SEISMIC DATA PROCESSING REPORT

for

BASS STRAIT OIL COMPANY LTD

Survey:	BOBS08
Location:	T42/43P, Bass Basin
Date:	August 2008

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1 Introduction

Th BOBS08 survey was recorded by CGG Veritas using M/V Pacific Titan in the month of May 2008. A total of 1191.750 km of seismic data was acquired, comprised of 17 lines. The survey is located in the T42/43P, Bass Basin in water depths ranging from approximately 40 to 80 metres.

Testing for the BOBS08 survey was comprehensive with attention paid to multiple and noise attenuation, steep dip and amplitude preservation. As with survey of this type of complex geology, this is difficult to have an one size fit all parameters that it works everywhere. Parameters for most processes vary according to water bottom time, but in some cases, vary according to the geology.

The main final delivered products consisted of Final Migrations, Raw Migrations and Angle Migrations. Final PSTM gathers was also archived.

All processing, including velocity picking and QC was undertaken at the Fugro Seismic Imaging office in Perth, Western Australia.

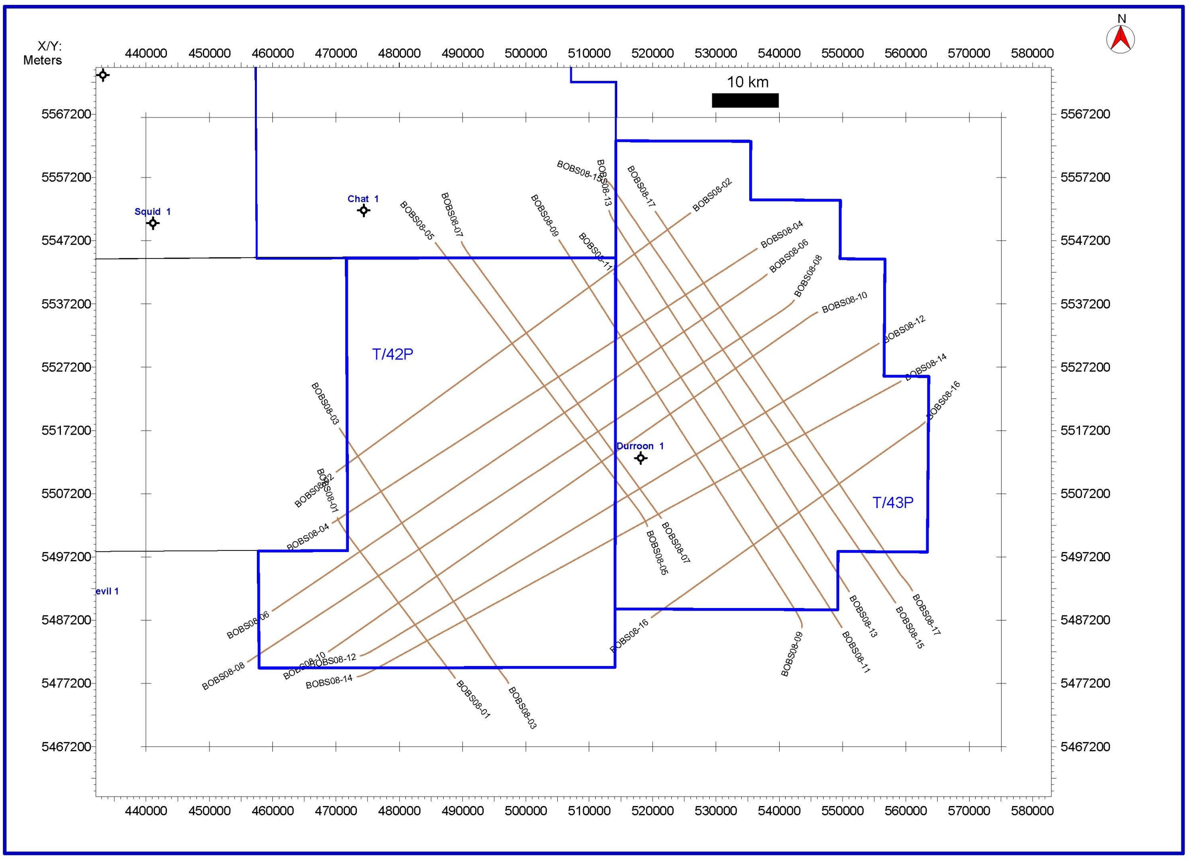
1.1 Personnel

Fugro Seismic Imaging Pty Ltd
Teck Goh **Senior Geophysicist**

Bass Strait Oil
Keith Martens **Consultant**

1.2 Location Map

T42/43P, Bass Basin



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1.3 Line Listing

Sqn	Line name	SP range	CDP range	Km
1	BOBS08-01	2022 - 881	1 - 2522	28.550
2	BOBS08-02	3537 - 881	1 - 5552	66.425
3	BOBS08-03	1001 - 2818	1 - 3874	45.450
4	BOBS08-04	1001 - 4080	1 - 6398	77.000
5	BOBS08-05	1001 - 3123	1 - 4484	53.075
6	BOBS08-06	4545 - 881	1 - 7568	91.625
7	BOBS08-07	2921 - 881	1 - 4320	51.025
8	BOBS08-08	4906 - 881	1 - 8290	100.650
9	BOBS08-09	1001 - 3779	1 - 5796	69.475
10	BOBS08-10	4526 - 881	1 - 7530	91.150
11	BOBS08-11	1001 - 3543	1 - 5324	63.575
12	BOBS08-12	1001 - 4711	1 - 7660	92.775
13	BOBS08-13	3612 - 881	1 - 5702	68.300
14	BOBS08-14	1001 - 4794	1 - 7826	94.850
15	BOBS08-15	4002 - 881	1 - 6482	78.050
16	BOBS08-16	2890 - 881	1 - 4258	50.250
17	BOBS08-17	1001 - 3781	1 - 5800	69.525
			Total	1191.750

2 Acquisition Parameters

DESCRIPTION	***DETAILS***
Data recorded by:	CGG Veritas
Date recorded:	May 2008
Vessel:	M/V Pacific Titan
General:	
Nominal fold	120
Recording format:	SEG D 8058 rev 1.0
Seismic source:	
Type	Gun array
Volume	3040 cu.in.
Pressure:	2000 psi
Depth:	6 m
Shot interval:	25 m
Gun delay	0 ms
Recording system:	
Instrument:	Sercel Seal 480XL
Record length:	6000 ms
Sample interval:	2 ms
Instrument delay:	50 ms
Low cut filter:	4.7 Hz @ 12 dB/octave
High cut filter:	200 Hz @ 370 dB/octave
Receivers:	
Streamer length:	6000 m
Streamer depth:	8 m
Number of groups:	480
Near group number:	1
Group interval:	12.5 m
Centre source to centre near group:	145 m
SP annotation:	Source position

3 Parameter Testing

One test line was chosen for BOBS08 survey :

1) BOBS08-12

The processing test sequence includes review of the following processing phases and parameter choices:

1) Designature
   Using far field signature provided by CGG Veritas. Test various fuzzy cable ghost at 8m +/- 0.5m , 1m and 1.5 m.

2) Gain Recovery
   Initial gain correction estimate, compensating for spherical divergence and inelastic attenuation losses. Test t**2 gain to confirm applicability.

3) Pre-Filter
   Application of various low-cut frequency filters: 3 Hz to 6 Hz at 12 dB/oct.

4) Time Frequency De-noise
   Test different frequency ranges and threshold attributes.

5) Tau-P Deconvolution
   Testing various gap lengths and operators.

6) Tau-P Linear Noise Attenuation
   Testing different severities of muting in Tau-P domain. Compare shot records and stack sections.

7) SRME
   Comparison of shot records and stack sections with and without SRME plus using different global shift.

8) Radon Demultiple
   Test varying frequency range, number of p values and definition of the multiple modelling polygon.
   Also test the linear mode versus parabolic mode.

9) FX Deconvolution and FK Filter
   Test different white noise for FX deconvolution and various FK filter severities and also test varying the mix-back according to WBT and according to geology.

10) Pre-Stack Kirchhoff Migration
   Test different half aperture and percentages of stretch mute. Also test straight ray versus curved ray, found that there was no added benefit of using curved ray algorithm.

11) Residual Radon Demultiple
   Test varying frequency range, number of p values and definition of the multiple modelling polygon.
   Also test the linear mode versus parabolic mode.

12) Mutes
   Test different severities of normal outer and inner mutes, also different ranges of angle mutes.

13) Tau-P Dip Filter
   Test various dip limits and percentage of mix-backs.

14) Post-Stack FX Deconvolution
Test different white noise and different percentages of mix-back.
It was decided to use it more as a tool to reduce the patchy diffracted noise due to the migration of residual multiple diffraction noise rather than as a general coherency filter.

15) Bandpass Filter
Run a suite of increasing narrow bandpass to pick the filters.

16) Post-Stack Scaling
Produce various dual window AGC with different percentages of mix-back.

17) Angle Migrations
Test different ranges of angle of incidence.

4 Processing Sequence

Field Tape Transcription
↓
Designature outputting zero phase
↓
Initial Gain Recovery
↓
Resample & Pre-Filter
↓
Correction for Instrument Delay
↓
Time Frequency De-Noise
↓
Random Spike Attenuation
↓
Navigation Merging
↓
First Pass Velocity Analysis
↓
Tau-P Deconvolution and
Tau-P Linear Noise Attenuation
↓
SRME
↓
Receiver Array Simulation
↓
Sort to CDP gathers
↓
Removal of T**2 Scaling and Spherical
Divergence Correction
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Radon Multiple Attenuation
↓
FX Deconvolution and FK Filter
in common offset domain
↓
First Pass PSTM
↓
Second Pass Velocity Analysis
↓
Final PSTM
↓
Third Pass Velocity Analysis
↓
Residual Radon Demultiple
↓
NMO correction
↓
Outer Trace Mutes
↓
Inner Trace Mutes
↓
Stack
↓
Gun and Cable Static Corrections
↓
Tau-P Dip Filter
↓
FX Deconvolution
↓
Exponential Gain
↓
Band-Pass Filter
↓
Post-Stack Scaling

5 Processing Description

A brief description of each of the processes used in the processing sequence follows:

5.1 Transcription

Field data in SEG-D format is converted to Fugro Seismic Imaging internal format for processing. Fugro Seismic Imaging internal format is trace sequential, with samples in 32 bit IEEE floating point. When reading the shot records, strategic header values related to acquisition are reserved (where available).

5.2 Designature

Designature outputting zero phase wavelet is designed from the far field signature provided by CGG-Veritas with the same spectrum. Fuzzy cable ghost at 8 m +/- 1 m is used.

5.3 Initial Gain Recovery

A gain function is applied to the data set to compensate for amplitude decay. The functions applied use t squared compensation for inelastic attenuation and spherical divergence losses. (t is the two way travel time in milliseconds).

5.4 Resample and Pre-Filter

The data is resampled in the frequency domain - from 2 ms to 4 ms sample period. Prior to resample, a zero phase Butterworth pre-filter filter is applied : 4 Hz at 12dB/octave to 100 Hz at 72dB/Octave.

5.5 Correction for Instrument Delay

A static correction of -50 ms is applied to the whole survey to account for the instrument delay.

5.6 Time Frequency De-noise

TFDN is applied to attenuate noise in the shot records, It works by transforming all traces in a short sliding time window to the frequency domain. There, it compares the frequency content of each trace to the frequency content of neighboring traces in order to identify anomalies. It then attenuates the anomalous amplitude at that frequency in the current trace under investigation to the level of the threshold attribute. The frequency range used is 0 – 20 Hz and the threshold attribute is 3.5.

5.7 Random Spike Attenuation

Despike is applied to remove any anomalous high energy amplitudes which could be the source of noise in the pre-stack migration. Amplitudes are measured in a matrix of 25 time windows of 100 ms length. The matrix is composed of seven consecutive time windows across 7 adjacent traces in a shot gather. The amplitude of the central window is compared to the rest of the matrix and the central window is defined as containing a spike if the peak to median ratio is greater than 30, or if the central window median value exhibits more than 10 units of standard deviation from the average median. Spike affected windows are scaled to the mean of the matrix.

Despike is not performed in the shallow parts of the shot record or near the first breaks, as shown in the following table:

Parameters for Random Spike Attenuation			
Despike start time at following WBT and offset	100 m	2000 m	6200 m
200 ms	1900 ms	2400 ms	5400 ms
1000 ms	2900 ms	3400 ms	5800 ms
2000 ms	4300 ms	4400 ms	6200 ms
3000 ms	5300 ms	5400 ms	6400 ms

5.8 Navigation Merging

The seismic trace headers are updated with easting and northing values for sources, receivers and CDPs from the supplied navigation files. Water bottom times are digitised from stacks and read into the headers.

Parameters for Navigation	
Spheroid:	GDA94 (6378137.000 298.2572236)
Projection type:	002 UTM South
Projection Zone:	55 S
Longitude of CM:	147 0 0.000 E

5.9 First Pass Velocity Analysis

The first pass velocities are picked at 1 km interval on TFDN gathers applied with random spike attenuation using Fugro Seismic Imaging Pty Ltd "MGIVA" interactive velocity analysis program. Each velocity analysis comprises a semblance display, a CDP stacked panel repeated 14 times with a suite of velocity functions, and a central CDP gather. The suite of functions are generated using 0%, +/-5%, +/-10%, +/-15%, +/-20%, +/-25% , +/-30% and +/-40% increments from a central velocity function. The central functions for this velocity analysis are based on crude velocity functions varied according to WBT.

5.10 Tau-P Deconvolution and Tau-P Linear Noise Attenuation

The data is transformed to the Tau-P domain using the linear transform. Strong linear noise trains with large dip can be differentiated from primary energy in the linear tau-p space, and these events are attenuated by a scaling pattern - tapering from the primary to noise areas of the transform. The transform is performed with p limits of -4500 ms and 5500 ms, with increments of 10 ms (reference offset of 6200m).

Predictive deconvolution is utilised in the Tau-P domain to attenuate short period reverberations, and to broaden the amplitude spectrum. Deconvolution is applied using one window with the following parameters :

Tau-P Deconvolution Parameters			
Parameters/seafloor twt	100 ms	300 ms	500 ms
Operator plus gap	348 ms	348 ms	348 ms
Gap length	48 ms	48 ms	48 ms
Design windows *p = -4500* *p = 2890* *p = 5500*	 1000 – 5000 ms 300 – 4300 ms 0 – 4000 ms	 1200 – 5200 ms 500 – 4500 ms 100 – 4100 ms	 1400 – 5400 ms 700 – 4700 ms 300 – 4300 ms
Application windows (start times)	0 ms	200 ms	not applied

Deconvolution is not applied on data where the WBT exceeds 500 ms.

The input data is resampled to 2 ms prior to the transform and resampled back to 4 ms after the transform.

5.11 SRME

SRME or **S**urface **R**elated **M**ultiple **E**limination uses the geometry of shot recording to estimate all possible multiples that can be generated by the surface. It was developed by the Delphi Consortium at TUDelft in the Netherlands. One order of surface related multiples is predicted using auto-convolutions of input data. The predicted multiple energy is then removed from the input gathers by a process of cascaded adaptive subtraction.

Prior to forming the multiple estimate, it is necessary to interpolate new shots such that the shotpoint interval is equal to the group interval. The recorded data is then extrapolated to zero offset, before constructing the multiple estimate by a series of convolutions and summation.

A mute is applied to the input shot records prior to remove direct arrival energy. Before adaptive subtraction, the modelled multiples are NMO corrected and any energy above the first seafloor multiple removed by muting.

Parameters for SRME	
Group interval	12.5m
SP interval (after interpolation)	12.5m
SRME	80 reciprocal traces to generate 60 reciprocal traces to taper 300 shots used 8 ms global shift
Adaptive subtraction	Common shot domain 30 filter traces 500 ms window 21 adjacent traces used in matching

5.12 Receiver Array Simulation

A time variant receiver array simulation varying according to WBT is achieved by first time shifting the NMO corrected data to a reference time, performing a weighted summation followed by the decimation of the shot records. After decimation, the shot records consist of half the number of channels, with new group intervals being double the original group intervals and the data is shifted back to its original time and NMO correction is reversed.

Parameters for Trace Mix	
Time (ms)	***Trace Mix***
WBT + 2000	0 – 1 – 2 – 1 - 0
WBT + 3000	1 – 2 – 3 – 2 - 1

Parameters for Adjacent Trace Sum	
Input traces:	480
Input trace interval:	12.5 m
Output traces:	240
Output trace interval:	25 m

5.13 CDP Gather

Data from each source/cable combination is sorted into the common midpoint domain.

Parameters for CDP Gather	
Shot interval:	25 m
Group interval:	25 m
Number of channels:	240
CDP interval:	12.5 m
CDP fold:	120

5.14 Reverse Gain Recovery

t^2 scaling that is applied at the start of processing is removed.

5.15 Spherical Divergence (Ursin & Gain)

With the previously applied t^2 gain function removed, it is then replaced with an offset and velocity dependent spherical divergence approximation as described by Bjorn Ursin (GEOPHYSICS Vol.55 No.4, pp492-496 1990).

$$\sqrt{\frac{T0\times V^4}{V0^2}+(2\times(\frac{V}{V0})^2-1)\times X^2+\frac{X^4\times(\frac{1}{V0^2}-\frac{1}{V^2})}{t0^2}}$$

Where T0 is the two way travel time, V is the RMS velocity at T0, and V0 is the velocity in the first layer. Although this method is applicable to uncorrected data as a moveout tracking divergence correction, for algorithmic ease it is applied to NMO corrected CDP gathers.

5.16 Radon Multiple Attenuation (HI-Res)

Two passes of Radon demultiple are used. These processes are performed in either high resolution linear or parabolic Tau-P domain using NMO corrected gathers with the first pass velocities.

Attenuation of multiples was achieved by modelling and subtraction using a least squares, radon transform. Initially, normal moveout corrections were performed using the first pass velocities, and the CDP gathers transformed into either linear or parabolic Tau-P domain. Weighting terms are added to the least squares solution to reduce residual error in the transform – a method known as “high resolution radon”. The segment of the Tau-P domain corresponding to primary reflections is muted, leaving the multiple energy to be transformed back into the T-X domain and subtracted from the original CDP gather.

Parameters for 1st pass Linear Radon Transform	
Reference offset	6200 m
Frequency range	4 - 100 Hz
Minimum p	*-500 (linear delta-t, at reference offset)*
Maximum p	+4500 *(linear delta-t, at reference offset)*
No. of p traces	501

Parameters for 2nd pass Parabolic Radon Transform	
Reference offset	6200 m
Frequency range	4 - 100 Hz
Minimum p	-800 *(linear delta-t, at reference offset)*
Maximum p	+3200 *(linear delta-t, at reference offset)*
No. of p traces	401

The application start times vary according to water bottom times and are as follows :

Parameters for Radon Demultiple Start Time	
WBT (ms)	***Application start time (ms)***
100	600
500	900
1000	1500
3000	3500

Parameters for Multiple Modelling		
WBT (ms)	**Tau (ms)**	**Primary p range (muted) (ms)**
100	600	-1000 to 1000
	1100	-1000 to 700
	1500	-1000 to 500
	6000	-1000 to 200
500	1000	-1000 to 1000
	1500	-1000 to 700
	2000	-1000 to 400
	6000	-1000 to 200
1000	1000	-1000 to 1000
	1500	-1000 to 7000
	2000	-1000 to 400
	6000	-1000 to 200
1500	1500	-1000 to 1000
	2000	-1000 to 700
	3000	-1000 to 400
	6000	-1000 to 200
2000	2000	-1000 to 1000
	3000	-1000 to 500
	4000	-1000 to 300
	6000	-1000 to 200
3000	3000	-1000 to 1000
	4000	-1000 to 500
	5000	-1000 to 300
	6000	-1000 to 200

To reduce the potential for aliasing, 2:1 interpolation is performed along common offset domain prior to demultiple. After demultiple, interpolated traces are dropped from the processing stream.

A 300 ms AGC is applied before the Radon demultiple, and the scalars preserved for later removal.

5.17 FX Deconvolution and FK Filter

FX deconvolution is designed to effectively attenuate random noise by prediction of the non-random signal content in a block of seismic traces. FK filter of 1500 m/s is used to attenuate some of the remnant steeply dipping noise trains which are not being removed by the Tau-P linear noise attenuation. Time and space variant mix-backs varying according to WBT are applied to protect the earlier part of the section which has good signal to noise ratio.

Parameters for FX Deconvolution	
Filter length	9
Number of input traces per filter prediction	96
White noise percentage	1

5.18 First Pass PSTM

Pre-stack Kirchhoff time migration is used to migrate data for velocity analysis. The migration algorithm is used in straight ray mode, with a 5 km half aperture. The velocity field is constructed by smoothing the first pass velocities. Anti-aliasing protection is applied by pre-filtering the data within the migration scan depending upon the local migration operator dip. Apertures are muted with a 70% stretch mute to avoid operator aliasing. Migration is performed on the full offset planes. The migration generates fully corrected CDP gathers on each line. The migration velocity field is then used to 'remove' the NMO corrections before velocity analysis.

Parameters for Surface Consistent Velocity Smoothing for PSTM		
Layer from seafloor	***Smoothing Radius***	***Mix-back of Original***
1st	1 km	50%
12th	2 km	25%
20th	4 km	25%
30th	4 km	0%

5.19 Second Pass Velocity Analysis

The second pass of velocities are picked at 1 km interval on first pass PSTM gathers using Fugro Seismic Imaging Pty Ltd “MGIVA” interactive velocity analysis program. Each velocity analysis comprises a semblance display, a CDP stacked panel repeated 14 times with a suite of velocity functions, and a central CDP gather. The suite of functions are generated using 0%, +/-4%, +/-8%, +/-12%, +/-16%, +/-20% , +/-24% and +/-30% increments from a central velocity function. The first pass velocities are used as the central functions for this suite of velocity variant functions.

5.20 Final PSTM

Kirchhoff pre-stack time migration is applied with a maximum half aperture of 5 km. Anti-aliasing protection is applied by pre-filtering the data within the migration scan depending upon the local migration operator dip. Apertures are muted with a 70% stretch mute to avoid operator aliasing. Smoothed 100% second pass velocities at 1 km are used and migration is performed on the full offset planes.

Surface consistent velocity smoothing for final PSTM employs the same scheme as that for the first pass PSTM, refer to section 5.18 for the parameters.

5.21 Third Pass Velocity Analysis

The third pass of velocities are picked at 0.5 km intervals on final PSTM gathers using Fugro Seismic Imaging Pty Ltd "MGIVA" interactive velocity analysis program. Each velocity analysis comprises a semblance display, a CDP stacked panel repeated 14 times with a suite of velocity functions, and a central CDP gather. The suite of functions are generated using 0%, +/-2%, +/-4%, +/-6%, +/-8%, +/-12% ,+/-16% and +/-20% increments from a central velocity function. The second pass of velocities are used as the central functions for this suite of velocity variant functions.

5.22 Residual Radon Demultiple (Hi-Res)

The data benefits from applying a residual Radon demultiple to remove some of the steeply dipping noises still residing on the PSTM gathers which could not be removed in the earlier attempt of demultiple and also to remove multiple events with similar moveout to the primary data.

Normal moveout corrections are performed using the third pass velocities, and the pre-stack time migrated gathers transform into the linear Tau-P domain. Weighting terms are added to the least squares solution to reduce residual error in the transform – a method known as "high resolution radon". The segment of the Tau-P domain corresponding to primary reflections is then muted, leaving the multiple energy to be transformed back into the T-X domain and subtracted from the original CDP gather.

Parameters for Linear Radon Transform	
Reference offset	6200 m
Frequency range	4 – 100 Hz
Minimum p	-800 *ms (linear delta-t, at reference offset)*
Maximum p	+4000 *ms (linear delta-t, at reference offset)*
No. of p traces	481
Tau-P muting	-10% of third pass velocities

To reduce the potential for aliasing, 2:1 interpolation is performed in CDP domain prior to demultiple. After demultiple, the interpolated traces are dropped from the processing stream.

5.23 NMO Correction

Fourth order NMO corrections are applied using the final picked PSTM velocity functions.

5.24 Outer Trace Mute

Post-NMO outer trace mutes are applied to remove any coherent noise on the outer races and to reduce contamination from the effect of NMO stretch on the far offsets. Muting parameters are spatially varied according to water bottom time.

Parameters for Outer Trace Mute					
WBT (ms)	***Offset (m)***	***100***	***320***	***720***	***6200***
200	***Time (ms)***	0	0	600	4200
WBT (ms)	***Offset (m)***	***100***	***360***	***920***	***6200***
600	***Time (ms)***	300	300	1000	4600
WBT (ms)	***Offset (m)***	***100***	***460***	***1220***	***6200***
1000	***Time (ms)***	800	800	1400	5000
WBT (ms)	***Offset (m)***	***100***	***560***	***1320***	***6200***
1500	***Time (ms)***	1300	1300	1800	5400
WBT (ms)	***Offset (m)***	***100***	***660***	***1420***	***6200***
2000	***Time (ms)***	1800	1800	2400	5800
WBT (ms)	***Offset (m)***	***100***	***760***	***1620***	***6200***
2500	***Time (ms)***	2300	2300	2900	6000

5.25 Inner Trace Mute

A post NMO inner trace mute is applied to help remove remnant multiple energy still apparent on the inner traces following the demultiple.

Parameters for Inner Trace Mute				
WBT (ms)	***Offset (m)***	***100***	***540***	***740***
600	***Time (ms)***	1200 – 6000	1600 – 6000	2400 – 6000
1000	***Time (ms)***	1600 – 6000	1800 – 6000	2400 – 6000
2000	***Time (ms)***	2600 – 6000	2800 – 6000	3400 – 6000
2500	***Time (ms)***	3100 – 6000	3300 – 6000	3900 – 6000

5.26 Stack

The traces within each common depth point gather are summed using 1/N stack compensation.

5.27 Gun and Cable Static Corrections

A +8 ms static compensation for gun and cable depths is applied.

5.28 Tau-P Dip Filter

Tau-P filtering provides an effective time variant dip filter, and enhances coherent events while discriminating against random noise. Semblance enhancement of the data in the Tau-P domain, together with editing of sections of the Tau-P plane, permits retention of data within specified dip limits at any time and enhancement of these dips after transformation back into X-T space.

Tau-P Dip Filter Parameters		
Dip limits	*-8 to 8 ms/trace*	
Seafloor twt (ms)	*Time (ms)*	*% addback*
100	100	90
	1000	90
	2000	80
	4000	70
1000	1000	90
	2000	90
	3000	80
	5000	70
2000	2000	90
	3000	90
	4000	80
	5000	70
3000	3000	90
	4000	90
	5000	80
	6000	70

5.29 FX Deconvolution

FX deconvolution is designed to effectively attenuate random noise by prediction of the non-random signal content in a block of seismic traces. Data are split into 2 blocks of every 2nd trace and FX deconvolution is applied on each block prior to merging back all traces. Time and space variant mix-backs varying according to WBT are applied to specifically target the water bottom multiples.

Parameters for FX Deconvolution	
Filter length	15
Number of input traces per filter prediction	15
White noise percentage	5

5.30 Band-Pass Filter

Unwanted noise that lay outside the frequency range of the desired reflection data is attenuated by the application of a series of zero phase Butterworth time variant filters.

Bandpass Filter Parameters		
Seafloor twt (ms)	***Time(ms)***	***Frequency (Hz)(dB/oct)***
100	100	6/18 – 110/72
	1000	4/12 – 75/72
	3000	4/12 – 45/60
	5000	4/12 – 40/48
1000	1000	6/18 – 110/72
	2000	4/12 – 75/72
	4000	4/12 – 45/60
	6000	4/12 – 40/48
2000	2000	6/18 – 110/72
	3000	4/12 – 75/72
	4500	4/12 – 45/60
	6000	4/12 – 40/48
2500	2500	6/18 – 110/72
	3500	4/12 – 75/72
	4000	4/12 – 45/60
	6000	4/12 – 40/48

5.31 Exponential Gain

An exponential gain of 12 dB per second is used to boost up amplitudes at the deeper sections. It is applied from the WBT.

5.32 Post-Stack Scaling

A dual window, time variant AGC method is used for post-stack scaling. The negative effects normally associated with AGC are avoided by employing two different length windows to determine the amplitude model (using the minimum of the two mean amplitudes determined at each sample), then conditioning the model by a weighted mix with the amplitude model derived from a single window per trace.

Window lengths of 1200 ms and 400 ms are defined with equalization applied at 80%.

5.33 Angle Products

Angle products, stacks generated after restricting input to a portion of the residual Radon demultiple gathers corresponding to a particular range of incident angles, are produced for lithology and fluid predictions. The angle of incidence calculations are performed using 1D raytracing method, and considered a smoothed version of the final velocities. The angle gathers are produced where the incident angles are restricted to the specified ranges, prior to stacking.

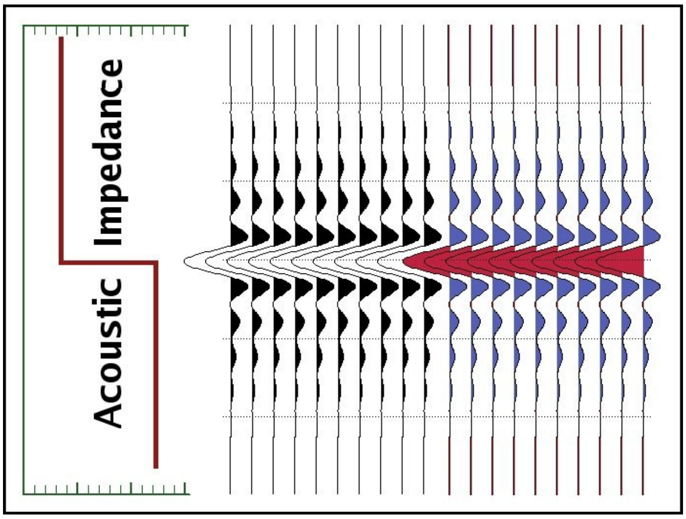
The angle mutes use smoothed velocities (3 passes of lateral and temporal smoothing with 50% mix-back) and the stacks do not have any pre-stack nor post-stack scaling applied. Matching scalars are used to bring the near and far angle products to an overall mean value of 1000.

Parameters for Angle Products	
Near Angle	5 – 25 degrees
Far Angle	20 – 40 degrees

6 Polarity Statement

The final desired polarity was SEG negative (or SEG reverse), where an increase in acoustic impedance is represented by a negative number on tape, and white trough on display.

Figure 6.1 Desired polarity diagram. An acoustic impedance increase is represented by a trough.



7 Archive Listing

The following datasets were archived:

1) Final Migrations : all post-stack processing up to including gun/cable static correction, Tau-P dip filter, FX deconvolution, bandpass filter, exponential gain and post-stack scaling
2) Raw Migrations : all post-stack processing up to including gun/cable static correction and exponential gain.
3) Angle Migrations : all post-stack processing up to including gun/cable static correction, Tau-P dip filter, FX deconvolution, bandpass filter and exponential gain.
4) Final PSTM Gathers : all pre-stack processing up to final PSTM including residual Radon demultiple, NMO correction and gun/cable static corrections.

All final post-stack data were archived in SEGY format onto DVD and all final pre-stack data were archived in SEGY format onto DLT IV.

Tape No.	*Media*	*Date*	*Description*
678FM001DVD	DVD	13-08-08	Final Migrations
678RM002DVD	DVD	13-08-08	Raw Migrations
678AM003DVD	DVD	13-08-08	Angle Migrations
678SV004CD	CD	13-08-08	Shot-CDP relationships and Final Velocities
678FG005L	DLT IV	13-08-08	Final PSTM Gathers (BOBS08-01 to 09)
678FG006L	DLT IV	13-08-08	Final PSTM Gathers (BOBS08-10 to 17)

Please note the following :
For line BOBS08-11, the P190 navigation is missing from sp 1001 to 1119 at the beginning of the line due to short run in to the line. As such there is no navigation in the headers for above range on the final gather data, but for the final post-stack data, navigaiton has been extrapolated.

The SP-CDP relationships for all lines are as follows:

Sqn	Line name	SP range	CDP range	CDP	SP	CDP	SP
1	BOBS08-01	2022 - 881	1 - 2522	246	2022	446	1922
2	BOBS08-02	3537 - 881	1 - 5552	246	3537	446	3437
3	BOBS08-03	1001 - 2818	1 - 3874	246	1001	446	1101
4	BOBS08-04	1001 - 4080	1 - 6398	246	1001	446	1101
5	BOBS08-05	1001 - 3123	1 - 4484	246	1001	446	1101
6	BOBS08-06	4545 - 881	1 - 7568	246	4545	446	4445
7	BOBS08-07	2921 - 881	1 - 4320	246	2921	446	2821
8	BOBS08-08	4906 - 881	1 - 8290	246	4906	446	4806
9	BOBS08-09	1001 - 3779	1 - 5796	246	1001	446	1101
10	BOBS08-10	4526 - 881	1 - 7530	246	4526	446	4426
11	BOBS08-11	1001 - 3543	1 - 5324	246	1001	446	1101
12	BOBS08-12	1001 - 4711	1 - 7660	246	1001	446	1101
13	BOBS08-13	3612 - 881	1 - 5702	246	3612	446	3512
14	BOBS08-14	1001 - 4794	1 - 7826	246	1001	446	1101
15	BOBS08-15	4002 - 881	1 - 6482	246	4002	446	3902
16	BOBS08-16	2890 - 881	1 - 4258	246	2890	446	2790
17	BOBS08-17	1001 - 3781	1 - 5800	246	1001	446	1101

8 SEGY Header Information

8.1 Header of Post-Stack Data

Type	Start byte	Description	Type	Start byte	Description
I32	1	Trace number within line.	I16	99	Source static correction.
I32	5	Trace number within reel.	I16	101	Receiver static correction.
I32	9	Sequential record number.	I16	103	Total static applied.
I32	9	Original field record number.	I16	109	Delay recording time (ms).
I32	13	Trace number.	I16	111	Mute time start.
I32	17	Shot point number.	I16	113	Mute time end.
I32	21	CDP number.	I16	115	No. of samples.
I32	25	Trace no. within the CDP.	I16	117	Sample interval in microseconds.
I16	29	Trace identification code.	I16	157	Year of recording.
I16	31	No. of summed traces.	I16	159	Julian day number (1-366).
I16	33	Total number of traces in CDP.	I16	161	Hour of day (24 hour clock).
I16	35	Data use 1=production, 2=test.	I16	163	Minute of hour.
I32	37	Trace offset (integer).	I16	165	Second of minute.
I32	41	Elevation at receiver.	I16	167	Time base code 1.local,2.gmt,3.?
I32	45	Elevation at source.	I32	181	3D Line number.
I32	61	Water depth at source.	I32	185	CDP no. within 3D line.
I32	65	Water depth at receiver.	I32	189	2D shotpoint number (Maersk).
I16	69	Scaler to be applied to elevations.	I32	193	Easting of CDP.
I16	71	Scaler to be applied to coordinates.	I32	197	Northing of CDP.
I32	73	Source easting.	I16	201	Scaler to be applied to SPNO.
I32	77	Source northing.			
I32	81	Receiver easting.			
I32	85	Receiver northing.			
I16	89	Coordinate units (m/arc).			

8.2 Header of Pre-Stack Data

Type	Start byte	Description	Type	Start byte	Description
I32	1	Trace number within line.	I16	99	Source static correction.
I32	5	Trace number within reel.	I16	101	Receiver static correction.
I32	9	Sequential record number.	I16	103	Total static applied.
I32	9	Original field record number.	I16	109	Delay recording time (ms).
I32	13	Trace number.	I16	111	Mute time start.
I32	17	Shot point number.	I16	113	Mute time end.
I32	21	CDP number.	I16	115	No. of samples.
I32	25	Trace no. within the CDP.	I16	117	Sample interval in microseconds.
I16	29	Trace identification code.	I16	157	Year of recording.
I16	31	No. of summed traces.	I16	159	Julian day number (1-366).
I16	33	Total number of traces in CDP.	I16	161	Hour of day (24 hour clock).
I16	35	Data use 1=production, 2=test.	I16	163	Minute of hour.
I32	37	Trace offset (integer).	I16	165	Second of minute.
I32	41	Elevation at receiver.	I16	167	Time base code 1.local,2.gmt,3.?
I32	45	Elevation at source.	I32	181	3D Line number.
I32	61	Water depth at source.	I32	185	CDP no. within 3D line.
I32	65	Water depth at receiver.	I32	189	2D shotpoint number (Maersk).
I16	69	Scaler to be applied to elevations.	I32	193	Easting of CDP.
I16	71	Scaler to be applied to coordinates.	I32	197	Northing of CDP.
I32	73	Source easting.	I16	201	Scaler to be applied to SPNO.
I32	77	Source northing.	I16	203	Seqn record nos. (pre-stack only).
I32	81	Receiver easting.	I32	205	Source station number.
I32	85	Receiver northing.	I32	209	Receiver station number.
I16	89	Coordinate units (m/arc).			

9 SEGY EBCDIC Headers

Typical SEGY EBCDIC line header (from line BOBS08-12)

9.1 Final Migration

```
C01 CLIENT : BASS STRAIT OIL          SURVEY : BOBS08
C02 LINE   : BOBS08-12
C03 AREA   : T42/43P
C04 DATASET: FINAL MIGRATION
C05
C06 ACQ. YEAR        : 2008           PROCESSED DATE   : JUL 2008
C07 SHOT INTERVAL    : 25 M           GROUP INTERVAL   : 12.5 M
C08 CABLE LENGTH     : 6000 M         GROUPS PER CABLE : 480
C09 MIN OFFSET       : 145 M          MAX OFFSET       : 6132.5 M
C10 DATUM OF REF     : GDA 94         PROJECTION       : UTM 55S
C11 COORDINATE UNITS : METRES         VERTICAL DATUM   : MEAN SEA LEVEL
C12 SAMPLE RATE (MS) : 2              MAX TIME (MS)    : 6000
C13
C14 PROCESSING SUMMARY
C15 TRANSCRIPTION          / DESIG ZERO PHASE OUTPUT   / INITIAL GAIN RECOVERY
C16 RESAMPLE               / PRE-FILTER 4HZ            / INSTRUMENT DELAY 50MS
C17 TIME FREQ DE-NOISE     / DESPIKE                   / NAVIGATION MERGING
C18 1ST PASS VELOCITIES    / TAU-P DECON               / TAU-P LIN NOISE FILTER
C19 SRME                   / REC ARRAY SIMULATION      / CDP GATHERS
C20 REMOVING INITIAL GAIN  / SPHERICAL DIVERGENCE      / RADON DEMULTIPLE
C21 FX DECON AND FK FILTER / 1ST PASS PSTM             / 2ND PASS VELOCITIES
C22 FINAL PSTM             / 3RD PASS VELOCITIES       / RESIDUAL RADON DEMULT
C23 NMO CORRECTION         / MUTES                     / STACK
C24 GUN/CABLE CORRECTION   / TAU-P DIP FILTER          / FX DECONVOLUTION
C25 BANDPASS FILTER        / EXPONENTIAL GAIN 12DB/SEC / POST-STACK SCALING
C26 POLARITY: SEG NEGATIVE
C27
C28 TRACE HEADER DEFINITION
C29             ITEM            BYTES     FORMAT
C30             SHOTPOINT     017 - 020   INTEGER
C31             CDP           021 - 024   INTEGER
C32             CDP EASTING   193 - 196   INTEGER
C33             CDP NORTHING  197 - 200   INTEGER
C34
C35 NAVIGATION REFERENCE: SOURCE
C36 SP/CDP RELATIONSHIP : CDP  246 = SP 1001
C37                       CDP  446 = SP 1101
C38 SP RANGE:    1001 TO 4711
C39 CDP RANGE:     1 TO 7660
C40 END OF EBCDIC HEADER
```

9.2 Raw Migration

```
C01 CLIENT : BASS STRAIT OIL          SURVEY : BOBS08
C02 LINE   : BOBS08-12
C03 AREA   : T42/43P
C04 DATASET: RAW MIGRATION
C05
C06 ACQ. YEAR        : 2008           PROCESSED DATE   : JUL 2008
C07 SHOT INTERVAL    : 25 M           GROUP INTERVAL   : 12.5 M
C08 CABLE LENGTH     : 6000 M         GROUPS PER CABLE : 480
C09 MIN OFFSET       : 145 M          MAX OFFSET       : 6132.5 M
C10 DATUM OF REF     : GDA 94         PROJECTION       : UTM 55S
C11 COORDINATE UNITS : METRES         VERTICAL DATUM   : MEAN SEA LEVEL
C12 SAMPLE RATE (MS) : 2              MAX TIME (MS)    : 6000
C13
C14 PROCESSING SUMMARY
C15 TRANSCRIPTION         / DESIG ZERO PHASE OUTPUT   / INITIAL GAIN RECOVERY
C16 RESAMPLE              / PRE-FILTER 4HZ            / INSTRUMENT DELAY 50MS
C17 TIME FREQ DE-NOISE    / DESPIKE                   / NAVIGATION MERGING
C18 1ST PASS VELOCITIES   / TAU-P DECON               / TAU-P LIN NOISE FILTER
C19 SRME                  / REC ARRAY SIMULATION      / CDP GATHERS
C20 REMOVING INITIAL GAIN  / SPHERICAL DIVERGENCE     / RADON DEMULTIPLE
C21 FX DECON AND FK FILTER / 1ST PASS PSTM            / 2ND PASS VELOCITIES
C22 FINAL PSTM            / 3RD PASS VELOCITIES       / RESIDUAL RADON DEMULT
C23 NMO CORRECTION        / MUTES                     / STACK
C24 GUN/CABLE CORRECTION  / EXPONENTIAL GAIN 12DB/SEC
C25 POLARITY: SEG NEGATIVE
C26
C27
C28 TRACE HEADER DEFINITION
C29             ITEM            BYTES     FORMAT
C30             SHOTPOINT     017 - 020   INTEGER
C31             CDP           021 - 024   INTEGER
C32             CDP EASTING   193 - 196   INTEGER
C33             CDP NORTHING  197 - 200   INTEGER
C34
C35 NAVIGATION REFERENCE: SOURCE
C36 SP/CDP RELATIONSHIP : CDP  246 = SP 1001
C37                       CDP  446 = SP 1101
C38 SP RANGE:    1001 TO 4711
C39 CDP RANGE:     1 TO 7660
C40 END OF EBCDIC HEADER
```

9.3 Angle Migration (near)

```
C01 CLIENT : BASS STRAIT OIL          SURVEY : BOBS08
C02 LINE   : BOBS08-12
C03 AREA   : T42/43P
C04 DATASET: NEAR ANGLE MIGRATION 5 - 25 DEG
C05
C06 ACQ. YEAR        : 2008           PROCESSED DATE   : JUL 2008
C07 SHOT INTERVAL    : 25 M           GROUP INTERVAL   : 12.5 M
C08 CABLE LENGTH     : 6000 M         GROUPS PER CABLE : 480
C09 MIN OFFSET       : 145 M          MAX OFFSET       : 6132.5 M
C10 DATUM OF REF     : GDA 94         PROJECTION       : UTM 55S
C11 COORDINATE UNITS : METRES         VERTICAL DATUM   : MEAN SEA LEVEL
C12 SAMPLE RATE (MS) : 2              MAX TIME (MS)    : 6000
C13
C14 PROCESSING SUMMARY
C15 TRANSCRIPTION          / DESIG ZERO PHASE OUTPUT   / INITIAL GAIN RECOVERY
C16 RESAMPLE               / PRE-FILTER 4HZ            / INSTRUMENT DELAY 50MS
C17 TIME FREQ DE-NOISE     / DESPIKE                   / NAVIGATION MERGING
C18 1ST PASS VELOCITIES    / TAU-P DECON               / TAU-P LIN NOISE FILTER
C19 SRME                   / REC ARRAY SIMULATION      / CDP GATHERS
C20 REMOVING INITIAL GAIN  / SPHERICAL DIVERGENCE      / RADON DEMULTIPLE
C21 FX DECON AND FK FILTER / 1ST PASS PSTM             / 2ND PASS VELOCITIES
C22 FINAL PSTM             / 3RD PASS VELOCITIES       / RESIDUAL RADON DEMULT
C23 NMO CORRECTION         / ANGLE MUTE                / STACK
C24 GUN/CABLE CORRECTION   / TAU-P DIP FILTER          / FX DECONVOLUTION
C25 BANDPASS FILTER        / EXPONENTIAL GAIN 12DB/SEC
C26 POLARITY: SEG NEGATIVE
C27
C28 TRACE HEADER DEFINITION
C29             ITEM            BYTES     FORMAT
C30             SHOTPOINT     017 - 020   INTEGER
C31             CDP           021 - 024   INTEGER
C32             CDP EASTING   193 - 196   INTEGER
C33             CDP NORTHING  197 - 200   INTEGER
C34
C35 NAVIGATION REFERENCE: SOURCE
C36 SP/CDP RELATIONSHIP : CDP  246 = SP 1001
C37                       CDP  446 = SP 1101
C38 SP RANGE:    1001 TO 4711
C39 CDP RANGE:    1 TO 7660
C40 END OF EBCDIC HEADER
```

9.4 Final PSTM Gathers

```
C01 CLIENT : BASS STRAIT OIL          SURVEY : BOBS08
C02 LINE   : BOBS08-12
C03 AREA   : T42/43P
C04 DATASET: FINAL PSTM GATHERS
C05
C06 ACQ. YEAR        : 2008           PROCESSED DATE   : JUL 2008
C07 SHOT INTERVAL    : 25 M           GROUP INTERVAL   : 12.5 M
C08 CABLE LENGTH     : 6000 M         GROUPS PER CABLE : 480
C09 MIN OFFSET       : 145 M          MAX OFFSET       : 6132.5 M
C10 DATUM OF REF     : GDA 94         PROJECTION       : UTM 55S
C11 COORDINATE UNITS : METRES         VERTICAL DATUM   : MEAN SEA LEVEL
C12 SAMPLE RATE (MS) : 2              MAX TIME (MS)    : 6000
C13
C14 PROCESSING SUMMARY
C15 TRANSCRIPTION          / DESIG ZERO PHASE OUTPUT   / INITIAL GAIN RECOVERY
C16 RESAMPLE               / PRE-FILTER 4HZ            / INSTRUMENT DELAY 50MS
C17 TIME FREQ DE-NOISE     / DESPIKE                   / NAVIGATION MERGING
C18 1ST PASS VELOCITIES    / TAU-P DECON               / TAU-P LIN NOISE FILTER
C19 SRME                   / REC ARRAY SIMULATION      / CDP GATHERS
C20 REMOVING INITIAL GAIN  / SPHERICAL DIVERGENCE      / RADON DEMULTIPLE
C21 FX DECON AND FK FILTER / 1ST PASS PSTM             / 2ND PASS VELOCITIES
C22 FINAL PSTM             / 3RD PASS VELOCITIES       / RESIDUAL RADON DEMULT
C23 NMO CORRECTION         / GUN/CABLE CORRECTION
C24 POLARITY: SEG NEGATIVE
C25
C26
C27
C28 TRACE HEADER DEFINITION
C29             ITEM            BYTES     FORMAT
C30             SHOTPOINT     017 - 020   INTEGER
C31             CDP           021 - 024   INTEGER
C32             CDP EASTING   193 - 196   INTEGER
C33             CDP NORTHING  197 - 200   INTEGER
C34
C35 NAVIGATION REFERENCE: SOURCE
C36 SP/CDP RELATIONSHIP : CDP  246 = SP 1001
C37                       CDP  446 = SP 1101
C38 SP RANGE:    1001 TO 4711
C39 CDP RANGE:    1 TO 7660
C40 END OF EBCDIC HEADER
```

10 Appendices

10.1 Example sections

10.11 Line BOBS08-12 Brute Stack
processed through time frequency de-noise and up to random spike attenuation

10.12 Line BOBS08-12 SRME Stack
processed through Tau-P deconvolution and Tau-P linear noise attenuation and up to SRME

10.13 Line BOBS08-12 FX Deconvolution and FK Filter Stack
processed through spherical divergence, Radon demultiple and up to FX deconvolution and FK filter

10.14 Line BOBS08-12 Final Migration
processed through final PSTM, residual Radon demultiple, post-stack Tau-P dip filter and FX deconvolution, exponential gain and up to final band-pass filter

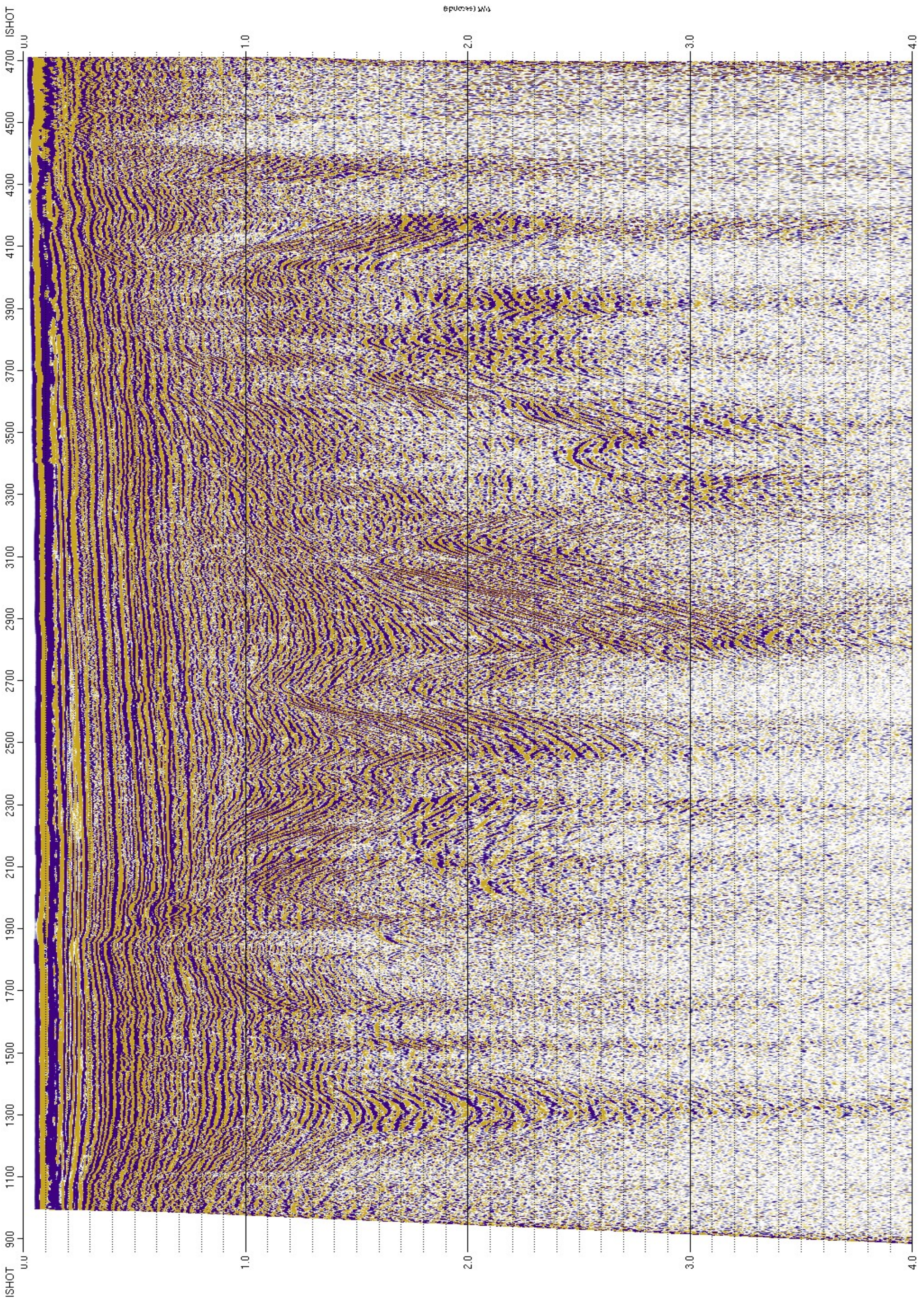


Figure 10.11 Line BOBS08-12 Brute Stack

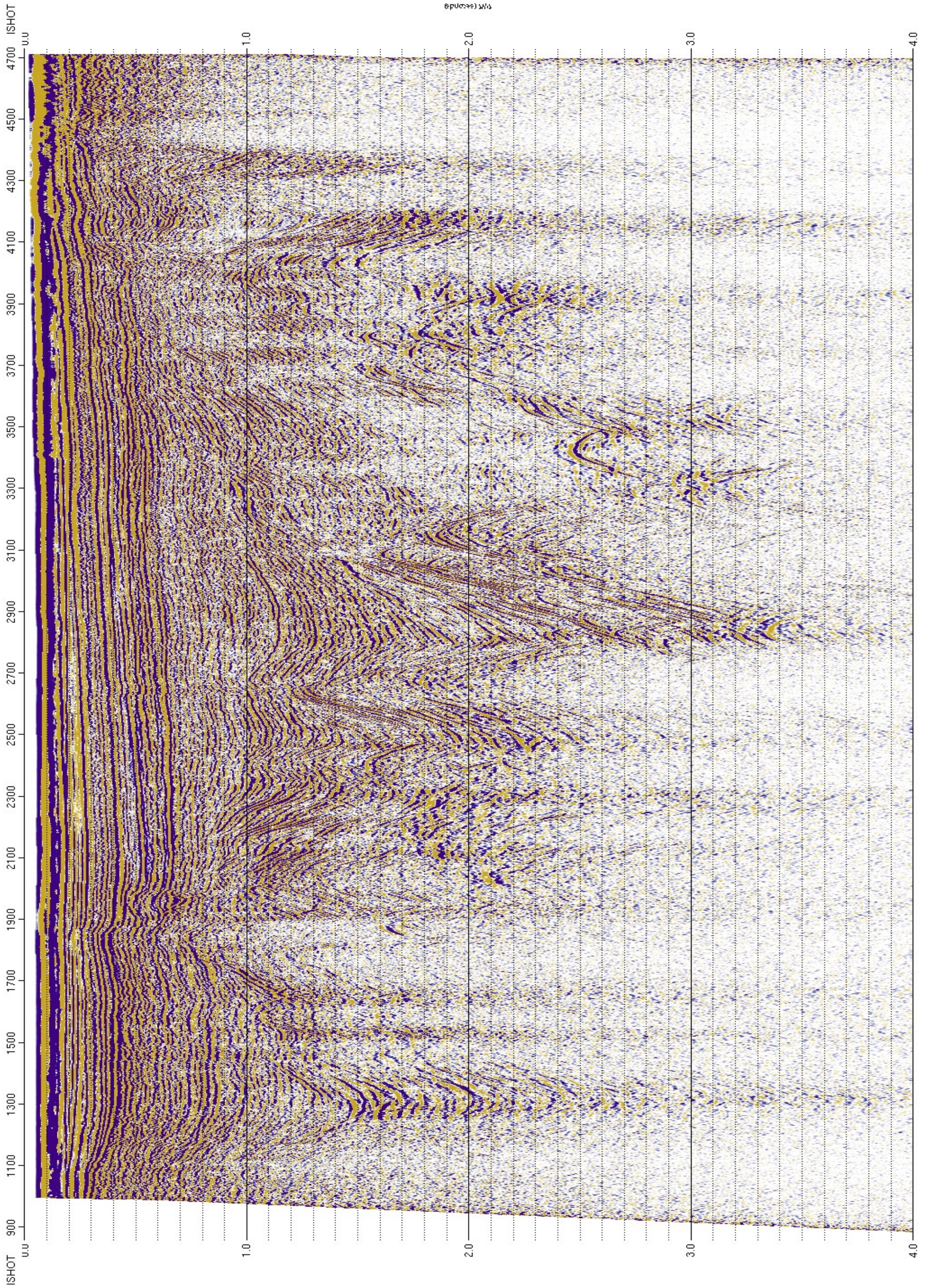


Figure 10.12 Line BOBS08-12 SRME Stack

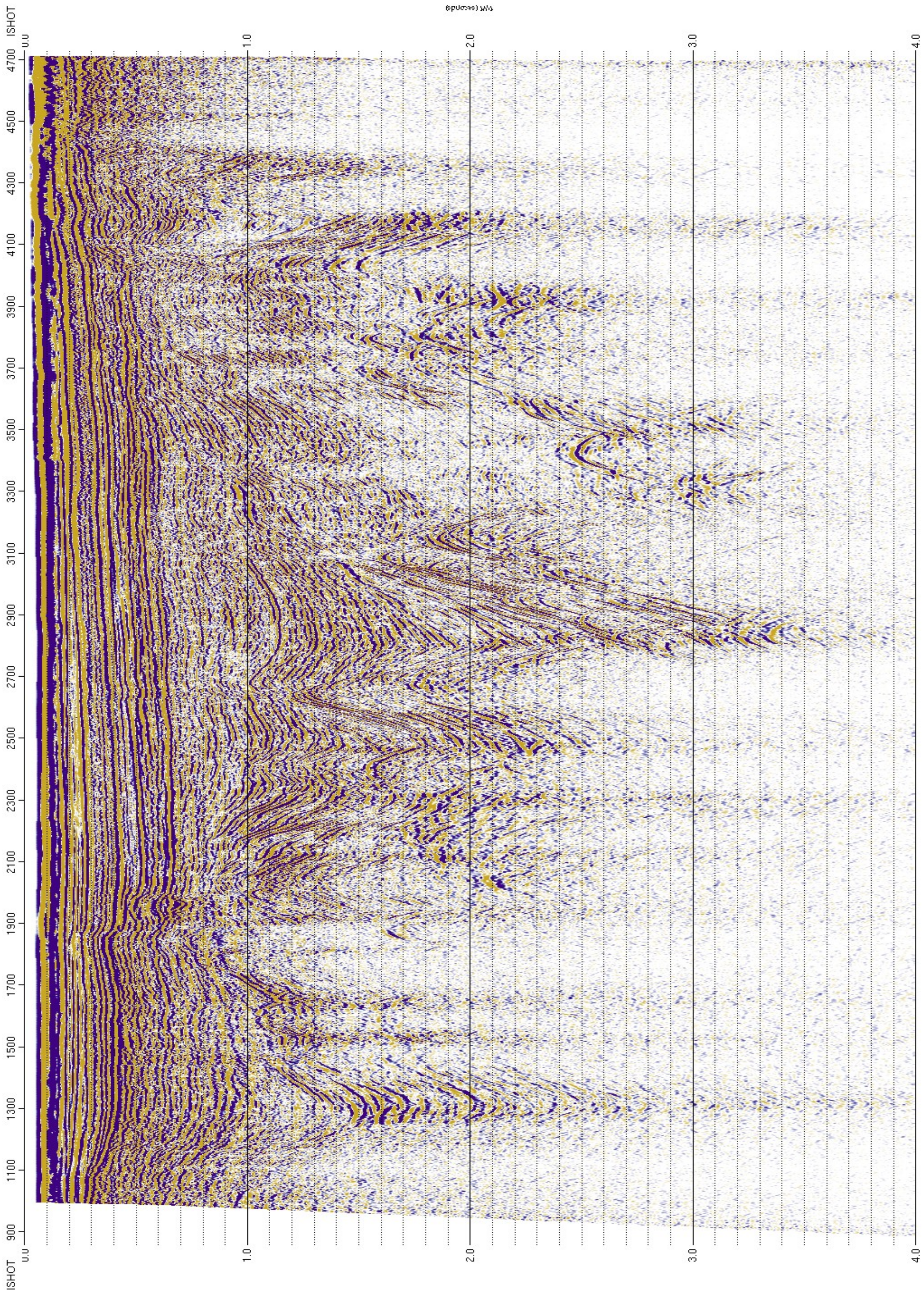


Figure 10.13 Line BOBS08-12 FX Deconvolution and FK Filter Stack

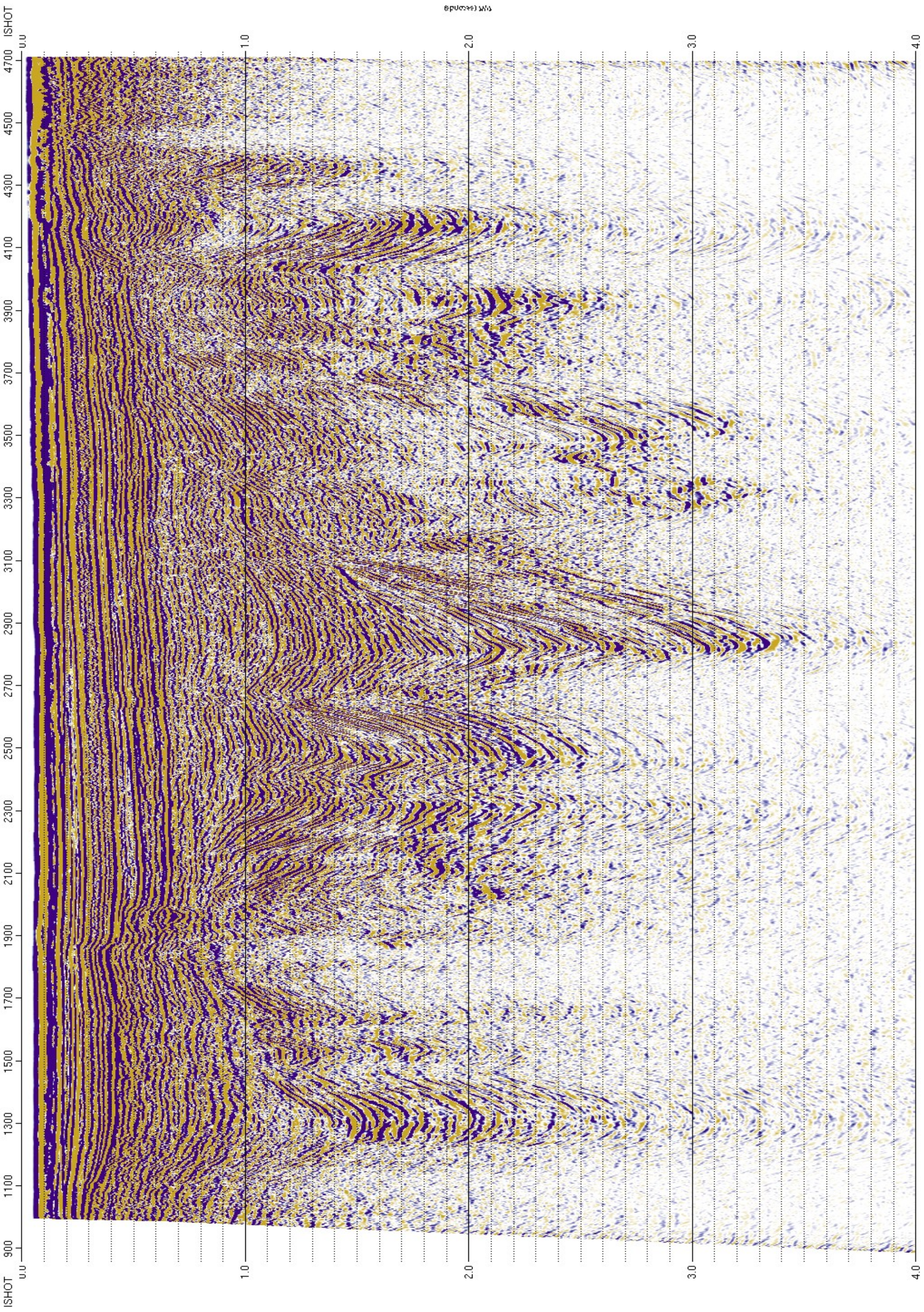


Figure 10.14 Line BOBS08-12 Final Migration

10.2 Example gathers

10.21 Line BOBS08-12 Crude Gather
processed through time frequency de-noise and up to random spike attenuation

10.22 Line BOBS08-12 SRME Gather
processed through Tau-P deconvolution and Tau-P linear noise attenuation and up to SRME

10.23 Line BOBS08-12 FX Deconvolution and FK filter Gather
processed through spherical divergence, Radon demultiple and up to FX deconvolution and FK filter

10.24 Line BOBS08-12 Residual Radon Demultiple Gather
processed through final PSTM and up to residual Radon demultiple

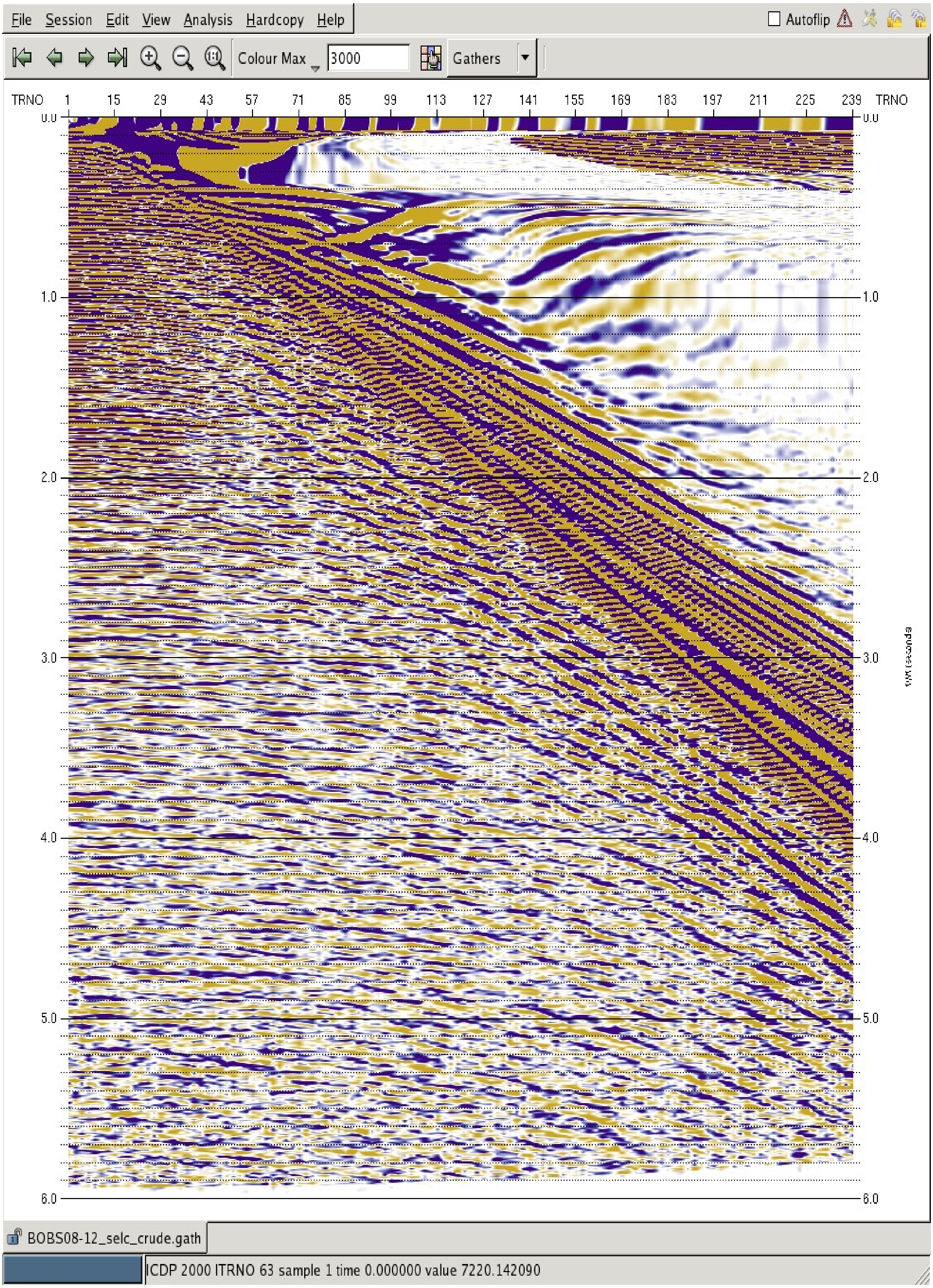


Figure 10.21 Line BOBS08-12 Crude Gather

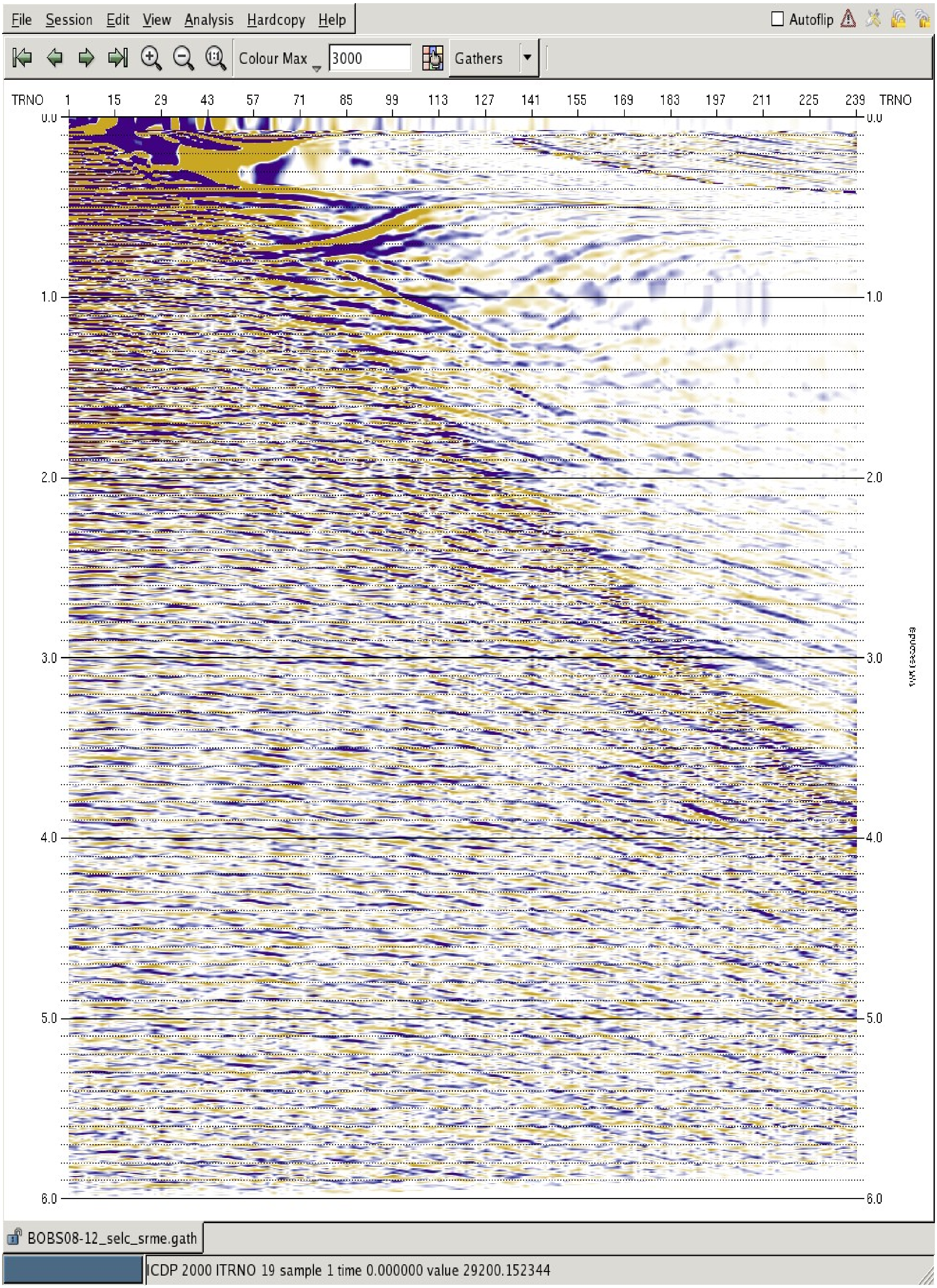


Figure 10.22 Line BOBS08-12 SRME Gather

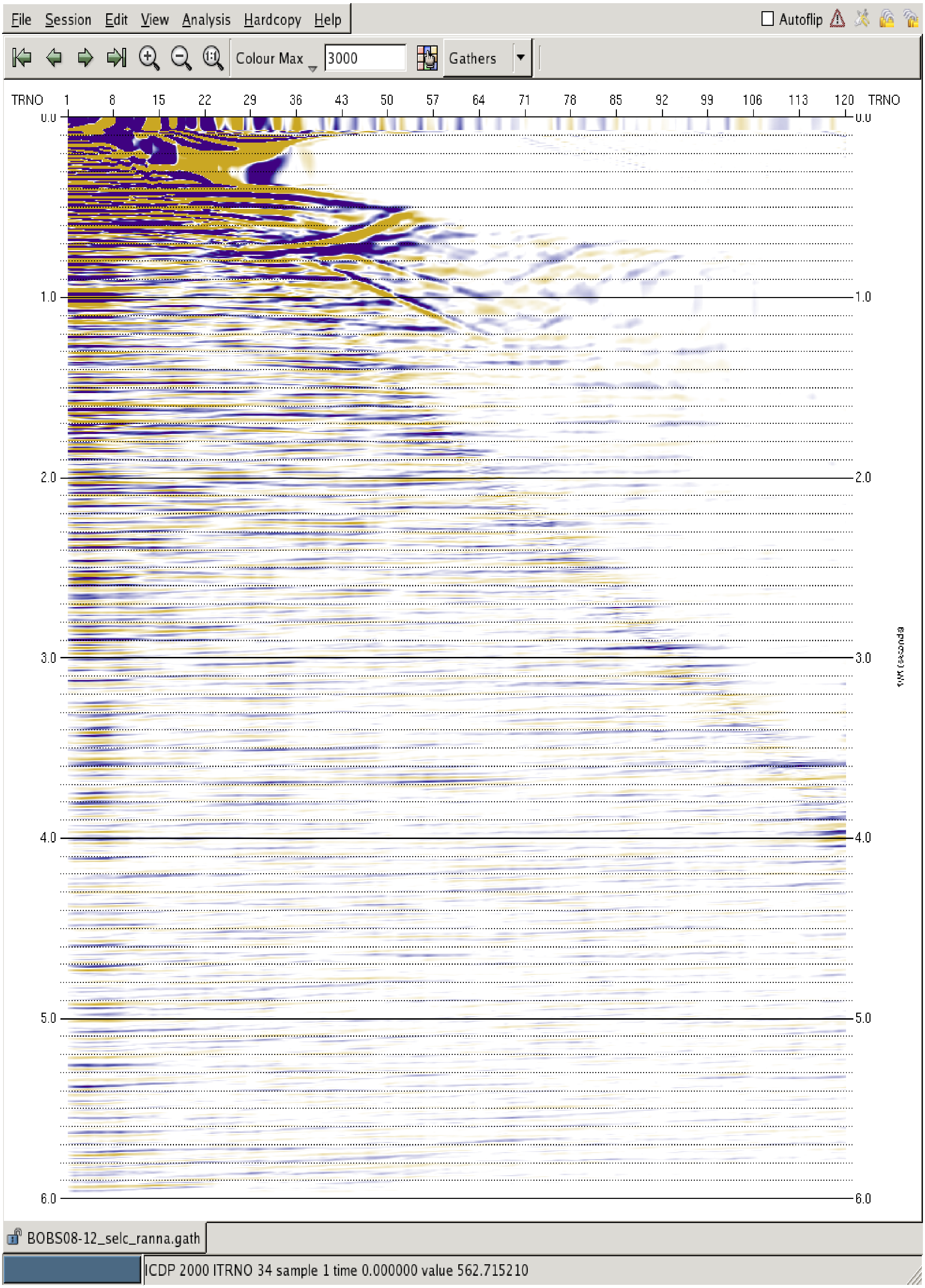


Figure 10.23 Line BOBS08-12 FX Deconvolution and FK filter Gather

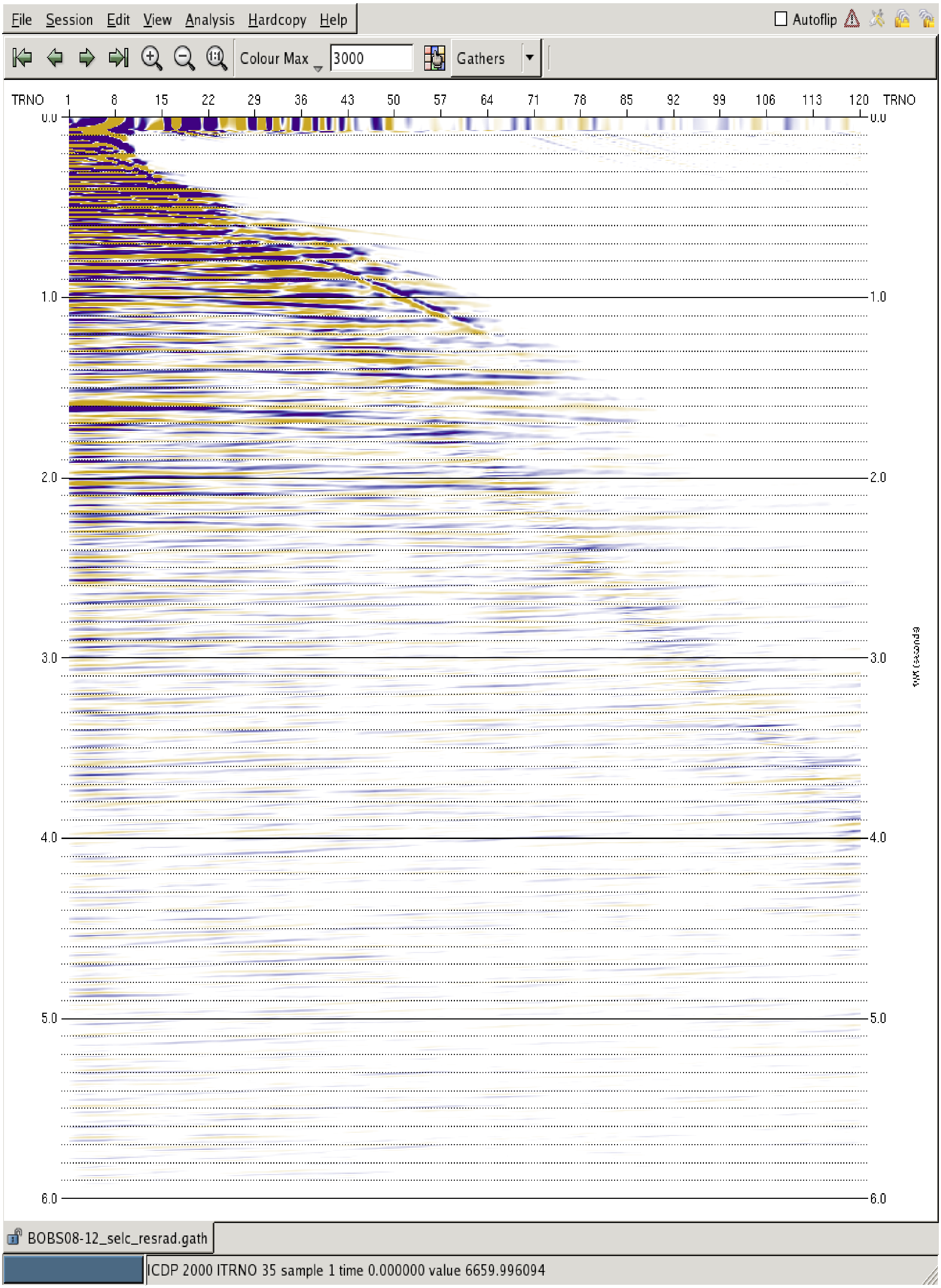


Figure 10.24 Line BOBS08-12 Residual Radon Demultiple Gather

10.3 Example shots

10.31 Line BOBS08-12 Demultiplex Shot
processed through designature, initial gain recovery, resample, pre-filter and up to correction for instrument delay

10.32 Line BOBS08-12 Time Frequency De-noise Shot
processed through time frequency de-noise and up to random spike attenuation

10.33 Line BOBS08-12 Tau-P Deconvolution and Tau-P Linear Noise Attenuation Shot
processed through Tau-P Deconvolution and up to Tau-P linear noise attenuation

10.34 Line BOBS08-12 SRME Shot
processed up to SRME

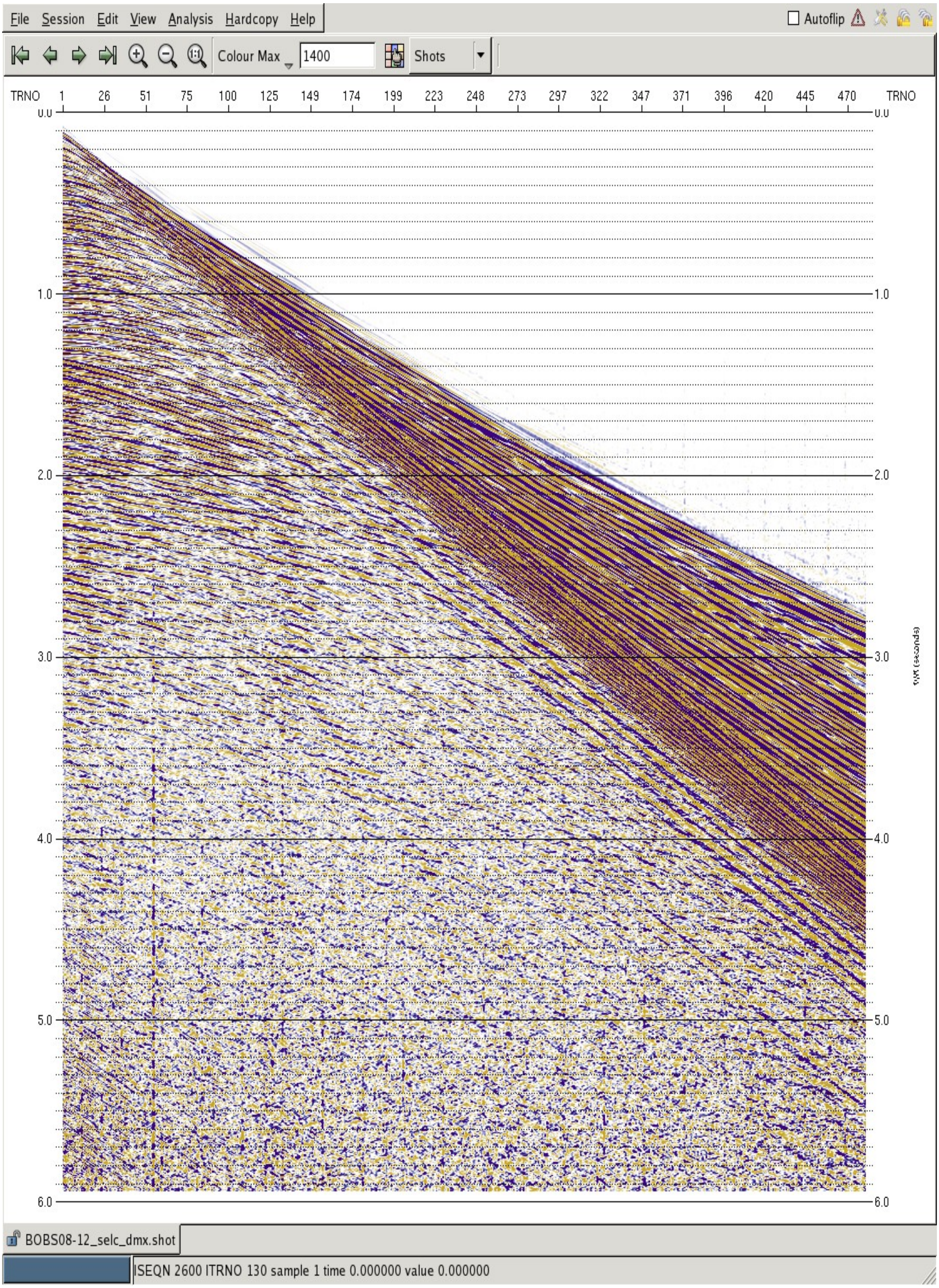


Figure 10.31 Line BOBS08-12 Demultiplex Shot

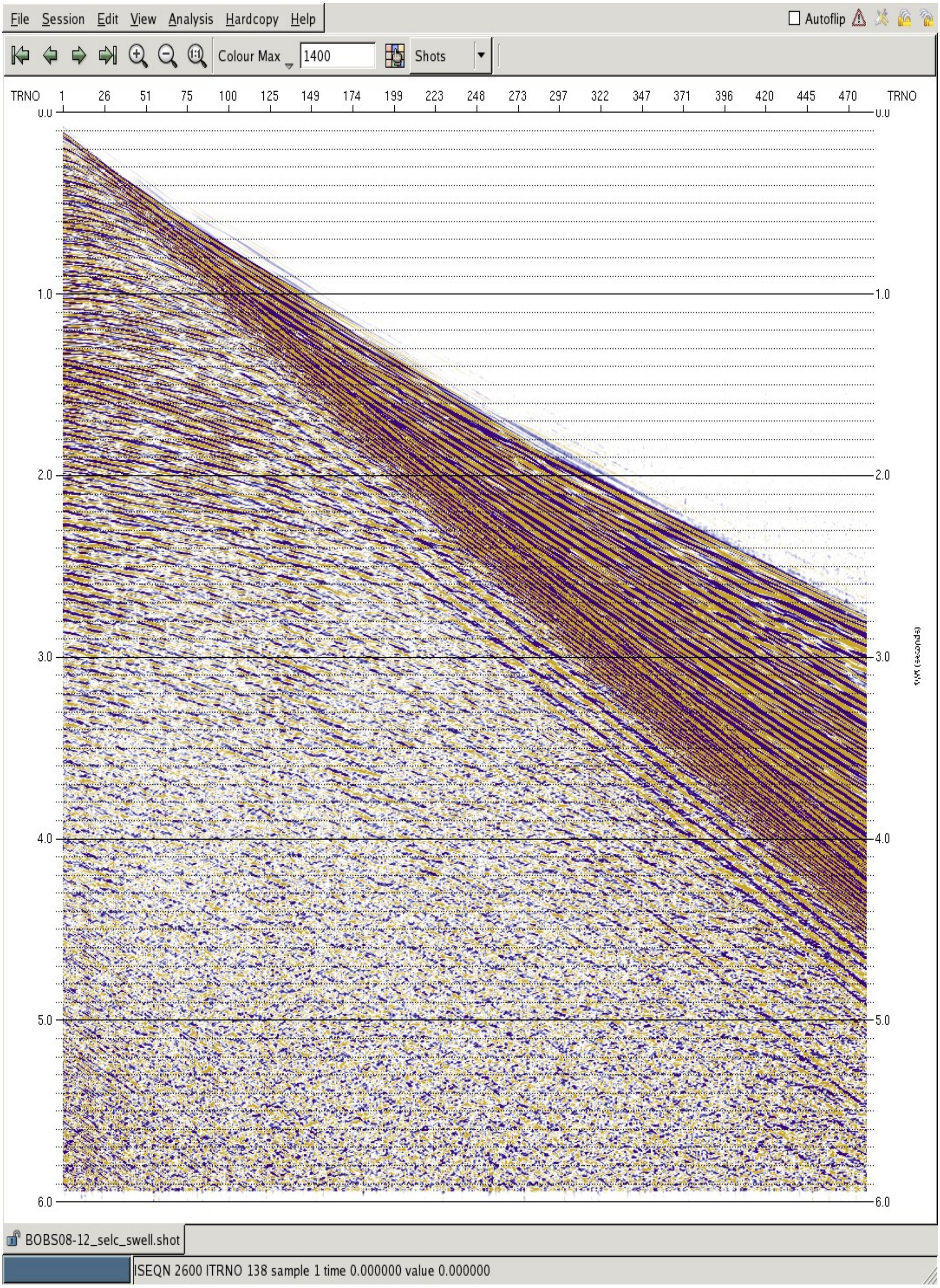


Figure 10.32 Line BOBS08-12 Time Frequency De-noise Shot

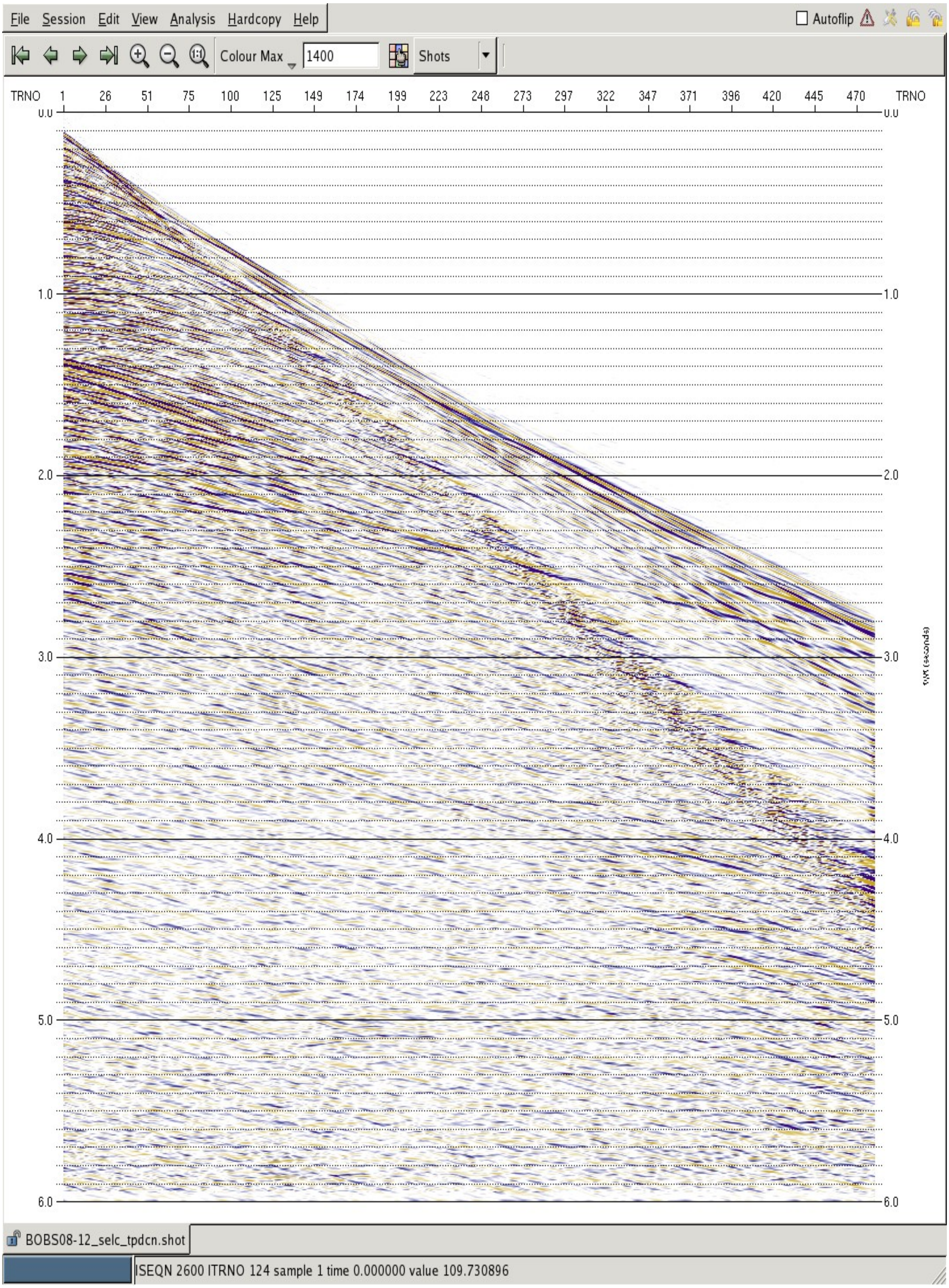


Figure 10.33 Line BOBS08-12 Tau-P Deconvolution and Tau-P Linear Noise Attenuation Shot

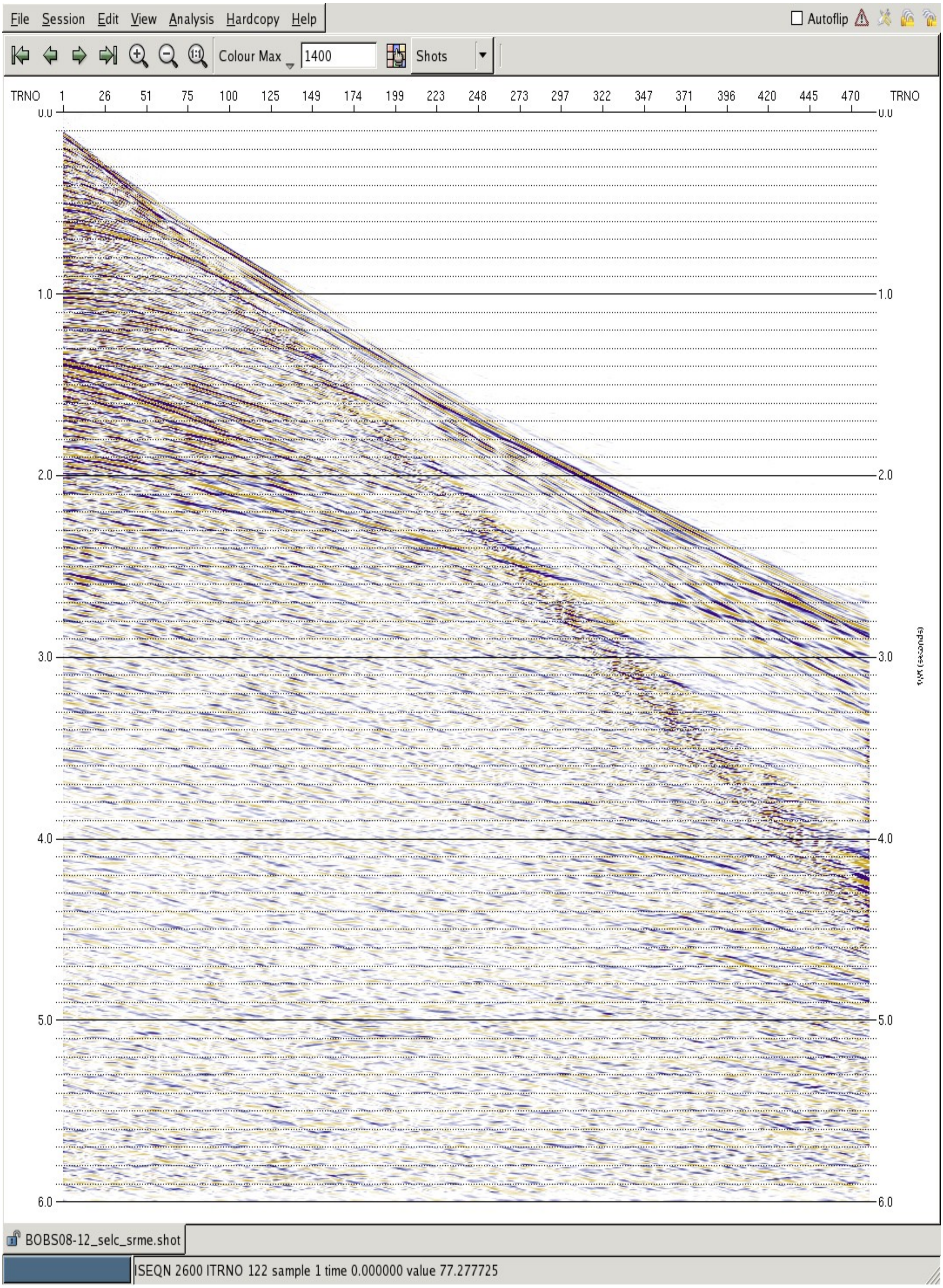


Figure 10.34 Line BOBS08-12 SRME Shot

10.4 Far Field Signature

Far field signature with source depth of 6 m and cable depth of 8m, incorporating the fuzzy cable ghost at 8 m +/- 1m