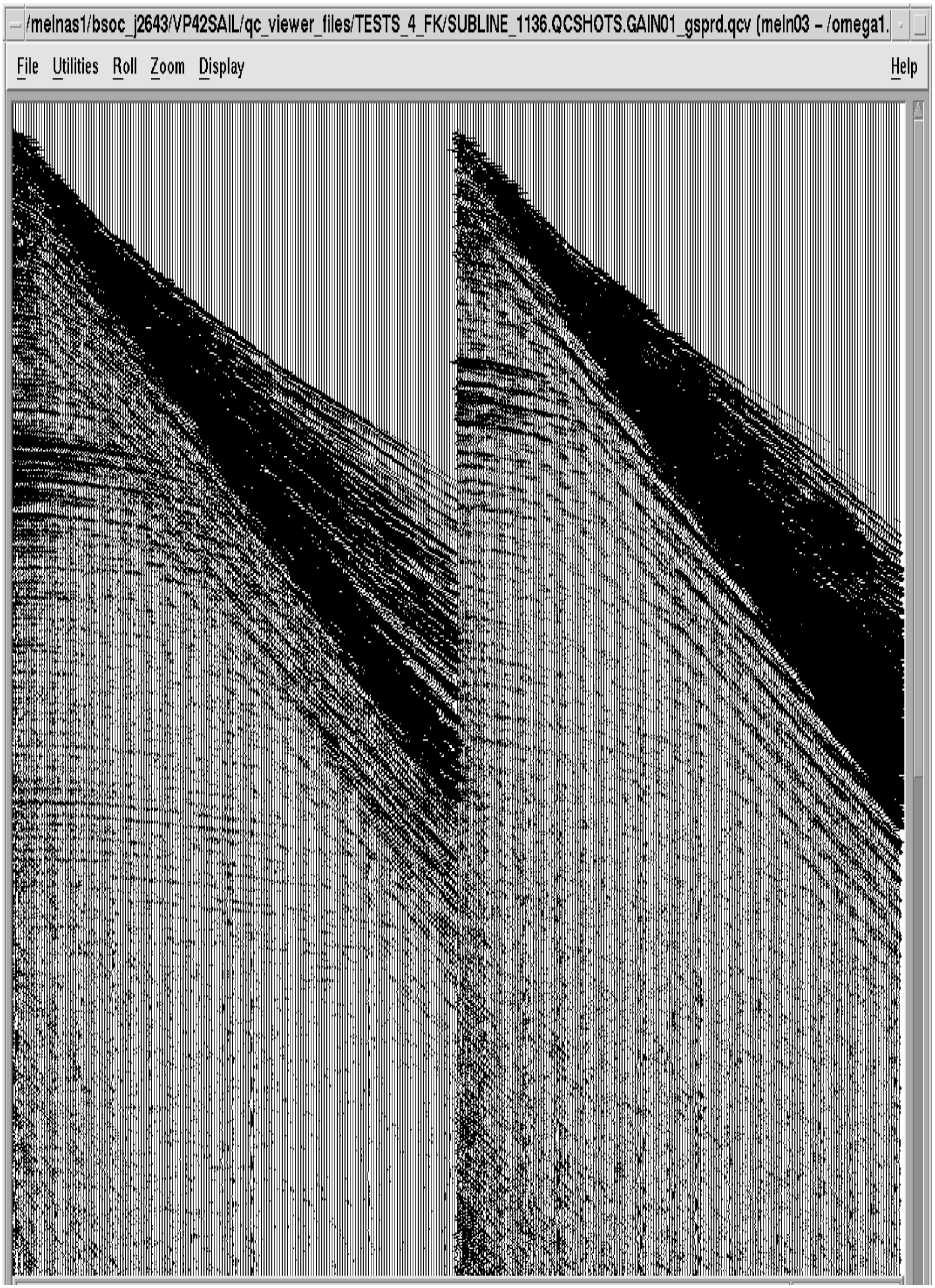
Q00828	3590 SEGY	PSTM CMP Gathers (Lines 1355-1361 inc 1)
Q00829	3590 SEGY	PSTM CMP Gathers (Lines 1362-1368 inc 1)
Q00830	3590 SEGY	PSTM CMP Gathers (Lines 1369-1375 inc 1)
Q00831	3590 SEGY	PSTM CMP Gathers (Lines 1376-1382 inc 1)
Q00832	3590 SEGY	PSTM CMP Gathers (Lines 1383-1389 inc 1)
Q00833	3590 SEGY	PSTM CMP Gathers (Lines 1390-1396 inc 1)
Q00834	3590 SEGY	PSTM CMP Gathers (Lines 1397-1404 inc 1)
Q00835	3590 SEGY	PSTM CMP Gathers (Lines 1405-1414 inc 1)
Q00836	3590 SEGY	PSTM CMP Gathers (Lines 1415-1424 inc 1)
Q00837	3590 SEGY	PSTM CMP Gathers (Lines 1425-1434 inc 1)
Q00838	3590 SEGY	PSTM CMP Gathers (Lines 1435-1444 inc 1)
Q00839	3590 SEGY	PSTM CMP Gathers (Lines 1445-1454 inc 1)
Q00840	3590 SEGY	PSTM CMP Gathers (Lines 1455-1464 inc 1)
Q00841	3590 SEGY	PSTM CMP Gathers (Lines 1465-1474 inc 1)
Q00842	3590 SEGY	PSTM CMP Gathers (Lines 1475-1484 inc 1)
Q00843	3590 SEGY	PSTM CMP Gathers (Lines 1485-1494 inc 1)
Q00844	3590 SEGY	PSTM CMP Gathers (Lines 1495-1504 inc 1)
Q00845	3590 SEGY	PSTM CMP Gathers (Lines 1505-1514 inc 1)
Q00846	3590 SEGY	PSTM CMP Gathers (Lines 1515-1524 inc 1)
Q00847	3590 SEGY	PSTM CMP Gathers (Lines 1525-1534 inc 1)
Q00848	3590 SEGY	PSTM CMP Gathers (Lines 1535-1540 inc 1)
NEAR TRACE GATHERS		
X00287	8mm SEGY	Near Trace Volume (Lines 998-1264 inc 1)
X00288	8mm SEGY	Near Trace Volume (Lines1265-1528 inc 1)

The following archive products were produced for post-stack data:

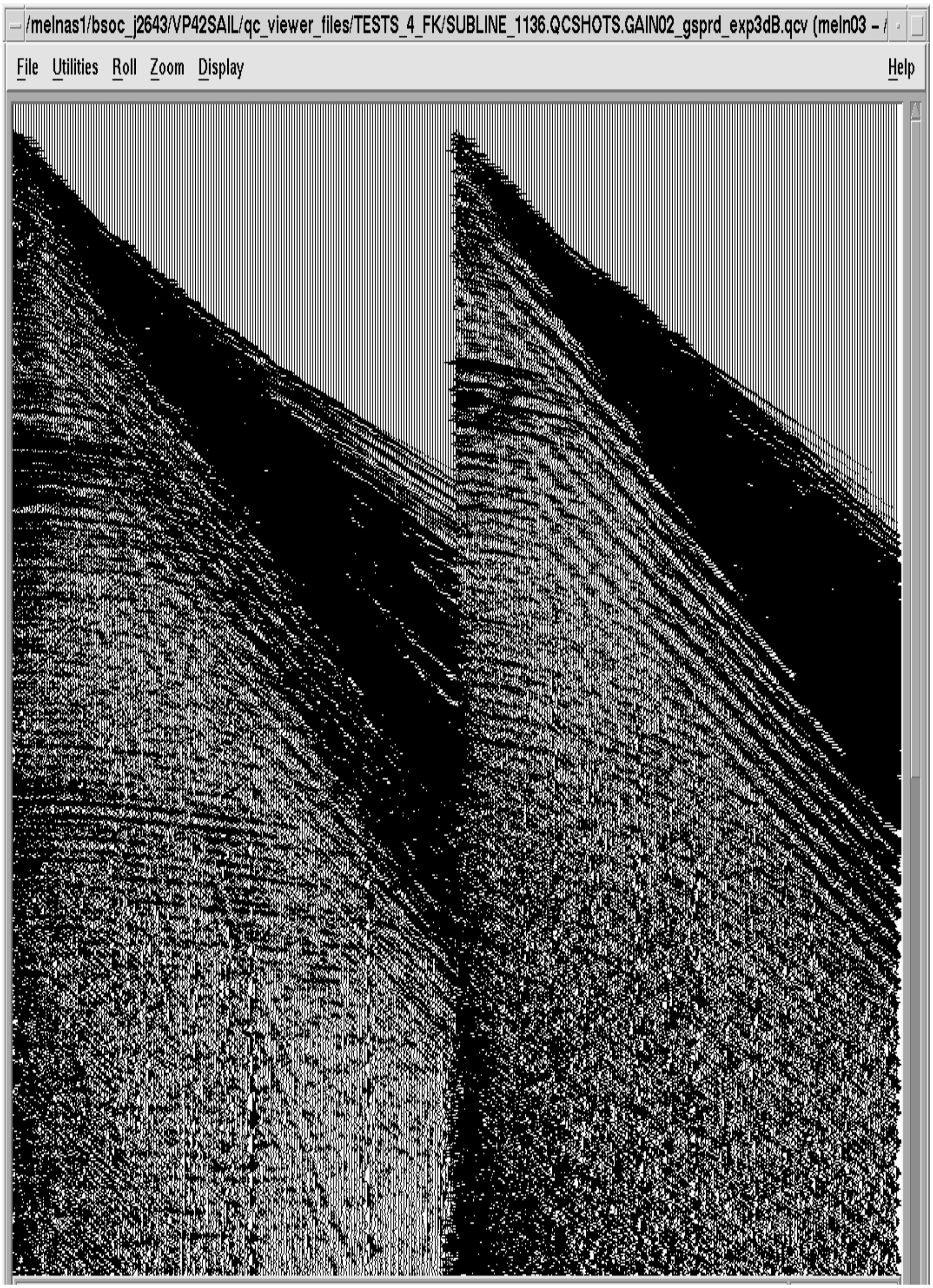
Tape Number	Media / Format	Data on tape
PRE STACK TIME MIGRATION		
X00272	8mm SEGY	Filter/Scale Migrated Final Stack (Lines 1956-2165 inc 1)
X00018	8mm SEGY	Filter/Scale Migrated Final Stack (Lines 2166-2367 inc 1)
X00019	8mm SEGY	Filter/Scale Migrated Final Stack (Lines 2368-2573 inc 1)
X00020	8mm SEGY	Filter/Scale Migrated Final Stack (Lines 2574-2785 inc 1)
X00021	8mm SEGY	Filter/Scale Migrated Final Stack (Lines 2786-3081 inc 1)
X00012	8mm SEGY	Raw Migrated Final Stack (Lines 1956-2165 inc 1)
X00013	8mm SEGY	Raw Migrated Final Stack (Lines 2166-2367 inc 1)
X00014	8mm SEGY	Raw Migrated Final Stack (Lines 2368-2573 inc 1)
X00015	8mm SEGY	Raw Migrated Final Stack (Lines 2574-2785 inc 1)
X00016	8mm SEGY	Raw Migrated Final Stack (Lines 2786-3081 inc 1)
X00022	8mm SEGY	Raw Migrated Near Angle Stack (Lines 1956-2165 inc 1)
X00023	8mm SEGY	Raw Migrated Near Angle Stack (Lines 2166-2367 inc 1)
X00024	8mm SEGY	Raw Migrated Near Angle Stack (Lines 2368-2573 inc 1)
X00025	8mm SEGY	Raw Migrated Near Angle Stack (Lines 2574-2785 inc 1)
X00026	8mm SEGY	Raw Migrated Near Angle Stack (Lines 2786-3081 inc 1)
X00027	8mm SEGY	Raw Migrated Mid Angle Stack (Lines 1956-2165 inc 1)
X00028	8mm SEGY	Raw Migrated Mid Angle Stack (Lines 2166-2367 inc 1)
X00029	8mm SEGY	Raw Migrated Mid Angle Stack (Lines 2368-2573 inc 1)
X00265	8mm SEGY	Raw Migrated Mid Angle Stack (Lines 2574-2785 inc 1)
X00266	8mm SEGY	Raw Migrated Mid Angle Stack (Lines 2786-3081 inc 1)
X00267	8mm SEGY	Raw Migrated Far Angle Stack (Lines 1956-2165 inc 1)
X00268	8mm SEGY	Raw Migrated Far Angle Stack (Lines 2166-2367 inc 1)
X00269	8mm SEGY	Raw Migrated Far Angle Stack (Lines 2368-2573 inc 1)
X00270	8mm SEGY	Raw Migrated Far Angle Stack (Lines 2574-2785 inc 1)
X00271	8mm SEGY	Raw Migrated Far Angle Stack (Lines 2786-3081 inc 1)

ENCLOSURES

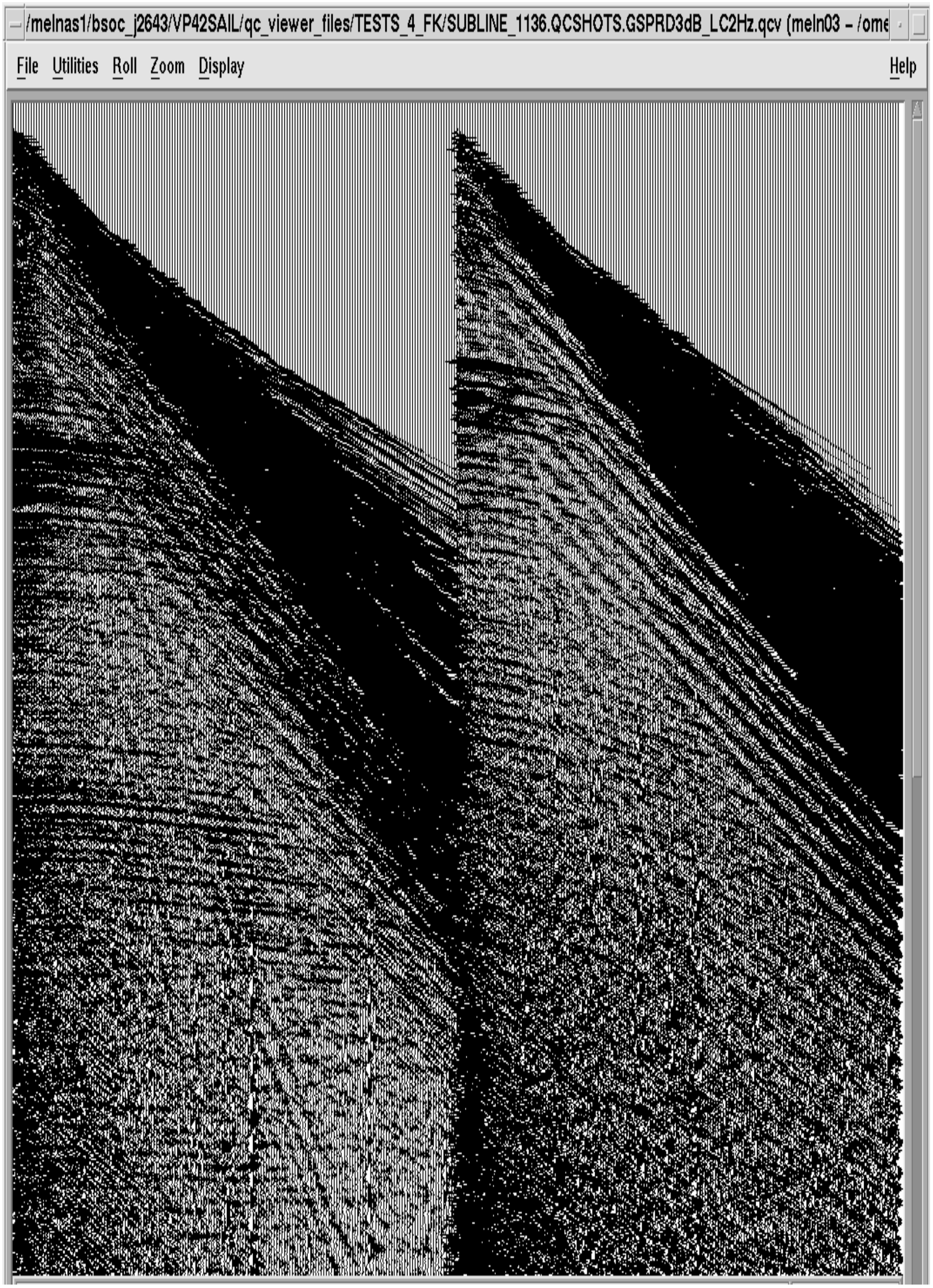
Enclosure 1: Line 1136 – Raw shot gathers.



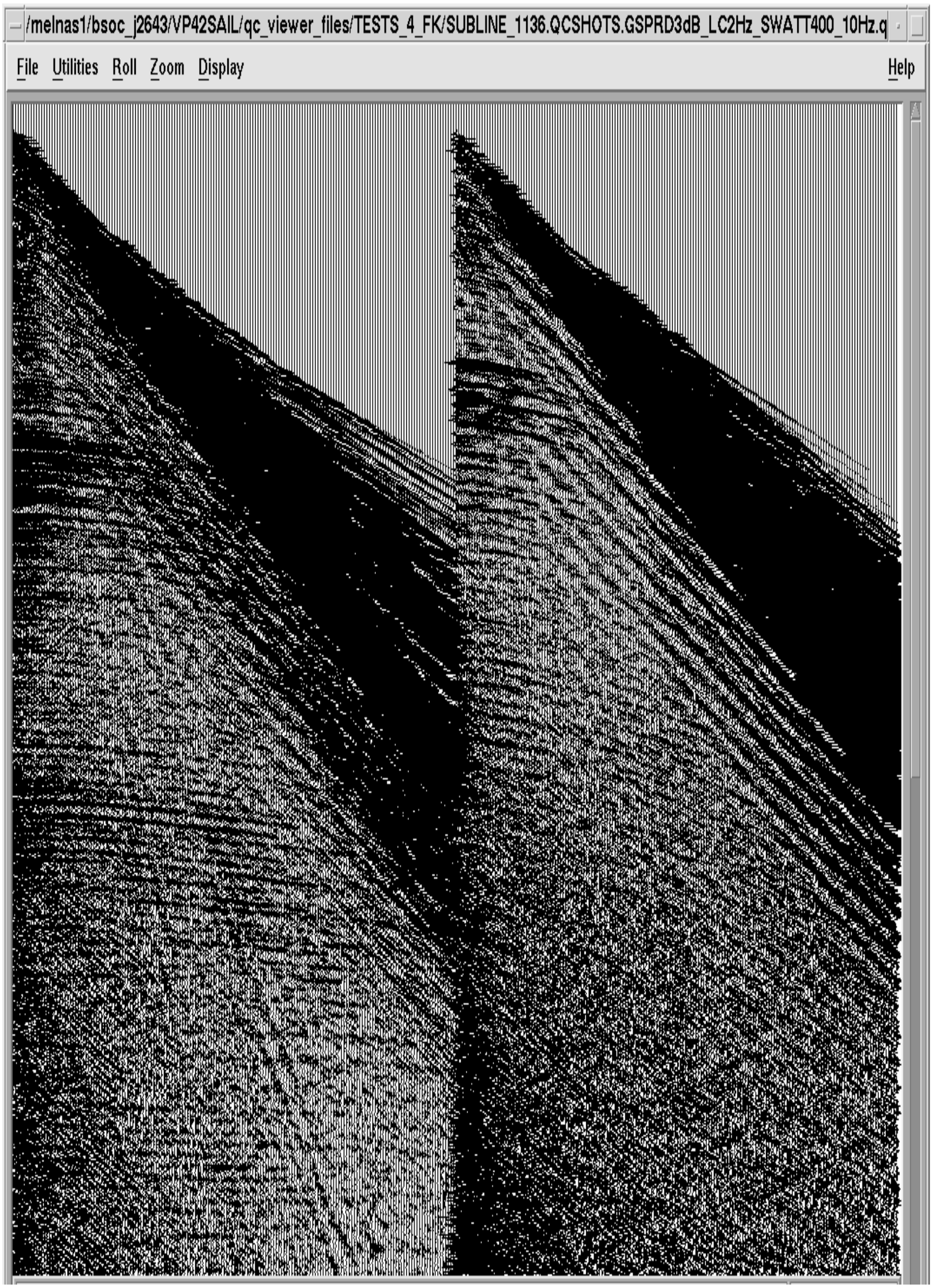
Enclosure 2: Line 1136 – Geometric Spreading + 3 dB/sec gain.



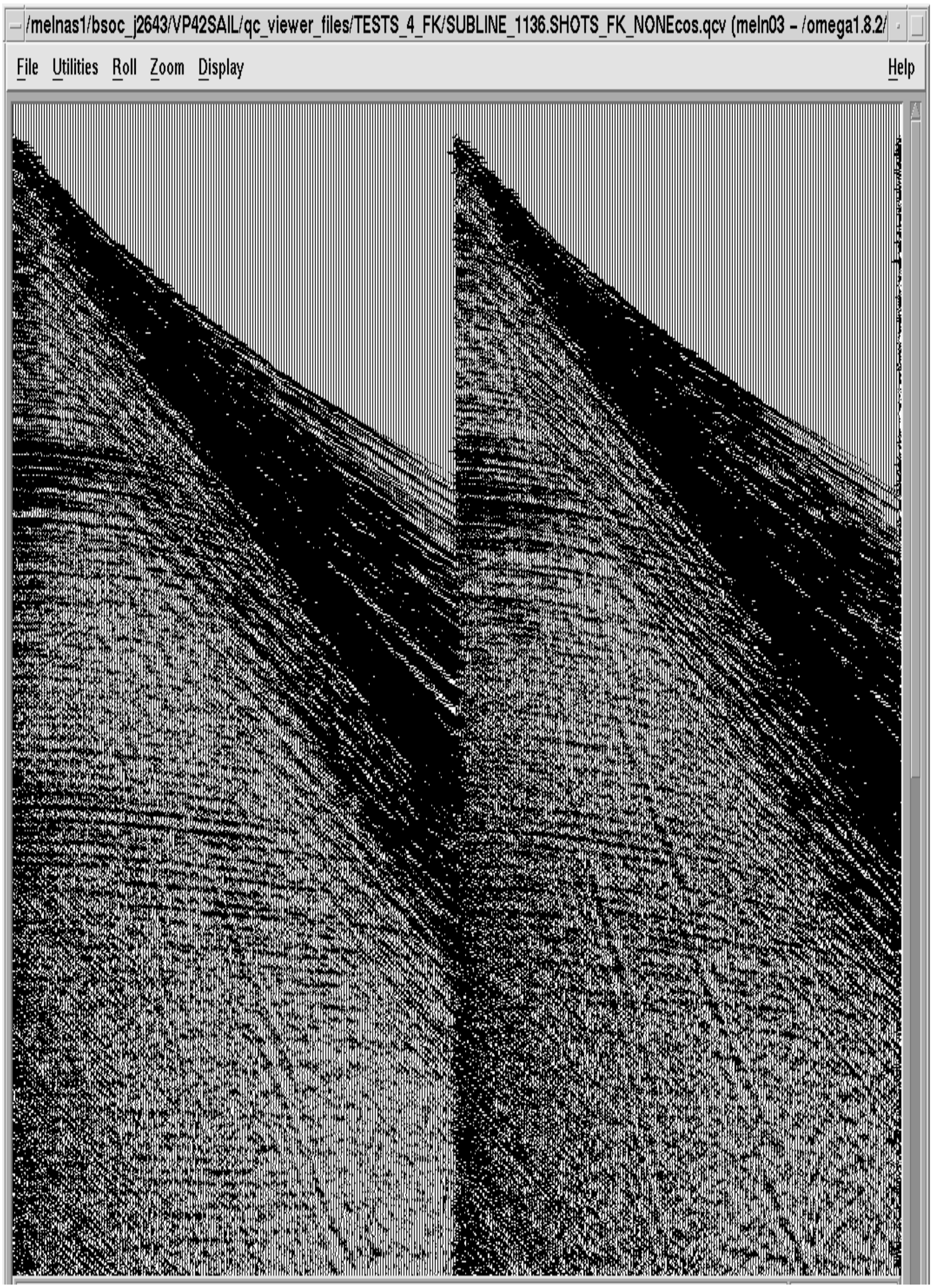
Enclosure 3: Line 1136 – Geometric Spreading + 3 dB/sec gain + 2Hz filter.



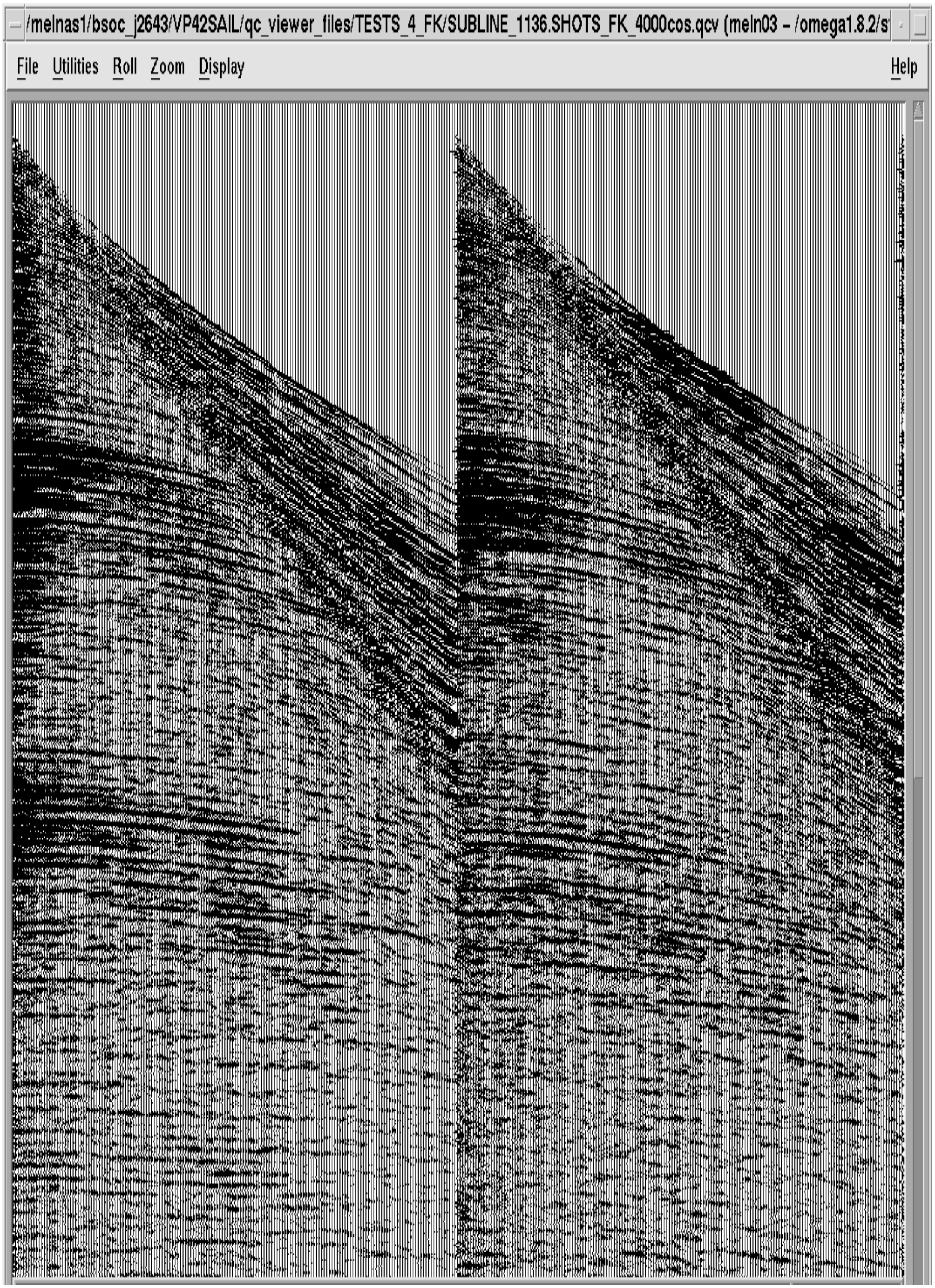
Enclosure 4: Line 1136 – Geometric Spreading + 3 dB/sec gain + 2Hz filter + 400% SWATT.



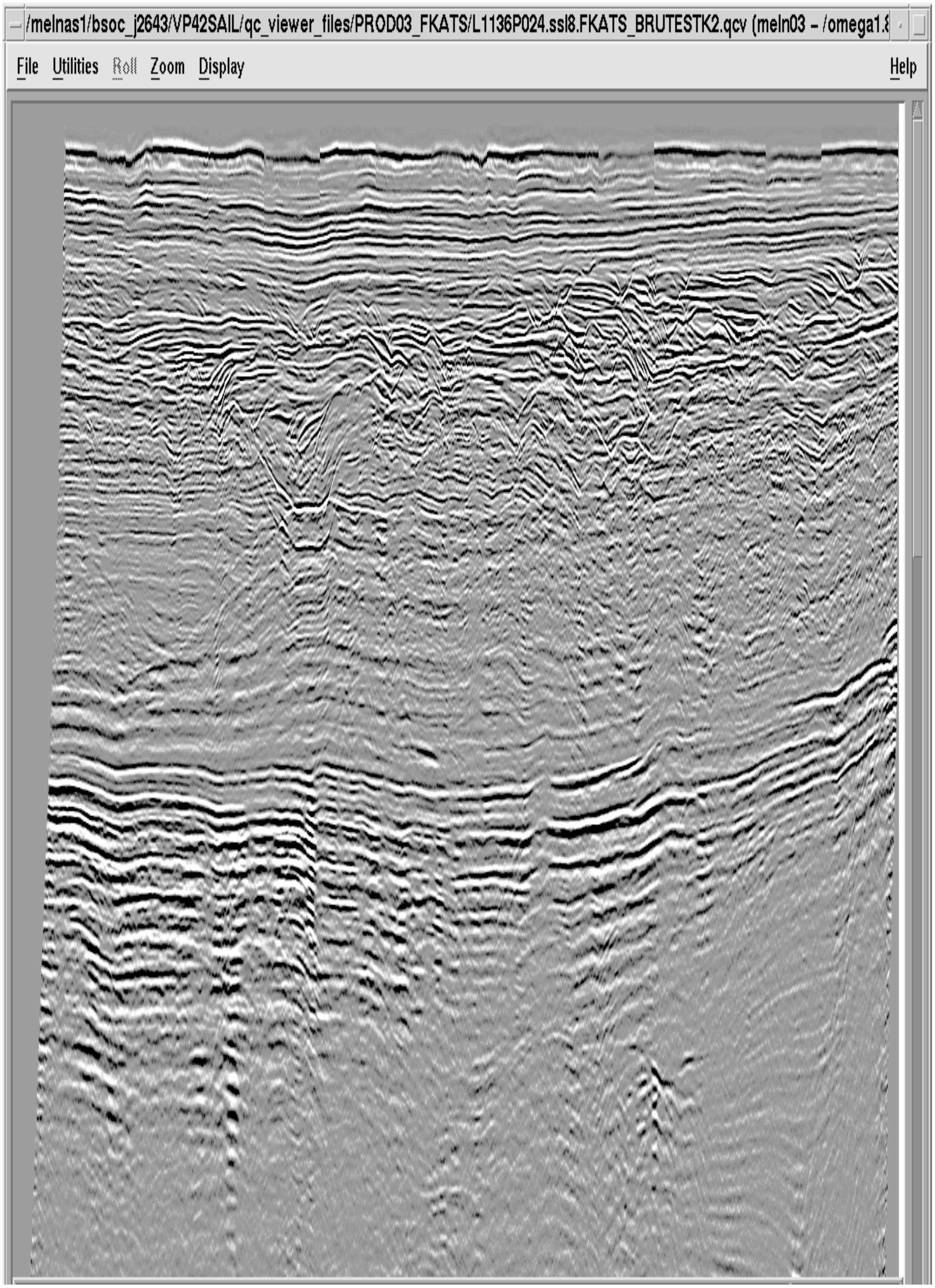
Enclosure 5: Line 1136 – Shot gathers with no FK filter.



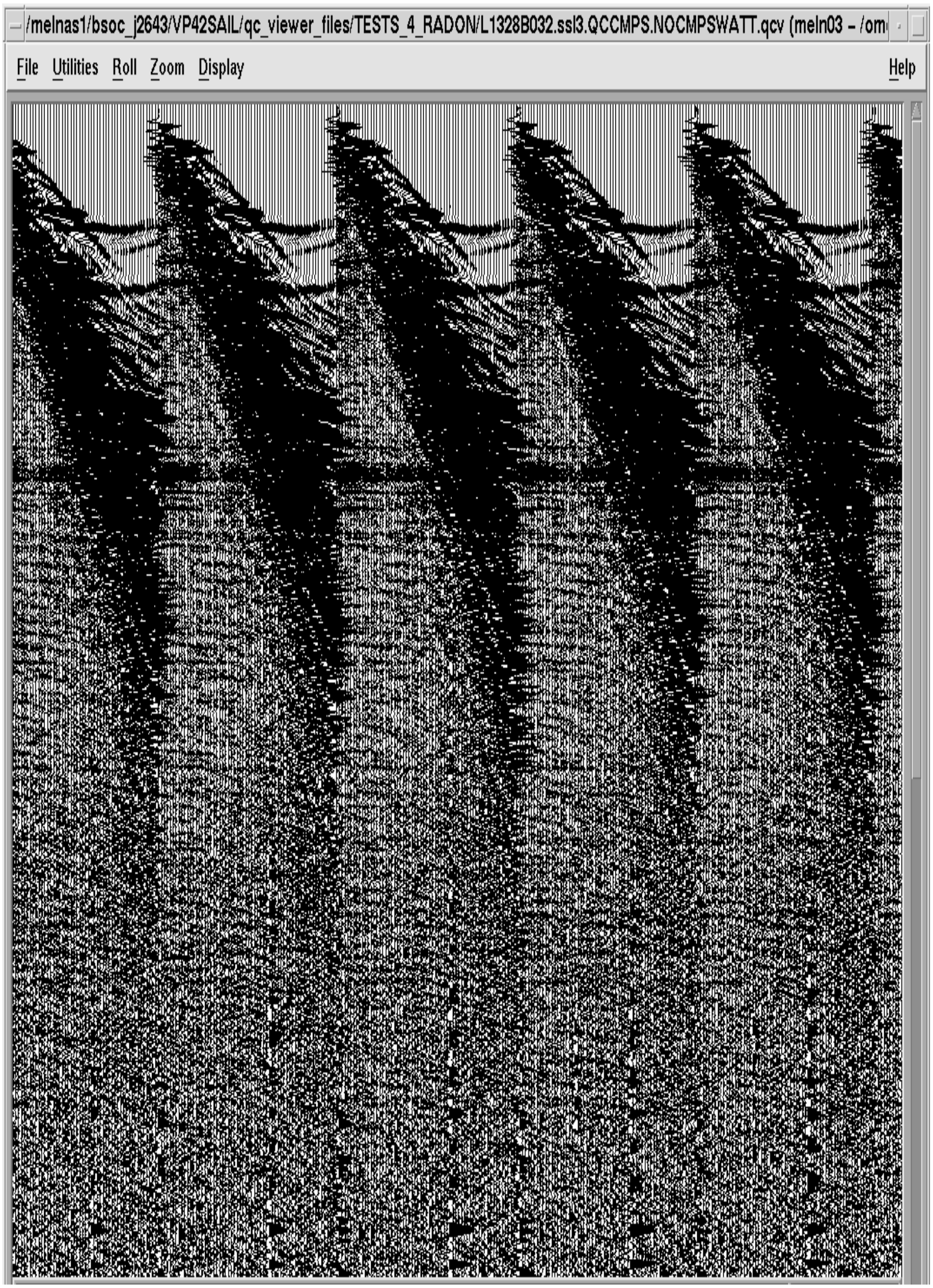
Enclosure 6: Line 1136 – Shot gathers with +/- 4000 m/s FK filter.



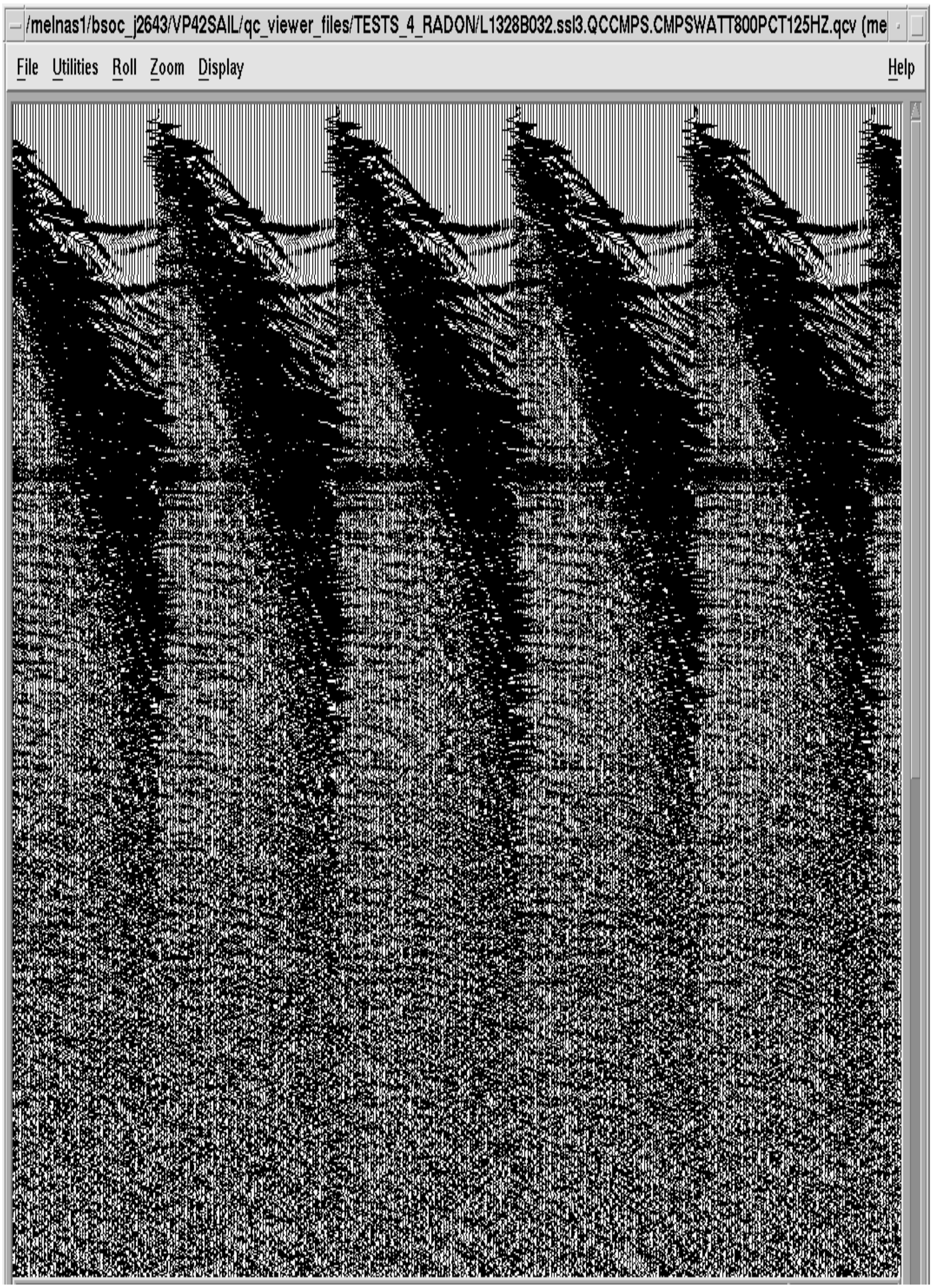
Enclosure 7: Line 1136 – Brute stack.



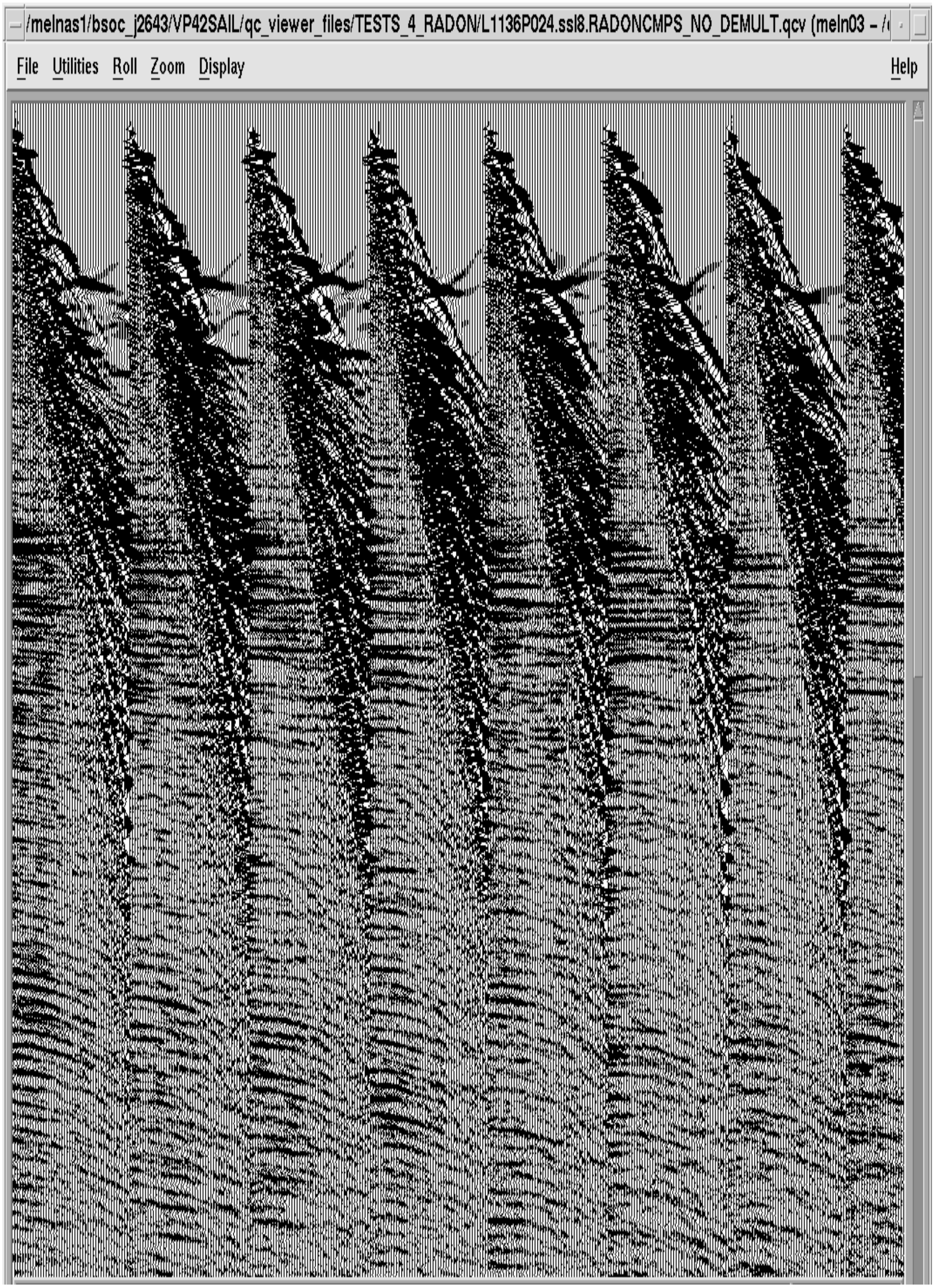
Enclosure 8: Line 1328 – CMP gathers with no CMP SWATT.



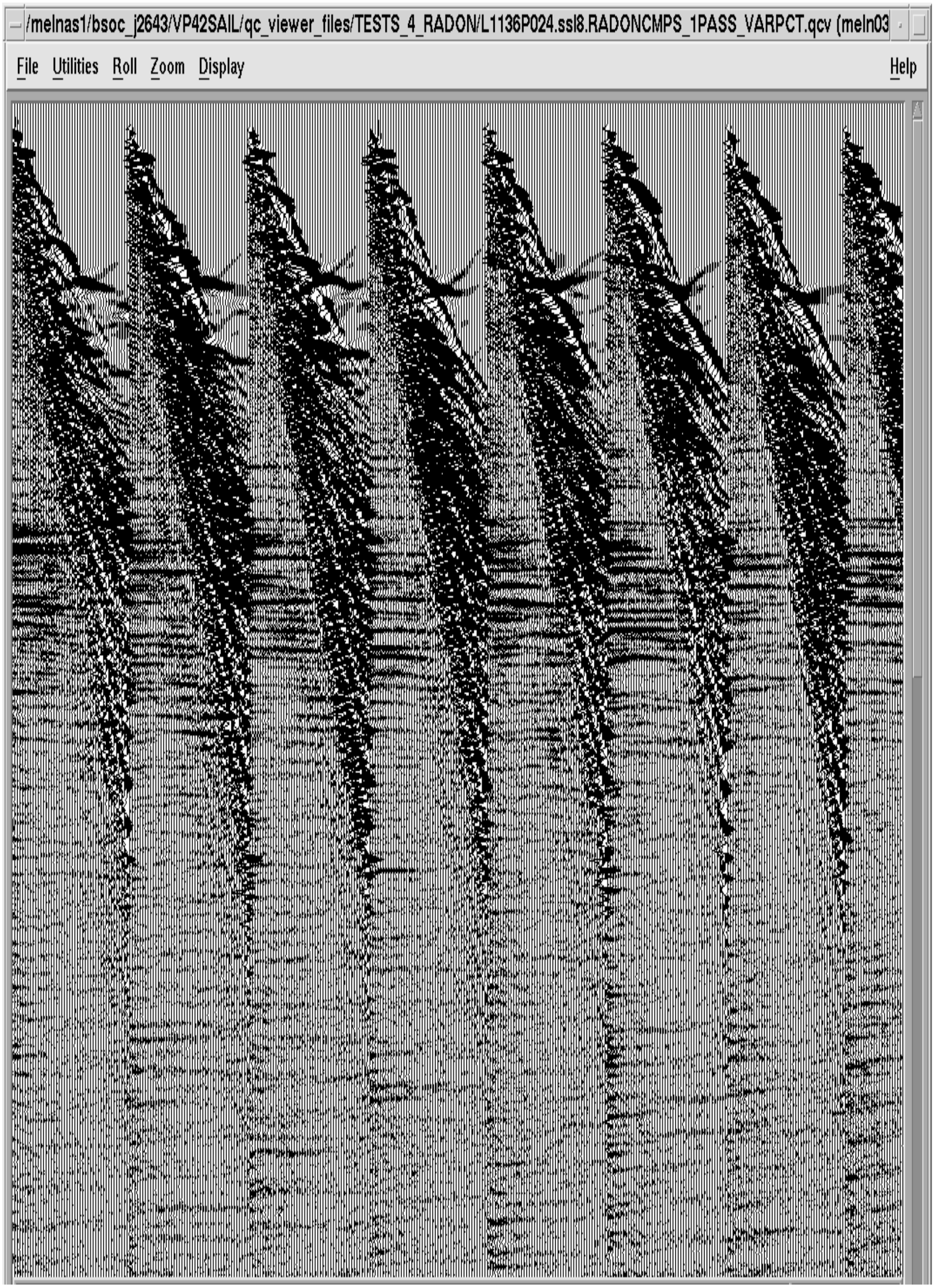
Enclosure 9: Line 1328 – CMP gathers with 800% CMP SWATT.



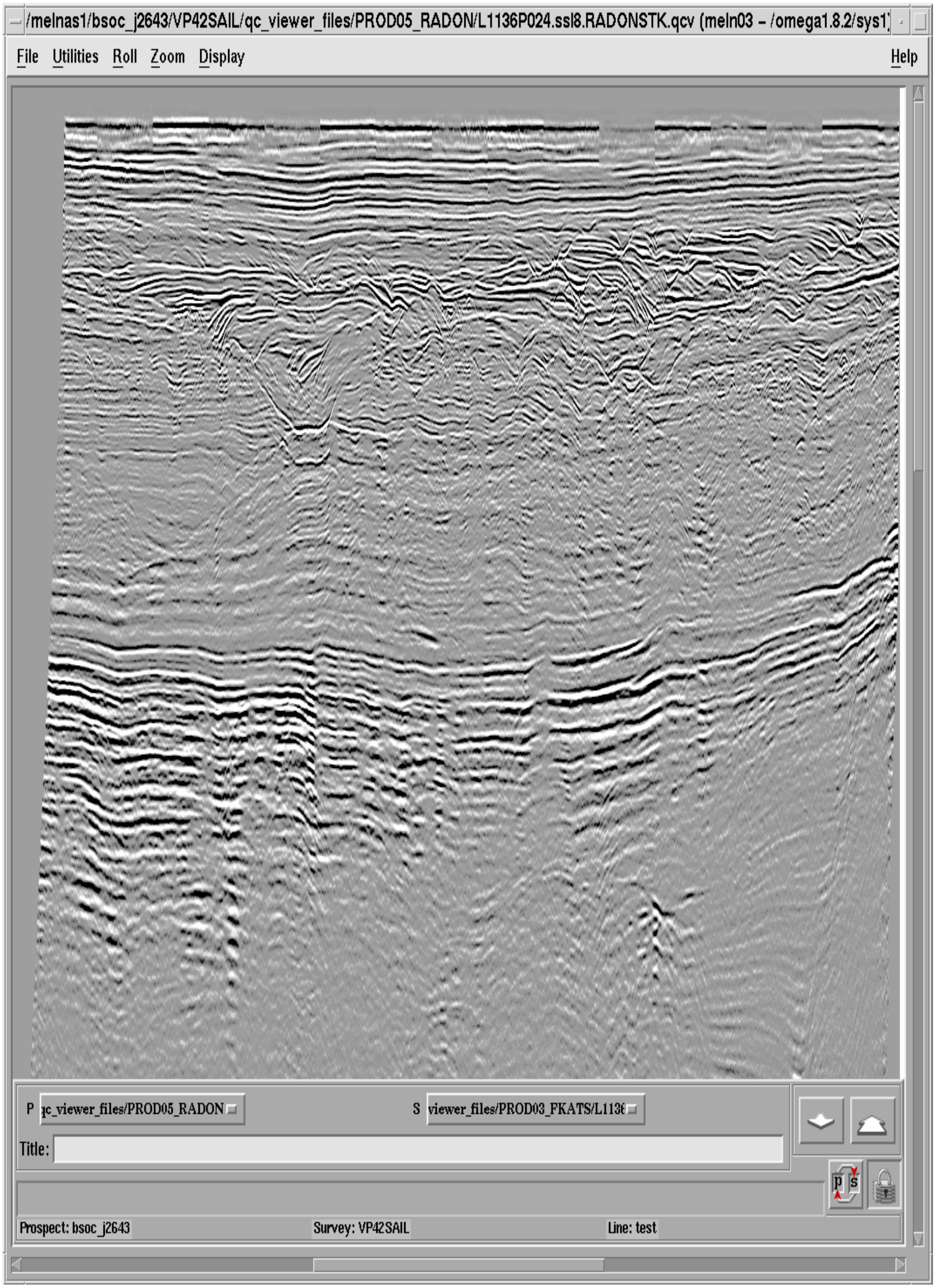
Enclosure 10: Line 1136 – CMP gathers with no Radon demultiple.



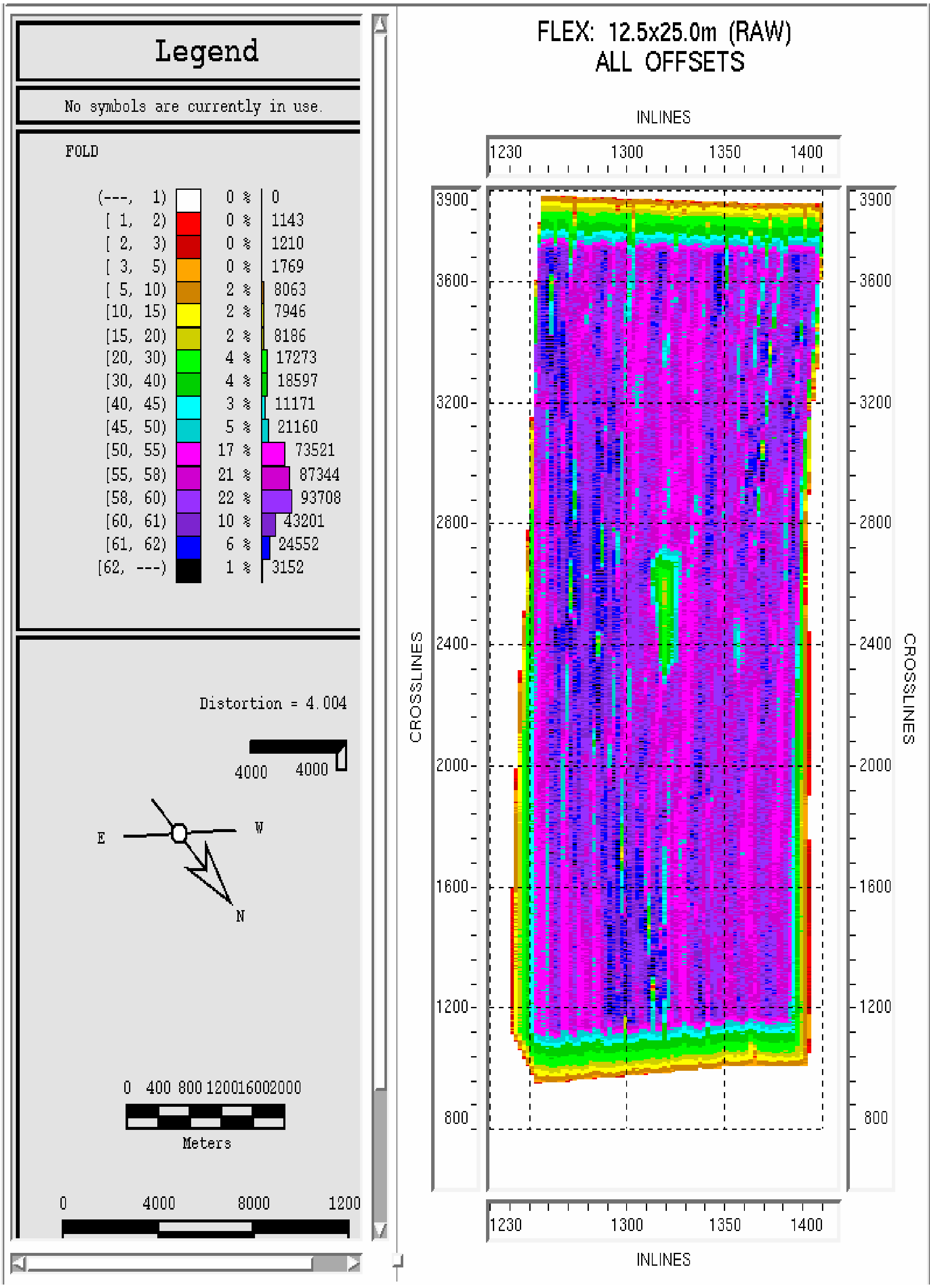
Enclosure 11: Line 1136 – CMP gathers with Radon demultiple.



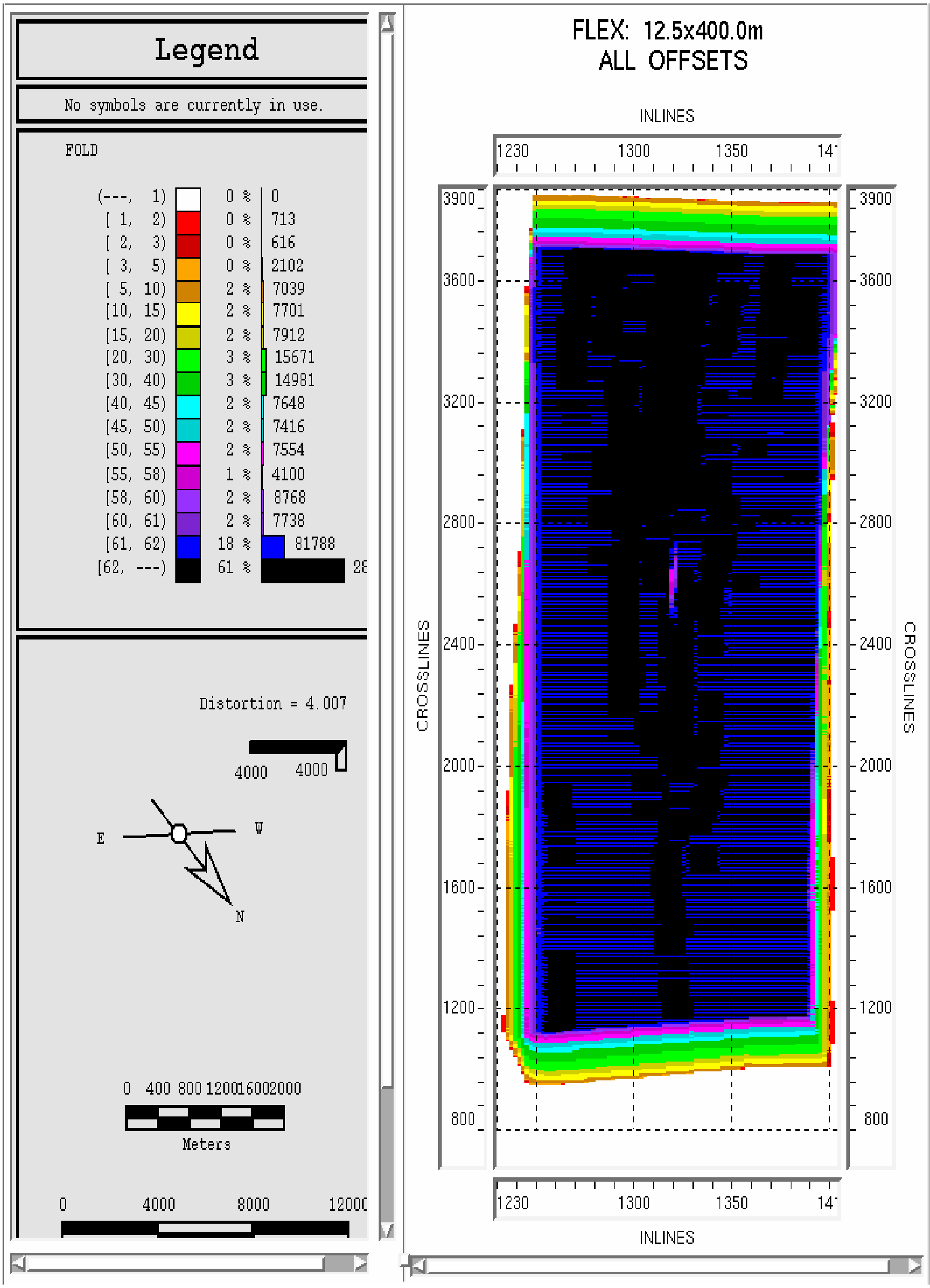
Enclosure 12: Line 1136 – Radon demultiple stack.



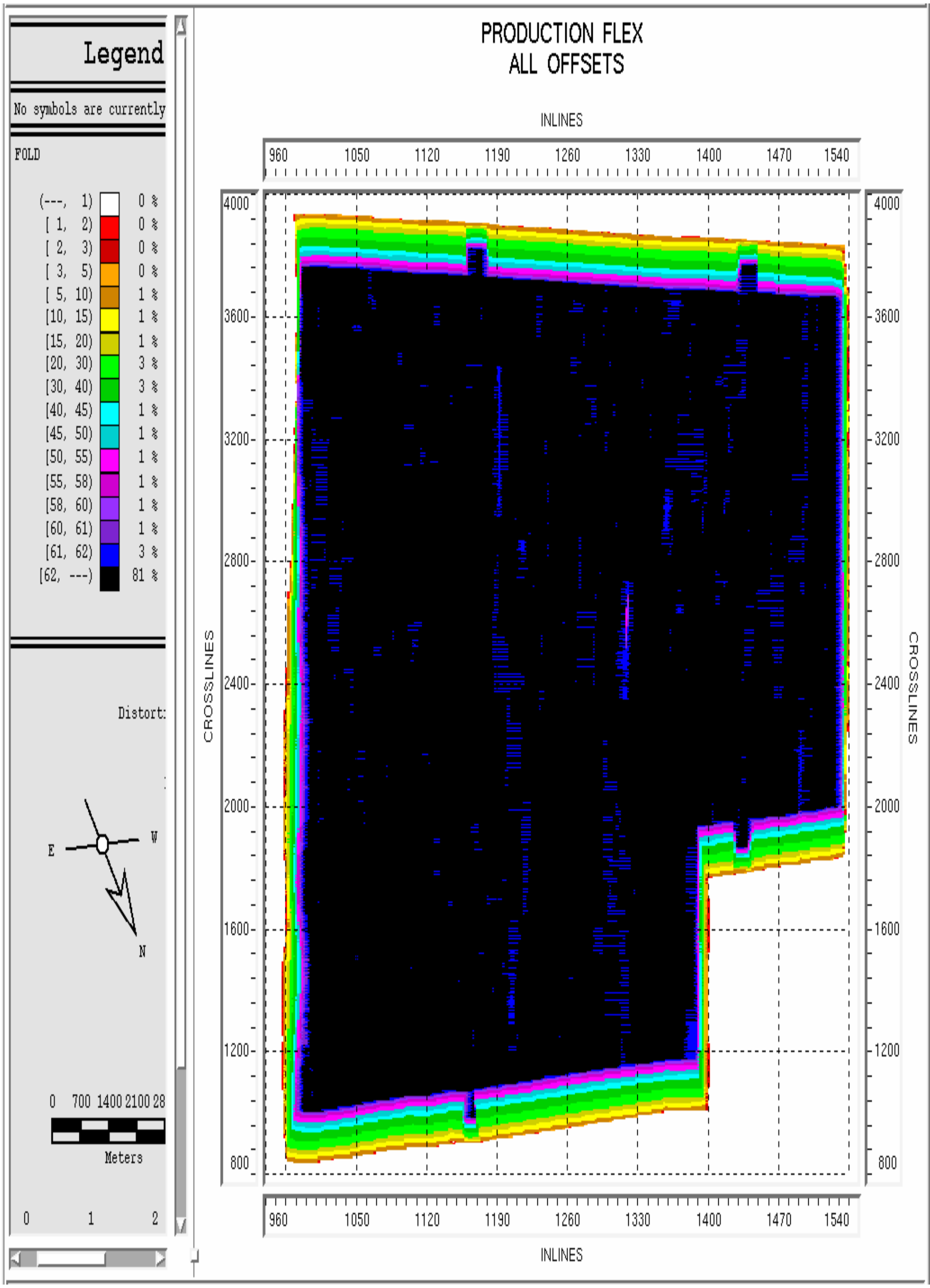
Enclosure 13: Flex Binning – Raw unflexed all offsets (sample area with acquisition void).



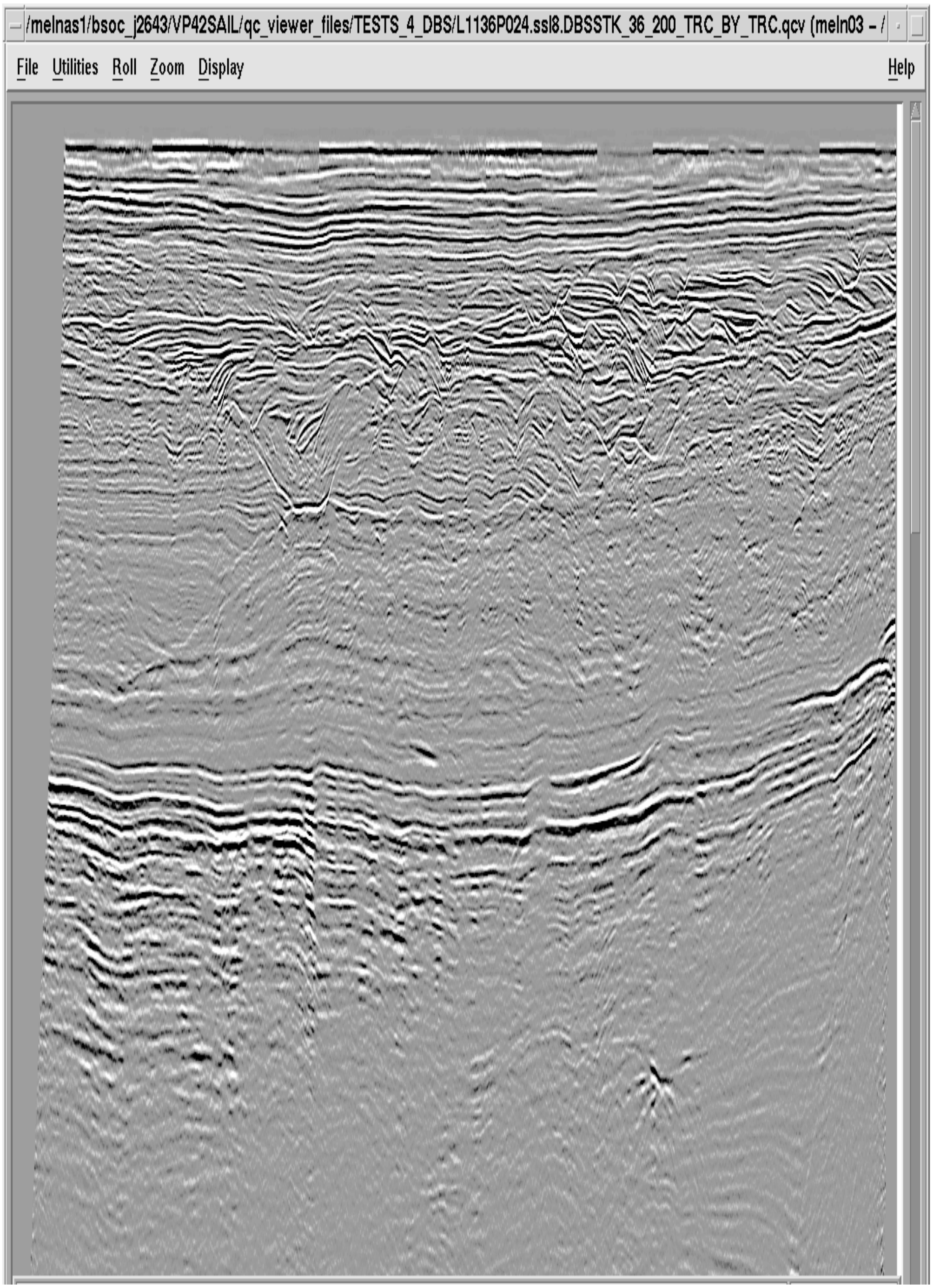
Enclosure 14: Flex Binning – 400 m flex all offsets (sample area).



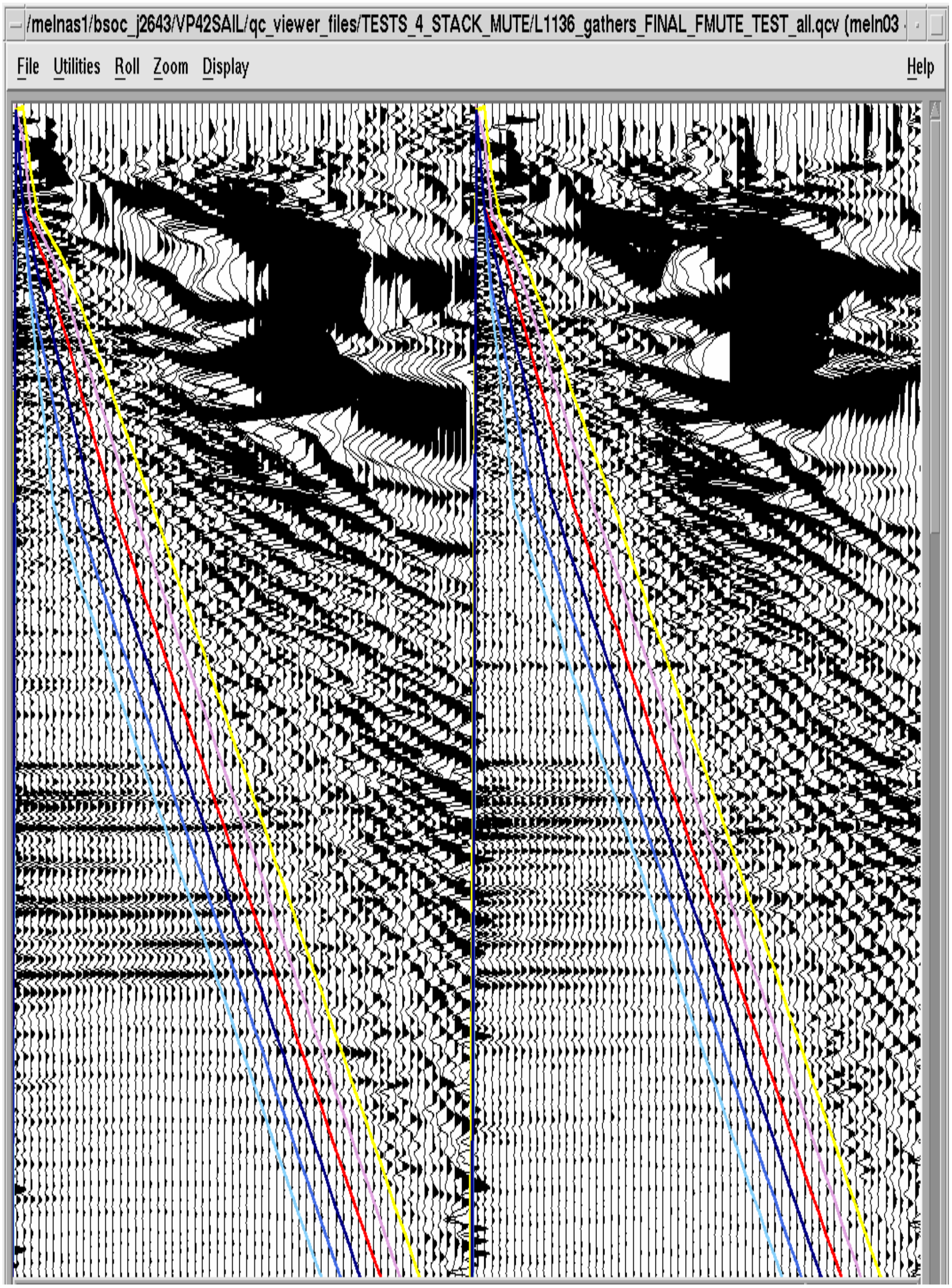
Enclosure 15: Flex Binning – 400 m flex all offsets (entire data volume).



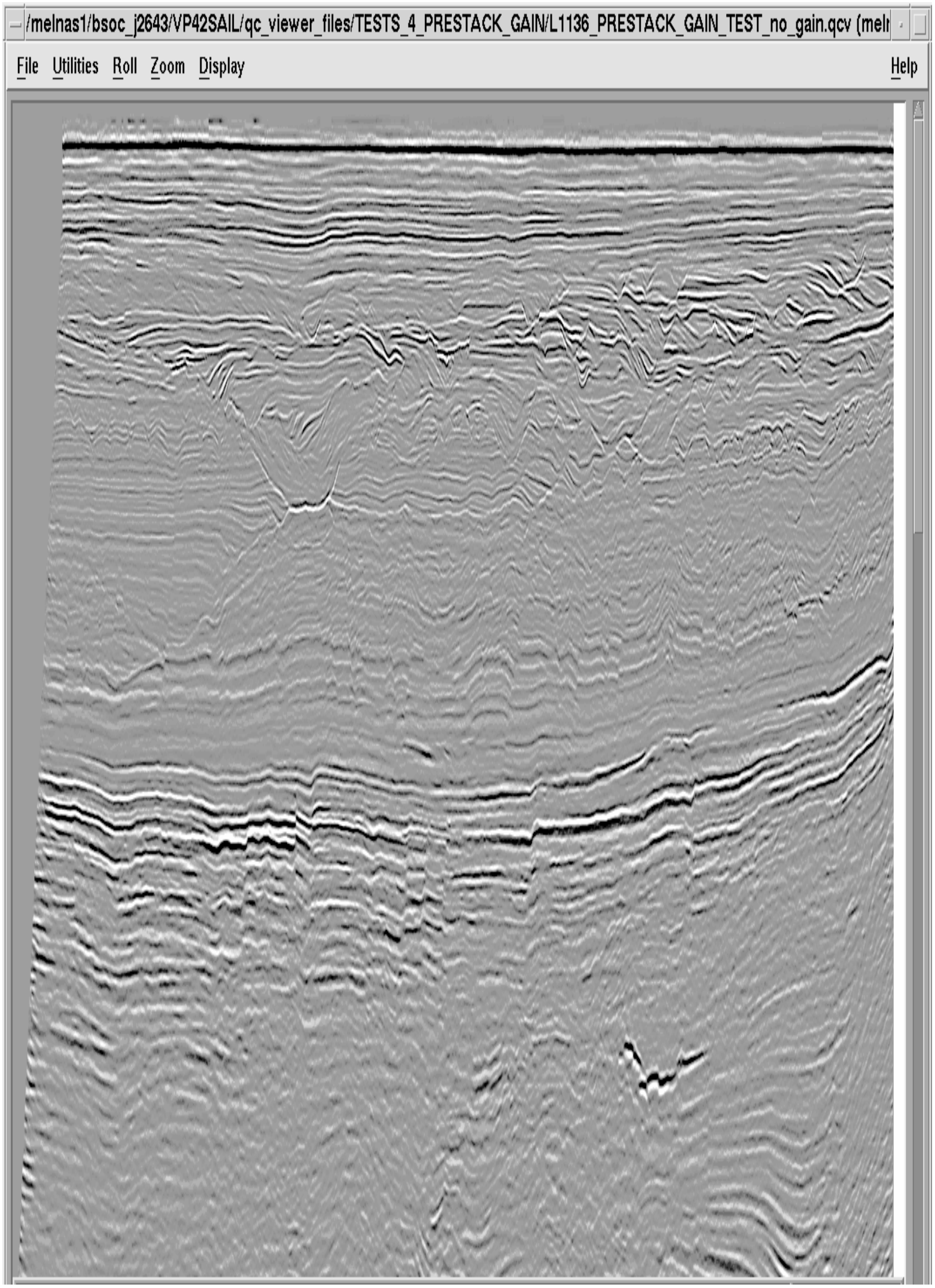
Enclosure 16: Line 1136 – DBS and Flexed stack.



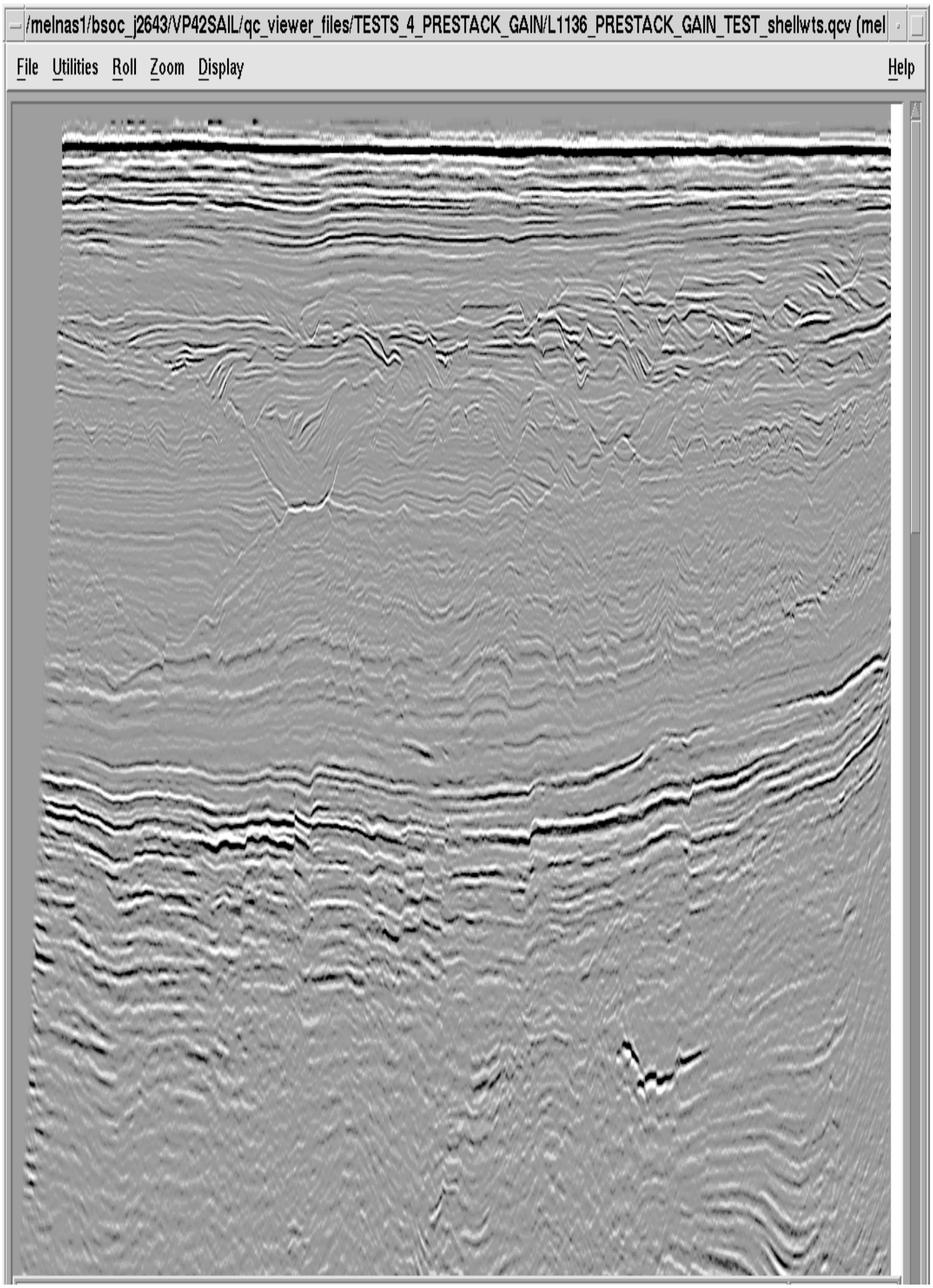
Enclosure 17: Line 1136 – Mute functions on NMO corrected PSTM gathers.
(Cyan: -300m, Blue: -200m, Purple: -100m, Red: Current Mute, Pink: +100m, Yellow: +200m)



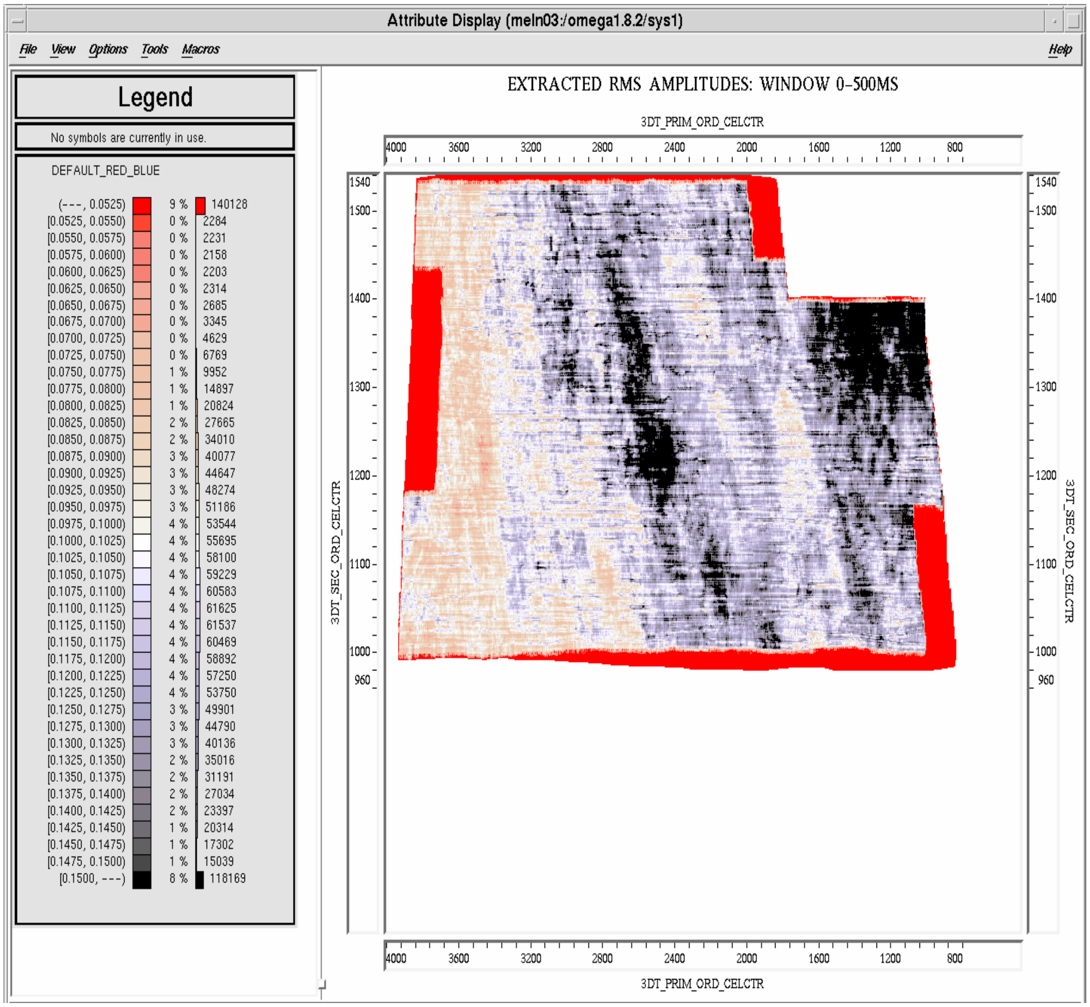
Enclosure 18: Line 1136 – PSTM stack with no Weighting



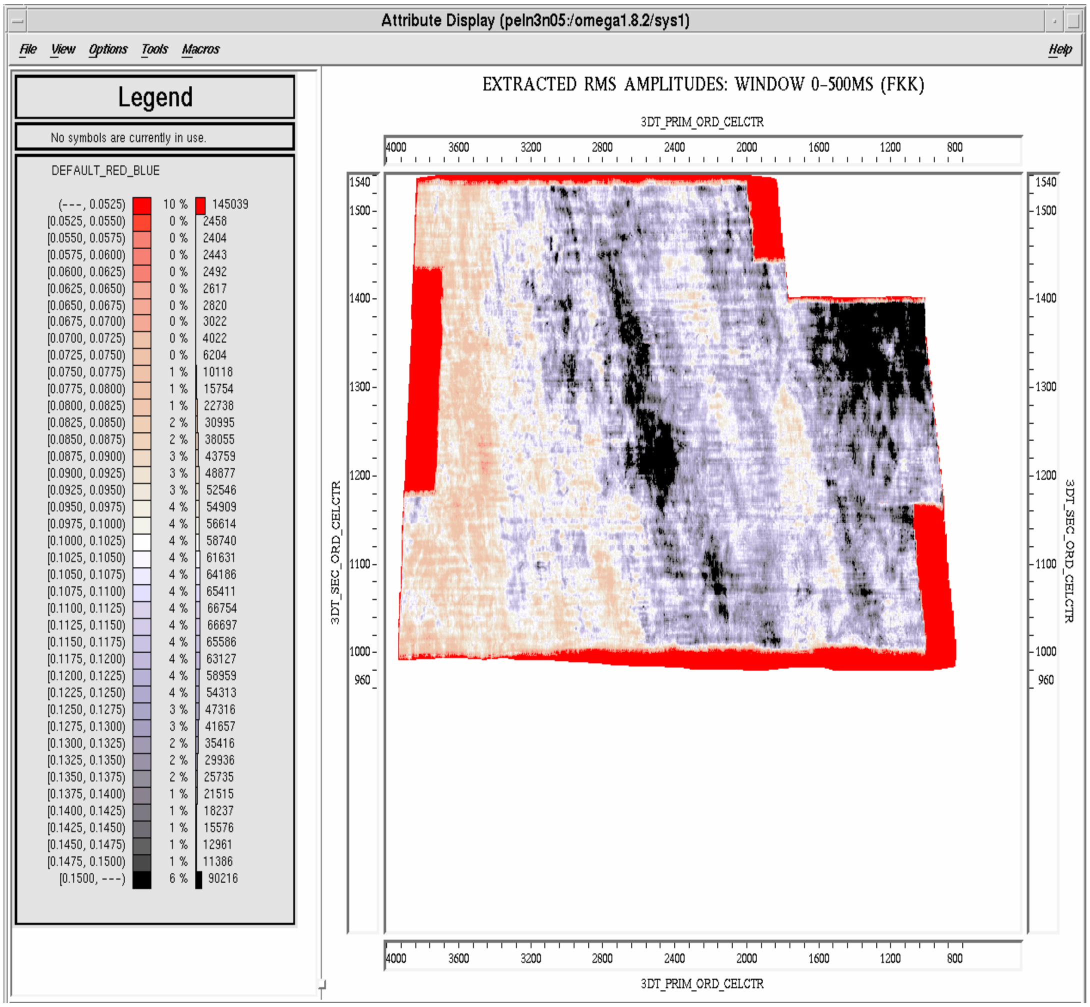
Enclosure 19: Line 1136 – PSTM stack with Weighting



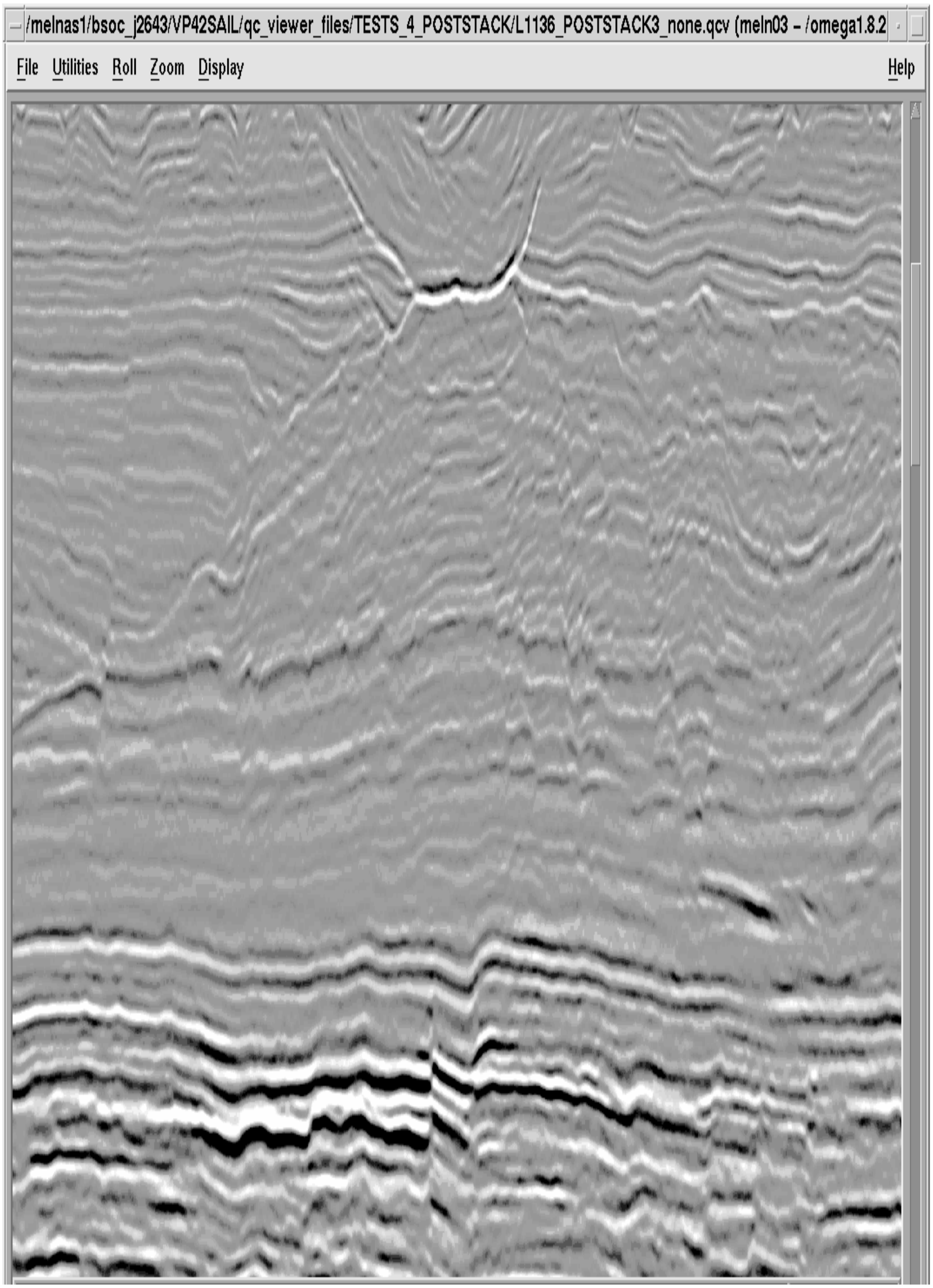
Enclosure 20: PSTM stack volume – Extracted RMS amplitude (0 – 500 ms)



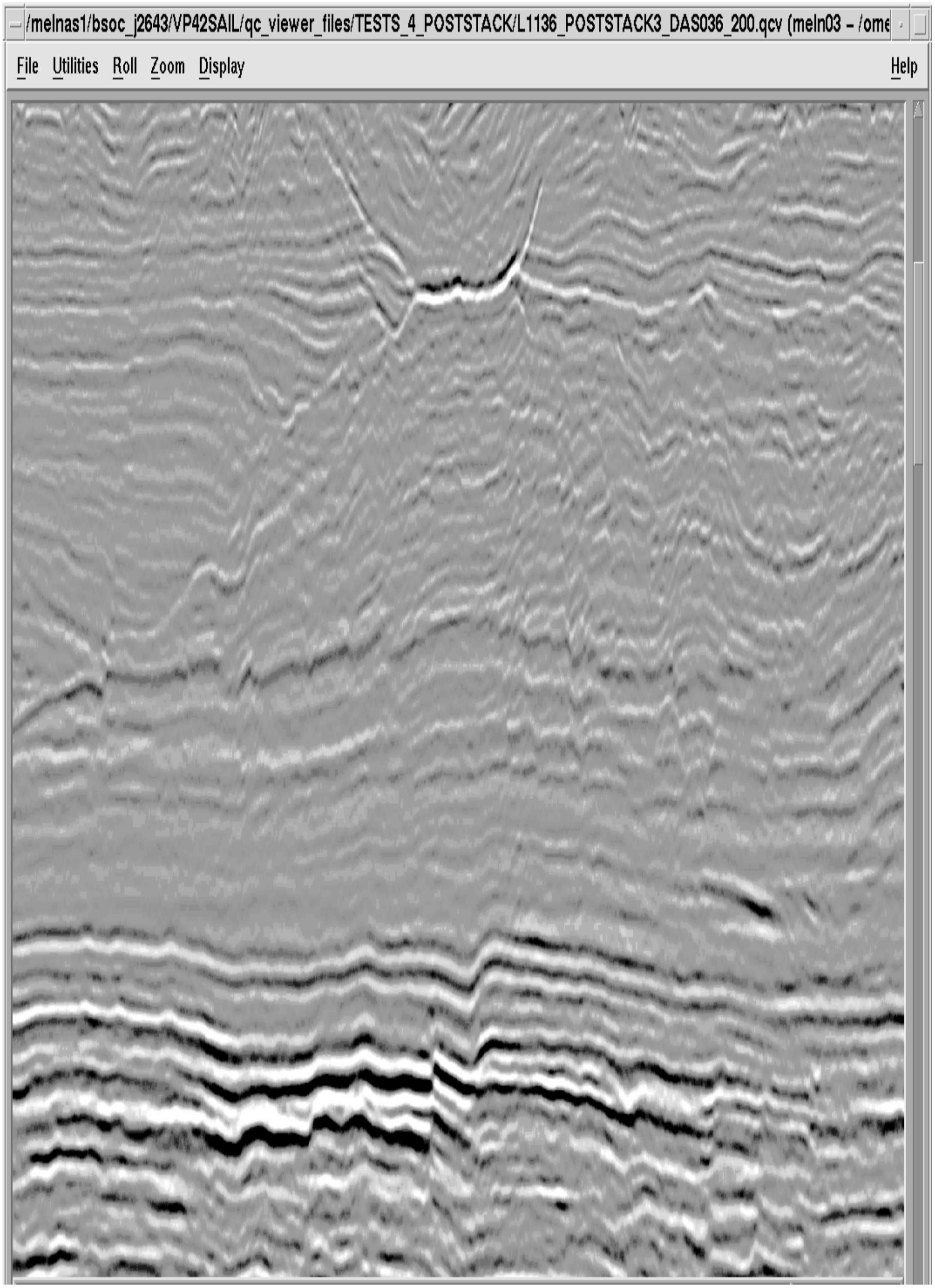
Enclosure 21: PSTM stack volume – Extracted RMS amplitude with 3D FK filter (0 – 500 ms)



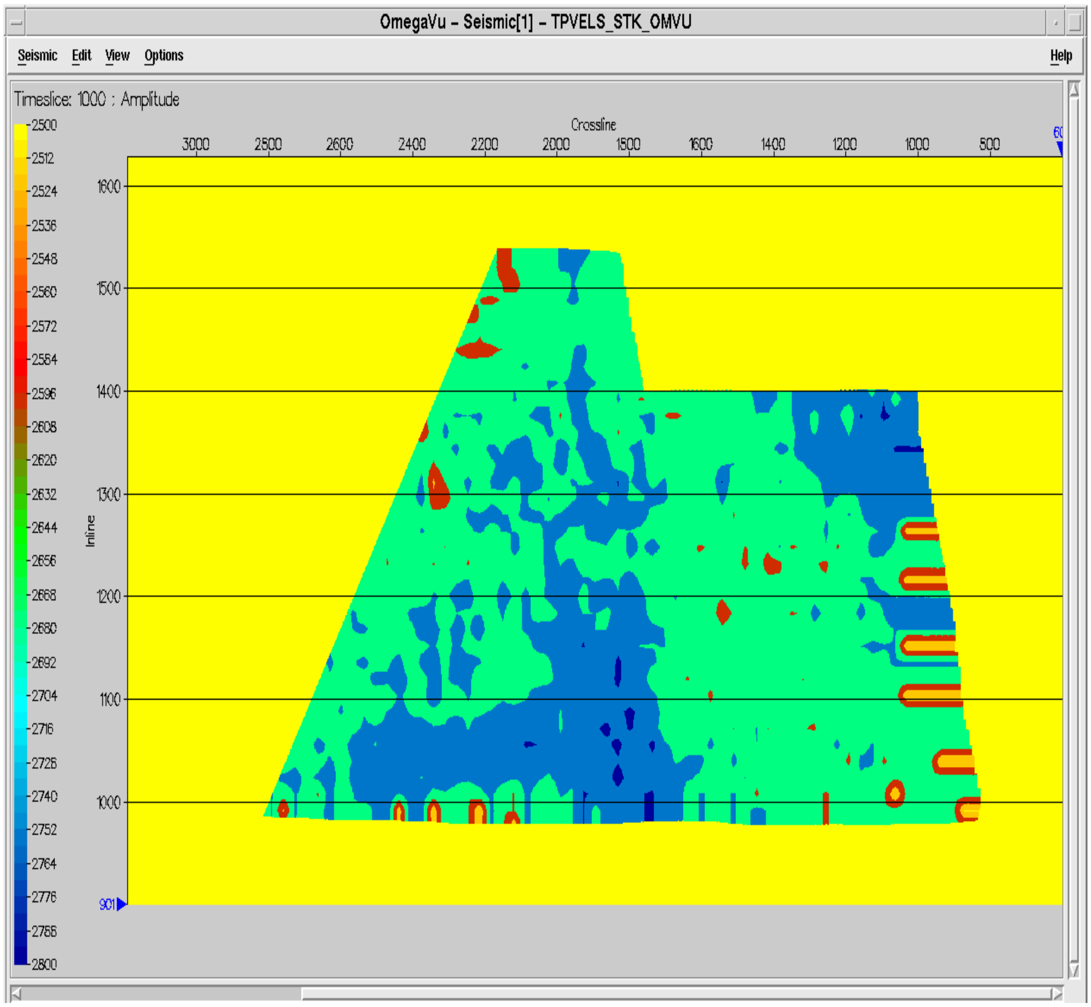
Enclosure 22: Line 1136 – PSTM stack with no DAS.



Enclosure 23: Line 1136 – PSTM stack with 36/200 ms DAS.



Enclosure 24: Time Slice 1000 ms – Third Pass velocity traces.



Enclosure 25: Time Slice 1000 ms – HDVA velocity traces.